KINGETT MITCHELL & ASSOCIATES LTD
ENVIRONMENTAL CONSULTANTS

30 June, 1995

Our Ref: 75910

Water Quality Officer
Southland Regional Council
Private Bag 90116
INVERCARGILL

Attention: Mr I Welsh

Dear Ian

RE: SOUTHGAS JOINT VENTURE : USE OF GELLING AGENT FOR FRACCING WATER

Mr John Barry, consulting geologist to the Southgas Joint Venture has asked me to comment directly to you regarding the environmental implications of use of a gelling agent formulation in the carrier fluid for the fraccing trials. Halliburton Australia Pty Limited have supplied copies of their inhouse compound safety data sheets to John and he has forwarded these to me.

The carrier fluid additives constituting the gelling agent and their final concentrations in the carrier fluid would be as follows:

Carrier Fluid Additives

Additive	**Composition**	**Hazard**	**Concentration (g m^{-3})**
WG 11	guar gum derivative	None	2400
HYG 3	fumaric acid	None at low concentration	120
K 34	sodium bicarbonate	None at low concentration	120
GBW 30	cellulase enzyme carbohydrate	None	6

Guar gum derivatives are complex mucopolysaccharides which are used widely in the pharmaceutical industry including in orally ingested pills and syrups. They are non toxic and would be readily biodegraded in the aquatic environment. Fumaric acid is a weak, low molecular weight organic acid which appears in a wide variety of environmental contexts

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FRED THOMAS DRIVE,
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(e.g., landfill leachate). It is non-toxic, non corrosive and readily biodegraded. Sodium bicarbonate is a weakly alkaline inorganic salt which, in such dilute solution, poses no environmental hazard. The cellulase enzyme (a carbohydrate) would be non-toxic and non-corrosive at these very low concentrations and is also likely to be readily biodegraded in the environment. I am further advised by Mr Bill Farraley of Halliburton that the final pH of the carrier fluid after addition of these compounds lies in the range 6 - 7.

It is my opinion that inclusion of these additives in the fraccing fluid adds no increased environmental risk from accidental discharge to the environment of carrier fluid or from the later planned, gradual discharge of back-extracted fluid and coal seam formation water to Oranea Stream.

Please call me if you have any further queries regarding this matter.

Yours sincerely,
KINGETT MITCHELL & ASSOCIATES LTD

DR S A SHORT

R J Hill Laboratories Limited

incorporating Analytical Services Laboratory

25 Te Aroha Street,
P O Box 4048,
Hamilton, New Zealand

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Facsimile: +64 (7) 854-9886
Internet/Email: rjh@rjhill.co.nz

Client: Southland Regional Council
Address: Private Bag 90116
INVERCARGILL
Contact: Graeme McKenzie

Laboratory No: 95329
Date Registered: 12/09/95
Date Completed: 25/09/95
Page Number: 1 of 3

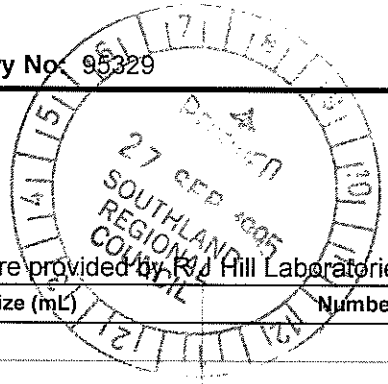
The results for the analyses you requested are as follows:

Sample Type: Water, Dirty

Sample Name		95/1279 07/09/95	95/1280 07/09/95
Lab No		95329/1	95329/2
Calcium	(g.m-3)	12.2	3.51
Magnesium	(g.m-3)	6.00	1.62
Sodium	(g.m-3)	1100	8.54
Potassium	(g.m-3)	11.2	0.61
Ammonium-N	(g.m-3)	3.08	< 0.01
Total Kjeldahl Nitrogen (TKN)	(g.m-3)	3.7	0.7
Total Organic Nitrogen (TON)	(g.m-3)	0.6	0.7
Fluoride	(g.m-3)	2.73	2.81
Sulphate	(g.m-3)	7	8
Total Sulphide*	(g.m-3)	< 0.04 #	< 0.5 #
Total Boron*	(g.m-3)	0.14	< 0.01
Soluble Iron*	(g.m-3)	< 0.5	0.62
Soluble Manganese*	(g.m-3)	0.088	0.0111
Soluble Aluminium*	(g.m-3)	0.05	0.759
Total Arsenic*	(g.m-3)	< 0.02	< 0.004
Total Barium*	(g.m-3)	0.406	0.0106
Total Cadmium*	(g.m-3)	< 0.0005	0.0002
Soluble Chromium*	(g.m-3)	0.010	0.0013
Total Chromium*	(g.m-3)	0.031	0.002
Total Copper*	(g.m-3)	< 0.005	0.009
Total Nickel*	(g.m-3)	0.02	0.007
Total Lead*	(g.m-3)	0.002	0.0003
Total Selenium*	(g.m-3)	< 0.05	< 0.01
Total Zinc*	(g.m-3)	0.05	0.011

* This test is not Telarc Registered.

