TO: CITY MANAGER 1993 APRIL 29

FROM: ACTING DIRECTOR PLANNING AND BUILDING

SUBJECT: **CHEVRON CANADA REFINERY**
REPLACEMENT OF SULPHUR RECOVERY PLANT
PRELIMINARY PLAN APPROVAL APPLICATION #10529

PURPOSE: **To provide Council with updated information on the status of the request to the G.V.R.D. for a variance to Chevron's existing air permit and to seek authority for a response.**

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RECOMMENDATION:

1. **THAT** Council authorize staff to file a notice with the G.V.R.D. that Burnaby would object to issuance of an amendment to the Air Emission Permit (GVA - 0117) until it has had an opportunity to review the G.V.R.D.'s technical evaluation of the dispersion model report and to reach conclusions regarding the potential health impacts for the community.

R E P O R T

BACKGROUND

On 1993 March 22, Council received an information report on the status of the request by Chevron Canada Limited to revise its plan for replacement of the existing sulphur recovery plant at the refinery. At that time, it was reported that Chevron would be pursuing a dispersion modelling exercise to predict how a shutdown of the sulphur plant, as proposed under the revised plan, would affect areas of North Burnaby and the North Shore. The simulation model would study the impact expected, associated with a projected 6 tonne/day increase in sulphur dioxide emissions to the atmosphere during a projected shutdown from 1993 March 08 through September 01.

The report concluded with a statement that following the G.V.R.D.'s evaluation, a further report would be provided to Council, incorporating comments from the Environmental Health Services division.

PRESENT STATUS

The Acting Chief Public Health Inspector has forwarded the attached memo dated 1993 April 29, with attachments, for submission to Council in connection with recent developments on this topic. The consultant's report referenced in the memo, and related technical attachments are included in Council's agendas, and are available for the public at the Environmental Health Services offices.

As noted in the memorandum, a letter report prepared by Cirrus Consultants was submitted to the G.V.R.D. on April 22, and the G.V.R.D. has indicated that they have agreed to make a decision on the requested variance by 1993 May 07. However, the G.V.R.D. has also indicated that it does not expect to be able to complete its evaluation of the report until May 05. As a result, Environmental Health Services has expressed the concern that this will leave insufficient time to conduct a health evaluation and give an opportunity for public input or to properly advise Council, prior to the G.V.R.D. making a decision.

In view of the information received by Environmental Health that the G.V.R.D. does intend to provide some form of notice to the public and to set a deadline for receiving comments, it may be that Council would wish to reserve the opportunity to submit comments prior to a decision being made, but following a proper evaluation of the potential effects on the community, based on the simulation model results. This report recommends that Burnaby inform the G.V.R.D. to this effect prior to May 07.

A further report will be submitted on the results of the analysis and any G.V.R.D. response as soon as this information is available and prior to Council's formal consideration of an application for Preliminary Plan Approval.

D. G. Stenson
Acting Director
Planning & Building

cc: Director Administrative & Community Services
Acting Chief Public Health Inspector

ITEM	14
MANAGER'S REPORT NO.	29
COUNCIL MEETING	93/05/03

C I T Y O F B U R N A B Y

INTER-OFFICE COMMUNICATION

TO: ACTING DIRECTOR PLANNING & BUILDING 1993 APRIL 29

FROM: ACTING CHIEF PUBLIC HEALTH INSPECTOR

SUBJECT: SULPHUR PLANT REPLACEMENT PROPOSAL UPDATE
CHEVRON REFINERY - 5201 PENZANCE DRIVE

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On 1993 January 08, staff were informed by Chevron officials regarding their revised proposal for replacement of the sulphur plant previously reported to Council under PPA #10529 in August of 1992. This information was brought to Council's attention as an information report by your Department during the 1993 January 18 Council Meeting.

On 1993 February 11, subsequent to further discussions between the G.V.R.D. and City staff, a letter was forwarded from the regional district to Chevron requesting them to undertake a dispersion modelling study. The study would assist in addressing potential local impacts from emitting six tonnes of sulphur dioxide per day from the refinery as a result of the sulphur plant shutdown between the months of 1993 March to September.

On 1993 March 10, Environmental Health Services staff received information from Chevron regarding the sulphur dioxide dispersion modelling approach proposed by their consultant, Cirrus Consultants, and accepted by the G.V.R.D.

On 1993 April 22 at an invitation by the G.V.R.D. staff, Environmental Health Services attended a meeting with the G.V.R.D. and Chevron officials. At this meeting, Chevron presented staff with a copy of a letter report from Cirrus Consultants regarding dispersion modelling evaluation and requested an official response on the submitted information by 1993 May 07 (Attachment #1). During the meeting it was stated by the G.V.R.D. officials that Chevron would be required to apply for an amendment to their existing G.V.R.D. Air Emission Permit GVA 0117. This requirement had also been stated to Chevron during their earlier meeting on 1993 March 29. However, Chevron refused to submit an application and instead wished to seek for a variance to the noted Permit.

Subsequent to the meeting, the G.V.R.D. officials and Environmental Health Services staff agreed on the approach that the regional district would review the letter report from Cirrus to determine the acceptability of the dispersion modelling evaluation. Once the results of the model were acceptable, Environmental Health Services would evaluate the impact on health of the nearby residents. Staff would then provide an appropriate report to Council. With respect to the issue of filing requirement of an application by Chevron and its associated consequences, it was determined that the regional district staff would discuss this issue with their senior officials and respond appropriately.

ITEM	14
MANAGER'S REPORT NO.	29
COUNCIL MEETING	93/05/03

On 1993 April 23, staff were informed by the G.V.R.D. that Chevron would be required to file an application for amendment to their existing G.V.R.D. air emissions permit and a request for a variance was not acceptable.

On 1993 April 24, Environmental Health Services staff were informed by the regional district that if Chevron was willing to file an application but were reluctant to provide public notification the G.V.R.D., would on behalf of Chevron, provide public notification.

On 1993 April 26, Environmental Health Services contacted the G.V.R.D. to determine the status on review of the dispersion modelling evaluation. While their staff indicated that they were still evaluating the submitted information, it was stated to staff that filing of an application by Chevron was still a requirement by the G.V.R.D. In addition, Environment Health staff were invited to attend a meeting on 1993 April 29 with Chevron on this issue.

On the afternoon of 1993 April 27, Environmental Health Services staff were informed by the G.V.R.D. that they were intending to complete the review of the dispersion modelling work and make their decision on this issue by 1993 May 07. Information regarding the change in the regional districts previous requirements for filing of an application by Chevron to amend their existing permit and the details of public notification were not clearly indicated to staff. During this discussion, Environmental Health Services staff stressed the concerns regarding the approach taken as well as emphasized the need for adequate time required to conduct a health impact assessment and inform the Burnaby Council appropriately.

On 1993 April 28, Environmental Health Services contacted the G.V.R.D. to obtain clarifications on the new development and were informed as follows. Further information required by the G.V.R.D. on the dispersion modelling evaluation would be forwarded to Chevron as soon as possible. Subsequent to receiving a response from Chevron, the G.V.R.D anticipates that the evaluation would be finalized by 1993 May 05. The G.V.R.D. will than advise the public. However, the form of advisement and the deadline for receiving comments from the public were not provided to staff. Once again Environmental Health Services raised concerns regarding the lack of time to conduct a health evaluation, appropriately advise and seek comments from public prior to the G.V.R.D. making a decision.

On 1993 April 29, Environmental Health Services received a copy of the letter sent by the G.V.R.D. to Chevron commenting on the dispersion modelling evaluation (Attachment #2). In addition, staff have now been informed that the regional district is in the process of coordinating a meeting with Chevron on 1993 April 30.

K.C. Johnston, C.P.H.I.(C)
ACTING CHIEF PUBLIC HEALTH INSPECTOR

DD/KCJ/gl

cc: Medical Health Officer
Director Administrative &
Community Services

Chevron Canada Limited
1500 - 1050 West Pender Street, Vancouver, B.C. V6E 3T4 • Phone (604) 668-5300
Refinery: 355 North Willingdon Ave., Burnaby, B.C. V5C 1X4 • Phone (604) 293-4040

R.E. Gray
Manager, Health, Environment & Loss Prevention

ATTACHMENT #1

April 22, 1993
Burnaby, B.C.

Variance Request
Permit GVA-0117
• Fuel Gas Desulphurization
• Sulphur Plant Operation
File: 320.62

Mr. Robert S. Smith
Assistant Air Quality Director
Air Quality and Source Control Department
Greater Vancouver Regional District
4330 Kingsway
Burnaby, B.C.
V5H 4G8

Dear Mr. Smith:

Please refer to our subject requests of February 17 and January 12, 1993 and your February 23, 1993 letter outlining the need to assess local environmental impacts of additional SO_2 emissions.

