A Department of Ecology Report

Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2006 and March 2007

Abstract

Groundwater beneath downtown Montesano is contaminated with petroleum products. The contamination is largely the result of releases from leaking underground storage tanks. To characterize the lateral extent of contamination, the Washington State Department of Ecology (Ecology) collected groundwater samples from 25 monitoring wells during October 2006 and March 2007. Samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX), total petroleum hydrocarbons as gasoline (TPH-G), and volatile organic compounds (VOCs).

The highest concentrations of gasoline-range petroleum hydrocarbons were detected in monitoring wells at or near three previously identified source areas: Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell (GeoEngineers, 2005). BTEX and TPH-G concentrations in samples collected from these wells were above (exceeded) the Model Toxic Control Act (MTCA) cleanup levels for groundwater. Benzene concentrations across the site ranged from non-detect to 28,000 µg/L. TPH-G concentrations ranged from non-detect to 490,000 µg/L. Free-phase petroleum product was also observed in wells at the three source areas, which continue to serve as sources of dissolved phase contamination.

Chlorinated solvents have also been detected in some wells at the three source areas. Most VOC concentrations were near or below the laboratory practical quantitation limits. However, tetrachloroethene exceeded the MTCA Method A cleanup level for groundwater (5 µg/L) in well KBMW-1. The occurrence of chlorinated solvents in wells at Whitney's Inc./Key Bank (Sterling) suggests the presence of a VOC contaminant plume in this portion of the project area.

Ecology also collected water samples from the City's storm drain and abandoned sanitary sewer to determine if these underground utilities were providing another contaminant migration pathway. Petroleum related contaminants were detected in some of the samples.

Because of the high concentrations of groundwater contamination and the potential for contaminants to continue to migrate from the three source areas, additional investigations are being conducted to better define the nature and extent of the contamination.

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by Pamela B. Marti

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Table of Contents

List of Figures

List of Tables

Background

The city of Montesano is located in Grays Harbor County in western Washington along U.S. Highway 12 (Figure 1). Montesano offered a major stopping place for travelers prior to the repositioning of the highway south of town in the late 1960s. With the highway relocation, the demand for gas stations lessened and several of the downtown gas stations closed. It is suspected that many underground storage tanks (USTs) were left in place, possibly still containing petroleum products. Tanks from past and still-operating gas stations have leaked, creating large areas of soil and groundwater contamination beneath downtown Montesano.

In 2004 Ecology began an investigation to determine the extent of the groundwater contamination underlying downtown Montesano. The project area encompassed several blocks, primarily from Pioneer Avenue south along Main Street. Existing monitoring wells on properties with known releases of petroleum were used in the early phases of this investigation. The wells are located at Tony's Short Stop, Grays Harbor Grange (Montesano Farm & Home), Key Bank (Sterling Savings Bank), P.J. MaxiMart (Montesano 76), Montesano City Shop, and Brumfield-Twidwell (Figure 1). Petroleum contamination was detected at all six of these locations.

During the 2004 monitoring, Ecology also detected chlorinated solvents in the groundwater at some of the well locations (Marti, 2006). Past or present activities within the project area that are potential sources of chlorinated solvents are related to auto repair and paint shops.

In 2005, Ecology contracted GeoEngineers, Inc. to conduct further investigations. Ground penetrating radar was used to locate any remaining underground storage tanks at Whitney's Chevrolet and Brumfield-Twidwell. Soil and groundwater samples were collected from direct push borings throughout the project area to determine if utility corridors were acting as preferential migration pathways for contaminants. Water samples were collected from the city's storm drain and abandoned sanitary sewer.

Results from the GeoEngineer investigation identified three source areas where soil and groundwater contamination have impacted the shallow aquifer: Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell. The contamination at the three sites also included the presence of light non-aqueous phase liquid (LNAPL) in the form of free-phase petroleum product. (GeoEngineers, 2005.)

In the spring of 2006, Ecology contracted GeoEngineers to install nine additional wells between the three source areas to monitor off-site contaminant migration (GeoEngineers, 2006). These wells have been added to Ecology's monitoring network (Marti, 2007).

In addition to the work that Ecology has been conducting, additional investigations began in 2005 at three of the identified source areas (Tony's Short Stop, Grays Harbor Grange, Brumfield-Twidwell) to better define the nature and extent of contamination. At Tony's Short Stop and Brumfield-Twidwell, some remediation work has already been completed. Work on these three projects is continuing.

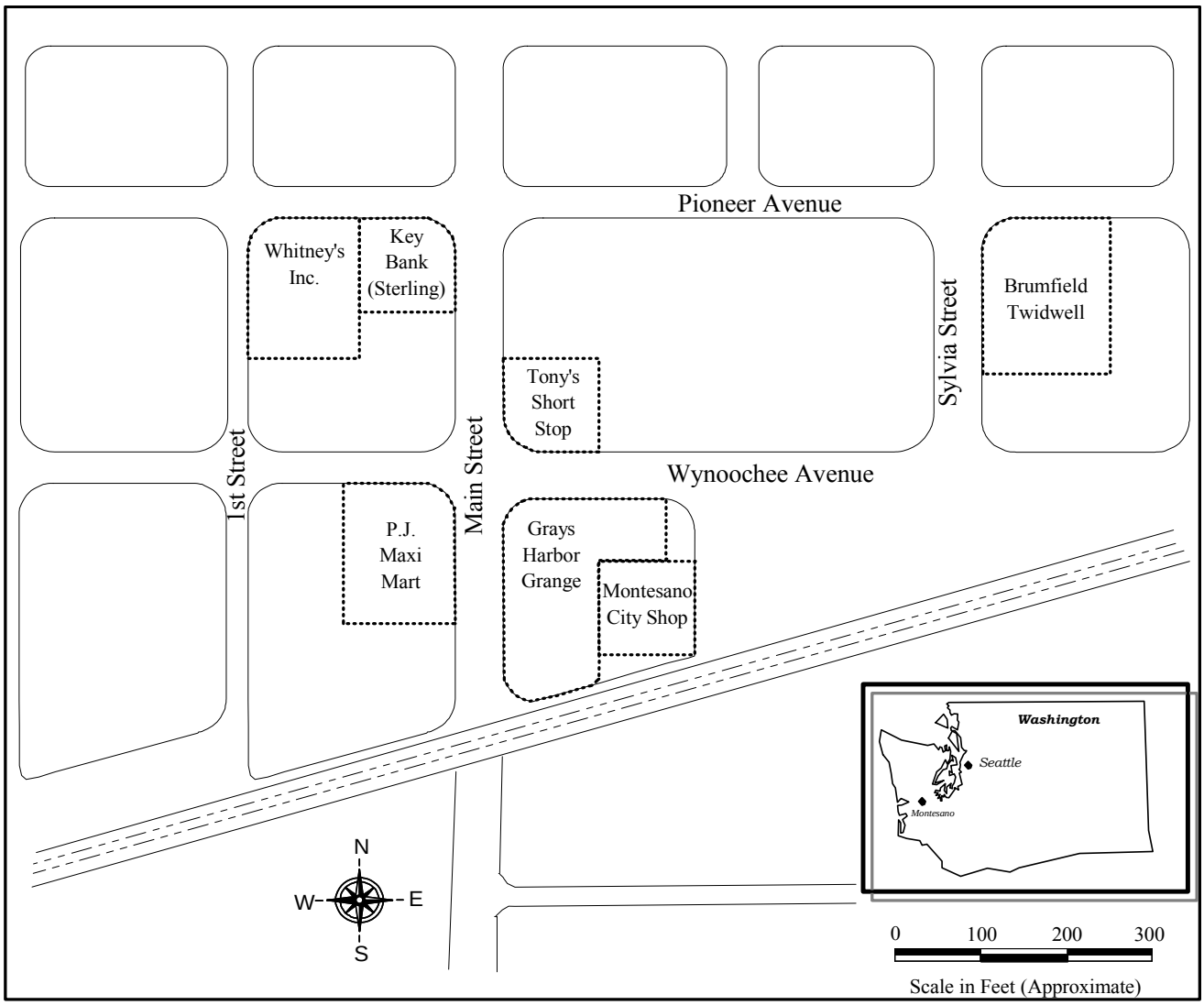

Figure 1. Montesano Groundwater Investigation Site Location Map.

Downtown Montesano is situated on the north side of the Chehalis River valley. The ground surface in the project area generally slopes gently downward (south-southeast) to the Chehalis River over a distance of about 3,000 feet. The geology of the area is comprised mostly of alluvial deposits, consisting of unconsolidated to partly consolidated fluvial and glaciofluvial sand and gravels with interbeds of clay and silt up to 20 feet thick. The alluvial deposits are underlain by a relatively impermeable silt or clay unit of unknown thickness. Regional groundwater flow is to the south-southeast direction toward the Chehalis River. The water table occurs approximately 3 to 15 feet below the ground surface.

Methods

Groundwater Sampling

The primary contaminants of concern in the project area are gasoline-range hydrocarbons. Ecology collected and analyzed groundwater samples for benzene, toluene, ethylbenzene, and xylene (BTEX), as well as total petroleum hydrocarbons as gasoline (TPH-G). Samples were collected from 25 monitoring wells in October 2006 and March 2007 (Figure 2). Samples were also collected and analyzed for 72 target volatile organics compounds (VOCs) from six of the wells in October 2006 and 12 of the wells in March 2007. These wells were selected based on their proximity to potential sources such as auto repair and paint shops.

The monitoring wells have been installed on, or adjacent to, sites with known releases: Tony's Short Stop, Grays Harbor Grange, Key Bank (Sterling), Brumfield-Twidwell, P.J. MaxiMart, and Montesano City Shop (Figure 2). The wells were installed between 1995 and 2006. All wells are constructed of either 2″ or 4″ I.D. PVC and range in depth from approximately 12 to 25 feet, with screen lengths of 10 and 15 feet. In May 2006, Ecology had nine additional wells installed throughout the project area to address data gaps in the existing monitoring network. The new wells are constructed of 2" PVC and range in depth from about 15 to 22 feet, with 10 foot screen lengths. Well construction details are provided in Appendix A.

Static water levels were measured in wells that did not have LNAPL using a calibrated Solinst water level meter prior to well purging and sampling. Measurements were recorded to 0.01 foot and are accurate to 0.03 foot. The probe was rinsed with deionized water between measurements. In wells known to be contaminated, the probe was washed with laboratory grade detergent and rinsed with deionized water.

Ecology purged and sampled most of the monitoring wells using a Grundfos® Redi-Flo2 stainless steel submersible pump, using low-flow sampling techniques. The pump intake was placed at the mid-screen interval in each well, and purged and sampled at a pump rate of 0.5 to 1-liter/ minute. Wells were purged through a continuous flow cell until pH, specific conductivity, and temperature readings stabilized. At the completion of purging, samples were collected directly from the dedicated pump discharge tubing into laboratory supplied containers. The pump was decontaminated between each well by circulating laboratory-grade detergent/ water through the pump followed by a clean water rinse, with each cycle lasting five minutes. Rinsate blanks were collected to determine if the field cleaning procedures were sufficient to prevent cross contamination of samples from the sample equipment.