See Note 1.



Sample Containers

The following table shows the sample containers that were provided by R J Hill Laboratories Ltd.

Container Description	Container Size (mL)	Number of Containers
Zinc acetate preserved (sulphide)	250	2
Filtered Nitric Preserved	250	2
Sulphuric Preserved	250	2

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

The following table(s) gives a brief description of the methods used to conduct the analyses for this job.

SubstanceType: Water

Parameter	Method Used	Detection Limit
Microwave total (nitric) acid digestion	Add nitric acid, digest in microwave. Test not Telarc Reg.	N/A
Calcium	Flame AA Spectroscopy APHA 3500-Ca B	0.05 g.m-3
Magnesium	Flame AA Spectroscopy APHA 3500-Mg B	0.02 g.m-3
Sodium	Flame AA Spectroscopy APHA 3500-Na B	0.02 g.m-3
Potassium	Flame AA Spectroscopy APHA 3500-K B	0.02 g.m-3
Ammonium-N	Phenol/hypochlorite colorimetry APHA 4500-NH3 D	0.01 g.m-3
Total Kjeldahl Nitrogen (TKN)	Kjeldahl digestion, phenol/hypochlorite colorimetry APHA 4500-Norg C	0.1 g.m-3
Total Organic Nitrogen (TON)	Calculation: TKN - NH4-N	0.1 g.m-3
Fluoride	Ion selective electrode APHA 4500-F C	0.05 g.m-3
Sulphate	BaCl2 Turbidimetry In-House	1 g.m-3
Total Sulphide	Methylene blue colorimetry APHA 4500-S2- D Test not Telarc Reg.	0.02 g.m-3
Total Boron	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.01 g.m-3
Soluble Iron	Filtered Sample. ICP-MS. Test not Telarc Reg.	0.05 g.m-3
Soluble Manganese	Filtered Sample. ICP-MS. Test not Telarc Reg.	0.0005 g.m-3
Soluble Aluminium	Filtered Sample. ICP-MS. Test not Telarc Reg.	0.003 g.m-3
Total Arsenic	Boiling nitric acid digestion. ICP-MS. APHA 3113 (Modified) Test not Telarc Reg.	0.004 g.m-3
Total Barium	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.0002 g.m-3
Total Cadmium	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.0001 g.m-3
Soluble Chromium	Filtered Sample. ICP-MS. Test not Telarc Reg.	0.0005 g.m-3
Total Chromium	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.001 g.m-3

Parameter	Method Used	Detection Limit
Total Copper	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.001 g.m-3
Total Nickel	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.002 g.m-3
Total Lead	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.0002 g.m-3
Total Selenium	Boiling nitric acid digestion. ICP-MS. APHA 3113 (Modified) Test not Telarc Reg.	0.01 g.m-3
Total Zinc	Boiling nitric acid digestion. ICP-MS. Test not Telarc Reg.	0.002 g.m-3

Analyst's Comments:

These samples were collected by yourselves and analysed as received at the laboratory.

Note 1:

Severe matrix interference required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Manager

Terry Cooney, MSc(Hons), PhD MNZIC
Laboratory Manager

ESR ENVIRONMENTAL

Certificate of Analysis

Southland Regional Council
Private Bag 90 116
Invercargill

BP9175
RE 2/5

25 November 1994

Attention: Graeme McKenzie

Ultra Trace metal analysis of water samples

Date Received : 17.11.94
Sample Type : Water

ANALYSES				
	Lab No:	**BP9175/1**	**BP9175/2**	**BP9175/3**
	Site	**94/1200**	**94/1201**	**94/1202**
	Method			
Al	DISS	<5*	11	16
As	DISS	5.5	0.51	0.65
B	DISS	150	<3*	<3*
Ba	DISS	180	2.3	6.1
Cd	DISS	0.17	0.13	0.12
Cr	DISS	5.0	1.6	1.3
Cu	DISS	<2*	<2*	<2*
Fe	DISS	75	120	170
Mn	DISS	17	26	76
Ni	DISS	0.41	0.43	0.55
Pb	DISS	<.1*	<.1*	<.1*
Se	DISS	0.81	1.7	1.6
Zn	DISS	4.2	<1.3*	<1.3*