During a meeting on February 24 your staff indicated that the only concern regarding our proposal was potential local impacts. It was agreed that on a regional basis the additional SO_2 emitted during the proposed Sulphur Plant shutdown period was not of concern. The increased SO_2 emitted for a four month period by Chevron (6.0 tonnes per day) is more than offset by reductions as other refineries cease processing (6.9 tonnes per day). The major environmental benefit of our proposal will be availability of low sulphur diesel fuel by the fourth quarter of this year. The equivalent SO_2 emission reductions from use of this fuel are estimated at 7.8 tonnes per day.

Modelling of the air shed surrounding our Burnaby Refinery has now been completed. The consultants report is attached. The report shows that SO_2 ambient concentrations during the Sulphur Plant shutdown period are projected to be well within maximum desirable Environment Canada levels for all but three hours per year. The report concludes "since the predicted ambient concentrations of sulphur dioxide are almost always well within published Environment Canada and U.S. Environment Protection Agency criteria for SO_2 there should be no adverse effect on public health or vegetation".

Mr. R.S. Smith

April 16, 1993

The base for the model was the maxima of SOx and flow as in the current permit, with the FCC regenerator, # 19, at the 3300 kg/day limit and one of the boilers at 300 mg/M_3 for gas from the Sour Water Stripper, the other boilers at 150 mg/M^2 reflecting process gas/natural gas fuel only.

The modelling is based on use of actual meterological data for the year 1991 as supplied by the GVRD. The details of the modelling are included within the consultants report. Our estimate of additional SO_2 emissions used is attached for your information.

Our Sulphur Plant variance request is now revised to the months of June, July, August and September.

We would appreciate your response to our request by May 7 in order that we can meet other project deadlines.

R.E. GRAY

Attach.

rssgva01.reg

4/21/93
REG

SO_2 BALANCE INCREMENTS ESTIMATE
TONNES/DAY

1993 AIR	CHEVRON	SHELL	PCP	LSD	TOTAL	TONNES
APRIL	.18	3.4	3.5	--	7.1	213
MAY	.18	(3.4)	(3.5)	--	(6.7)	(208)
JUNE	6.0	(3.4)	(3.5)	--	(0.9)	
JULY	6.0	(3.4)	(3.5)	--	(0.9)	
AUGUST	6.0	(3.4)	(3.5)	--	(0.9)	
SEPTEMBER	6.0	(3.4)	(3.5)	--	(0.9)	(110)
OCTOBER	.34	(3.4)	(3.5)	(7.8)	(14.4)	
NOVEMBER	.34	(3.4)	(3.5)	(7.8)	(14.4)	
DECEMBER	.34	(3.4)	(3.5)	(7.8)	(14.4)	(1325)
						(1429)
GVRD SEWER						(6.7)T/D
JUN 1 - DEC 31	2.8 (1)					214 Days
						(504)
						180 Days

Will this be reflected in GVRD permit?

SHELL & PCP - ESTIMATED SO_2 EMISSIONS 1993
PCP & SHELL CEASE PROCESSING MAY 1/93

LSD -- ESTIMATED REDUCTION IN SO_2 EMISSIONS DUE TO USE OF LOW SULPHUR DIESEL CONSUMED

(1) - EQUIVALENT SO_2 REMOVED FROM GVRD SEWER BY ADVANCING 6 MONTHS.

↳ does not reflect for impact to the air!

Net gain for the region but does not address + compare to local impacts/zones directly!

How is the variation of SO_2 discharge accounted for as it relates to processing of different crude TYPES!

M E M O R A N D U M

January 7, 1993
Burnaby, B.C.

Stretford Plant
Potential Discharge
File: 362.08

REG;

If the sulphur plant were to be off-line, the total estimated SO_2 discharge for March to September, 1993 would be approximately 3.04 tonnes per day, based on the following:

	Average equivalent tonnes SO_2 per day		
	On-line	Off-line	Delta = Net Change
Sulphur plant	0.16	5.28	5.12
Effluent treating	2.80	0	-2.80
Sour water stripper	0.02	0.74	0.72
TOTAL	2.98	6.02	**3.04**

This estimation is based on 1993 forecast crude rates of 39,000 to 47,000 barrels per day, with above SO_2 discharge varying +/- 20%, depending on crude TYPE.

Should you require anything further, please let me know.

Jill Donnelly

Jill Donnelly

cc: DWR
PMS

Avg. H_2S In: 7482 ppm (July 1/91 → June 30/92)
(best annual data)

Permitted Recovery = 97% ⇒ What is the actual recovery??

So H_2S Out = 7482 − .97(7482)
= 224 ppm.

Avg. fuel gas flow = 9.2×10^6 SCFD (Mar/92 − Sept/92)
(similar time frame as 1993 expected)

ON-LINE: $9.2\times10^6 \frac{ft^3}{day} \times \frac{1\ mole}{379\ ft^3}$ = 24,274 $\frac{moles\ gas}{day}$ × 0.0224 % H_2S (vol)

= 5.44 $\frac{moles\ gas}{day}$ × 34 $\frac{lbs\ H_2S}{mole}$

= 185 $\frac{lbs\ H_2S}{day}$ ON-LINE

OFF-LINE

= 24,274 $\frac{moles\ gas}{day}$ × 0.7482 % H_2S (vol)

= 181.6 $\frac{moles\ gas}{day}$ × 34 $\frac{lbs\ H_2S}{mole}$

= 6174 $\frac{lbs\ H_2S}{day}$ OFF-LINE

Δ 6174 − 185 = 5989 $\frac{lbs\ H_2S}{day}$

Δ Convert to SO_2 = (181.6 $\frac{moles\ gas}{day}$ × 64 $\frac{lbs\ SO_2}{mole}$) − (5.44 $\frac{moles\ gas}{day}$ × 64 $\frac{lbs\ SO_2}{mole}$

= 11.622 $\frac{lbs\ SO_2}{day}$ (5.28 times) − 348 $\frac{lbs\ SO_2}{day}$ (0.16 times)

ADA $2 \frac{\text{us. gal}}{\text{min}} \times 60 \frac{\text{min}}{\text{hr}} \times 24 \frac{\text{hrs}}{\text{day}} \times 3.785 \frac{\text{l}}{\text{gal}} \times 0.8 \frac{\text{gm ADA}}{\text{l}} \times \frac{1 \text{ kg}}{1000 \text{ gm}} = \boxed{8.7 \frac{\text{kg}}{\text{day}}}$

Vanadium $\times 0.6 \frac{\text{gm Van}}{\text{l}} = \boxed{6.5 \frac{\text{kg Van}}{\text{day}}}$

Thiosulphate to Sewer $\times 500 \frac{\text{gm thio}}{\text{l}} = 5450 \frac{\text{kg thio}}{\text{day}}$

↳ $Na_2S_2O_3 \cdot 5H_2O$

m.w = 248 $\frac{\text{kg}}{\text{kg-mole}}$

S_2

m.w. = 64 $\frac{\text{kg}}{\text{kg mole}}$ $\therefore S_2 = \frac{64 \text{ kg}}{248 \text{ kg}} \times 5450 \frac{\text{kg thio}}{\text{day}}$

$= 1406 \frac{\text{kg S}}{\text{day}} \times \frac{64 \text{ kg } SO_2 \text{ m.w}}{32 \text{ kg S m.w}}$

$= 2812 \frac{\text{kg } SO_2}{\text{day}} \times \frac{1 \text{ tonne}}{1000 \text{ kg}}$

$= \boxed{2.8 \frac{\text{tonnes } SO_2 \text{ from thiosulphate}}{\text{day}}}$

SWS Gas

Design: 85 gpm to SWS yields 2.11 moles H_2S/hr

Usual: 42 gpm

1.06 moles H_2S/hr = 1.06 moles S/hr

= 1.06 moles SO_2/hr

= 1.06 $\frac{\text{moles } SO_2}{\text{hr}} \times 64 \frac{\text{lbs } SO_2}{\text{mole}}$

= 68 $\frac{\text{lbs } SO_2}{\text{hr}} \times 24 \frac{\text{hr}}{\text{day}}$

OFF-LINE

SWS OFF-LINE = 1632 lbs SO_2

SWS Gas

Usual: 42 gpm Recovery 97%

ON-LINE Δ SO_2 out = 1632 - .97(1632)

= 49 lbs SO_2 / day

$\triangleq$ = 1632 - 49

= 1583 lbs SO_2 / day × 1 tonne / 2205 lbs

SWS

$\triangleq$ = 0.72 tonne / day

Cirrus
CONSULTANTS

SUITE 410 • 475 W. GEORGIA STREET
VANCOUVER, BC CANADA V6B 4M9
FAX: (604) 683-5732 TEL: (604) 683-5697

April 21, 1993

Mr. P.M. Stephen
Senior Engineer
Technical Services
Chevron Canada Limited
355 North Willingdon
Burnaby, B.C.
V5C 1X4

Dear Mr. Stephen:

Re: Chevron Refinery - Dispersion Modelling Evaluation of Sulphur Plant Shutdown

This letter briefly describes the approach to, and results of, the air quality evaluation for the sulphur plant shutdown at the Chevron Refinery. Specifically, the predictions of ambient SO_2 concentrations are made using the procedures outlined in this letter.