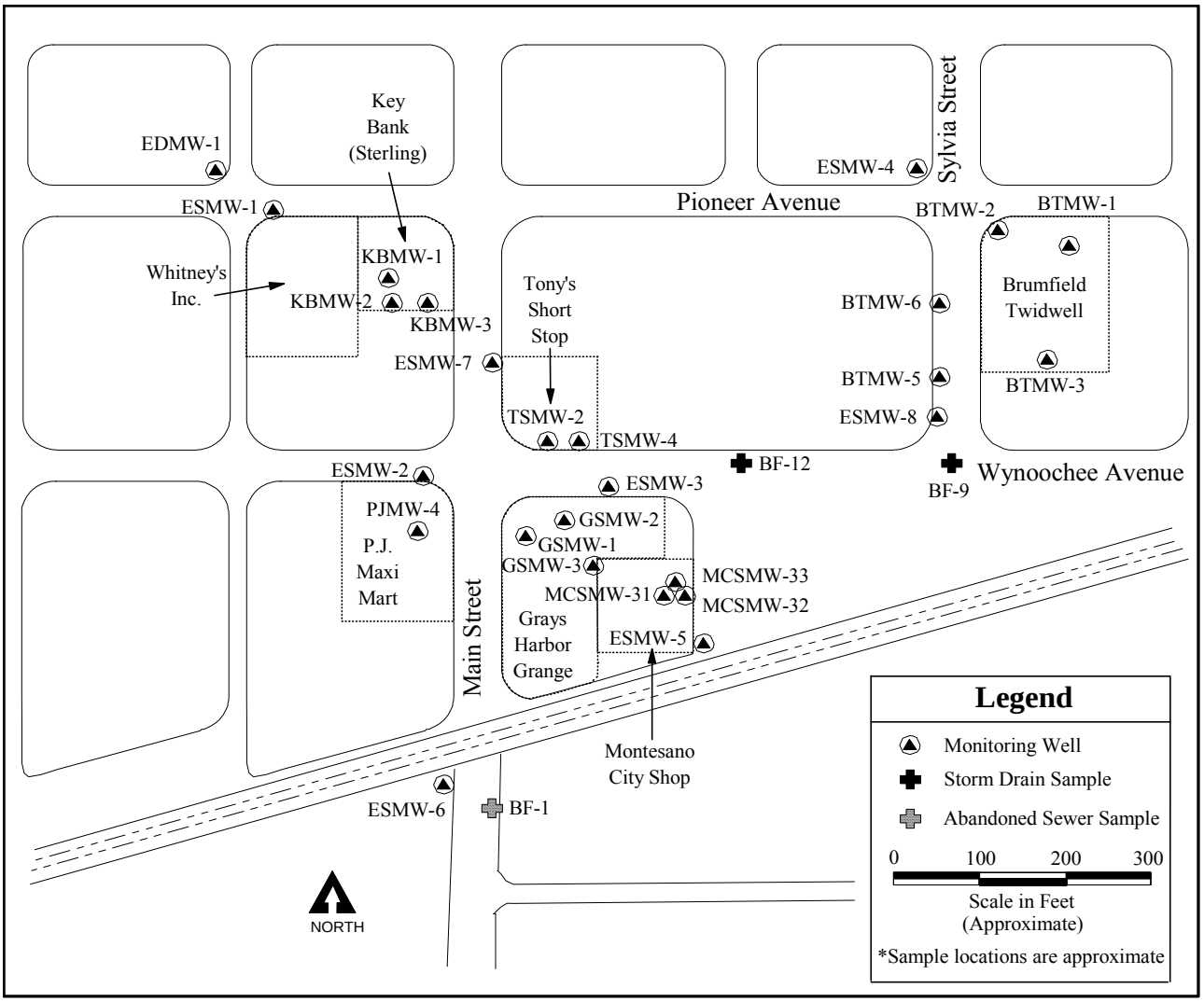

Figure 2. Montesano Groundwater Investigation, Sample Locations October 2006 and March 2007.

Because of the presence of free-phase petroleum product in the groundwater in wells TSMW-2 and TSMW-4 at Tony's Short Stop, KBMW-2 at Key Bank (Sterling), and BTMW-2 at Brumfield-Twidwell, these wells were purged and sampled with decontaminated Teflon bailers. At the completion of purging, samples were transferred from the bailer to the laboratory-supplied bottles using a bottom-emptying, controlled flow assembly. The bailers had been pre-cleaned with a Liquinox® wash and sequential rinses of hot tap water, 10% nitric acid, deionized water, and pesticide-grade acetone. After cleaning, the bailers were air-dried and wrapped in aluminum foil.

In addition to the monitoring well samples Ecology collected water samples in March 2007 from the City of Montesano's storm drain and abandoned sanitary sewer system. Both of these drains appear to collect groundwater. To ensure the samples would be representative of groundwater leaking into the drains, samples were collected during a period of dry weather. Two samples were collected from manholes on the storm drain along Wynoochee Avenue, and one sample from the abandoned sanitary sewer system on Main Street (Figure 2).

Samples from the storm and sewer drains were collected using pre-cleaned glass beakers. The glass beakers were pre-cleaned with a Liquinox® wash and sequential rinses of hot tap water, deionized water, and pesticide-grade acetone. After cleaning, the beakers were air-dried and wrapped in aluminum foil. Samples were transferred from the beaker into the laboratory-supplied bottles. Water samples collected from the storm and sewer drains were analyzed for VOCs and TPH-G.

BTEX/TPH-G and VOC samples were each collected free of headspace in three 40-mL glass vials with Teflon-lined septa lids and preserved with 1:1 hydrochloric acid. After sample collection and proper labeling, all samples were stored in ice-filled coolers. Samples were transported to Ecology's Operation Center in Lacey. Samples were kept in the walk-in cooler until taken by courier to Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Laboratory protocols (Ecology, 2005).

Purge water from the wells was collected and stored at a secure facility in 55-gallon drums. Purge water is transported and disposed of in accordance with Washington State Dangerous Waste Regulations (Chapter 173-303 WAC).

Laboratory

Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. Samples were analyzed for the gasoline-range hydrocarbons of benzene, toluene, ethylbenzene, and xylene (BTEX); total petroleum hydrocarbons as gasoline (TPH-G); and volatile organics (VOCs).

Table 1. Field and Laboratory Methods.

Field Measurements	Instrument Type	Method	Accuracy
Water Level	Solinst Water Level Meter	EPA SOP 2043	±0.03 feet
pH	Orion 25A Field Meter	EPA Method 150.1	±0.1 std. units
Temperature	YSI 3510 Temperature Probe	EPA Method 150.1	±0.1 ºC
Specific Conductance	YSI 3520 Conductivity Cell	EPA Method 120.1	±10 µmhos/cm
Laboratory Analytes	**Method**	**Reference**	**Reporting Limit**
BTEX	EPA SW-846 Method 8021B	EPA 1996	1 µg/L
TPH-G	TPH-Gx	Ecology 2003	0.14 mg/L
VOCs	EPA SW-846 Method 8260B	EPA 1996	1-5 µg/L

SOP = Standard Operating Procedure.
EPA = Environmental Protection Agency.

Data Quality

Quality control samples collected in the field consisted of blind field duplicate samples and equipment rinsate blanks. Field duplicates were collected by splitting the pump discharge between two sets of sample bottles, which provides a measure of the overall sampling and analytical precision. Precision estimates are influenced not only by the random error introduced by collection and measurement procedures, but also by the natural variability of the concentrations in the media being sampled. Field duplicates were collected from wells GSMW-2, KBMW-3, and BTMW-2 in October 2006, and wells KBMW-3, BTMW-2, and ESMW-3 in March 2007. These wells were selected to represent the range of concentrations found over the project area.

Tables 2 and 3 show results of the duplicate samples and the relative percent difference (RPD). RPD is calculated as the difference between sample results, divided by the mean and expressed as a percent.

Table 2. Relative Percent Difference (RPD) of Duplicate Sample Results (µg/L) for October 2006.

Sample ID:	GS MW-2	GS MW-2A	RPD	KB MW-3	KB MW-3A	RPD	BT MW-2	BT MW-2A	RPD
	µg/L	µg/L	%	µg/L	µg/L	%	µg/L	µg/L	%
Benzene	140	150	7	10	160	**176**	150	160	6
Toluene	2 U	2 U	--	4.4 J	80 J	--	230	170	30
Ethylbenzene	2 U	2 U	--	38	680	**179**	1200	710	**51**
m- & p-xylene	4 U	4 U	--	44	710	**177**	2900	2000	37
o-xylene	26	26	0	20	350	**178**	1200	770	44
TPH-G	280 U	280 U	--	16,000	17,000	6	46,000	19,000	**83**

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Does not meet data quality objectives of 50%.

Table 3. Relative Percent Difference (RPD) of Duplicate Sample Results (µg/L) for March 2007.

Sample ID:	KB MW-3	KB MW-3A	RPD	BT MW-2	BT MW-2A	RPD	ES MW-3	ES MW-3A	RPD
	µg/L	µg/L	%	µg/L	µg/L	%	µg/L	µg/L	%
Benzene	40	45	12	450	360	22	8300	8400	1
Toluene	2.5	3	18	1300	460	**95**	9000	9100	1
Ethylbenzene	4.5	5.8	25	2200	1400	44	950	930	2
m- & p-xylene	2.1	2.6	21	9600	5700	**51**	2900	2900	0
o-xylene	8	10	22	4600	2400	**63**	1100	1000	9
TPH-G	1200	1300	8	84,000	78,000	7	43,000	43,000	0

Bold – Does not meet data quality objectives of 50%.

In October 2006, duplicate samples were collected from wells GSMW-2, KBMW-3, and BTMW-2. The RPD for analytes detected in duplicate samples from monitoring well GSMW-2 was good. The RPD for the BTEX results from well KBMW-3 did not meet the data quality objectives of 50%. When the BTEX samples were collected the pump discharge water did not have a steady flow. Because the samples were not collected under uniform conditions and the BTEX results have very high RPDs, these data have been rejected. Duplicate results for ethylbenzene and TPH-G from well BTMW-2 also did not meet the data quality objectives, while the remainder of the analytes had RPDs that ranged from 6% to 44%.

In March 2007, duplicate samples were collected from wells KBMW-3, BTMW-2, and ESMW-3. The RPDs for the March results from wells KBMW-3 and ESMW-3 were acceptable and ranged from 0% to 25%. As with the October 2006 duplicates for well BTMW-2, some of the sample results did not meet the data quality objectives of 50%, while the remainder of the RPDs ranged from 7% to 44%.

Field duplicates are expected to have higher variability compared to other quality control samples because they incorporate environmental and sampling variability. The variability in well BTMW-2 duplicate results and subsequent high RPD values may be attributed to the presence of free-phase petroleum product in this well during both sample rounds. Because of the uncertainty introduced by the presence of a LNAPL, average concentrations of the duplicate samples will be used in the remainder of this report and will be "J" qualified as estimated. Data for the other wells where free-phase petroleum product was encountered will also be "J" qualified because of the possibility that these data have not met the data quality objectives. These wells are KBMW-2, TSMW-2, and TSMW-4.

Rinsate blanks were also collected in the field to determine if field cleaning procedures were sufficient to prevent cross contamination of samples from the sample equipment. Rinsate blanks were collected by pumping deionized water through the submersible pump after the pump had been cleaned. BTEX and TPH-G were not detected in any of the rinsate blanks.

Most of the data met the measurement quality objectives established in the Quality Assurance Project Plan (Marti, 2004). A review of the data quality control and quality assurance from laboratory case narratives indicates that overall analytical performance was good. The reviews include descriptions of analytical methods, holding times, instrument calibration checks, blank results, surrogate recoveries, and laboratory control samples. It was noted that certain samples did not appear to be homogeneous since dilutions made from the triplicate bottles did not produce linear dilutions. In a few cases, some analytes exceeded the upper calibration limit, and the associated results are qualified. No major problems were reported that compromised the usefulness or validity of the sample results; therefore, all results are usable as qualified. Quality assurance case narratives and laboratory reporting sheets are available upon request.

All field measurements and analytical result data are available in electronic format from Ecology's EIM data management system: www.ecy.wa.gov/eim/index.htm at study ID, PMART004.

Results

Field Observations

Depth-to-water of each monitoring well was measured prior to purging. End-of-purge specific conductivity readings, as well as the total purge volume, are listed in Table 4. Temperature measurements recorded during purging were collected for comparative purposes only and have not been included in Table 4. Because temperatures are measured in a flow cell which is influenced by ambient air conditions, they are not considered to be representative of in-situ groundwater conditions. pH measurements have been rejected due to a faulty probe.