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Wellington Science Centre
Gracefield Road, PO Box 30-547, Lower Hutt, New Zealand
Telephone: (04) 570-1555, Facsimile: (04) 569-4500

25 November 1994

ANALYSES			
	Lab No:	**BP9175/4**	**BP9175/5**
	Site	**94/1203**	**94/1204**
	Method		
Al	DISS	17	<5*
As	DISS	0.60	8.8
B	DISS	<3*	<3*
Ba	DISS	6.3	1200
Cd	DISS	0.079	0.46
Cr	DISS	1.3	74
Cu	DISS	<2*	9.4
Fe	DISS	170	130
Mn	DISS	74	32
Ni	DISS	0.73	1.1
Pb	DISS	<.1*	<.1*
Se	DISS	1.1	<.2*
Zn	DISS	<1.3*	3.7

The units used are mg/m^3.

The abbreviations and symbols in the above report have the following meanings:
Al = Aluminium
As = Arsenic
B = Boron
Ba = Barium
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Mn = Manganese

25 November 1994

Ni	= Nickel
Pb	= Lead
Se	= Selenium
Zn	= Zinc
DISS	= Dissolved

<	= less than
*	= Warning: below criterion of detection

Analytical results are for samples as received.

Lawrence Pickston
Analyst

Dr S K Fellows
Section Leader

ESR ENVIRONMENTAL

Certificate of Analysis

Southland Regional Council
Private Bag 90 116
Invercargill

BP9177
RE 2/5

25 November 1994

Attention: Graeme McKenzie

Ultra Trace metal analysis of water samples

Date Received : 17.11.94
Sample Type : Water

ANALYSES				
	Lab No:	**BP9177/1**	**BP9177/2**	**BP9177/3**
	Site	**94/1224**	**94/1225**	**94/1226**
	Method			
Al	DISS	<5*	12	16
As	DISS	5.8	0.54	0.46
B	DISS	140	<3*	<3*
Ba	DISS	190	2.4	5.9
Cd	DISS	0.17	0.088	0.084
Cr	DISS	5.6	1.7	1.6
Cu	DISS	<2*	<2*	<2*
Fe	DISS	100	130	160
Mn	DISS	18	19	66
Ni	DISS	0.42	0.14(DL.2)#	0.58
Pb	DISS	<.1*	<.1*	<.1*
Se	DISS	<.2*	0.70	1.6
Zn	DISS	3.1	<1.3*	<1.3*

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ANALYSES			
	Lab No:	**BP9177/4**	**BP9177/5**
	Site	**94/1227**	**94/1228**
	Method		
Al	DISS	13	<5*
As	DISS	0.45	10
B	DISS	<3*	<3*
Ba	DISS	5.9	1300
Cd	DISS	0.057	0.22
Cr	DISS	1.4	79
Cu	DISS	<2*	8.9
Fe	DISS	140	120
Mn	DISS	60	33
Ni	DISS	0.55	1.3
Pb	DISS	<.1*	<.1*
Se	DISS	0.97	<.2*
Zn	DISS	<1.3*	<1.3*

The units used are mg/m^3.

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Fe = Iron
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25 November 1994

Ni	= Nickel
Pb	= Lead
Se	= Selenium
Zn	= Zinc
DISS	= Dissolved

<	= less than
DL	= Detection Limit
*	= Warning: below criterion of detection
#	= Warning: below limit of detection (but above criterion of detection)

Analytical results are for samples as received.

Lawrence Pickston
Analyst

Dr S K Fellows
Section Leader

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Certificate of Analysis

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Invercargill

BP9174
RE 2/5

25 November 1994

Attention: Graeme McKenzie

Ultra Trace metal analysis of water samples

Date Received : 17.11.94
Sample Type : Water

ANALYSES					
	Lab No:	**BP9174/1**	**BP9174/2**	**BP9174/3**	**BP9174/4**
	Site	**94/1216**	**94/1217**	**94/1218**	**94/1219**
	Method				
Al	DISS	<5*	12	12	10
As	DISS	4.5	0.34	0.34	0.37
B	DISS	150	<3*	<3*	<3*
Ba	DISS	190	2.0	5.2	5.2
Cd	DISS	0.049	0.042	0.021	0.032
Cr	DISS	3.4	1.0	1.0	0.94
Cu	DISS	<2*	<2*	<2*	<2*
Fe	DISS	160	140	160	150
Mn	DISS	19	22	33	42
Ni	DISS	0.22	0.24	0.61	0.54
Pb	DISS	<.1*	<.1*	<.1*	<.1*
Se	DISS	<.2*	<.2*	<.2*	<.2*
Zn	DISS	2.9	<1.3*	<1.3*	<1.3*

