AGI
TECHNOLOGIES

Preliminary Contamination Assessment
All Fab (Former)
Snohomish County Airport, Paine Field
Everett, Washington

June 23, 1999

Prepared For:

Snohomish County Public Works
2930 Wetmore Avenue
Everett, Washington 98201

AGI Project No. 15,512.323

AGI TECHNOLOGIES

A Report Prepared For :

Snohomish County Public Works Department
2930 Wetmore Avenue
Everett, Washington 98201

PRELIMINARY CONTAMINATION ASSESSMENT
ALL FAB (FORMER)
SNOHOMISH COUNTY AIRPORT, PAINE FIELD
EVERETT, WASHINGTON

June 23, 1999

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1.0 INTRODUCTION

This report presents AGI Technologies' (AGI) groundwater sampling results and review of historical data for the All Fab facility (the site) at Snohomish County Airport (Paine Field) in Everett, Washington. Snohomish County Public Works Department (the County) retained AGI to perform this work under Master Agreement OC10-94, Work Authorization No. 23, and our January 5, 1999 proposal.

1.1 BACKGROUND

UNC All Fab, Inc. currently occupies the site and is a fabricator of aircraft parts. Major processes include metal fabrication, parts painting, solvent degreasing, sandblasting, and foundry operations. UNC All Fab, Inc. and its predecessor All Fab, Inc. have occupied the site and have engaged in essentially the same business activities since 1965. The site name is referred to throughout this report as All Fab (former) to be consistent with historical referenced sources.

Concerns of potential environmental contamination were raised when Landau Associates, Inc. (Landau) completed a Phase 1 Environmental Site Assessment (ESA) of the site in November 1993. The Phase 1 ESA identified numerous historical practices that could have resulted in potential soil and groundwater contamination. In 1994 and 1996, Landau conducted three limited scope investigations of soil and groundwater in the immediate vicinity of onsite buildings C-19 and C-29. Landau's investigations identified chlorinated volatile organic compounds (VOCs) in soil and perched groundwater at both locations investigated. Chromium also was identified in soil and perched water at building C-29.

1.2 PURPOSE AND SCOPE

The purpose of AGI's services was to conduct a preliminary evaluation of the source or sources and magnitude of VOC and chromium contamination onsite. Our scope of services for this assessment included:

- Reviewing reports of prior environmental investigations conducted by Landau.
- Reviewing available data from environmental sampling conducted by the County.
- Locating and accessing ten existing monitoring wells in the immediate vicinity of the site.
- Collecting groundwater samples from the ten monitoring wells.
- Analyzing collected groundwater samples for halogenated VOCs by EPA method 8260, and total and dissolved chromium by EPA method 6010.
- Preparing this report presenting our findings and conclusions regarding environmental conditions with respect to the site.

2.0 SITE DESCRIPTION

2.1 SETTING AND LOCATION

The site is located within Snohomish County Airport, which is about 6 miles southwest of downtown Everett, Washington. The site itself is located near the southeastern corner of the Snohomish County Airport on 29th Avenue W. (**Figure 1**). Land use in the surrounding area is primarily industrial in nature. The site and vicinity topography is relatively level with an elevation of about 590 feet above Mean Sea Level.

2.2 SITE DESCRIPTION

The site is irregularly shaped with five large industrial/warehouse type structures (**Figure 2**). These buildings are referred to as C-19, C-20, C-21, C-22, and C23. Buildings C-20 and C-22 have been combined to form essentially one building. The land and buildings C-20 through C-23 are owned by the County. Building C-19 has been privately owned byAll Fab, Inc. (1978-91), Thomas V. Giddens (1991-93), and the Thomas V. Giddens Living Trust (1993-present). The land surrounding the buildings is mostly asphalt paved and is primarily used for parking. A gravel-surfaced strip that extends along the fence line is west of building C-23 and also is presently used for parking. A small unpaved section surrounded by temporary chain link fencing is at the northwest corner of the site. Building C-29, a chemical storage shed, was removed from this area in January 1996.

2.3 SITE VICINITY

Facilities in the site vicinity are shown on **Figure 2**. Runway 16L/34R is east of the site. Property is presently undeveloped to the south/southwest. A large hangar owned by BF Goodrich and parking for this facility is to the west/northwest. A small hazardous storage shed owned by BF Goodrich also is located off the northwest corner of the site. In addition, a former fuel farm, referred to as the East Fuel Farm, is located immediately north of the site. The USTs at this location have been used to store aviation fuel and jet A fuel (AGI, 1994).

3.0 ENVIRONMENTAL SETTING

3.1 REGIONAL GEOLOGY

The site is located within the Puget Sound Lowland – a north-south trending structural and topographic depression bordered on the west by the Olympic Mountains and on the east by the Cascade Mountains. The lowland depression is underlain by Tertiary volcanic and sedimentary bedrock and is filled to the present day land surface with Pleistocene glacial and nonglacial sediments. Geologic maps indicate that native sediments underlying the site were deposited during the last Pleistocene glaciation (Newcomb, 1952; Smith, 1976).

3.2 SITE GEOLOGY

AGI researched and reviewed available logs of borings drilled in the site vicinity including:

- Water Well Reports filed with Washington State Department of Ecology (Township 28 N., Range 4 West, Sections 3, 9, 10, 11, 13, 14, 15, 16, 17, 21, 22, and 23).
- A 547 foot boring drilled for the U.S. Army Air Corps in 1938 near the center of Paine Field (Newcomb, 1952).
- Borings drilled in the East and West Fuel Farms (maximum depth 48 feet) by AGI.
- Borings drilled into the aquifer for Boeing in Sections 10, 11, and 15 (maximum depth 234 feet).

Based on our review, the site surface is underlain by fill that may range from 0 to 20 feet thick. The fill is underlain by Vashon Till, which comprises an unstratified and undifferentiated, dense to very dense, heterogeneous mixture of gravel, sand, silt, and clay. The upper portion of the till is weathered to varying degrees. Localized zones of more granular material (e.g. sand lenses) also tend to be present in the till. Boeing's well logs indicate that the fill/till thickness ranges from 60 to 80 feet and is in turn underlain by a silty gravel/silty sand mixture that is interpreted to be of glacial outwash origin. Esperance Sand, an advance outwash sand and gravel, underlies the outwash silt, sand, and gravel mixture at a depth of about 130 to 150 feet below ground surface. According to the log of the boring drilled for the U.S. Army Air Corps, the Esperance Sand is about 130 feet thick and is underlain by 210 feet of Admiralty Clay. Admiralty Clay is a fine-bedded, horizontally stratified clay and silt sequence (Newcomb, 1952).

3.3 GROUNDWATER

The aquifer beneath the site is in the Esperance Sand member. Based on Boeing's boring logs and Newcomb (1952), the aquifer is at a depth of about 200 to 220 feet beneath the site and the direction of groundwater flow generally is toward the southeast.

Near-surface groundwater is perched within the fill, as well as the more permeable zones of till. Depths to perched groundwater onsite range from about 1.5 to 15.5 feet bgs. Localized variations in perched groundwater depth are due to the thickness of fill and weathered till and to the configuration of sand interlayers in the till. Seasonal variations also create significant variation in the perched groundwater zone.