Completion depths for the monitoring wells range from approximately 12 to 25 feet. Depth-to-groundwater below the land surface ranged from about 6 to 19 feet in October 2006 and 4 to 15 feet in March 2007.

During the monitoring period, specific conductivity measurements ranged from 94 to 1228 µmhos/cm. Groundwater temperatures measured in the flow cell averaged 16.4ºC in October and 14ºC in March. The higher temperatures in October are partly caused by the influence of warmer ambient air.

While purging at the lowest flow possible, water levels dropped in well ESMW-7 in October, in well ESMW-1 in March, and in wells EDMW-1, ESMW-2, and ESMW-3 during both sample rounds. In October, the water level dropped below the pump intake in wells ESMW-1 and KBMW-3. The pump was shut off during purging to allow the water in these two wells to recover. Well ESMW-6 purged dry in October and March and required several hours to recover for the well to have enough water for sample collection.

In October 2006 and March 2007, free-phase petroleum product was present in water bailed from Brumfield-Twidwell well BTMW-2 and the wells at Tony's Short Stop (TSMW-2 and TSMW-4). Free-phase petroleum product was present in water bailed from well KBMW-2 at Key Bank (Sterling) in October 2006, but was not present in March 2007, although the purge water did have a strong petroleum odor and a visible sheen on the surface. Approximate product thickness as measured in the bailer is listed in Table 4.

Table 4. Summary of Field Parameter Results for October 2006 and March 2007.

Monitoring Well Sample ID	Total Depth (feet)[1]	Depth-to-Water Below Ground Surface (feet)		Water Table Elevation (feet msl)		Specific Conductivity (umhos/cm)		Purge Volume (gallons)	
		10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Brumfield-Twidwell									
BTMW-1	23.30	15.77	9.31	21.83	28.29	120	113	5	5
BTMW-2	24.9	Product (~6")	Product (~0.25")	--	--	--	--	3	3
BTMW-3	22.28	13.23	9.38	17.14	20.99	188	233	5.5	5
BTMW-5	24	14.36	13.88	16.34	16.82	163	163	5	3.5
BTMW-6	24	14.94	10.20	19.50	24.24	201	281	4	5
Whitney's Inc./ Key Bank (Sterling)									
KBMW-1	21.97	18.61	15.42	21.11	24.30	207	196	4	4.5
KBMW-2	20.16	Product (~14")	13.90	--	24.60	--	--	2	3
KBMW-3	20.17	17.58	14.29	20.10	23.39	319	457	3.5[(2)]	4
P.J. MaxiMart									
PJMW-4	20	13.52	9.88	17.66	21.30	148	179	4	4
Tony's Short Stop									
TSMW-2	18.77	Product (~2")	--	--	--	--	--	2	--
TSMW-4	--	--	Product (~12")	--	--	--	--	--	4
Grays Harbor Grange									
GSMW-1	22.7	11.64	9.32	16.60	18.92	182	170	4	4
GSMW-2	21.74	11.54	9.26	16.38	18.66	243	255	3.5	5
GSMW-3	17.73	7.71	5.13	15.32	17.90	326	504	5.5	4.5
Montesano City Shop									
MCSMW-31	12.50	6.62	4.15	14.77	17.24	297	434	5	5
MCSMW-32	12.50	7.30	5.23	14.59	16.66	294	412	3.25	3.5
MCSMW-33	12.11	7.76	5.72	14.74	16.78	337	331	5	4
Ecology Wells									
ESMW-1	20.08	18.15	14.45	23.36	27.06	263	186	2[(1)]	3.5[(2)]
ESMW-2	20.08	13.43	10.41	19.29	22.31	218	200	3.5[(2)]	4.5[(2)]
ESMW-3	17.53	11.03	8.92	18.53	20.64	367	339	2[(2)]	3[(2)]
ESMW-4	20.09	15.88	9.71	22.14	28.31	120	94	5	6
ESMW-5	14.73	6.45	4.04	14.76	17.17	264	116	6	4
ESMW-6	14.70	10.06	9.08	12.64	13.62	1325	1228	2.5[(1)]	4[(1)]
ESMW-7	19.53	16.61	14.09	19.84	22.36	351	309	3.75[(2)]	3.5
ESMW-8	15.10	10.31	8.95	15.14	16.50	198	163	5	4.5
EDMW-1	22.61	16.36	13.01	25.95	29.03	214	198	4[(2)]	4[(2)]

-- Not measured [1] Purged dry [2] Water level dropped while purging

Product: Free-phase petroleum product present in the groundwater with approximate bailed thickness.

A groundwater flow pattern for the project area for October 2006 is shown in Figure 3. The location of the water-table contours was determined using a geostatistical gridding method known as kriging. The groundwater flow direction is approximately perpendicular to the contours. The overall flow direction appears to be to the south and southeast, toward the Chehalis River. There are multiple factors in the project area that may affect water level measurement and should be taken into consideration. These include (1) the presence of free-phase petroleum product in wells KBMW-2, BTMW-2, and TSMW-2, (2) a vapor extraction system operating at P.J. MaxiMart, (3) excavation and removal of soils at Tony's Short Stop and Brumfield-Twidwell, and (4) the possible influence of the storm drain and abandoned sewer system which appear to collect groundwater.

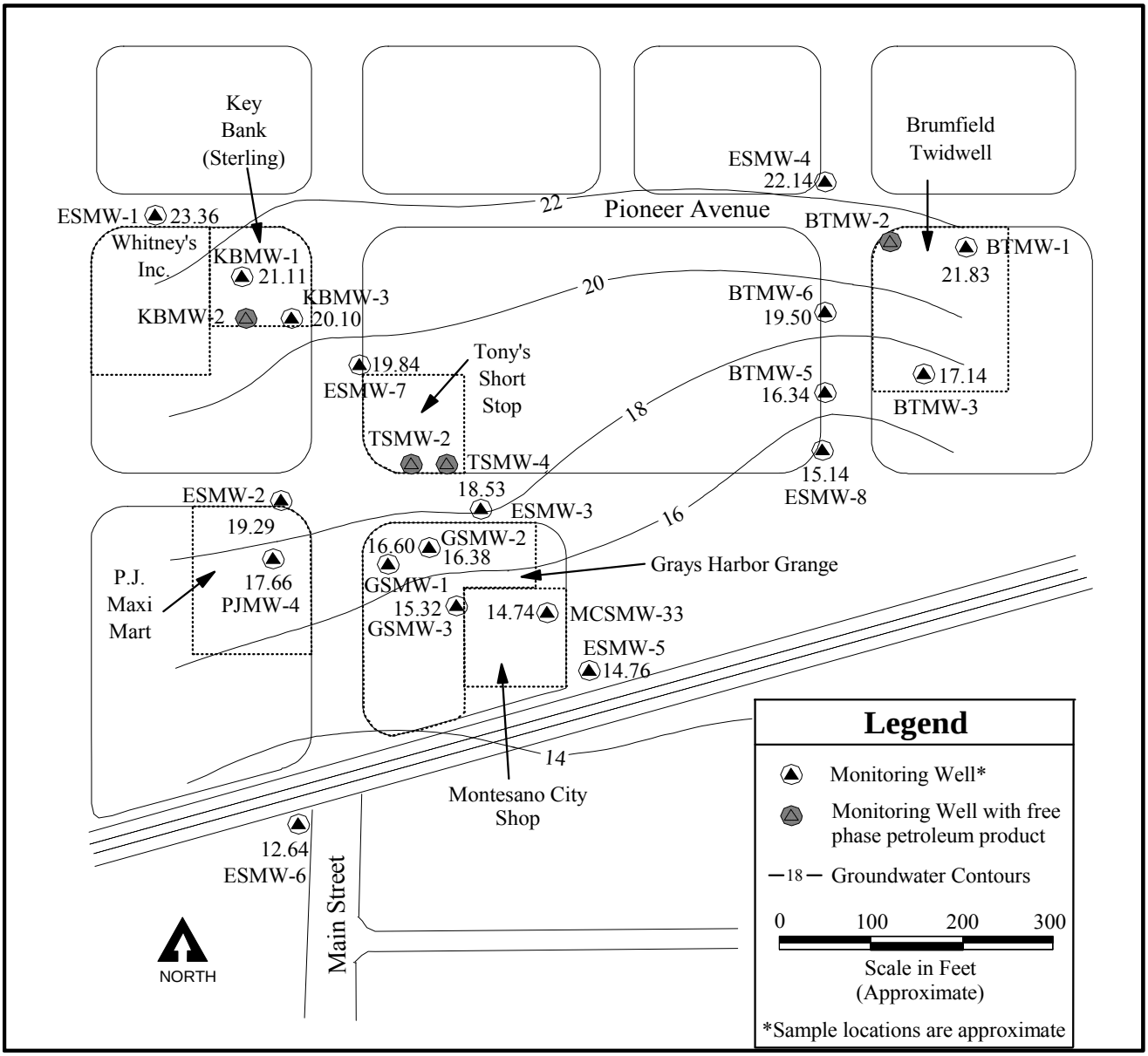

Figure 3. Montesano Groundwater Investigation – Water Table Elevation (feet) - October 2006.

Analytical Results

Analytical results, as well as Model Toxics Control Act (MTCA) cleanup levels for groundwater, for BTEX and TPH-G are summarized in Tables 5, 7, 9, and 11. For comparison, a summary of historical data for this project is presented in Appendix B. Volatile organic results are summarized in Tables 6, 8, 10, 12, and 13.

Project results have been separated into three contaminant source areas as identified in a previous study (GeoEngineers, 2005): Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell. Tables 11 and 12 present results for the remaining wells, which include wells at P.J. MaxiMart, Montesano City Shop, and the nine Ecology wells. Results are presented graphically in Figures 4 and 5. Table 13 presents results for the storm and sewer drain samples.

Tony's Short Stop/Grays Harbor Grange

The highest concentrations of petroleum-related contamination in the project area were detected in groundwater samples collected from monitoring wells TSMW-2 and TSMW-4 at Tony's Short Stop. Both wells, which had free-phase petroleum product in the groundwater, had BTEX and TPH-G concentrations which exceeded the MTCA Method A cleanup levels (Table 5).

Table 5. BTEX and TPH-G Results (µg/L) for Tony's Short Stop and Grays Harbor Grange for October 2006 and March 2007.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Tony's Short Stop												
TSMW-2	**2600J**	--	**4500E**	--	**2400J**	--	**1700J**	--	**1900E**	--	**140,000E**	--
TSMW-4	--	**28,300J**	--	**91,300J**	--	**10,000J**	--	**37,500J**	--	**15,200J**	--	**490,000J**
Grays Harbor Grange												
GSMW-1	**51**	1 U	**33 J**	1 U	**37**	1 U	**39**	2 U	**32 J**	1 U	**550**	140 U
GSMW-2	**140**	**120**	2 U	1 U	2 U	**34**	4 U	**63**	**26**	**5.5**	280 U	**390 J**
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U

* MTCA Method A cleanup level for TPH-G is 1,000 •g/L if benzene is not detectable in groundwater.
-- Not sampled.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
E – Concentration of the associated value exceeds the known calibration range.
Bolded – Analyte was detected.
Shaded – Values are greater than MTCA cleanup levels.

Monitoring wells at the Grays Harbor Grange, GSMW-1 and GSMW-2, had much lower BTEX and TPH-G concentrations. In well GSMW-1, benzene exceeded the cleanup level in October 2006. Toluene, ethylbenzene, xylene, and TPH-G were also detected in this well, but below the cleanup levels. In March 2007, BTEX and TPH-G were not detected in well GSMW-1. Benzene and o-xylene were detected in well GSMW-2 in October. In March, benzene, ethylbenzene, xylene, and TPH-G were detected in this well. Benzene exceeded the cleanup level in this well during both sample rounds.