The specific components considered in this letter are:

- Emission rates for dispersion modelling;
- Application of the available meteorological data to the dispersion model;
- Dispersion model selection and application;
- Assessment of background air quality for sulphur dioxide (SO_2);
- Comparison of the predicted maximum ambient SO_2 concentrations to the relevant ambient guidelines.

1.0 EMISSION PARAMETERS USED IN THE DISPERSION MODEL

The emission parameters for each stack at the refinery include:

- Stack base elevation (m ASL) and stack height (m);
- The internal diameter of each stack at stack exit;
- Stack exit velocity and exit temperature;
- Stack gas moisture content and volumetric flow rate with the volumetric flow rate presented at actual conditions;
- Worst case SO_2 emission rate as defined later in this Section.

While Cirrus Consultants converted the data supplied by Chevron to the format necessary for use in dispersion modelling, the detailed evaluation of SO_2 emission rates and verification that the emission rates meet the GVRD emission criteria for dispersion modelling is being conducted by Chevron. Therefore, this letter describes only the procedures used to convert the emission data provided by Chevron into the values used in the dispersion model which were:

- Chevron provided the flowrates in m^3/min at <u>standard dry conditions</u>. These flowrates were converted to flowrates at <u>stack conditions</u>, expressed as actual m^3/sec, by correcting for stack discharge temperature and moisture content. The flow rates at actual conditions are expressed as actual m^3/sec. This conversion enabled the actual stack discharge velocity to be determined for use in the model by firstly using the stack diameter to calculate the cross-sectional area of the discharge. Secondly, the exit volume was determined by dividing the volumetric flow rate by the stack's cross-sectional area to determine the stack discharge velocity;
- Sulphur dioxide (SO_2) emission rates are expressed in the units of grams per second (g/s) for entry into the model. The emission rates were calculated by multiplying the flowrate at standard dry conditions by the SO_2 concentration at standard dry conditions and converting to the desired g/s units;

- The additional 6 t/d SO_2 (69.4 g/s), that would be emitted from the refinery when the sulphur plant is shut down, was distributed among the other emission sources as requested by Chevron. The distribution of the additional 6 t/d SO_2 was allocated to each source according to the ratio of the standard dry flowrate of the source to the total standard dry flowrate (excluding source #19 referred to as "FCC regen"). This additional SO_2 emission rate (g/s) was then added to the current SO_2 emission rates for a second application of the dispersion models.

The emission parameters used in this evaluation are listed in the enclosed Table 1.

2.0 METEOROLOGICAL APPROACH TO MODELLING

In the initial discussions with the Greater Vancouver Regional District (GVRD), it was agreed that a synthetic meteorological data set could be used for the dispersion modelling evaluation. This GVRD approved data set, which is based on U.S. EPA modelling criteria, was overly conservative for air flow, under stable atmospheric conditions, moving towards elevated terrain above both shores of Burrard Inlet. Consequently, with the approval of the GVRD, the meteorological data from Station T6 (Second Narrows) and Station T9 (Rocky Point Park) were used for the wind speed/wind direction and temperature data input respectively into the dispersion models.

Atmospheric stability was determined using data from the nearest (Vancouver International Airport) monitoring station at which data is collected 24 hours per day. GVRD approved procedures, that had been developed by the U.S. Environmental Protection Agency (U.S. EPA), were followed. Mixing height was calculated using GVRD Station T6 data and is defined as stack height plus plume rise (for the largest emission source) plus 100 m in accordance with past provincial practice for major industrial facilities. The mixing height was calculated using GVRD Station T6 wind speed data along with parameters for stack #19 (i.e., stack height exit velocity, inside stack diameter and discharge temperature).

The GVRD provided the meteorological data for the years of 1982-84 and 1990-92 for the purposes of dispersion modelling. As previously noted, other meteorological data from the Atmospheric Environment Service of Environment Canada were used to determine atmospheric stability for the same time periods for use in the dispersion models.

For the reasons outlined below, the drainage winds off the north and south sides of Burrard Inlet were rotated to east or west winds using the following criteria:

- For wind directions from 0 to 75° or from 105-180°, these wind directions were converted to 90°;
- For wind directions from 285-360° and from 181-255°, these wind directions were converted to 270°.

Since the Chevron refinery is located on a promontory jutting into the Inlet, the refinery emissions are more subject to up and down Inlet flow, than, for example, the Shell refinery emissions. This makes the above wind rotation approach more reasonable for the Chevron refinery location and for the reasons noted below.

Under a strong inversion (i.e., stable atmospheric) conditions, the air in Burrard Inlet tends to drain into the Inlet under the influence of gravity and flow either up or down along the Inlet (i.e., in an east or west direction). Under neutral or unstable conditions, it is possible and expected that air will flow up the slopes on either side of the Inlet.

For initially stable air to flow down one side of the Inlet's sides and up and over the other side, this air flow pattern must be either mechanically driven by forces such as the outflow winds that can occur from Indian Arm or become less stable (i.e., no longer an inversion condition). Therefore, uphill flow into the hillside should not occur under stable atmospheric conditions.

Mechanical forcing of air flow by up the Inlet slopes can be caused by Inlet scale or broader atmospheric thermal (temperature) or pressure gradients. This mechanical forcing of air up the Inlet slopes under neutral or moderate inversion conditions would be subject to destabilizing conditions that should change the stability classification. That change is a prerequisite to allow the air that passes over the refinery and then flow uphill.

Therefore, the wind rotation algorithm under inversion or near inversion conditions is both reasonable and scientifically appropriate.

3.0 DISPERSION MODEL SELECTION AND APPLICATION

As noted in the Cirrus letter of 3 March 1993 to Mr. K.P. Stubbs of the GVRD, the latest version of the U.S. Environmental Protection Agency (U.S. EPA) Industrial Source Complex Short-Term (ISCST2) model was used to predict SO_2 concentrations at locations close to the facility and for all terrain elevations below the elevation of the top of the lowest height stack at the Chevron facility (i.e., 22.9 m AGL). The U.S. EPA Rough Terrain Diffusion Model (RTDM) was used to predict SO_2 concentrations for locations at higher evaluations.

The models were applied to a number of locations in the receiving environment. Specifically, the ISCST2 model used 398 receptor locations and the RTDM model used 580 receptor locations for a total of 978 locations in the dispersion models. The dispersion modelling grid, which is illustrated in the enclosed Figure 1, was approved by the GVRD prior to dispersion modelling. Figure 1 also shows the location of receptors at sensitive locations such as schools and medical care facilities.

The dispersion modelling, as previously noted, considered two cases: prior to and during shutdown of the sulphur recovery plant.

4.0 ASSESSMENT OF BACKGROUND AIR QUALITY

The primary emitters of SO_2 in the Burrard Inlet area are the petroleum refineries. However, the Shell and Petro Canada refineries are currently in the process of shutdown and/or conversion to storage and minor processing facilities. The permanent shutdown and similar conversion of the Imperial Oil (IOCO) refinery has also been recently announced. Consequently, the future (May 1993) background ambient SO_2 concentrations should be much lower than listed in the current GVRD annual ambient air quality monitoring reports.

However, for the purposes of illustration and to demonstrate that adverse ambient air quality concentrations have not been normally measured in the area including periods of time when the sulphur plant had been previously shutdown at the Chevron refinery , the maximum SO_2 background ambient air quality concentrations for GVRD Stations T4 (Kensington Park), T5 (Confederation Park), T6 (Second Narrows) and T9 (Rocky Point Park) are listed in the enclosed Table 2. All measured ambient SO_2 concentrations in 1991 at those Stations are were well within the most restrictive ambient guidelines of Environment Canada. The same conclusion applies to 1988, the year during which Chevron advised that the sulphur plant was shutdown for reasonable time periods.

Short not an extension presently proposed.

5.0 PREDICTED AMBIENT AIR QUALITY CONCENTRATIONS AND COMPARISON TO THE AMBIENT GUIDELINES

The maximum (worst case) ambient SO_2 concentrations were predicted using available meteorological data for the 6 years noted above. These maximum concentrations are listed on Table 3, for each relevant averaging period, using predictions of both current ambient air concentrations and concentrations during the planned sulphur plant shutdown. In addition, the ambient air quality guidelines used in this evaluation are also presented on Table 3.

For the current operating conditions, when the existing sulphur plant is in operation, the maximum predicted ambient air quality concentrations from the Chevron refinery are well within both the Environment Canada Maximum Desirable and Maximum Acceptable criteria. When the sulphur plant is shutdown, the Maximum Acceptable criteria are met in most locations for the 1 hour averaging period and at all modelled locations for 24 hour and annual averaging periods. The contours (isopleths) of ambient SO_2 concentrations both prior to and following sulphur plant shutdown are illustrated on the enclosed Figures 2 through 7 for the 1 hour, 24 hour and annual averaging periods (to be consistent with the averaging periods used for the ambient air quality guidelines).