4.0 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

4.1 LANDAU ASSOCIATES, INC. ENVIRONMENTAL INVESTIGATIONS

In November 1993, Landau completed a Phase 1 ESA. Subsequently, Landau completed three limited scope soil and groundwater investigations during 1994 and 1996. These investigations were conducted on behalf of Snohomish County Public Works Department and Snohomish County Airport. The findings of each of these investigations are summarized below.

4.1.1 Phase 1 ESA

Landau's Phase 1 ESA scope included conducting a site reconnaissance, review of historical information sources, and review of agency databases and files to identify the potential for site contamination from historical onsite and offsite activities. Landau concluded that the potential for site soil and groundwater contamination was high. Potential contamination sources that were identified included:

- Permeation of concrete sumps by chlorinated solvents.
- Potential discharges of chlorinated solvents to the local storm system, sanitary sewer, and natural features.
- Past and present underground storage tanks.
- Use of an area at the northeast corner of the site as a reclamation yard and for debris storage.
- Chemical and petroleum products storage at the northwest corner of the site.

4.1.2 Degreaser Pit Investigation, Building C-19

In 1994, Landau drilled two shallow holes through the concrete floor of a vapor degreaser sump in building C-19. The degreaser pit is at the south corner of building C-19 as shown on **Figure 3**. The pit is currently used as secondary containment for the degreaser presently in operation at the site (Rardin, 1999). Four soil and one water samples were analyzed for VOCs. The soil samples were collected just beneath the concrete slab and about 1 foot beneath it. The water was collected from seepage that entered one of the shallow boreholes.

Trichloroethene (TCE) was detected in each soil sample. 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), *cis*-1,2-dichoroethene (*cis*-1,2-DCE), and 1,1-dichloroethane (1,1-DCA) also were detected but with less frequency and lower concentrations. In the water sample, relatively high concentrations of TCE and 1,1,1-TCA were detected. 1,1-DCE, 1,1-DCA, *trans*-1,2-DCE, *cis*-1,2-DCE, 2-butanone (MEK), 4-methyl-2-pentanone, toluene, and vinyl chloride also were detected but at lower concentrations. Analytical results from this investigation are summarized in **Table 1.**

4.1.3 *Environmental Sampling and Analysis*

Landau (1996a) collected one sample of perched groundwater in a test pit that had been dug during demolition of the concrete floor and footings of chemical storage building C-29. This sample was analyzed for VOCs, semivolatile organic compounds (SVOCs), ethylene glycol, and propylene glycol, and priority pollutant metals. Analytical results for this water sample are summarized in **Table 2.**

Relatively high concentrations of chromium, TCE, and vinyl chloride were detected in the water sample. Other VOCs, SVOCs, and metals were detected, but at relatively low concentrations.

4.1.4 *Interim Environmental Investigation Results Summary*

Landau (1996b) drilled four soil borings and excavated eight test pits to characterize soil and groundwater conditions beneath and adjacent to the former chemical storage building C-29. Two of the borings were completed as monitoring wells in perched groundwater (C29-MW1, C29-MW2, see **Figures 2** and **4**). Landau collected groundwater samples from these two wells and from two monitoring wells immediately north of C-29 that had originally been installed to monitor conditions in the East Fuel Farm (TRM-MW1, TRM-MW2, see **Figure 4**). Soil and groundwater samples were analyzed for chromium and VOCs.

Twenty-nine soil samples collected from boreholes and test pits were analyzed for chromium. Chromium was significantly elevated (790 mg/kg) in only one soil sample that was collected beneath the former building C-29 at a depth of 0.5 foot below ground surface (bgs). The test pit location, TP5A, is shown on **Figure 4.**

Only three soil samples from this investigation were analyzed for VOCs. One of the soil samples was collected at 15 feet bgs from the borehole for C29-MW-1. Two of the samples were collected at 1.6 and 3.5 feet bgs at test pit TP-2 (see **Figure 4**). TCE was detected at 17 mg/kg in the sample from borehole C29-MW1 (see **Table 3**). TCE and numerous other VOCs were detected in the test pit samples as summarized in **Table 4.**

Chromium was not detected in any of the groundwater samples. High concentrations of TCE and *cis*-1,2-DCE were detected in all four water samples. *Trans*-1,2-DCE also was detected at TRM-MW-1. Vinyl chloride and ethylbenzene also were at TRM-MW-2. Some of these compounds may not have been detected in the other wells because dilution of the samples resulted in high reporting limits. Analytical results for the halogenated compounds in groundwater are summarized in **Table 5.** Ethylbenzene was not included because it was detected only once and at a relatively low concentration [8.88 micrograms per liter (µg/L)].

4.2 SNOHOMISH COUNTY PUBLIC WORKS DEPARTMENT INVESTIGATION

During December 1996, Snohomish County Public Works Department drilled six borings and installed monitoring wells in four of the borings - one near building C-29 and three near building C-19. Locations of monitoring wells (SCPWD-1 through SCPWD-4) and borings (TC-2 and TC-3) are shown on **Figures 2** through **4.** Boring depths ranged from 22 to 38.5 feet. The County submitted 25 soil samples from five of the borings (all but SCPW-1) for analysis of VOCs. Sample depths ranged from 8.5 to 33.5 feet bgs.

Soil analytical results are summarized in **Table 3.** TCE was detected in 18 of the soil samples at concentrations ranging from 0.0649 to 4.30 mg/kg. The sample with the highest TCE concentration (4.30 mg/kg) was collected at 28.5 feet bgs from SCPWD-3. At this same borehole, TCE was still detected in the 33.5 foot sample at 1.25 mg/kg. *Cis*-1,2-DCE also was detected in four of the samples. No other VOCs were detected.

Current method A: TCE = 103 mg/kg

5.0 GROUNDWATER SAMPLING

5.1 MONITORING WELLS

AGI identified 11 monitoring wells installed in the immediate vicinity of the All Fab (former) site. Two wells were installed by Landau to evaluate subsurface conditions next to building C-29 (C29-MW1 and C29-MW2). Four wells were installed by Snohomish County Public Works Department to further evaluate subsurface conditions near building C-19 (SCPWD-1) and those near building C-29 (SCPWD-2 through SCPWD-4). One monitoring well was installed by B.F. Goodrich (or its predecessor Tramco) to evaluate subsurface conditions adjacent to their hazardous materials storage shed (HMB1). Four monitoring wells (TRM-MW1 through TRM-MW4) were installed by AGI Technologies on behalf of SCA to evaluate subsurface conditions with respect to the East Fuel Farm. Monitoring well locations are shown on **Figures 2** through **4**.

AGI located and accessed all monitoring wells except C29-MW2. This well may have been covered by dirt and debris at the time of our reconnaissance. All monitoring wells are constructed with 2-inch diameter PVC casing. AGI compiled well construction data including the well depth and screened interval for each well based on available well logs and field measurements (see **Table 6**). Monitoring well depths range from about 16 to 30 feet and appear to be screened across varying discontinuous perched water-bearing zones.