Samples for a target list of 72 volatile organic compounds (VOCs) were also collected from wells TSMW-4, GSMW-1, and GSMW-2 during this monitoring period. VOC samples were collected from these wells because of the possible historical use of Tony's Short Stop as a service station. Table 6 is a summary of those results.

Table 6. Summary of VOC Results (µg/L) for Monitoring Wells at Tony's Short Stop and Grays Harbor Grange for October 2006 and March 2007.

Volatile Organic Compounds	TSMW-4		GSMW-1		GSMW-2	
	10/06	3/07	10/06	3/07	10/06	3/07
Tetrachloroethene	--	1000 U	**1.2**	**0.62 J**	**2**	**1 J**
Trichloroethene	--	1000 U	1 U	1 U	1 U	1 U
Cis-1,2-Dichloroethene	--	1000 U	1 U	1 U	1 U	1 U
Trans-1,2-Dichloroethene	--	1000 U	1 U	1 U	1 U	1 U
Vinyl Chloride	--	2000 U	1 U	2 U	2 U	2 U
1,1-Dichloroethane	--	1000 U	1 U	1 U	**0.48 J**	**0.46 J**
1,1,1-Trichloroethane	--	1000 U	1 U	1 U	1 U	**0.45 J**
1,2-Dichloroethane	--	1000 U	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	--	2000 U	2 U	2 U	2 U	2 U
Benzene	--	**45,400 J**	**63**	1 U	**192**	**202**
Toluene	--	**74,800 J**	**58**	1 U	**0.44 NJ**	**1.2**
Ethylbenzene	--	**44,300 J**	**65**	1 U	1 U	**59**
m & p-Xylene	--	**70,500 J**	**115**	4 U	4 U	**94**
o-Xylene	--	**30,500 J**	**76**	1 U	**34**	**12 J**
Isopropylbenzene (Cumene)	--	**2490 J**	**3.4**	1 U	**0.64 J**	**4.4 J**
n-Propylbenzene	--	**9560 J**	**7.5**	1 U	1 U	**8.8**
1,3,5-Trimethylbenzene	--	**16,500 J**	**8.6**	2 U	1 U	**7.8**
Tert-Butylbenzene	--	2000 U	1 U	2 U	1 U	2 U
1,2,4-Trimethylbenzene	--	**49,100 J**	**31**	2 U	**0.70 J**	**31**
Sec-Butylbenzene	--	**316 J**	**0.33 NJ**	1 U	1 U	**0.57 J**
p-Isopropyltoluene	--	**856 J**	**0.23 NJ**	1 U	1 U	1 U
n-Butylbenzene	--	**1010 J**	**0.24 NJ**	2 U	2 U	**0.72 J**
Naphthalene	--	**3590 J**	**3.2**	1 U	**2.5**	**4.7**

-- Not sampled.

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
NJ – Analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

Bolded – Analyte was detected.
Shaded – Values are greater than MTCA cleanup levels.

Chlorinated compounds were not detected in well TSMW-4. However, the high concentrations of the petroleum contaminants caused the practical quantitation limits for the VOC analysis to range from 1000 to 2000 µg/L. The naphthalene concentration in well TSMW-4 did exceed the MTCA Method A cleanup level of 160 µg/L.

In addition to other petroleum-related contaminants, some chlorinated compounds – such as tetrachloroethene, 1,1-dichloroethane, and 1,1,1-trichloroethane – were detected in well GSMW-2 at concentrations near or below the practical quantitation limit (Table 6). Tetrachloroethene was also detected in well GSMW-1 near the practical quantitation limit of 1 µg/L.

Toluene was detected in the October and March VOC samples from well GSMW-2 at concentrations near the practical quantitation limit of 1 µg/L. Toluene was not detected in the BTEX analysis.

Whitney's Inc./Key Bank (Sterling)

Monitoring well KBMW-2, located at Key Bank (Sterling), also had high concentrations of BTEX and TPH-G in the groundwater samples (Table 7). In October 2006, free-phase petroleum product was present in groundwater from this well. BTEX and TPH-G concentrations exceeded the MTCA cleanup levels during both sample rounds, with the exception of ethylbenzene in October. BTEX results for well KBMW-3 from October have been rejected because they did not meet the data quality objectives for this project. In March, the benzene concentration in well KBMW-3 exceeded the cleanup level. TPH-G concentrations also exceeded the cleanup levels in well KBMW-3 during both sample rounds. BTEX and TPH-G were also detected in the March 2007 samples from well KBMW-1, with benzene exceeding the cleanup level.

Table 7. BTEX and TPH-G Results (µg/L) for Key Bank (Sterling) for October 2006 and March 2007.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
KBMW-1	1 U	**48**	1 U	**1.4**	1 U	**3.1**	2U	2 U	1 U	**1.3**	140 U	**560**
KBMW-2	**360 J**	**850 J**	**1500J**	**7900 J**	**430 J**	**1900 J**	**1200 J**	**6800 J**	**550 J**	**3300 J**	**19,000J**	**74,000J**
KBMW-3	REJ	**40**	REJ	**2.5**	REJ	**4.5**	REJ	**2.1**	REJ	**8**	**16,000**	**1200**

* MTCA Method A cleanup level for TPH-G is 1,000 •g/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
REJ – Results have been rejected because duplicate samples did not meet data quality objectives.
Bolded – Analyte was detected.
Shaded – Values are greater than MTCA cleanup levels.

Samples were also collected for VOCs from the three Key Bank (Sterling) wells (Table 8). The Key Bank site is located next to Whitney's Inc., which has an auto repair and painting shop. In 2003, Ecology found that waste solvents and waste oil were being stored in on-site fuel storage tanks. The tanks were decommissioned and cleaned. Chlorinated solvents have been detected in wells located on the Key Bank (Sterling) property (Ecology, 2007).

Table 8. Summary of VOC Results (µg/L) for Monitoring Wells at Key Bank (Sterling) for October 2006 and March 2007.

Volatile Organics Compounds	KBMW-1		KBMW-2		KBMW-3	
	10/06	3/07	10/06	3/07	10/06	3/07
Tetrachloroethene	1 U	**14 J**	--	20 U	1 U	1 U
Trichloroethene	1 U	2 U	--	20 U	**1.7**	1 U
Cis-1,2-Dichloroethene	1 U	2 U	--	20 U	**5.8**	**5.9**
Trans-1,2-Dichloroethene	1 U	2 U	--	20 U	**0.69 NJ**	**0.42 J**
Vinyl Chloride	2 U	5 U	--	40 U	2 U	2 U
1,1-Dichloroethane	1 U	2 U	--	20 U	1 U	1 U
1,1,1-Trichloroethane	1 U	2 U	--	20 U	1 U	1 U
1,2-Dichloroethane	**0.87 J**	**2.3 J**	--	20 U	**2.3**	**0.98 J**
4-Methyl-2-Pentanone	2 U	4 U	--	**20 J**	**2.1**	2 U
Benzene	1 U	**60**	--	**1060 J**	**159**	**46**
Toluene	1 U	**1 J**	--	**42,000 J**	**92**	**2.2**
Ethylbenzene	1 U	**4.5**	--	**31,000 J**	**792**	**7.7**
m & p-Xylene	4 U	**2 J**	--	**111,000 J**	**1640**	**4.2**
o-Xylene	1 U	**2.2**	--	**54,400 J**	**565**	**14 J**
Isopropylbenzene (Cumene)	1 U	**20**	--	**253 J**	**84**	**16 J**
n-Propylbenzene	1 U	**6.4**	--	**641 J**	**204**	**3.4**
1,3,5-Trimethylbenzene	1 U	**3.2 J**	--	**1050 J**	**323**	**1.7 J**
Tert-Butylbenzene	1 U	2 U	--	40 U	1 U	**0.98 J**
1,2,4-Trimethylbenzene	1 U	**2.2 J**	--	**118,000 J**	**1260**	**2.2**
Sec-Butylbenzene	**0.76 J**	**4.1**	--	**49 J**	**19**	**12 J**
p-Isopropyltoluene	1 U	**1.6 J**	--	**58 J**	**18**	**0.67 J**
n-Butylbenzene	2 U	**3.6 J**	--	**111 J**	**33**	**4.4**
Naphthalene	2 U	**13**	--	**507,000 J**	**448 E**	**44**

-- Not sampled.

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

NJ – Analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

E – Concentration of the associated value exceeds the known calibration range.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

In addition to other petroleum-related contaminants, some chlorinated compounds were detected. Most concentrations were near or below the practical quantitation limits, with the exception of tetrachloroethene in well KBMW-1, cis-1,2-dichloroethene in well KBMW-3, and 4-methyl-2-pentanone in well KBMW-2. The tetrachloroethene concentration exceeded the MTCA Method A cleanup level for groundwater of 5 µg/L in well KBMW-1.

Although the October 2006 BTEX results from well KBMW-3 were rejected because they did not meet data quality objectives, benzene, toluene, ethylbenzene and xylene were detected in the October VOC sample collected from this well. Concentrations are similar to those reported during previous sample events (Appendix B). Benzene, ethylbenzene, and xylene exceeded the MTCA cleanup levels.

Naphthalene concentrations also exceeded the MTCA Method A cleanup level of 160 µg/L in wells KBMW-2 and KBMW-3.

Brumfield-Twidwell

Of the five wells sampled at the Brumfield-Twidwell site, monitoring wells BTMW-2 and BTMW-6 contained BTEX and TPH-G in the groundwater samples (Table 9). Free-phase petroleum product was present in groundwater in well BTMW-2 during both sample rounds. Benzene, ethylbenzene, xylene, and TPH-G exceeded the cleanup levels in this well during both sample rounds. Of the petroleum-related contaminants detected in well BTMW-6, benzene and TPH-G exceeded the cleanup levels in March 2007. Benzene was detected in the March sample collected from well BTMW-5 at a concentration near the practical quantitation limit of 1 µg/L.

Table 9. BTEX and TPH-G Results (µg/L) for Brumfield-Twidwell for October 2006 and March 2007.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-2[a]	**155 J**	**405 J**	**200 J**	**880 J**	**955 J**	**1800 J**	**2450 J**	**7650 J**	**985 J**	**3500 J**	**32,500 J**	**81,000J**
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-5	1 U	**1.8**	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-6	1 U	**14**	1 U	**18**	**1.6**	**280**	**5.2**	**380**	1 U	10 U	140 U	**3700**

* MTCA Method A cleanup level for TPH-G is 1,000 •g/L if benzene is not detectable in groundwater.

a - Average concentration of duplicate samples. Results are J qualified as estimate.

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

Wells BTMW-3 and BTMW-6 were also sampled for VOCs during both sample rounds because VOCs had been detected in site soils during excavation and removal activities in 2006. 1,2- Dichloroethane was detected in well BTMW-6 in March 2007 (Table 10).

Benzene, toluene and o-xylene were detected in the October VOC sample from well BTMW-6 at concentrations near the practical quantitation limit of 1 µg/L. These analytes were not detected in the October BTEX analysis. o-Xylene was detected in the March VOC sample from well BTMW-3.

Table 10. Summary of VOC Results (µg/L) for Monitoring Wells at Brumfield-Twidwell for October 2006 and March 2007.