Since the dispersion modelling showed that the incremental ambient SO_2 concentrations from the Chevron refinery, during sulphur plant shutdown, could exceed the Maximum Desirable and Maximum Acceptable concentrations, a distribution of the maximum concentrations was prepared for a residential site on Capitol Hill which is 100 m north of the location of the maximum predicted 1 hour SO_2 concentration (Figure 8). In the year that gave the highest predicted SO_2 concentrations (i.e., for the modelled year of 1991), this residential location did not have any predicted 1 hour averaged SO_2 concentrations above the Maximum Acceptable level and only three hours above the Maximum Desirable level.

should not include in the report!

Since the maximum predicted ambient concentrations of sulphur dioxide are almost always well within the published Environment Canada and U.S. Environmental Protection Agency criteria for SO_2, there should be no adverse effect on public health or vegetation.

→ this issue has to be decided by the Health Agencies

Given that the main objective of the sulphur recovery plant replacement project is to produce a higher quality diesel fuel that will substantially reduce emissions from modern bus and heavy duty trucks, the GVRD may consider these temporary and infrequent higher SO_2 concentrations to be acceptable. We therefore suggest, in accordance with the original GVRD request, that these data be presented to the GVRD for their review.

This letter report is a brief summary of the modelling carried out and results obtained in accordance with GVRD's request. This letter should not be considered as a comprehensive environmental assessment or detailed air quality evaluation.

Yours sincerely,

Peter Sagert, P. Eng.
Principal

PS:df

Encls.
- Table 1, SO_2 Emissions from Chevron Refinery
- Table 2, Background SO_2 Concentrations for the Area Around the Chevron Refinery
- Table 3, Maximum Predicted SO_2 Concentrations for the Area Around the Chevron Refinery
- Figure 1, Receptor Locations for RTDM and ISCST2 Dispersion Modelling
- Figure 2, Predicted Ambient Air Quality SO_2 Concentrations, Maximum 1 Hour Average, Current Emissions
- Figure 3, Predicted Ambient Air Quality SO_2 Concentrations, Maximum 24 Hour Average, Current Emissions
- Figure 4, Predicted Ambient Air Quality SO_2 Concentrations, Maximum Annual Average, Current Emissions
- Figure 5, Predicted Ambient Air Quality SO_2 Concentrations, Maximum 1 Hour Average, Sulphur Plant Shutdown
- Figure 6, Predicted Ambient Air Quality SO_2 Concentrations, Maximum 24 Hour Average, Sulphur Plant Shutdown
- Figure 7, Predicted Ambient Air Quality SO_2 Concentrations, Maximum Annual Average, Sulphur Plant Shutdown
- Ambient SO_2 Concentrations on Capital Hill

Stephen.A19.651.0

Table 1 SO_2 Emissions From Chevron Refinery

rce iber	Emission Source	Stack Height m	Stack Diam. m	Stack Exit Velocity m/s	Stack Temp. °C	Current Emission Rate g/s	Emission Rate With Sulphur Plant Shutdown g/s	Moisture % H_2O v/v	Stack Flow Standard smd^3/s	Stack Flow Actual am^3/s
	Crude Furnaces F5104, F5105	36.6	1.83	9.1	177	3.85	18.43	18	12.8	24.0
	Splitter Furnace F5300	36.6	2.13	3.1	261	0.75	6.44	18	5.0	11.1
	NHT Furnace F5700	22.9	1.22	16.6	382	0.30	2.59	18	2.0	19.4
	De-Sulph Reboiler F5705	22.9	0.99	4.3	327	0.20	1.73	18	1.3	3.3
	Rheni Furnaces F5750, 5751, 5752	42.1	2.44	6.3	260	2.00	17.14	18	13.3	29.6
	CO Boiler F5204	36.6	1.98	7.4	316	1.40	12.02	11	9.3	22.8
1a	Steam Plant 6201, 6202	33.5	1.07	16.6	313	0.92	7.86	18	6.1	14.9
1b	Steam Plant 6203	30.5	1.37	5.1	326	0.92	4.39	18	3.1	7.6
1c	Steam Plant 6204	33.5	1.28	15.9	329	1.22	10.52	18	8.2	20.5
)	FCC Regen.	45.7	1.83	41.2	704	42.67	42.67	8	26.7	108

Table 2 Background SO_2 Concentrations for the Area Around the Chevron Refinery

Air Contaminant	Averaging Period	Maximum Background Concentration ($\mu g/m^3$) GVRD Monitoring Stations T4[1]	T5	T6	T9	Overall Maximum Background Concentration ($\mu g/m^3$)
Sulphur dioxide (SO_2)	1 hr	387	184	139	125	387
	24 hr	77	61	45	45	77
	1 year[2]	19	11	13	11	19

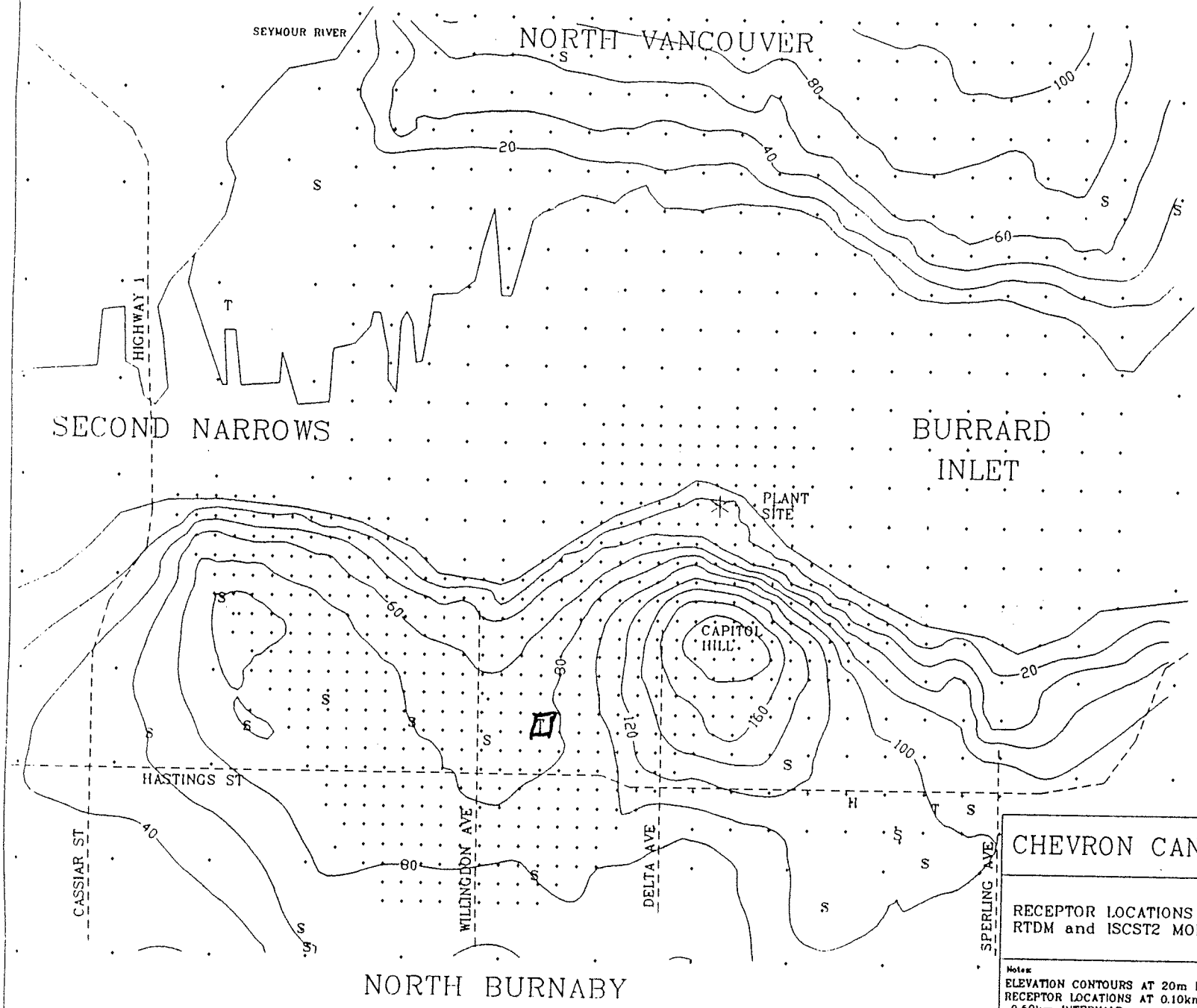
Notes:

1. All GVRD data for the T4, T5, T6, and T9 sites are for the calendar year 1991 as noted in the 3 March 1993 letter to the GVRD.