5.2 METHODS

5.2.1 Water Levels

Water levels were measured in the monitoring wells on February 24, March 9, and April 2, 1999. Static water levels in each well were measured using an electronic SINCO™ sounder. Each monitoring well was opened and allowed to equilibrate to the outside atmosphere prior to measuring water levels. Water levels are summarized on **Table 7**. Depths to water ranged from approximately 1.25 to 15.5 feet, but most commonly ranged from 1.5 to 5 feet.

5.2.2 Groundwater Sampling

On February 24, 1999, groundwater samples were collected from TRM-MW1 through TRM-MW4, SCPWD-1, HMB1, and C29-MW1. Monitoring wells SCPWD-2 through SCPWD-4 were sampled on March 9, 1999. Prior to sampling, the wells were purged of stagnant water within the well casing and sandpack. Disposable bailers and nylon twine were used to purge the wells and collect groundwater samples. The bailers and twine were discarded immediately after sampling each well. Depth to groundwater was measured prior to purging. Temperature, pH, and specific conductance were monitored during purging to check for stabilization. Purge water was transferred to 55-gallon drums located within the fence surrounding the former building C-29.

Groundwater samples were collected in laboratory supplied bottles containing hydrochloric acid or nitric acid preservative, as appropriate. Samples collected on February 24 to be analyzed for dissolved metals were filtered in the field using a 0.45-micron filter prior to placement into the bottle. Samples collected on March 9 to be analyzed for dissolved metals were placed into an unpreserved bottle, shipped to the laboratory where they were filtered on the same day. The samples were packed in Blue Ice and shipped by courier under chain-of-custody protocol to the contract laboratory.

5.3 CHEMICAL ANALYSIS

The samples were submitted to CCI Analytical Laboratories, Inc. (CCI) in Everett, Washington. Groundwater samples were analyzed for halogenated VOCs by EPA Method 8260A and for total and dissolved chromium by EPA Method 6010. The laboratory report is included in **Appendix A.** An AGI chemist reviewed the analytical data and a quality-assurance report is included in **Appendix A.** All data were of known quality and acceptable for use.

6.0 ANALYTICAL RESULTS AND DISCUSSION

6.1 VOLATILE ORGANIC COMPOUNDS

During the current sampling round, chlorinated VOCs were detected in all monitoring wells except HMB1 as summarized below and in Table 5.

Compound	Number of Detections	Maximum Concentration (µg/L)	Method A Cleanup Level [a]
PCE	1	12	5
TCE	9	140,000	5
Cis-1,2-DCE	9	26,000	--
Trans-1,2-DCE	9	530	--
1,1-DCE	7	120	--
Vinyl Chloride	9	4,000	0.2
1,2-DCA	3	180	5
Chloroethane	1	27	--

[a] Model Toxics Control Act Method A cleanup level for Groundwater See section 7.0 for further discussion.

Clearly, the predominant VOCs detected in groundwater are TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride, based on the frequency of detection and concentrations. TCE is a chlorinated solvent commonly used as degreaser for metal parts. Most of the other VOCs detected in site groundwater are likely degradation products of TCE. Figure 5 shows the typical degradation pathways of the chlorinated ethenes. TCE degrades predominantly to *cis*-1,2-DCE, and to a lesser extent, to 1,1-DCE and *trans*-1,2-DCE. Under certain conditions, the di-chlorinated ethenes degrade to vinyl chloride. PCE, which was detected in only one groundwater sample, is not a degradation product, rather it is in itself a solvent. PCE is mostly recognized for its use as a dry cleaning solvent, but has had a number of miscellaneous uses such as in solvent soaps, printing inks, adhesives, glues, sealants, and lubricants. PCE degrades to TCE and then follows the same pathway previously described. Chloroethane (ethyl chloride) and 1,2-DCA were detected in wells near former building C-29. These two chemicals are typically degradation products of 1,1,1-TCA. 1,1,1-TCA is known to have been used onsite and during prior investigations, 1,1,1-TCA was detected in the soil and water samples collected by Landau (1994) during their degreaser pit investigation at building C-19.

Table 5 also compares historical VOC analyses for groundwater sampled from TRM-MW1, TRM-MW2, C29-MW1, and C29-MW2 (Landau, 1996b). TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride were similarly detected during the earlier sampling round.

6.2 CHROMIUM

Total chromium was detected in only one groundwater sample, SCPWD-2 at 0.4 mg/L (Table 5). Dissolved chromium was not detected in any groundwater samples. Similarly, during Landau's May 1996 groundwater sampling, total chromium was not detected in TRM-MW1, TRM-MW2, C29-MW1, or C29-MW2.

7.0 REGULATORY FRAMEWORK

The Model Toxics Control Act Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC), establishes the administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are identified. Following discovery, the cleanup process proceeds in a step-wise approach.

WAC 173-340-510 establishes that it is the responsibility of the liable party or parties to conduct remedial actions so that sites are cleaned up well and expeditiously. The cleanup process may be conducted under an agreed order, enforcement order, or consent decree with Ecology. The liable party also may choose to conduct an independent cleanup without assistance or oversight from Ecology. However, persons performing remedial actions do so at their own risk and may be required to additional remedial actions, if Ecology deems necessary.

7.1 CLEANUP PROCESS

7.1.1 Discovery and Initial Assessment

Sites where contamination is found must be reported to Ecology's Toxics Cleanup Program within 90 days of discovery. Within 90 days of receiving a site discovery report, Ecology will conduct an initial investigation. Based on information obtained during the initial investigation, Ecology will decide whether the site requires additional investigation, emergency cleanup , or no further action. For sites that require additional investigation, Ecology will conduct a site hazard assessment (SHA) and rank the site based on the perceived relative health and environmental risk the site poses. The Snohomish County Health District completed the SHA and site ranking on behalf of Ecology. Their results were submitted in a letter dated January 29, 1997. Based on the Health District's review of Landau's reports for the degreaser pit investigation (1994) and analysis of a water sample from a test pit (1996a), the site was ranked as a 4, where 1 represents the highest relative risk and 5 the lowest.

The ranking provides a means by which Ecology can prioritize allocation of its resources. At least twice a year, Ecology determines which sites are a high priority for further investigation. Sites ranked as high priority during each biennium are scheduled for Ecology to conduct further investigation beginning within 6 months. The following describes subsequent actions and time frame for completion of an Ecology conducted cleanup (i.e. one that is conducted under an order or decree).

7.1.2 Remedial Investigation and Feasibility Study

The next step of the cleanup process consists of the performance of a remedial investigation (RI) and feasibility study (FS). The RI defines the extent and magnitude of contamination at a site and evaluates all potential impacts on the environment. The FS evaluates alternative cleanup technologies. WAC 173-340-140(6) specifies that the RI/FS be completed within 18 months of signing the order or decree. A 12-month extension may be granted under extenuating circumstances.

7.1.3 Selection of Cleanup Action

Using the information gathered during the RI/FS, a cleanup action plan is developed. The plan identifies preferred cleanup methods and specifies cleanup standards and other requirements at the site. WAC 173-340-140(7) specifies that the cleanup action plan be completed within 6 months of completion of the State RI/FS with the potential to extend the deadline up to 4 months.