Volatile Organics Compounds	BTMW-3		BTMW-6	
	10/06	3/07	10/06	3/07
Tetrachloroethene	1 U	2 U	1 U	2 U
Trichloroethene	1 U	2 U	1 U	2 U
Cis-1,2-Dichloroethene	1 U	2 U	1 U	2 U
Trans-1,2-Dichloroethene	1 U	2 U	1 U	2 U
Vinyl Chloride	2 U	5 U	2 U	5 U
1,1-Dichloroethane	1 U	2 U	1 U	2 U
1,1,1-Trichloroethane	1 U	2 U	1 U	2 U
1,2-Dichloroethane	1 U	5 U	1 U	**1.6 J**
4-Methyl-2-Pentanone	2 U	4 U	2 U	4 U
Benzene	1 U	2 U	**1.1**	**17**
Toluene	1 U	2 U	**0.91 J**	**29**
Ethylbenzene	1 U	2 U	**2.3**	2 U
m & p-Xylene	4 U	4 U	**7.8**	4 U
o-Xylene	1 U	**1.4 J**	**0.34 J**	**8.1**
Isopropylbenzene (Cumene)	1 U	2 U	**0.37 NJ**	**34**
n-Propylbenzene	1 U	5 U	**0.35 NJ**	**60**
1,3,5-Trimethylbenzene	1 U	5 U	**0.25 J**	**30**
Tert-Butylbenzene	1 U	2 U	1 U	2 U
1,2,4-Trimethylbenzene	1 U	5 U	**1.4**	**204**
Sec-Butylbenzene	1 U	2 U	1 U	**4.1**
p-Isopropyltoluene	5 U	5 U	1 U	**2.6 J**
n-Butylbenzene	1 U	5 U	2 U	**3.1 J**
Naphthalene	2 U	5 U	2 U	**51**

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

NJ – Analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

Remaining Wells

Samples were also collected from the new Ecology wells and wells located at P.J. MaxiMart, and Montesano City Shop. Because the P.J. MaxiMart site has had additional groundwater monitoring as part of remedial activities, only well PJMW-4 was sampled in October 2006 and March 2007. Analytical results for the remaining wells for this monitoring period are shown in Tables 11 and 12.

Table 11. BTEX and TPH-G Results (µg/L) for Ecology Wells, P.J. MaxiMart, and Montesano City Shop for October 2006 and March 2007.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Ecology Wells												
ESMW-1	**25**	**49**	**2.1 J**	**70**	**8.6**	**110**	2 U	**360**	1 U	**110**	140 U	**9300**
ESMW-2	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-3	**4900**	**8300**	**4100**	**9000**	**1700**	**950**	**1700**	**2900**	**1400**	**1100**	**86,000**	**43,000**
ESMW-4	1 U	**3.1**	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-5	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-6	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-7	**640**	**290**	**1300 J**	**470**	**1100**	**410**	**2200**	**1100**	**1000**	**470**	**21,000**	**7100**
ESMW-8	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
EDMW-1	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
P.J. MaxiMart												
PJMW-4	**1.1**	**1.4**	**14**	**28**	**25**	**58**	**62 E**	**280**	**37 E**	**110**	**770**	**2000**
Montesano City Shop												
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-32	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-33	**67**	**3**	**1.9**	1 U	1 U	1 U	2 U	2 U	1 U	1 U	**250**	140 U

* MTCA Method A cleanup level for TPH-G is 1,000 •g/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
E – Concentration of the associated value exceeds the known calibration range.
Bold – Analyte was detected.
Shaded values are greater than MTCA cleanup levels.

Elevated concentrations of petroleum-related contaminants were detected primarily in three of the Ecology wells: ESMW-1, ESMW-3 and ESMW-7. Groundwater cleanup levels were exceeded for benzene and TPH-G in well ESMW-1. This well is near the intersection of Pioneer Avenue and 1st Street, where Whitney's Inc. is located. Historically, gasoline was stored and sold from this corner of the business. In 1995, three underground storage tanks were closed in place. Soil samples taken at the time showed high levels of BTEX (Ecology, 2007).
Well ESMW-7 is located along Main Street near the northwest corner of the Tony's Short Stop property. BTEX and TPH-G were detected in this well in both October 2006 and March 2007, exceeding the MTCA cleanup levels with the exception of toluene and ethylbenzene in March.

BTEX and TPH-G cleanup levels were exceeded in well ESMW-3 in both October 2006 and March 2007. This well is located along Wynoochee Avenue, between Tony's Short Stop and Grays Harbor Grange. This well is less than 100 feet downgradient from well TSMW-4 which had free-phase petroleum product.

BTEX and TPH-G were detected in well PJMW-4 at the P.J. MaxiMart site (Table 11). BTEX concentrations were below the MTCA cleanup levels. In March 2007, TPH-G exceeded the cleanup level in this well.

Of the three wells sampled at the Montesano City Shop, petroleum-related contaminants were detected in well MCSMW-33 (Table 11). Benzene exceeded the cleanup level of 5 µg/L in October 2006, but was below the cleanup level in March 2007. Low concentrations of toluene and TPH-G were also detected in October.

Samples for VOCs were collected from Ecology wells ESMW-1, ESMW-2, ESMW-3, and ESMW-7 in March 2007. VOC samples were collected from these wells because they are located near properties where chlorinated solvents have been detected in the past. In addition to other petroleum-related contaminants, 4-methyl-2-pentanone was detected in well ESMW-1 at a concentration of 5 µg/L (Table 12). Naphthalene exceeded the MTCA cleanup level of 160 µg/L in wells ESMW-1 and ESMW-7.

Results for the three source areas, P.J. MaxiMart, Montesano City Shop, and the new Ecology wells, are shown in Figures 4 and 5. Figure 4 shows BTEX concentrations for the project area for October 2006 and March 2007. Figure 5 shows the TPH-G concentrations for the same time period. Concentration graphs on the two figures have been plotted using a logarithmic scale to accommodate the wide range of concentrations present in the project area.

Table 12. Summary of VOC Results (µg/L) for Ecology Monitoring Wells for March 2007.

Volatile Organics Compounds	ESMW-1		ESMW-2		ESMW-3		ESMW-7	
	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Tetrachloroethene	--	2 U	--	2 U	--	20 U	--	20 U
Trichloroethene	--	2 U	--	2 U	--	20 U	--	20 U
Cis-1,2-Dichloroethene	--	2 U	--	2 U	--	20 U	--	20 U
Trans-1,2-Dichloroethene	--	2 U	--	2 U	--	20 U	--	20 U
Vinyl Chloride	--	5 U	--	5 U	--	40 U	--	40 U
1,1-Dichloroethane	--	2 U	--	2 U	--	20 U	--	20 U
1,1,1-Trichloroethane	--	2 U	--	2 U	--	20 U	--	20 U
1,2-Dichloroethane	--	5 U	--	5 U	--	20 U	--	20 U
4-Methyl-2-Pentanone	--	**5**	--	4 U	--	40 U	--	40 U
Benzene	--	**44**	--	2 U	--	**13,000**	--	**535**
Toluene	--	**76**	--	2 U	--	**15,600**	--	**527**
Ethylbenzene	--	**59**	--	2 U	--	**1660**	--	**709**
m & p-Xylene	--	**475**	--	4 U	--	**5420**	--	**1430**
o-Xylene	--	**137**	--	2 U	--	**1790 J**	--	**717**
Isopropylbenzene (Cumene)	--	**66**	--	2 U	--	**69**	--	**49**
n-Propylbenzene	--	**118**	--	5 U	--	**165**	--	**104**
1,3,5-Trimethylbenzene	--	**214**	--	5 U	--	**201**	--	**120**
Tert-Butylbenzene	--	**1.5 J**	--	2 U	--	**12 J**	--	40 U
1,2,4-Trimethylbenzene	--	**1000**	--	5 U	--	**734**	--	**434**
Sec-Butylbenzene	--	**24**	--	2 U	--	20 U	--	**5.6 J**
p-Isopropyltoluene	--	**15**	--	5 U	--	**11 J**	--	**10 J**
n-Butylbenzene	--	**34**	--	5 U	--	**14 J**	--	**16 J**
Naphthalene	--	**271**	--	5 U	--	**122**	--	**454**

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

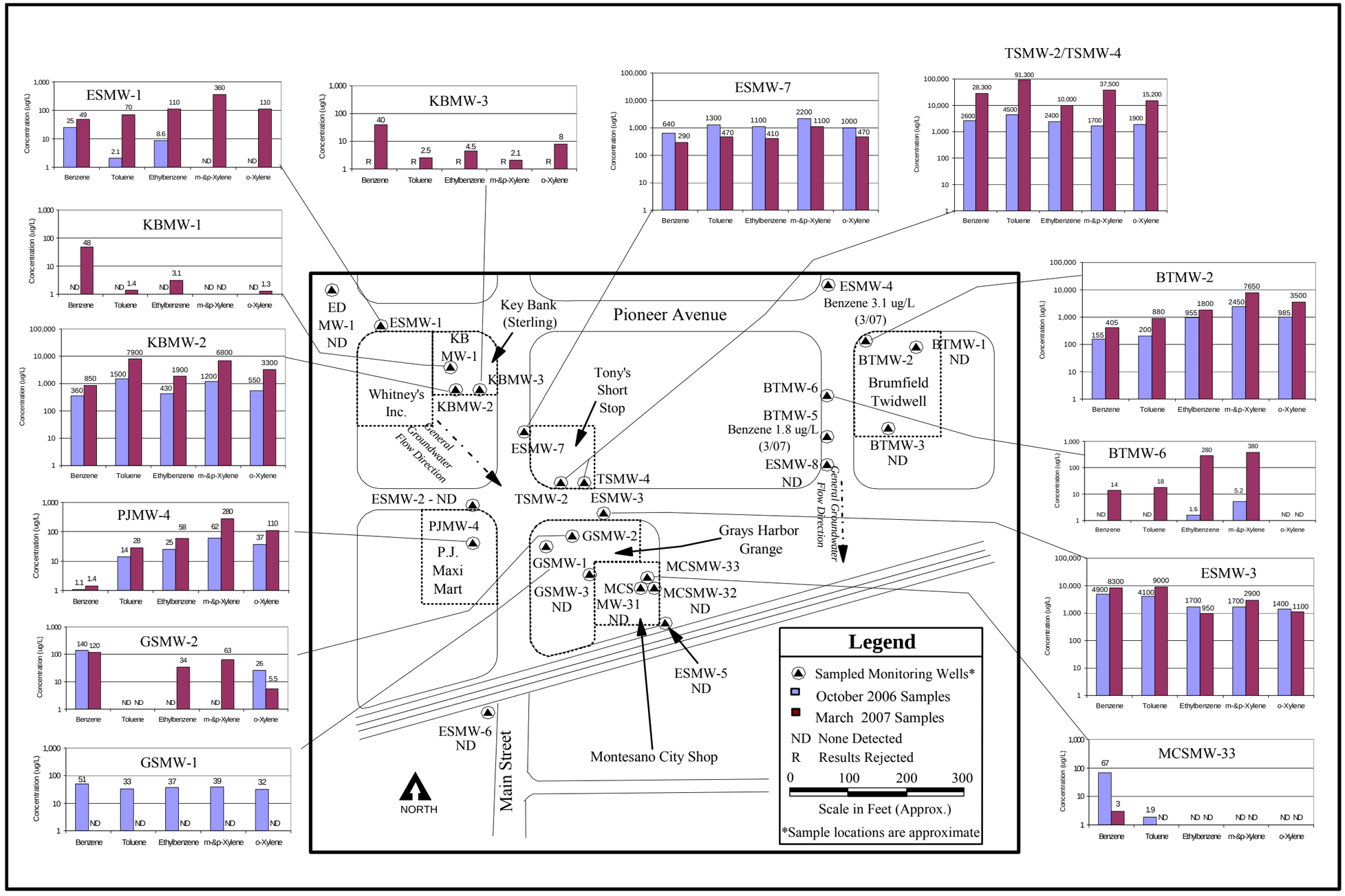

Figure 4. Montesano Groundwater Investigation – BTEX Results (ug/L- log scale) October 2006 and March 2007.