2. This is expressed by the GVRD as the annual average and is reported as such in this table.

Table 3 Maximum Predicted SO_2 Concentrations for the Area Around the Chevron Refinery

Emission Scenario	Air Contaminant	Averaging Period	Environment Canada Guidelines ($\mu g/m^3$)	Maximum Predicted Ambient Increment ($\mu g/m^3$)
Current Emissions	Sulphur Dioxide (SO_2)	1 hour	450-900	201
		24 hour	150-300	51
		Annual	30-60	10
Sulphur Plant Shutdown	Sulphur Dioxide (SO_2)	1 hour	450-900	1,006
		24 hour	150-300	264
		Annual	30-60	58



CHEVRON CANADA LIMITED

RECEPTOR LOCATIONS FOR
RTDM and ISCST2 MODELLING

Notes:
ELEVATION CONTOURS AT 20m INTERVALS
RECEPTOR LOCATIONS AT 0.10km, 0.20km, and 0.60km INTERVALS
SPECIAL RECEPTORS LOCATED AT SCHOOLS, HOSPITALS, and HILLTOPS

T-PERMANENT AIR QUALITY MONITORING STATION
H-HOSPITAL
S-SCHOOL

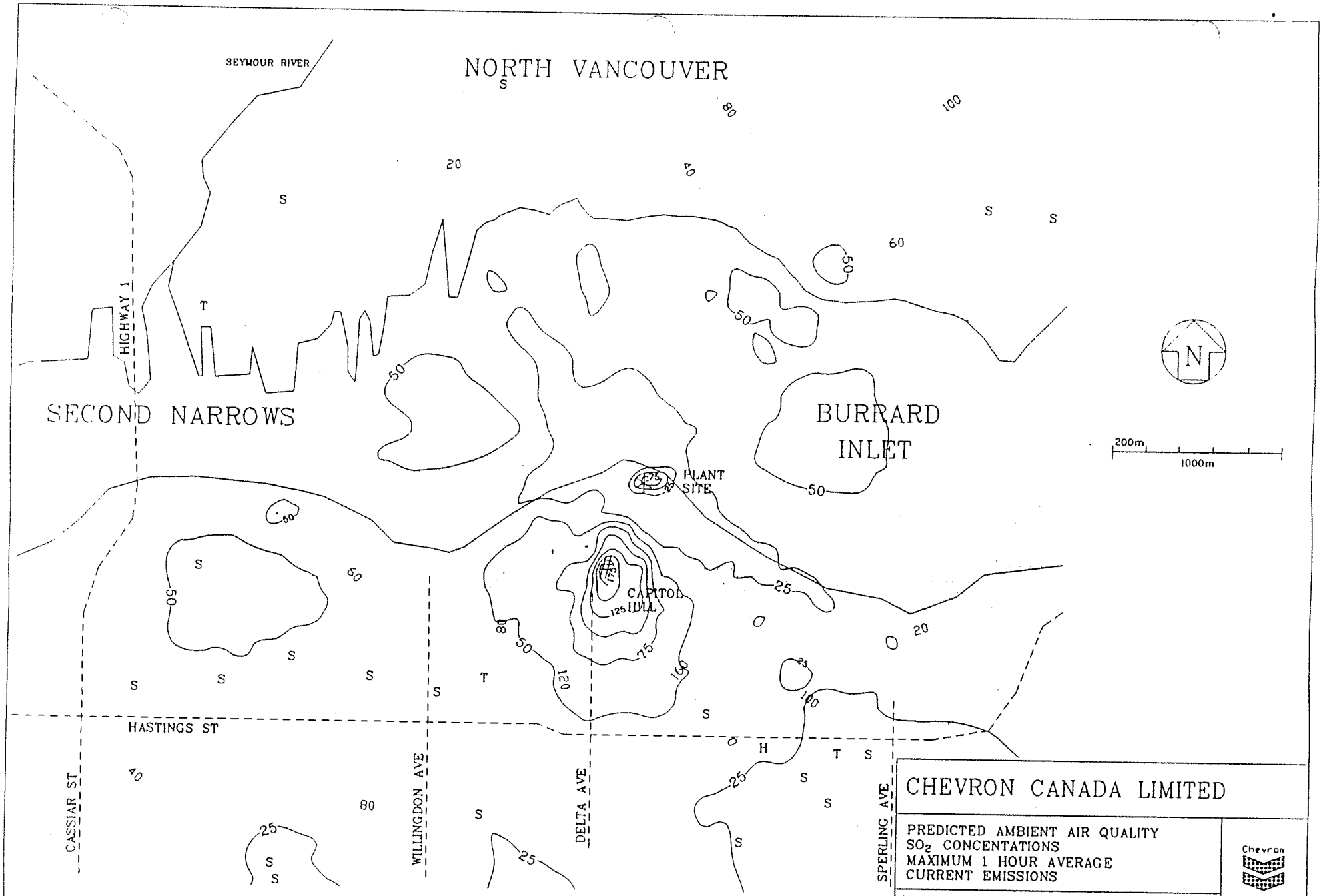
Prepared by:
Cirrus CONSULTANTS

Chevron

Date:
Mar. 1993

Ref No:
CHEVGRID DWG

Figure Number
1



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM 1 HOUR AVERAGE
CURRENT EMISSIONS

Chevron

ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETIIS AT 26ug/m3 INTERVALS
(I=LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

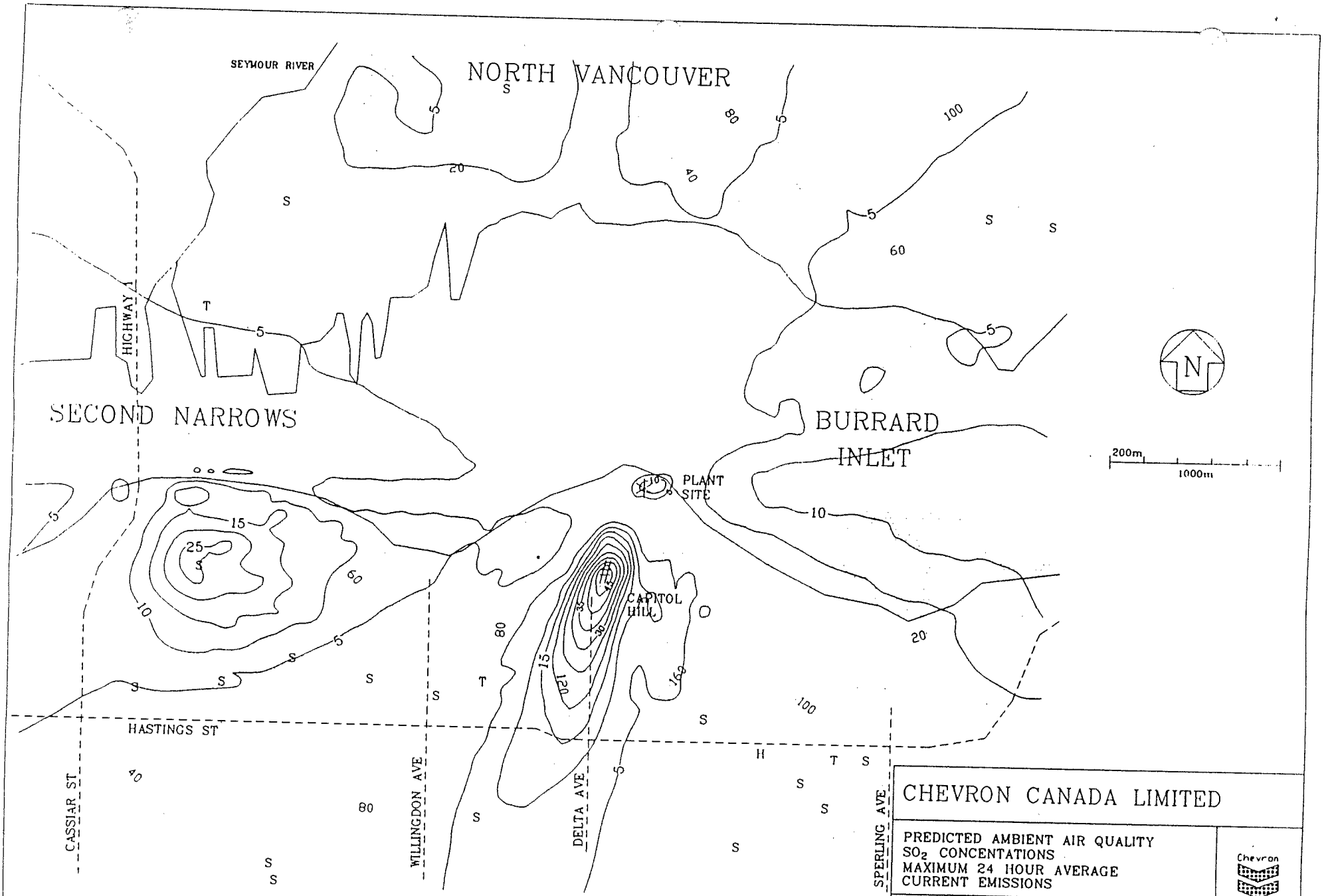
T=PERMANENT AIR QUALITY MONITORING STATION
H=HOSPITAL
S=SCHOOL

Prepared by
CIRRUS CONSULTANTS

Date
Apr. 1993

Ref. No.
CHEV-05.DWG

Figure Number
2



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM 24 HOUR AVERAGE
CURRENT EMISSIONS