7.1.4 Site Cleanup

Actual cleanup begins when the cleanup action plan is implemented This includes design, construction, operation, and monitoring of cleanup actions. Selection of the method or methods to achieve site cleanup is based on requirements of WAC 173-340-360. Specific considerations include:

- Protection of human health and the environment.
- Compliance with cleanup standards.
- The use of permanent solutions to the maximum extent practicable.
- Completion within a reasonable restoration time frame.

7.2 CLEANUP LEVELS

MTCA provides three approaches for determining cleanup levels: Methods A, B, and C. The methods are not ranked in order of preference; the regulations indicate that Method B is the standard approach for determining cleanup standards.

- Method A provides a simplified approach for routine cleanup actions using tabulated cleanup levels. Method A cleanup levels are at least as stringent as applicable state and federal laws – typically these values are the same. Method A is appropriate for routine sites as defined in WAC 173-340-130, or sites that involve relatively few hazardous substances. Method A cleanup levels are available for both residential and industrial sites. Remedial actions conducted using residential cleanup standards are the most stringent and result in the lowest potential for long-term liabilities. Remedial actions conducted using industrial cleanup standards are less stringent but have longer term implications, such as the placement of institutional controls.

- Method B allows for development of cleanup levels for specific compounds based on evaluation of applicable State and Federal laws, groundwater and surface-water protection, and risk-based concentrations calculated using the risk equations specified in the regulations (WAC 173-340-750). These cleanup levels may be more or less stringent than the Method A cleanup levels.

- Method C cleanup levels represent concentrations that are protective of human health and the environment for specific site uses (i.e., industrial sites). Method C cleanup levels are established similarly to Method B; however, because site-specific conditions are such that the potential for exposure is lower, Method C cleanup levels are higher than Method B. Just as for Method A industrial soil cleanup standards, institutional controls are required for Method C remedial actions.

Tables 8 and **9** provide a compilation of cleanup levels for the various contaminants of concern in soil and groundwater including Method A cleanup levels, and Method B and C formula values. Federal Drinking Water Standards also are provided in **Table 9**. Formula values are taken from Ecology's Cleanup Levels and Risk Calculation (CLARC II) tables dated February 1996. CLARC II formula values may not be acceptable for a site when considering other factors such as the potential for cross-media contamination and the presence of multiple contaminants of concern.

7.3 COMPARISON OF CONTAMINANT CONCENTRATIONS TO CLEANUP LEVELS

7.3.1 Volatile Organic Compounds

Table 8 compares the maximum concentrations of TCE and *cis*-1,2-DCE in soils with the various cleanup levels. Cleanup levels for *cis*-1,2-DCE were not exceeded. TCE in soil exceeded the MTCA Method A residential and industrial cleanup levels and Method B and C cleanup levels for protection of groundwater. Exceedances of the Method A residential and industrial soil cleanup levels for various soil samples collected onsite are shown on **Tables 1, 3,** and **4**. The Method A cleanup levels for TCE were exceeded in 16 of the 32 soil samples analyzed for VOCs. Based on the analytical results, TCE concentrations in soils that exceed multiple cleanup levels extend to depths greater than 33.5 feet bgs.

Table 9 compares the maximum contaminant concentrations in groundwater with the various cleanup levels. All Method A and Federal Drinking Water Standards that are established for the VOCs detected at this site are exceeded. Method B and Method C cleanup levels also are exceeded in one or more instances for each chemical. Exceedances of the Method A groundwater cleanup levels at each monitoring well location are shown on **Table 5**. Groundwater sampled from every well but HMB1 exceeded the Method A cleanup levels for TCE and vinyl chloride. When detected, PCE and 1,2-DCA also exceeded their respective Method A cleanup level. Method A cleanup levels do not exist for *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1-DCE, and chloroethane.

7.3.2 Chromium

Chromium exceeded its Method A residential and industrial soil cleanup levels in only one soil sample that was analyzed during Landau's previous investigations. This sample was a shallow subsurface soil sample collected under the C-29 building footprint. Chromium exceeded its Method A cleanup level only in a water sample collected by Landau from a shallow test pit. Methods B and C cleanup levels established for the protection of groundwater were exceeded for hexavalent chromium in this water sample. However, analyses measured total chromium; hexavalent chromium concentrations were not determined. Because hexavalent chromium, if present, would constitute a percentage of the total chromium, it is unlikely that hexavalent chromium cleanup levels were exceeded.

8.0 CONCLUSIONS

TCE and related chlorinated solvents were detected in soil and groundwater in the immediate vicinity of building C-19 and former building C-29. Numerous State cleanup levels and Federal standards are exceeded for both soil and groundwater. Based on All Fab's (former) operations and facility locations, we believe them to be the most likely source of contamination.

The lateral and vertical extent of VOC contamination has not yet been delineated. PCE, TCE, and related degradation products have relatively high water solubility and are denser than water. These compounds also are noted for their relatively slow degradation rates in the subsurface environment. These characteristics cause these compounds to be particularly mobile in the subsurface environment. TCE contamination has been identified in site soil at depths of at least 33.5 feet bgs. Given the concentrations detected at this site, there is a reasonable potential for continued vertical migration and subsequent impact to the underlying aquifer. Current groundwater data also indicate that VOC contamination is migrating laterally via perched groundwater.

Current soil and groundwater data indicate that chromium concentrations in soil and perched groundwater immediately underlying the area of former building C-29 exceed cleanup MTCA Method A cleanup levels. Elevated chromium concentrations appear to be limited to the building footprint. Lateral and vertical migration of chromium does not appear to be occurring.

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Table 1
Analytical Summary of VOCs in Soil and Water Beneath the Degreaser Pit
Building C-19 Investigation by Landau and Associates
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Volatile Organic Compound	Sample No. and Matrix					MTCA Method A Cleanup Levels	
	TP1-0.0 Soil	TP1-0.9 Soil	TP2-0.1 Soil	TP2-0.9 Soil	TP1-W Water	Soil	Water
	µg/kg				µg/L	µg/kg	µg/L
1,1,1-Trichloroethane (TCA)	44	39	5.4	ND	230	20,000 (2,000. Cement)	200
Trichloroethene (TCE)	220	590	19	27	15,000	500 (30 Cement)	5
Acetone	6.6	ND	ND	ND	17	--	--
1,1-Dichloroethene	2.2	ND	ND	ND	21	--	--
1,1-Dichloroethane	2.3	2.0	ND	ND	32	--	--
cis-1,2-Dichloroethene	8.1	11	ND	ND	94	--	--
trans-1,2-Dichloroethene	ND	ND	ND	ND	3.9	--	--
2-Butanone (MEK)	ND	ND	ND	ND	160	--	--
4-Methyl-2-pentanone	ND	ND	ND	ND	5.8	--	--
Toluene	ND	ND	ND	ND	1.6	--	40
Vinyl chloride	ND	ND	ND	ND	5.1	--	0.2

Notes:

Shaded value indicates concentration exceeds Method A cleanup level.

a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for residential soil and groundwater.

ND - not detected.

µg/kg - microgram per kilogram.