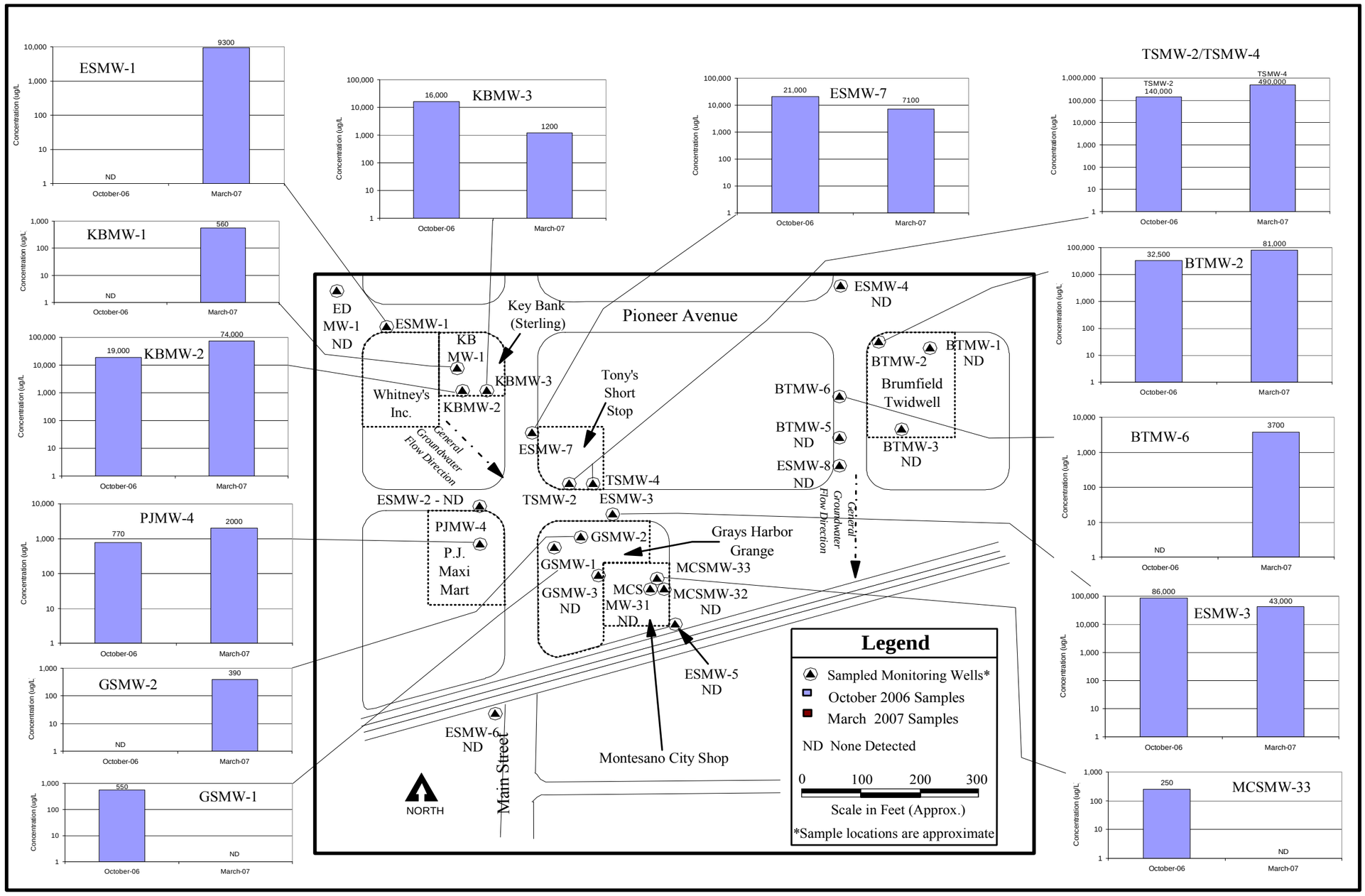

Figure 5. Montesano Groundwater Investigation – TPH-G Results (ug/L- log scale) October 2006 and March 2007.

Water samples were collected from the City of Montesano's storm drain and abandoned sanitary sewer system to determine if these underground utility corridors are providing another pathway for the migration of the contaminated groundwater. Samples were collected and analyzed for VOCs and TPH-G (Table 13).

Table 13. Summary of VOC and TPH-G Sample Results (µg/L) for the City of Montesano Storm Drain and Abandoned Sanitary Sewer for March 2007.

Volatile Organics Compounds	BF-1		BF-9N		BF-9W		BF-12	
	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Tetrachloroethene	--	1 U	--	5 U	--	5 U	--	10 U
Trichloroethene	--	1 U	--	5 U	--	5 U	--	10 U
Cis-1,2-Dichloroethene	--	1 U	--	5 U	--	5 U	--	10 U
Trans-1,2-Dichloroethene	--	1 U	--	5 U	--	5 U	--	10 U
Vinyl Chloride	--	2 U	--	10 U	--	10 U	--	20 U
1,1-Dichloroethane	--	1 U	--	5 U	--	5 U	--	10 U
1,1,1-Trichloroethane	--	1 U	--	5 U	--	5 U	--	10 U
1,2-Dichloroethane	--	1 U	--	5 U	--	5 U	--	10 U
4-Methyl-2-Pentanone	--	2 U	--	10 U	--	10 U	--	20 U
Benzene	--	**0.21 J**	--	**32**	--	**45**	--	**64**
Toluene	--	**0.37 J**	--	**108**	--	**145**	--	**195**
Ethylbenzene	--	**0.93 J**	--	**26**	--	**29**	--	**34**
m & p-Xylene	--	**2.8 J**	--	**96**	--	**102**	--	**120**
o-Xylene	--	**0.59 J**	--	**59**	--	**59**	--	**61**
Isopropylbenzene (Cumene)	--	**0.34 J**	--	**1.9 J**	--	**1.6 J**	--	10 U
n-Propylbenzene	--	**1.4 J**	--	**6.4 J**	--	**6.8 J**	--	**9.4 J**
1,3,5-Trimethylbenzene	--	**1 J**	--	**15**	--	**17**	--	**17 J**
Tert-Butylbenzene	--	2 U	--	10 U	--	10 U	--	20 U
1,2,4-Trimethylbenzene	--	**2.4**	--	**34**	--	**37**	--	**40**
Sec-Butylbenzene	--	1 U	--	5 U	--	5 U	--	10 U
p-Isopropyltoluene	--	1 U	--	**2.4 J**	--	5 U	--	10 U
n-Butylbenzene	--	2 U	--	**2.8 J**	--	**2.8 J**	--	20 U
Naphthalene	--	**1**	--	**21**	--	**25**	--	**24**
TPH-G	--	140 U	--	**1,500**	--	**930**	--	**1,000**

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

Two samples were collected from the storm drain along Wynoochee Avenue, and one sample from the abandoned sanitary sewer system on Main Street (Figure 2). Water in the storm drain along Wynoochee flows west to east. Sample BF-12 was collected from the manhole east of well ESMW-3, and sample BF-9 was collected at the intersection of Wynoochee and Sylvia Street. The manhole at this intersection accesses the storm drain along Wynoochee (BF-9W) and a north-south storm drain along Sylvia Street. (BF-9N).

Petroleum-related contaminants were detected in the three samples collected from the storm drain along Wynoochee Avenue. Benzene and TPH-G concentrations exceeded the MTCA cleanup levels at both of the sample locations.

One sample (BF-1) was collected from the abandoned sanitary sewer on south Main Street. Petroleum-related contaminants were detected in this sample but at concentrations near or below the practical quantitation limits. TPH-G was not detected in this sample.

Discussion

High concentrations of gasoline-range petroleum hydrocarbons are present throughout the surficial aquifer underlying downtown Montesano. LNAPL in the form of free-phase petroleum product is present at the three identified source areas: Tony's Short Stop, Whitney's/Key Bank (Sterling), and Brumfield-Twidwell. Table 14 provides a summary of those wells where BTEX and TPH-G concentrations exceeded MTCA groundwater cleanup levels in October 2006 and March 2007. Analytical results are discussed, along with past project data for comparison. Data are also presented as tables in Appendix B.

Figure 6 shows estimated TPH-G concentration contours in groundwater for the monitoring period. In addition to Ecology's groundwater sampling program, other investigations have been conducted for Ecology in the project area by GeoEngineers (GeoEngineers, 2006) and consultants for Tony's Short Stop. At Tony's Short Stop, a remedial investigation is being conducted which has included additional soil and groundwater sampling (AEG, 2007). Eleven new monitoring wells have been installed on this site. Although not shown on Figure 6, analytical data of groundwater samples collected during this monitoring period, in addition to groundwater data from the new wells at Tony's Short Stop, have been used to shape the TPH-G concentration contours in Figure 6.

The addition of well ESMW-1 at the northwest corner of Whitney's Inc. confirms that the shallow groundwater is contaminated with petroleum products in this part of the project area. Historically gasoline was stored and sold from this corner of the business. Soil contamination was discovered in this area when the three underground tanks were closed in place in 1995 (Ecology, 2007).

Groundwater flow direction in this part of the project area appears to be to the southeast, suggesting that the three wells located at Key Bank (Sterling) are downgradient of Whitney's Inc. At this time, Ecology has not established any other potential sources in this area other than Whitney's Inc. High concentrations of BTEX and TPH-G have been detected in wells KBMW-2 and KBMW-3 since monitoring began in October 2004. Free-phase petroleum product has also been present in well KBMW-2 during most monitoring events. Benzene and TPH-G consistently exceed the cleanup levels in well KBMW-3. Benzene concentrations in well KBMW-1 have increased since monitoring began in 2004, from 2.2 µg/L in March 2005 to 48 µg/L in March 2007.

Well ESMW-7 also appears to be downgradient of Whitney's Inc./Key Bank (Sterling). BTEX and TPH-G were detected in this well in both October 2006 and March 2007, exceeding MTCA cleanup levels. Petroleum contamination has also been detected in groundwater samples collected from newly installed wells along the western border of Tony's Short Stop (AEG, 2007). In 2006, a remedial investigation was conducted at this site. It included the installation of several monitoring wells as well as the removal of the old tanks and lines located in the southeast quarter of the property. Well ESMW-7 and new wells along the western property line are upgradient of the tanks that were decommissioned in 2006, which seems to suggest an off-site source of this petroleum contamination.

Table 14. BTEX and TPH-G Concentrations (µg/L) that Exceeded MTCA Method A Cleanup Levels for Groundwater during October 2006 and March 2007.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p- Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L		1000 µg/L		800 (1000*) µg/L	
Date:	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07	10/06	3/07
Tony's Short Stop												
TSMW-2	**2600J**	--	**4500 E**	--	**2400J**	--	**1700J**	--	**1900 E**	--	**140,000E**	--
TSMW-4	--	**28,300J**	--	**91,300J**	--	**10,000J**	--	**37,500J**	--	**15,200J**	--	**490,000J**
Grays Harbor Grange												
GSMW-1	**51**	1 U	**33 J**	1 U	**37**	1 U	**39**	2 U	**32 J**	1 U	**550**	140 U
GSMW-2	**140**	**120**	2 U	1 U	2 U	**34**	4 U	**63**	**26**	**5.5**	280 U	**390 J**
Whitney's Inc./Key Bank (Sterling)												
KBMW-1	1 U	**48**	1 U	**1.4**	1 U	**3.1**	2U	2 U	1 U	**1.3**	140 U	**560**
KBMW-2	**360 J**	**850 J**	**1500 J**	**7900 J**	**430 J**	**1900 J**	**1200 J**	**6800 J**	**550 J**	**3300 J**	**19,000 J**	**74,000 J**
KBMW-3	REJ	**40**	REJ	**2.5**	REJ	**4.5**	REJ	**2.1**	REJ	**8**	**16,000**	**1200**
Brumfield-Twidwell												
BTMW-2[a]	**155 J**	**405 J**	**200 J**	**880 J**	**955 J**	**1800 J**	**2450 J**	**7650 J**	**985 J**	**3500 J**	**32,500 J**	**81,000 J**
BTMW-6	1 U	**14**	1 U	**18**	**1.6**	**280**	**5.2**	**380**	1 U	10 U	140 U	**3700**
Montesano City Shop												
MCSMW-33	**67**	**3**	**1.9**	1 U	1 U	1 U	2 U	2 U	1 U	1 U	**250**	140 U
Ecology Wells												
ESMW-1	**25**	**49**	**2.1 J**	**70**	**8.6**	**110**	2 U	**360**	1 U	**110**	140 U	**9300**
ESMW-3	**4900**	**8300**	**4100**	**9000**	**1700**	**950**	**1700**	**2900**	**1400**	**1100**	**86,000**	**43,000**
ESMW-7	**640**	**290**	**1300 J**	**470**	**1100**	**410**	**2200**	**1100**	**1000**	**470**	**21,000**	**7100**

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.