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ANALYSES				
	Lab No:	**BP9174/5**	**BP9174/6**	**BP9174/7**
	Site	**94/1220**	**94/1222**	**94/1223**
	Method			
Al	DISS	<5*	<5*	<5*
As	DISS	10	10	0.12
B	DISS	<3*	<3*	<3*
Ba	DISS	1200	1300	0.84
Cd	DISS	0.13	0.13	0.050
Cr	DISS	78	79	0.99
Cu	DISS	8.8	8.5	<2*
Fe	DISS	160	160	<2.5*
Mn	DISS	31	31	<.1*
Ni	DISS	0.80	0.86	<.2*
Pb	DISS	<.1*	<.1*	<.1*
Se	DISS	<.2*	<.2*	0.23
Zn	DISS	3.3	3.9	<1.3*

The units used are mg/m^3.

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Ba = Barium
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Mn = Manganese

25 November 1994

Ni	= Nickel
Pb	= Lead
Se	= Selenium
Zn	= Zinc
DISS	= Dissolved

<	= less than
*	= Warning: below criterion of detection

Analytical results are for samples as received.

Lawrence Pickston
Analyst

Dr S K Fellows
Section Leader

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ENVIRONMENTAL

Certificate of Analysis

Southland Regional Council
Private Bag 90 116
Invercargill

BP9170
RE 2/5

25 November 1994

Attention: Graeme McKenzie

Ultra Trace metal analysis of water samples

Date Received : 10.11.94
Sample Type : Water

ANALYSES				
	Lab No:	**BP9170/1**	**BP9170/2**	**BP9170/3**
	Site	**94/1189**	**94/1193**	**94/1194**
	Method			
Al	DISS	<5*	<5*	19
As	DISS	7.7	4.5	0.18
B	DISS	<3*	150	<3*
Ba	DISS	1300	190	2.1
Cd	DISS	0.02	<.02*	<.02*
Cr	DISS	71	4.6	1.3
Cu	DISS	8.8	0.80	0.25
Fe	DISS	110	65	140
Mn	DISS	34	17	25
Ni	DISS	0.88	0.25	0.13
Pb	DISS	<.1*	<.1*	<.1*
Se	DISS	<1*	<1*	<1*
Zn	DISS	1.2	2.3	<1.3*
Al	DIRECT	<5*		

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As	DIRECT	8.8		
B	DIRECT	<3*		
Ba	DIRECT	1400		
Cd	DIRECT	0.02		
Cr	DIRECT	78		
Cu	DIRECT	8.6		
Fe	DIRECT	120		
Mn	DIRECT	39		
Ni	DIRECT	1.1		
Pb	DIRECT	<.1*		
Se	DIRECT	<1*		
Zn	DIRECT	27		

ANALYSES			
	Lab No:	**BP9170/4**	**BP9170/5**
	Site	**94/1195**	**94/1196**
	Method		
Al	DISS	12	60
As	DISS	0.20	0.15
B	DISS	<3*	<3*
Ba	DISS	6.2	6.2
Cd	DISS	<.02*	0.01(DL.02)#
Cr	DISS	1.0	0.95
Cu	DISS	0.63	0.73
Fe	DISS	140	140

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Mn	DISS	45	55
Ni	DISS	0.71	0.97
Pb	DISS	<.1*	<.1*
Se	DISS	<1*	<1*
Zn	DISS	<1.3*	<1.3*

The units used are mg/m^3.

The abbreviations and symbols in the above report have the following meanings:

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B	= Boron
Ba	= Barium
Cd	= Cadmium
Cr	= Chromium
Cu	= Copper
Fe	= Iron
Mn	= Manganese
Ni	= Nickel
Pb	= Lead
Se	= Selenium
Zn	= Zinc
DISS	= Dissolved (analysed by ICP-MS)
DIRECT	= Direct ICP-MS analysis of sample acidified in the laboratory
<	= less than
DL	= Detection Limit
*	= Warning: below criterion of detection
#	= Warning: below limit of detection (but above criterion of detection)

Analytical results are for samples as received.

Lawrence Pickston
Analyst

Dr S K Fellows
Section Leader