µg/L - microgram per liter.

-- no cleanup level established.

TCE = Method A Soil = 0.3 ppm = 30 ppb (Cement)

1,1 TCA = Method A Soil = 2 ppm = 2000 ppb

AGI TECHNOLOGIES

Table 2
Analytical Summary of Perched Water in Test Pit
Building C-29 Investigation by Landau and Associates
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Compound	Sample No. and Matrix: AF-1 Water	MTCA Method A Cleanup Levels [a] Water
	µg/L	
Semivolatile Organic Compounds		
4-Nitrophenol	16 J	--
Phenol	56	--
Metals		
Chromium	55,000 J	50
Copper	34	--
Zinc	58	--
Volatile Organic Compounds		
cis-1,2-Dichloroethene	13	--
p-Isopropyltoluene	2.0	--
Naphthalene	2.4	--
Toluene	4.8	40
Trichloroethene	31	5.0
1,2,4-Trimethylbenzene	2.3	--
1,3,5-Trimethylbenzene	2.5	--
Vinyl chloride	4.8	0.2
o-Xylene	1.1	--
m,p-Xylene	1.1	--

Notes:

Shaded value indicates concentration exceeds Method A cleanup level.

a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for groundwater.

J - estimated value.

µg/L - microgram per liter.

-- no cleanup level established.

AGI TECHNOLOGIES

Table 3
Analytical Summary of VOCs in Boring Soil Samples
Building C-19 and C-29 Investigations by Snohomish County
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Boring I.D.	Boring Location (Figure 2)	Date Sampled	Sample Depth (ft bgs)	Trichloroethene mg/kg	*cis*-1-2-Dichloroethene mg/kg
Building C-19					
TC-4	SCPWD-4	12/13/96	8.5	ND	ND
			13.5	ND	ND
			18.5	ND	ND
TC-5	SCPWD-2	12/23/96	8.5	0.0649	ND
			11.5	0.0694	ND
			16.5	1.05	0.0625
TC-6	SCPWD-3	12/23/96	8.5	1.72	ND
			11.5	1.35	ND
			13.5	0.463	ND
			16.5	0.0998	ND
			18.5	ND	ND
			21.5	1.99	ND
			23.5	2.1	ND
			28.5	4.30	ND
			33.5	1.25	0.05
Building C-29					
C29-MW-1	C29-MW1	04/19/96	15	17	<0.40
TC-2	TC-2	12/20/96	8.5	0.972	ND
			11.5	0.705	ND
			13.5	3.36	0.0645
			16.5	1.94	ND
			18.5	1.43	ND
			23.5	0.173	ND
TC-3	TC-3	12/20/96	8.5	1.43	0.0550
			18.5	ND	ND
			23.5	ND	ND
			28.5	ND	ND
Detection Limit				0.05	0.05
Cleanup Level [a]				0.5	N/A

Notes:

Shaded value indicates concentration exceeds Method A cleanup level.
VOC data for well C29-MW-1 was provided by Landau.
a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for residential soil.
ft bgs - feet below ground surface.
N/A - not available.
ND - not detected.

AGI TECHNOLOGIES

Table 4
Analytical Summary of VOCs in Test Pit Soils
Building C-29 Investigation by Landau and Associates
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Detected Volatile Organic Compound	Sample No., Depth, Lab I.D. TP2 1.6 B604188-01	TP2 3.5 B604188-02	MTCA Method A Cleanup Levels [a]
	µg/kg		
sec-Butylbenzene	0.26	ND	--
cis-1,2-Dichloroethene	0.30	3.9	--
Ethylbenzene	0.47	ND	20
Isopropylbenzene	0.69	ND	--
p-Isopropyltoluene	0.84	ND	--
n-Propylbenzene	0.91	ND	--
Toluene	0.45	0.32	40
Trichloroethene	ND	0.85	0.5
1,2,4-Trimethylbenzene	14	0.40	--
1,3,5-Trimethylbenzene	6.0	ND	--
Vinyl chloride	ND	0.33	--
o-Xylene	1.7	ND	--
m,p-Xylene	4.3	0.48	--

Notes:

Shaded value indicates concentration exceeds Method A cleanup level.

a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for residential soil.

ND - not detected.

µg/kg - microgram per kilogram.

-- no cleanup level established.

AGI TECHNOLOGIES

Table 5
Analytical Summary - Halogenated Compounds in Groundwater
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Well I.D.	Date Sampled	Tetra-chloroethene (PCE)	Trichloroethene (TCE)	*cis*-1,2-Dichloroethene (*cis*-1,2-DCE)	*trans*-1,2-Dichloroethene (*trans*-1,2-DCE)	1,1-Dichloroethene (1,1-DCE)	Vinyl Chloride (VC)	1,2-Dichloroethane (1,2-DCA)	Chloroethane (Ethylchloride)	Chromium	
		µg/L								mg/L	
										Total	Dissolved
Building C-19										0.04	ND
SCPWD-2	03/09/99	ND	39,000	2,500	18	24	9	ND	ND	ND	ND
SCPWD-3	03/09/99	12	140,000	4,200	18	110	68	ND	ND	ND	ND
SCPWD-4	03/09/99	ND	580	260	160	ND	82	ND	ND		
Building C-29											
TRM-MW1	05/07/96	–	1,490	3,730	189	–	(80 ND)	–	–	ND	ND
	02/24/99	ND	4,400	6,700	460	34	85	ND	ND	ND	ND
TRM-MW2	05/07/96		33.9	301	(8 ND)	–	131	–	–	ND	ND
	02/24/99	ND	79	2,600	50	9	920	8	ND	ND	ND
TRM-MW3	02/24/99	ND	7,900	9,400	530	120	440	180	ND	ND	ND
TRM-MW4	02/24/99	ND	19	83	58	ND	1,100	ND	ND	ND	ND
SCPWD-1	02/24/99	ND	17,000	7,400	79	45	880	ND	ND	ND	ND
HMB1	02/24/99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C29-MW1	05/07/96	–	74,700	21,000	(800 ND)	ND	(800 ND)	–	–	ND	NA
	02/24/99	ND	18,000	26,000	490	64	4,000	13	27	ND	ND
C29-MW2	05/07/99	–	10,400	956	(80 ND)	–	(80 ND)	–	–	ND	NA
Detection Limit		4	5	5	5	5	5	5	5	0.01	0.01
Cleanup Level [a]		5	5				0.2	5		0.05	0.05

Notes:

Shaded value indicates concentration exceeds Method A cleanup level.
Halogenated compound data for May 1996 was provided by Landau.
a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for groundwater.
NA - not analyzed.
ND - not detected.
– not reported (presumably analyzed and not detected, but detection limit not reported).
mg/L - milligram per liter.
µg/L - microgram per liter.

AGI TECHNOLOGIES

Table 6
Well Construction Details
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Well I.D.	Well Depth (feet)	Approximate Screened Interval (ft bgs)
Building C-19		
SCPWD-2	30	15-30
SCPWD-3	29.3	20-30
SCPWD-4	18.0	8-18
Building C-29		
TRM-MW1	23	13-23
TRM-MW2	17	12-17
TRM-MW3	17.5	12.5-17.5
TRM-MW4	16.3	6-16
SCPWD -1	19.5	10-20
HMB1	18	8-18
C29-MW1	19.1	9-19

Note:

ft bgs - feet below ground surface.