Chevron

ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETHS AT 5ug/m3 INTERVALS
(#=LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

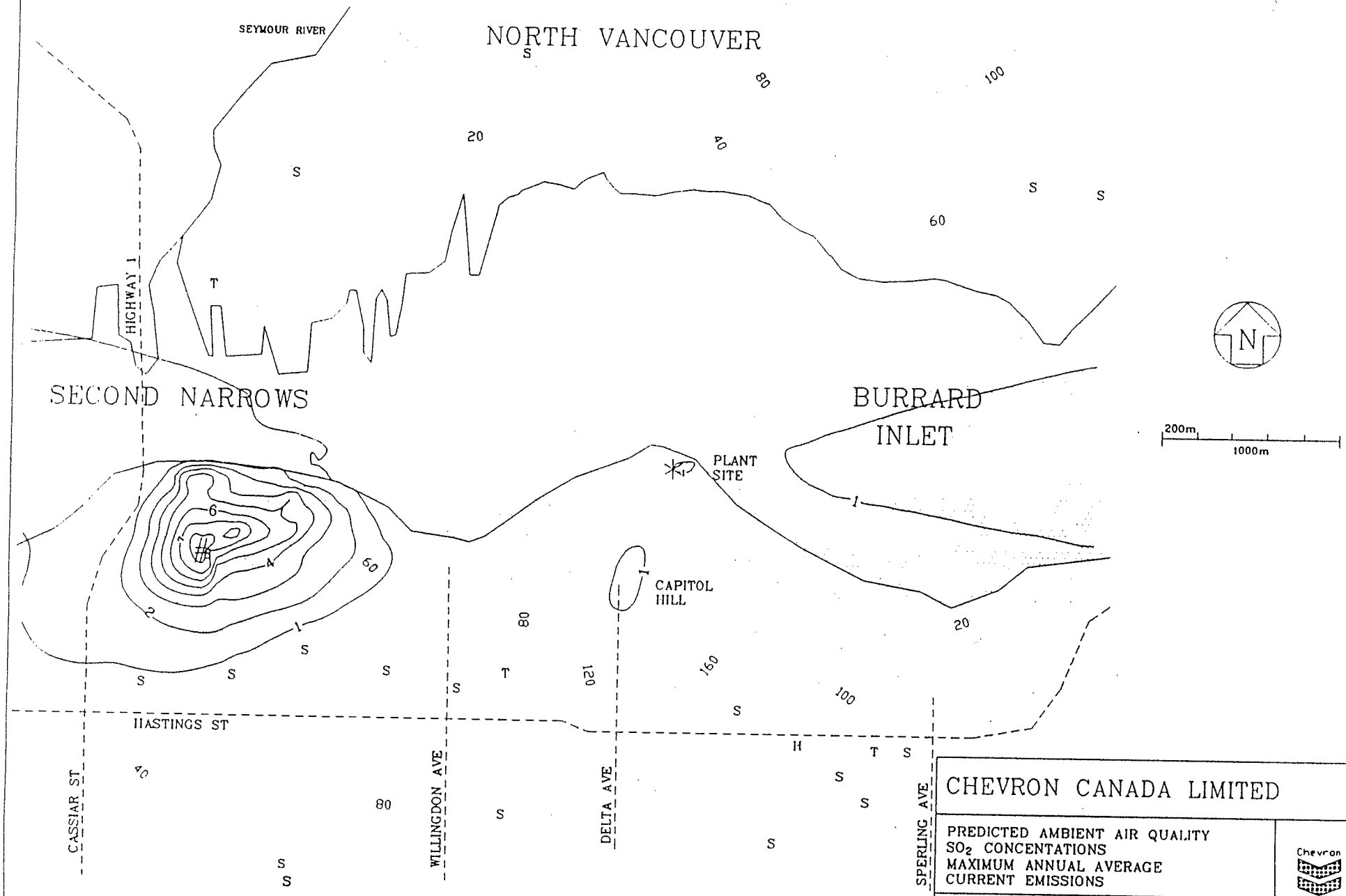
T-PERMANENT AIR QUALITY MONITORING STATION
H-HOSPITAL
S-SCHOOL

Prepared by
Cirrus CONSULTANTS

Date
Apr 1993

Drawing No.
CHEV-06 DWG

Page
3



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM ANNUAL AVERAGE
CURRENT EMISSIONS

Chevron

Notes:
ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETHS AT 1ug/m3 INTERVALS
(# = LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

T = PERMANENT AIR QUALITY MONITORING STATION
H = HOSPITAL
S = SCHOOL

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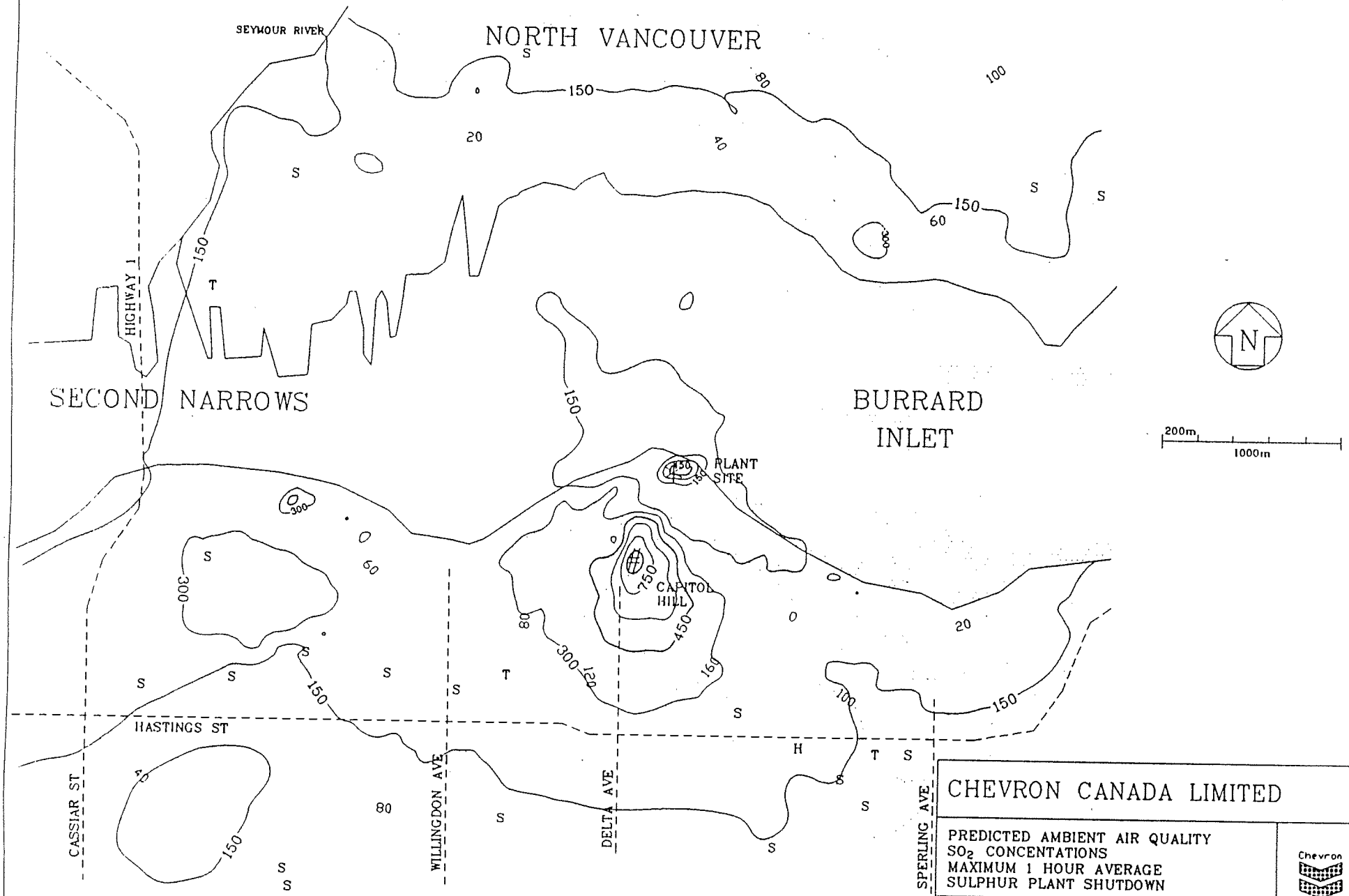
Ref. No.: CHEV-07 DWG