-- Not sampled.

a - Average concentration of duplicate samples. Results are J qualified as estimate.

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

E – Concentration of the associated value exceeds the known calibration range.

REJ – Results have been rejected because duplicate samples did not meet data quality objectives.

Bolded – Analyte was detected.

Shaded – Values are greater than MTCA cleanup levels.

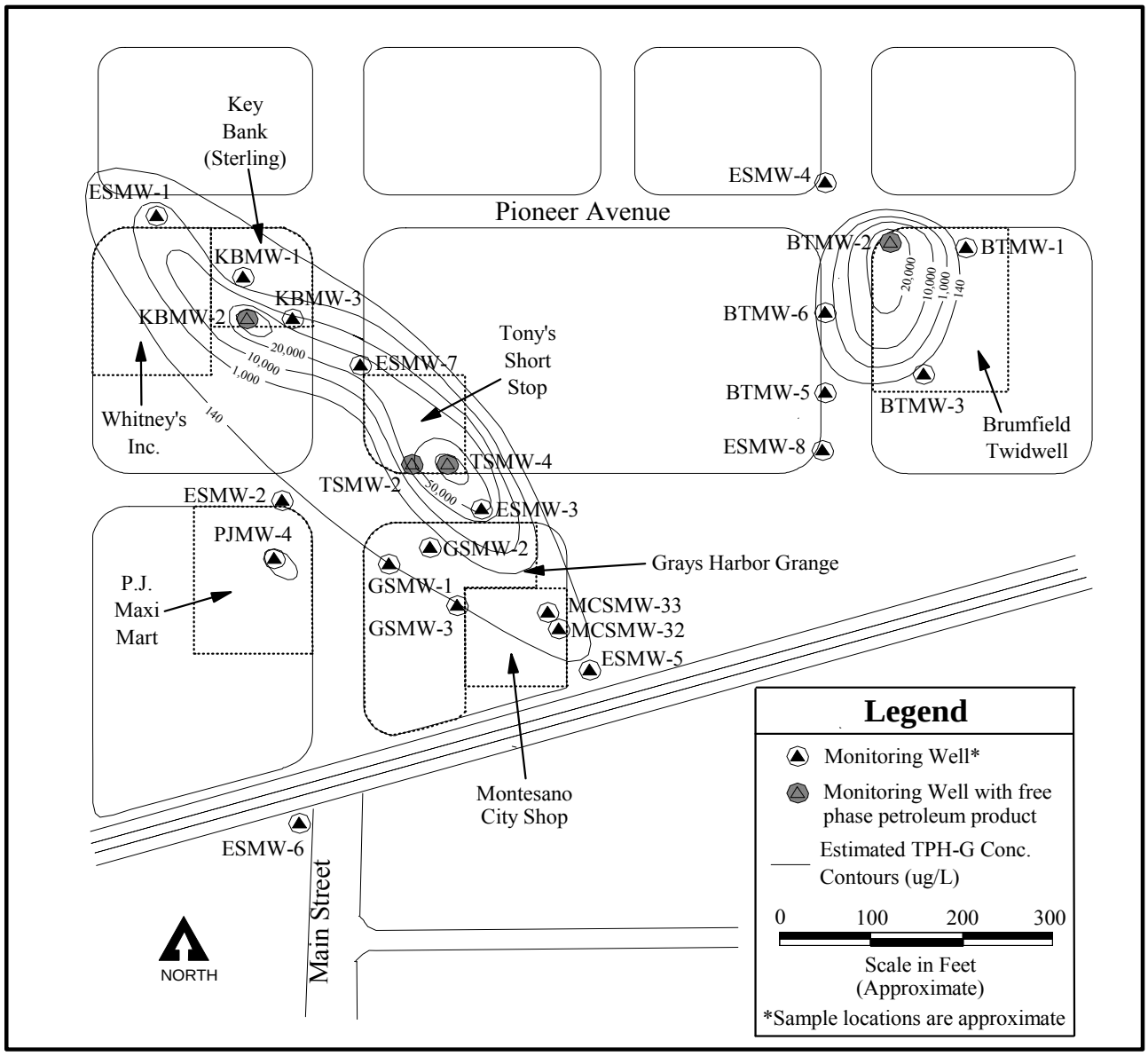

Figure 6. Montesano Groundwater Investigation – Estimated TPH-G Contours (ug/L).

During removal of the old tanks at Tony's Short Stop in May 2006, contractors encountered free product on the north edge of the excavation pit where the old product line trench was located. AEG concluded that the primary source of fuel contamination at the site appeared to be the old product lines (AEG, 2007). Wells TSMW-2 and TSMW-4 are downgradient of the former tank and lines. Free-phase petroleum product has been present in both of these wells, and BTEX and TPH-G concentrations continue to be the highest detected in the project area.

Well ESMW-3, located along Wynoochee Avenue, is less than 100 feet downgradient from well TSMW-4 which has free-phase petroleum product. BTEX and TPH-G concentrations in this well were also some of the highest detected in the project area. Contamination from the former lines and tank area at Tony's Short Stop appears to have migrated off-site as indicated by contaminant concentrations in well ESMW-3.

Since monitoring began in October 2004, wells GSMW-1 and GSMW-2, which are downgradient of Tony's Short Stop, have had much lower BTEX and TPH-G concentrations as compared to wells TSMW-2, TSMW-4 and ESMW-3. The lower concentrations may indicate that these wells are on the edge of the contaminant plume.

Two of the wells at Montesano City Shop had elevated benzene concentrations when monitoring began in 2004. Benzene was detected in well MCSMW-33 at concentrations of 980 µg/L (October 2004) and 1500 µg/L (March 2005). The elevated concentrations of benzene in the absence of the other BTEX analytes possibly suggested the front edge of a contaminant plume. Benzene concentrations have since been decreasing in this well to a low of 3 µg/L in March 2007. Benzene has not been detected in well MCSMW-32 since October 2005. The Montesano City Shop also appears to be hydraulically downgradient of Tony's Short Stop/Grays Harbor Grange (Marti, 2006).

The presence of LNAPL and related high BTEX and TPH-G concentrations at Whitney's/Key Bank (Sterling) and Tony's Short Stop, along with groundwater flow direction in this part of the project area, suggest that petroleum contamination from these two source areas may have co-mingled to form a large plume across downtown Montesano. It is possible that the plume extends from monitoring well ESMW-1 to as far as well MCSMW-33 at Montesano City Shop.

BTEX and TPH-G concentrations in Brumfield-Twidwell well BTMW-2 also continue to be among the highest in the project area. Overall, concentrations in this well appear to be increasing since monitoring began in October 2004. Benzene concentrations have increased from 75 µg/L in October 2004 to 450 µg/L in March 2007. BTEX and TPH-G have also been detected in well BTMW-6 indicating that petroleum contamination may also be migrating from Brumfield-Twidwell.

BTEX and TPH-G concentrations in well PJMW-4 at P.J. MaxiMart have been decreasing since monitoring began in October 2004. This site is being remediated with a vapor extraction system.

Chlorinated compounds have also been detected in some wells in the project area. Most VOC concentrations were near or below the laboratory practical quantitation limits. However, wells KBMW-1, KBMW-2, KBMW-3, and ESMW-1 had the highest concentrations of

tetrachloroethene and 4-methyl-2-pentanone. These wells are located adjacent to Whitney Inc. which has an auto repair and paint shop. It was reported in 2003 that waste solvents and waste oil were being improperly stored in underground tanks on the site (Ecology, 2007). The presence of these chlorinated solvents in these wells suggests a VOC contaminant plume is present in this portion of the project area.

Tetrachloroethene was also detected in wells GSMW-1 and GSMW-2 at concentrations near the practical quantitation limit of 1 µg/L. These wells are downgradient of Whitney's Inc. and Tony's Short Stop. In the past, solvents may have been used at Tony's Short Stop when it was a service station. Chlorinated compounds have not been detected in wells TSMW-2 or TSMW-4. However, because of the high petroleum contaminant concentrations in these wells, the laboratory reporting limits have also been high and may have masked low levels of other organic compounds.

Water samples were collected from the City of Montesano's storm drain and abandoned sanitary sewer system to determine if these underground utility corridors are providing a preferential pathway for the contaminant migration. Petroleum-related contaminants were detected in samples collected from the storm drain along Wynoochee Avenue. Benzene and TPH-G concentrations exceeded the MTCA cleanup levels. This suggests that contaminated groundwater is entering the storm drain.

One sample was collected from the abandoned sanitary sewer on south Main Street. Petroleum-related contaminants were detected in this sample but at concentrations near or below the practical quantitation limits.

The presence of contaminants in the City's storm drain and abandoned sewer system indicate that these utilities may be providing preferential pathways for contaminants. This is of concern since the storm drain empties into the Chehalis River system.

Conclusions

Water quality results over the 2006-07 monitoring period confirm the contamination of the surficial aquifer throughout the project area with gasoline-range petroleum hydrocarbons. The contaminants present at the various sites largely came from leaking tanks and piping over time. The presence of free-phase petroleum product in the areas of wells KBMW-2, TSMW-2, TSMW-4, and BTMW-2 continue to serve as sources of dissolved phase contamination. Analytical data show that the highest contaminant concentrations remain in the vicinity of these source areas.

Petroleum contamination from Whitney's/Key Bank (Sterling) and Tony's Short Stop has possibly co-mingled to form a large plume across downtown Montesano. Groundwater flow direction in this part of the project area appears to be to the southeast. The contaminant plume may extend from Whitney's Inc. to as far as the Montesano City Shop. The presence of chlorinated compounds in the wells at Whitney's Inc./Key Bank also suggests a VOC contaminant plume is present in this part of the project area.

Because of the level of the groundwater contamination, investigations continue to be conducted at the three source areas to better define the nature and extent of the contamination across the project area: Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell.

Recommendations

Based on the results of this 2006-2007 monitoring, the following recommendations are provided:

- Sampling should continue at monitoring wells associated with, and downgradient of, the three source areas – Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell – to collect additional data from wells that had contaminants exceeding MTCA cleanup levels.
- Sampling should continue at the nine new Ecology monitoring wells as they provide additional information on the three source areas.
- Sampling should continue for volatile organic compounds (VOCs) to define the extent of contamination.
- Additional investigation is needed at the Whitney's/Key Bank (Sterling) site to determine the source of free-phase petroleum product and chlorinated compounds in the groundwater.
- Additional wells have been installed at Tony's Short Stop and Brumfield-Twidwell as part of cleanup activities. Select wells from these sites should be included in Ecology's monitoring network to help better define the extent of the contamination.
- Additional wells east and southeast of well ESMW-3 should be installed to better define the southern portion of contaminant plume.
- Sampling of the storm drain and abandoned sanitary sewer should continue since the drains appear to be providing another contaminant migration pathway. Because the storm drain discharges to the Chehalis River system, a sample should be collected at the pipe discharge or as close to the discharge point as possible.

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Appendix A. Well Construction Details

Table A-1. Well Construction Details.