AGI TECHNOLOGIES

Table 7
Groundwater Level Data
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

Well I.D.	Date Measured	Time (hours)	Depth to Groundwater (feet)
Building C-19			
SCPWD-2	03/09/99	0915	2.47
	04/02/99	1154	2.52
SCPWD-3	03/09/99	0920	5.55
	04/02/99	1153	4.47
SCPWD4	03/09/99	1305	6.80
	04/02/99	1151	6.72
Building C-29			
TRM-MW1	02/24/99	0935	8.24
	03/09/99	1409	15.46
	04/02/99	1121	8.11
TRM-MW2	02/24/99	0945	4.56
	03/09/99	1402	4.52
	04/02/99	1120	4.22
TRM-MW3	02/24/99	0950	4.03
	03/09/99	1407	4.39
	04/02/99	1118	4.04
TRM-MW4	02/24/99	0940	2.73
	03/09/99	1358	3.85
	04/02/99	1116	3.57
SCPWD-1	02/24/99	1005	1.56
	03/09/99	1413	2.56
	04/02/99	1110	2.33
HMB1	02/24/99	0955	4.00
	03/09/99	1353	4.50
	04/02/99	1113	4.37
C29-MW1	02/24/99	1000	1.26
	03/09/99	1421	1.75
	04/02/99	1108	1.56

Table 8
MTCA Method A Cleanup Levels and Method B and C Formula Values - Soil
Snohomish County Public Works Department/All Fab (Former)
Everett, Washington

	Trichloroethene (TCE)	*cis*-1,2-Dichloroethene (*cis*-1,2-DCE)	Chromium, Total
	mg/kg		
Method A	.03 now		
Residential	0.5	–	100 [a]
Industrial	0.5	–	500 [a]
Method B			
Carcinogen	90.9	–	–
Noncarcinogen	–	800	80,000 [b] / 400 [c]
Protective of Groundwater			
Carcinogen	0.398	–	–
Noncarcinogen	–	8	1,600 [b] / 8 [c]
Method C			
Commercial Soil			
Carcinogen	3,640	–	–
Noncarcinogen	–	3,200	320,000 [b] / 1,600 [c]
Industrial Soil			
Carcinogen	11,900	–	–
Noncarcinogen	–	35,000	3,500,000 [b] / 17,500 [c]
Protective of Groundwater			
Carcinogen	3.98	–	–
Noncarcinogen	–	17.5	3,500 [b] / 17.5 [c]
Highest Detected Concentration	4.30	0.0645	760 [a]

Notes:

Shaded value indicates the particular cleanup level was exceeded in one or more soil samples analyzed during previous investigations.

a) total chromium.
b) trivalent chromium.
c) hexavalent chromium.
– not available.
mg/kg - milligram per kilogram.

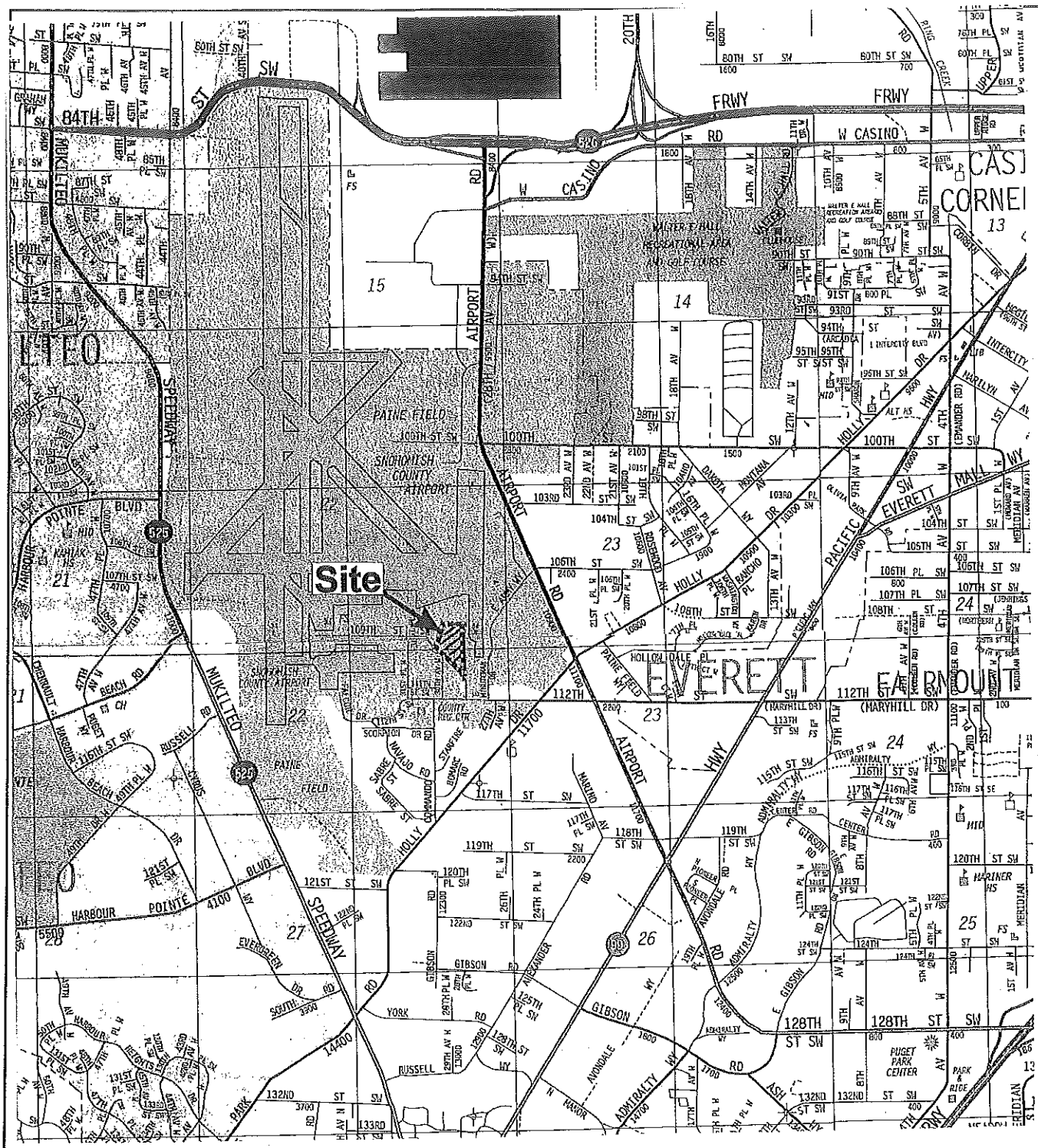
AGI TECHNOLOGIES

Table 9
MTCA Method A Cleanup Levels, Method B and C Formula Values, and Drinking Water Standards - Groundwater
Snohomish County/All Fab (Former)
Everett, Washington