Figure Number: 4



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM 1 HOUR AVERAGE
SULPHUR PLANT SHUTDOWN

Chevron

ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETHS AT 150ug/m3 INTERVALS
(#=LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

T-PERMANENT AIR QUALITY MONITORING STATION
H-HOSPITAL
S-SCHOOL

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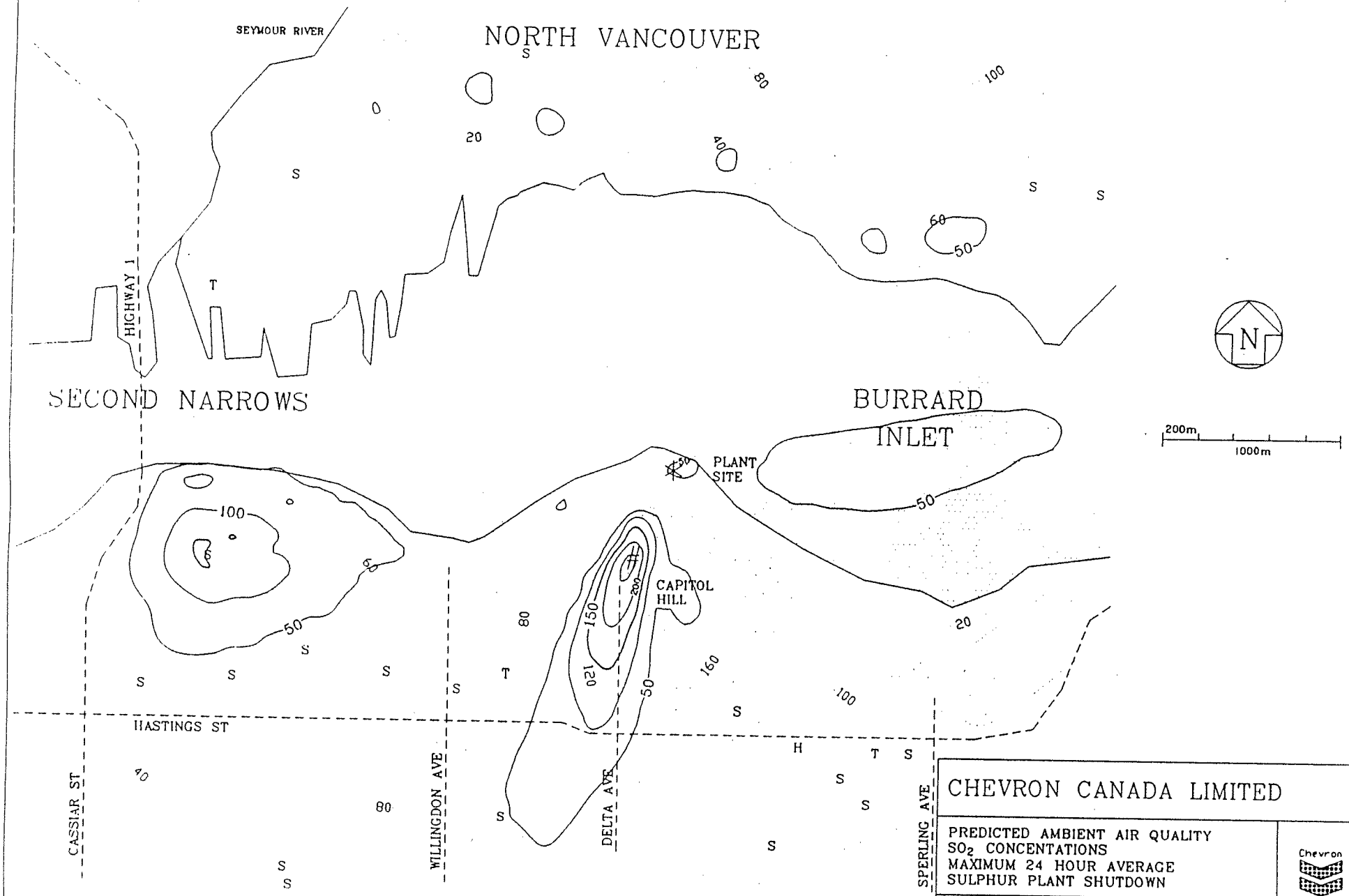
Date: Apr. 1993

Dwg. No.: CHEV-02 DWG

Page No.: 5



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM 24 HOUR AVERAGE
SULPHUR PLANT SHUTDOWN

ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETHS AT 50ug/m3 INTERVALS
(#=LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

T-PERMANENT AIR QUALITY MONITORING STATION
H-HOSPITAL
S-SCHOOL

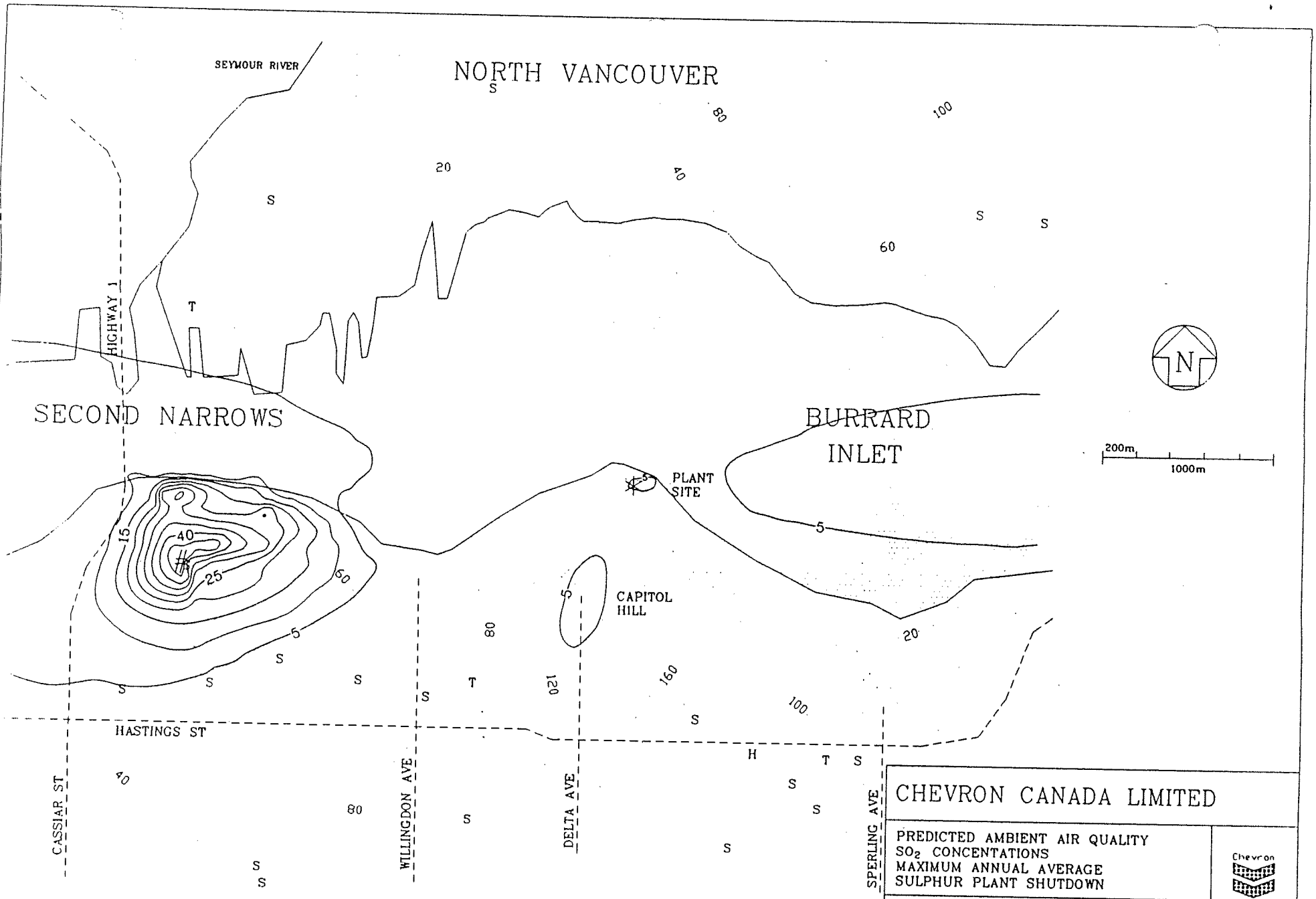
Prepared by
Cirrus CONSULTANTS

Chevron

Date
Apr. 1993

Ref. No.
CHEV-03 DWG

Figure Number
6



CHEVRON CANADA LIMITED

PREDICTED AMBIENT AIR QUALITY
SO_2 CONCENTATIONS
MAXIMUM ANNUAL AVERAGE
SULPHUR PLANT SHUTDOWN

Chevron

ELEVATION CONTOURS AT 20m INTERVALS
SO2 ISOPLETHS AT 5ug/m3 INTERVALS
(#=LOCATION OF MAXIMUM)
1991 MET DATA FROM GVRD and AES USED
STABLE NORTH and SOUTH WINDS ADJUSTED