Well #	Latitude (degrees)	Longitude (degrees)	Completed Well Depth (feet)	Casing Diameter (inches)	Tag/ Rim Elevation (feet)	PVC Elevation	Groundwater Level (feet bls)	Water Table Elevation (feet msl)	Groundwater Level (feet bls)	Water Table Elevation (feet msl)
							October 2006		March 2007	
BTMW-1	46-58-46.108	123-35-52.159	23.30	2	37.60	37.39	15.77	21.83	9.31	28.29
BTMW-2	46-58-46.112	123-35-53.435	24.9	2	37.83	37.44	Product	--	Product	--
BTMW-3	46-58-44.489	123-35-53.040	22.28	2	30.37	30.08	13.23	17.14	9.38	20.99
BTMW-5	46-58-44.220	123-35-54.600	24	2	30.70	30.30	14.36	16.34	13.88	16.82
BTMW-6	46-58-45.156	123-35-54.600	24	2	34.44	34.04	14.94	19.50	10.20	24.24
KBMW-1	46-58-45.2164	123-36-04.770	21.97	2	39.72	39.37	18.61	21.11	15.42	24.3
KBMW-2	46-58-44.7979	123-36-04.798	20.16	2	38.50	38.17	Product	Product	13.90	24.60
KBMW-3	46-58-44.7976	123-36-03.698	20.17	2	37.68	37.31	17.58	20.10	14.29	23.39
PJMW-4	46-58-41.867	123-36-04.117	20	4	31.18	30.97	13.52	17.66	9.88	21.30
TSMW-2	46-58-43.098	123-36-01.596	18.77	2	32.47	32.04	Product	--	--	--
TSMW-4	46-58-43.186	123-36-00.973	--	2	--	--	--	--	Product	--
GSMW-1	46-58-41.866	123-36-02.078	22.70	2	28.24	27.95	11.64	16.60	9.32	18.92
GSMW-2	46-58-42.094	123-36-01.187	21.74	2	27.92	27.29	11.54	16.38	9.26	18.66
GSMW-3	46-58-41.248	123-36-00.713	17.73	2	23.03	22.60	7.71	15.32	5.13	17.90
MCSMW-31	46-58-41.127	123-35-59.462	12.42	2	21.39	21.17	6.62	14.77	4.15	17.24
MCSMW-32	46-58-41.176	123-35-59.107	11.87	2	21.89	21.43	7.30	14.59	5.23	16.66
MCSMW-33	46-58-41.342	123-35-59.344	12.11	2	22.50	22.34	7.76	14.74	5.72	16.78
ESMW-1	46-58-45.9498	123-36-06.84437	20.08	2	41.51	41.14	18.15	23.36	14.45	27.06
ESMW-2	46-58-42.5028	123-36-03.7656	19.68	2	32.72	32.32	13.43	19.29	10.41	22.31
ESMW-3	46-58-42.5726	123-36-00.46377	17.53	2	29.56	29.27	11.03	18.53	8.92	20.64
ESMW-4	46-58-46.4124	123-35-54.6567	20.09	2	38.02	37.66	15.88	22.14	9.71	28.31
ESMW-5	46-58-40.4508	123-35-58.0532	14.73	2	21.21	20.85	6.45	14.76	4.04	17.17
ESMW-6	46-58-38.6616	123-36-03.46933	14.70	2	22.70	22.31	10.06	12.64	9.08	13.62
ESMW-7	46-58-44.2068	123-36-02.65674	19.53	2	36.45	35.96	16.61	19.84	14.09	22.36
ESMW-8	46-58-43.1724	123-35-54.4704	15.10	2	25.45	25.20	10.31	15.14	8.95	16.50
EDMW-1	46-58-46.5780	123-36-07.7976	22.61	2	42.31	41.92	16.36	25.95	13.01	29.03

VERTICAL DATUM: N.A.V.D. '88 HORIZONTAL DATUM: NAD '83/'91

bls = below land surface.

feet msl = feet relative to mean sea level.

Appendix B. Historical Data

Table B-1. Historical BTEX and TPH-G Results (•g/L).

Monitoring Well	Date of Last Samples	Benzene	Toluene	Ethylbenzene	Xylene	WTPH-G
GHCSMW-1*						
JPMW-1[1]	4/2004	1 U	1 U	1 U	3 U	50 U
JPMW-2[1]	4/2004	1 U	1 U	**2**	**5**	**88**
JPRW-3[1]	4/2004	**12**	1 U	**32**	**54**	**870**
JPMW-4S[1]	4/2004	**18**	1 U	**14**	**6**	**1600**
JPMW-4D[1]	4/2004	**12**	1 U	1 U	3 U	50 U
JPMW-5[1]	4/2004	1 U	1 U	1 U	3 U	50 U
JPMW-6[1]	4/2004	1 U	1 U	1 U	3 U	50 U
JPMW-7[1]	4/2004	1 U	1 U	1 U	3 U	50 U
JPMW-8[1]	4/2004	1 U	1 U	1 U	3 U	50 U
BTMW-1[2]	12/2002	1 U	**4.1**	1 U	1 U	ND
BTMW-2[2]	12/2002	**35**	**170**	**430**	**2,400**	**30,000**
BTMW-3[2]	12/2002	1 U	1 U	1 U	1 U	ND
BTMW-4[2]	12/2002	1 U	1 U	1 U	1 U	ND
KBMW-1*						
KBMW-2*						
KBMW-3*						
PJMW-1	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-2	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-3	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-4	4/2004	**14**	**540**	**390**	**2,200**	**12,000**
PJMW-5	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-6	4/2004	**1**	**16**	**24**	**74**	**450**
PJMW-7	4/2004	1 U	1 U	**1**	3 U	**180**
PJMW-8	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-9	4/2004	1 U	1 U	1 U	3 U	50 U
PJMW-10	4/2004	1 U	1 U	1 U	3 U	50 U
TSMW-1	7/1998	**21,750**	**23,425**	**2,650**	**15,500**	**192,250**
TSMW-2	7/1998	**11,200**	**10,300**	**780**	**4,580**	**79,600**
GSMW-1[3]	1/2004	1 U	1 U	1 U	1 U	100 U
GSMW-2[3]	1/2004	**1000**	**6.9**	1 U	**170**	**2700**
GSMW-3[3]	1/2004	**3.3**	1 U	1 U	1 U	**270**
MCSMW-31	6/1996	**1570**	**797**	**101**	**274**	**3000**
MCSMW-32	6/1996	**4140**	**1460**	**249**	**317**	**6760**
MCSMW-33	6/1996	**6280**	**2700**	**763**	**2770**	**19,100**

* = Data are not available for these wells.
U = Analyte was not detected at or above the reported value.
Bolded = Analyte was detected.
1 = Landau Associates, 2004.
2 = AEG, 2003 a.
3 = AEG, 2003 b.

Table B-2. Ecology BTEX and TPH-G Results (•g/L) from October 2004 to March 2006.

Monitoring Well	Benzene				Toluene				Ethylbenzene			
Date:	10/04	3/05	10/05	3/06	10/04	3/05	10/05	3/06	10/04	3/05	10/05	3/06
GHCSMW-1	1 U	1 U	--	1 U	1 U	1 U	--	1 U	1 U	1 U	--	1 U
JPMW-1	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
JPMW-2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**3.5**	1 U	1 U	1 U
JPRW-3	**17**	**4.1 J**	**12**	--	1 U	1 U	1 U	--	**55**	**17 J**	**17**	--
JPMW-4S	1 U	**10**	1 U	--	1 U	5 U	1 U	--	**11**	**6.3**	**8.9**	--
JPMW-4D	**12**	**15**	**7.2**	**14**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
JPMW-5	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
JPMW-6	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
JPMW-7	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
JPMW-8	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-1	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-2	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-3	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-4	10 U	10 U	1 U	1 U	**120**	**65**	**3.5**	**12**	**130**	**73**	1 U	**26**
PJMW-5	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-6	1 U	5 U	1 U	1 U	1 U	**11**	1 U	1 U	**0.78 J**	**45**	**2.8**	**2.1**
PJMW-7	**0.92 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**25**	1 U	1 U	1 U
PJMW-8	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-9	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-10	1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-2	**75**	20 U	**48**	**170**	**23**	20 U	**31**	**150**	**430**	**58**	**275**	**650**
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-4	--	--	--	--	--	--	--	--	--	--	--	--
KBMW-1	1 U	**2.2**	1 U	**12**	1 U	1U	1 U	1U	1 U	**0.82 J**	1 U	1U
KBMW-2	--	**338**	**510**	**360**	--	**3,320**	**3,200**	**2,400 E**	--	**654**	**610**	**460**
KBMW-3	**160**	**118**	**220**	**56**	**82**	**58 J**	**110**	**14**	**430**	**331**	**700**	**75**
TSMW-1	--	--			--	--			--	--		
TSMW-2	**8500**	--	**8400**	--	**13,000 J**	--	**15,400**	--	**1300**	--	**1500**	--
GSMW-1	**5.1**	10 U	**420**	1 U	1 U	10 U	**690**	1 U	**1.3**	**91**	**370**	**6.3**
GSMW-2	**54**	**140**	**54**	**394**	2 U	10 U	1 U	**4.6**	2 U	**15**	1 U	**33**
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-32	1 U	1 U	**149**	1 U	**3.7**	1 U	1 U	1 U	1 U	1 U	**1.1**	1 U
MCSMW-33	**980 J**	**1,500**	**294**	1 U	10 U	50 U	1 U	1 U	10 U	**56**	1 U	1 U

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Bolded = Analyte was detected.

Table B-2 (continued).

Monitoring Well	m- & p-Xylene				o-Xylene				WTPH-G			
Date:	10/04	3/05	10/05	3/06	10/04	3/05	10/05	3/06	10/04	3/05	10/05	3/06
GHCSMW-1	2 U	2 U	--	2 U	1 U	1 U	--	1 U	140 U	140 U	--	140 U
JPMW-1	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
JPMW-2	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	**150**	140 U	140 U	140 U
JPRW-3	**55**	**29 J**	**6**	--	1 U	1 U	**1.2**	--	**1,400**	**470 J**	**990**	--
JPMW-4S	2 U	10 U	2 U	--	**2**	5 U	**3.1**	--	**2,100**	**1,700**	**3100**	--
JPMW-4D	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
JPMW-5	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
JPMW-6	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
JPMW-7	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
JPMW-8	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-1	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-2	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-3	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-4	**550**	**340**	**33**	**151**	**210**	**130**	**33**	**28**	**4,200**	**3,300**	**340**	**800**
PJMW-5	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-6	**1.9 J**	**100**	**3**	2 U	1 U	**38**	**1.6**	1 U	140 U	**1,100**	140 U	140 U
PJMW-7	**11**	2 U	2 U	2 U	1 U	1 U	1 U	1 U	**650**	**310**	140 U	140 U
PJMW-8	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-9	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-10	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
BTMW-1	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
BTMW-2	**1280**	**300**	**905**	**2000E**	**310**	**160**	**330**	**770E**	**14,000**	**1,500J**	**11,000**	**15,000**
BTMW-3	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
KBMW-1	2 U	2 U	2 U	2 U	1 U	1U	1 U	1U	140 U	140 U	140 U	**240**
KBMW-2	--	**2290**	**1900**	**1300**	--	**977**	**910**	**660**	--	**56,000**	**26,000**	**15,000**
KBMW-3	**700 J**	**354**	**1400**	**68**	**280**	**218**	**570**	**64**	**12,000**	**4,700**	**17,000**	**3000**
TSMW-2	**5,300**	--	**5,900**	--	**2,000**	--	**2,400**	--	**81,000**	--	**78,000**	--
GSMW-1	**9.6**	**180**	**930**	**11**	1 U	**120**	**420**	**9.1**	**110 J**	**2,200**	**7,700**	**200**
GSMW-2	4 U	20 U	2 U	**23**	2 U	10 U	1 U	**11**	140 U	**170**	140 U	**340**
GSMW-3	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
MCSMW-31	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
MCSMW-32	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	140 U	140 U	140 U	140 U
MCSMW-33	20 U	100U	2 U	**2.2**	10 U	50 U	1 U	**1.1**	**220**	**730**	**160**	140 U

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