	Tetra-chloroethene (PCE)	Trichloroethene (TCE)	*cis*-1,2-Dichloroethene (*cis*-1,2-DCE)	*trans*-1,2-Dichloroethene (*trans*-1,2-DCE)	1,1-Dichloroethene (1,1-DCE)	Vinyl Chloride (VC)	1,2-Dichloroethane (1,2-DCA)	Chloroethane (Ethylchloride)	Chromium
	µg/L								
Method A	5	5	--	--	--	0.2	5	--	50 [a]
Method B									
Carcinogen	0.858	3.98	--	--	0.073	0.023	0.481	--	--
Noncarcinogen	80	--	80	160	72	--	--	--	16,000 [b] / 80 [c]
Method C									
Carcinogen	8.58	39.8	--	--	0.729	0.23	4.81	--	--
Noncarcinogen	175	--	175	350	158	--	--	--	35,000 / 175
Federal Drinking Water Standards	5	5	70	100	7	2	5	--	100
Maximum Detected Concentration	12	140,000	26,000	530	120	4,000	180	27	55

Notes:

Shaded value indicates the particular cleanup level was exceeded in one or more groundwater samples collected during prevous and/or the current investigations.
a) total chromium.
b) trivalent chromium.
c) hexavalent chromium.
-- not available.
µg/L - microgram per liter.



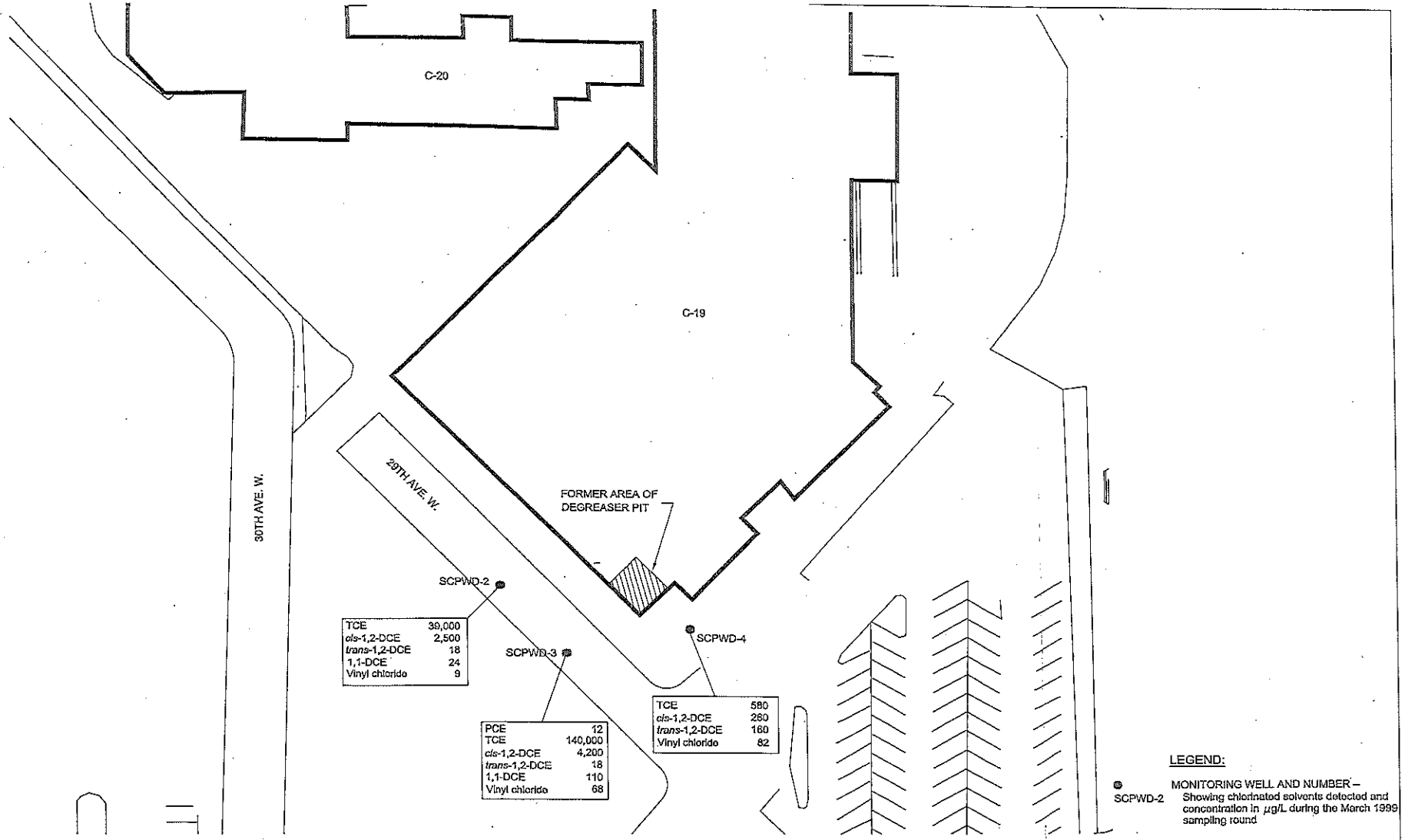
AGI TECHNOLOGIES

Vicinity Map

Snohomish County Public Works Department / All Fab (Former)
Everett, Washington

FIGURE 1

PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
512323-vm.cdr	15,512.323	PJR	30 Apr 99	MDW	22 Jun 99



Reference: Paine Field Layout Plan by Barnard Dunkleburg & Company, Tulsa, Oklahoma, August 1984