Date: Apr. 1993

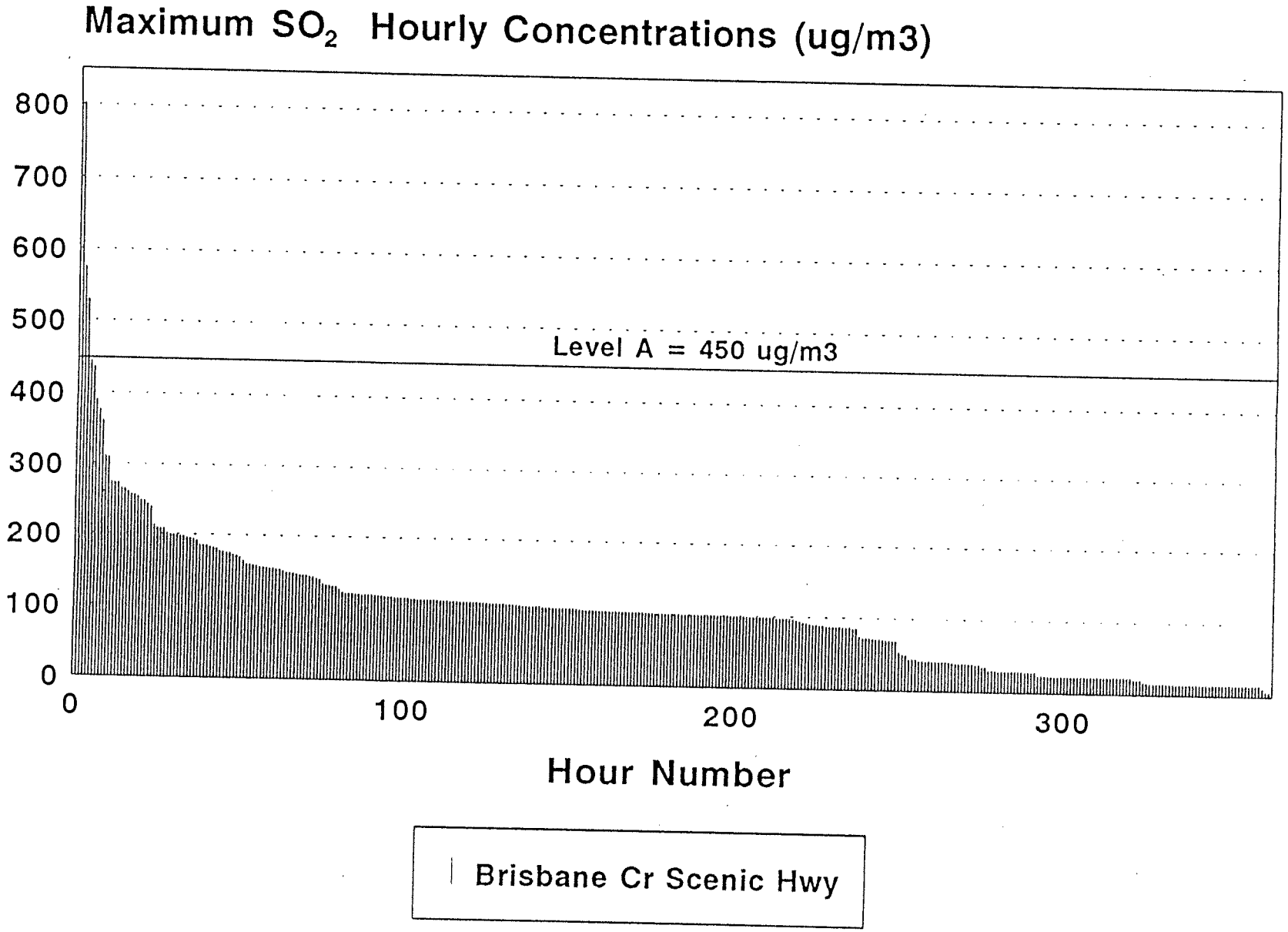
File no.: CHEV-04.DWG

T=PERMANENT AIR QUALITY MONITORING STATION
H=HOSPITAL
S=SCHOOL

Prepared by: Cirrus CONSULTANTS

Page: 7

FIGURE 8
AMBIENT HOURLY SO_2 CONCENTRATIONS ON CAPITOL HILL



Greater Vancouver Regional District
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General
Telephone (604) 432-6200
Fax (604) 432-6251

Air Quality and Source Control Department - Tel (604) 436-6700 Fax (604) 436-6707

ATTACHMENT #2

April 29, 1993

File: 632.2.117

RECEIVED
APR 29 '93
Environmental Health Services

Mr. P. M. Stephen
Senior Engineer
Technical Services
Chevron Canada Limited
355 North Willingdon
Burnaby, B.C.
V5C 1X4

Dear Mr. Stephen:

Re: **Dispersion Modelling Evaluation of Sulphur Plant Shutdown**

This letter details our evaluation of the CIRRUS Consultants report of April 21, 1993, on the above noted subject.

Page 3, para.1, line 3	- "...as requested by Chevron." should read "...as requested by the GVRD (March 4, 1993)"
Page 4, para. 2 (and on)	- there is no definition of "drainage winds" or any estimate of the frequency with which these winds occurred during the 5-6 years of "real" meteorological data used for this analysis. - there is no consideration in this section of upslope thermal winds under stable conditions, which may be induced by the "heat island" effect of the refinery. - this entire section, on which the rest of the analysis is based, needs to be discussed and resolved.
Page 6, para. 1	- this paragraph is irrelevant to the modelling and should be deleted.
Page 6, para. 2	- an analysis of these shutdowns indicate that a majority occurred during the winter months and not during the months of interest in this study.
Page 6, para. 2, line 6	- comparison with measured SO_2 concentrations should be for the 5-6 years used in the modelling study or last 5 years of record (see comments on Table 2).
Page 6, para. 3, line 3-4	- part of sentence starting at "... using prediction..." does not correspond with Table 3 headings (see comment on Table 3).

Page 7, para. 1	- some comparison to "Maximum Desirable" levels should also be made.
	- the analysis should have some indication of the % of time the levels for each time period are predicted to be above "Maximum Desirable" levels yet below "Maximum Acceptable". This will give some indication of the scope and duration of the projected impacts.
Page 7, para. 2	- why was a site 100 m north selected rather than the point of maximum concentration? This graph should indicate levels at the point of maximum predicted impact. Additional graphics of other representative residential areas would be useful to then compare to this site.
Page 7, para. 3	- can only be stated with the caveat that the said criteria were established based upon public health and vegetation impacts. Any other assumptions based upon public health and vegetation impacts should be referred to experts in those fields.
Page 7, para. 4	- irrelevant to this study and should be deleted
Table 2	- although the CIRRUS proposal of March 3, 1993 referred to 1991 as a background for comparison, a listing of the background levels in the other years being modelled would be useful. This would simply entail extracting those years from the GVRD Ambient Air Quality Annual Reports (or the GVRD will provide this information, if requested), as a method of confirming that 1991 was a typical year for SO_2 levels.
Table 3	- the title of the Table refers to "Maximum Predicted SO_2 Concentrations ..." while the last column refers to "Maximum Predicted Ambient Increment". Clarification as to which is correct is required prior to further analysis and review.

Earlier discussions with Chevron, indicated that some mitigative measures may be available, should results of the modelling indicate that ground level concentrations would reach an unacceptably high level. No evaluation of the impact of these options on predicted ground level concentrations is presented in this report.

In discussing the results of the modelling, emphasis has been placed on the few predicted exceedances of the one-hour criteria. Given the many fold increases in predicted 24-hour and longer term ground level concentrations of SO_2 and their close approach to the criteria, some discussion of their location and duration should be presented.

In addition to the above specific comments, the report lacks considerable detail in discussion of the process and the results, detail which is required for the reader to more fully understand the implications of the work. Pending resolution of these concerns and the provision to the GVRD of more details with respect to these matters, we are unable to assess the results of this modelling study.

In order to resolve these concerns, and so that we may draw a resolution to the modelling results in an expeditious fashion (as requested by Chevron Canada Limited), it is proposed that we meet with Chevron and CIRRUS staff on the morning of Friday, April 30th.

Please contact Silvano Padovan (436-6713) to confirm a time for the requested meeting.

Yours truly,

Kenneth P. Stubbs
Ambient Air Analyst

cc: D. Dittani, Burnaby Environmental Health