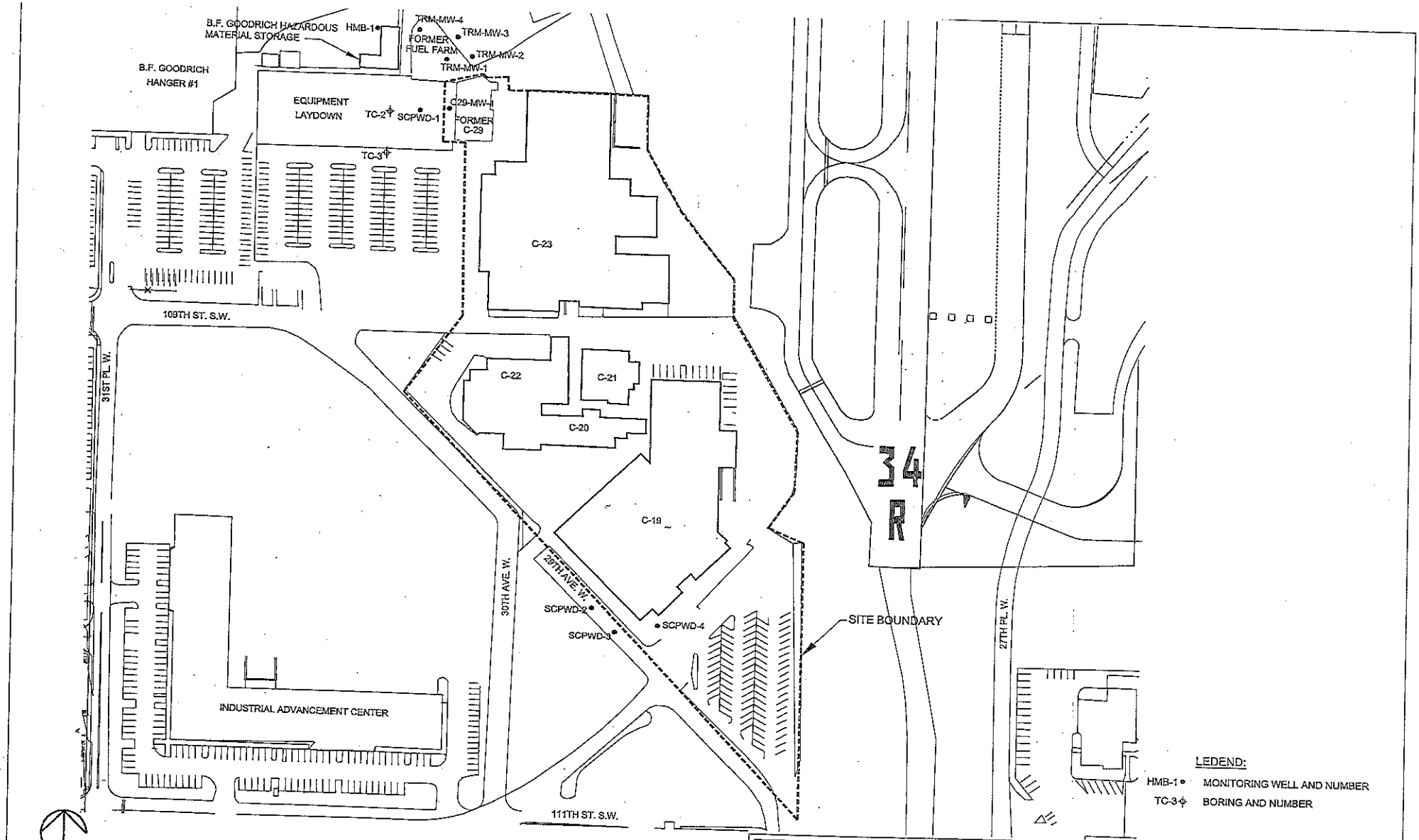
AGI TECHNOLOGIES

Chlorinated Solvents in Perched Water Near C-19

Snohomish County Public Works Department / All Fab (Former)
Everett, Washington

FIGURE 3

512323-FIG-3.dwg	PROJECT NO. 15,512.323	DRAWN PJR	DATE 30 Apr 99	APPROVED	REVISED MDW	DATE 22 Jun 99



Reference: Paine Field Layout Plan by Barnard Dunkleberg & Company, Tulsa, Oklahoma, August 1994

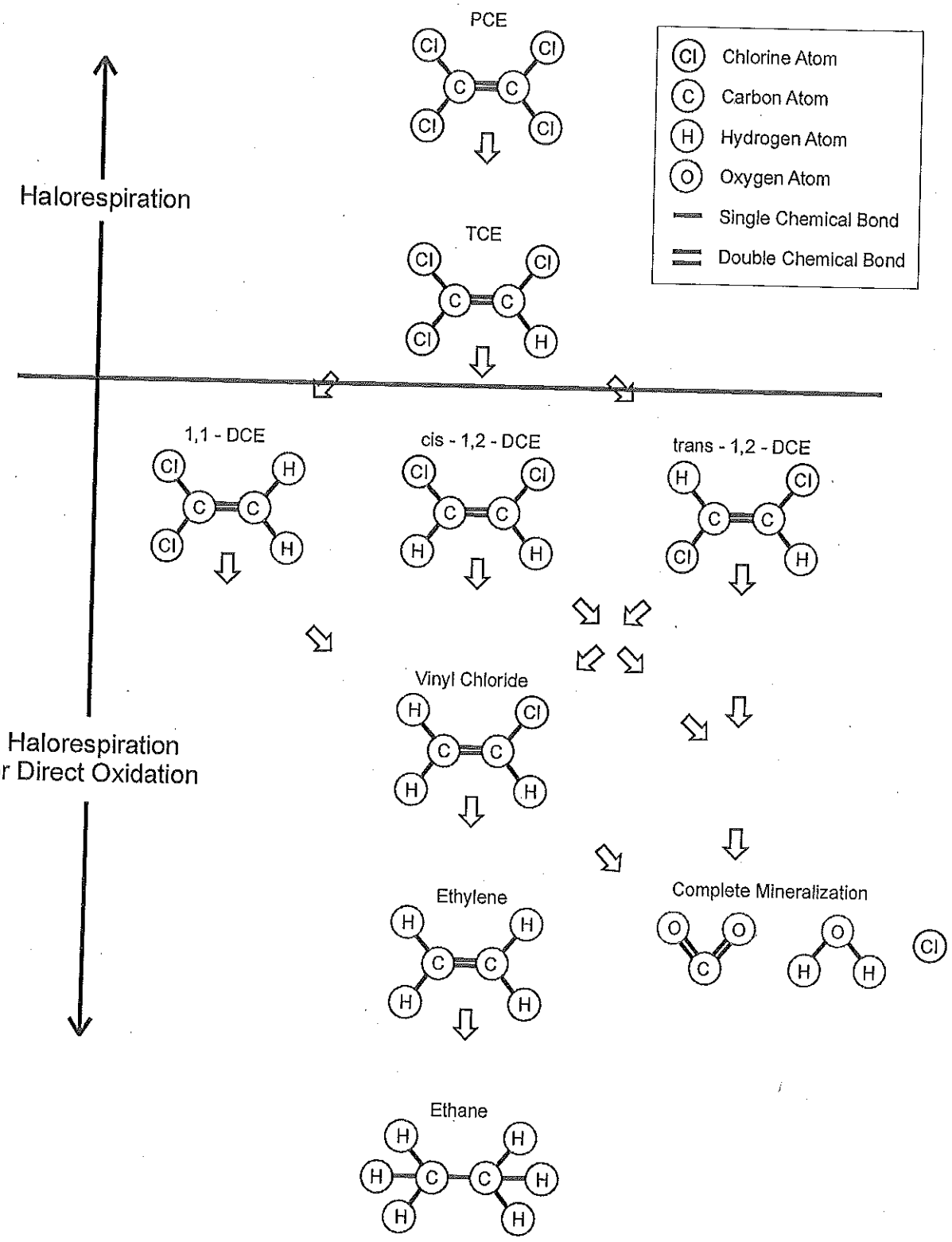
AGI TECHNOLOGIES

Site Plan

Snohomish County Public Works Department / All Fab (Former)
Everett, Washington

FIGURE 2

512323-FIG-2.dwg	PROJECT NO. 15,512.323	DRAWN PJR	DATE 30 Apr 99	APPROVED	REVISED MDW	DATE 22 Jun 99



AGI TECHNOLOGIES

Biological Transformation of Chlorinated Ethenes

Snohomish County Public Works Department / All Fab (Former)
Everett, Washington

FIGURE 5

1512323-BIO.cdr	PROJECT NO. 15,512,323	DRAWN PJR	DATE 10 May 99	APPROVED	REVISED +	DATE +

LAB Data

Not included,