



## Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2005 and March 2006

### Abstract

Groundwater beneath downtown Montesano is contaminated with petroleum products. The contamination is likely the result of historic releases from leaking underground storage tanks. To characterize the lateral extent of groundwater contamination in the downtown area, samples were collected from 20 existing monitoring wells during October 2005 and March 2006. Samples were submitted for analysis of benzene, toluene, ethylbenzene, and xylene (BTEX), as well as 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 from three sites which have been identified as source areas. These sites are Tony's Short Stop/Grays Harbor Grange, Key Bank (Sterling)/Whitney's Inc., and Brumfield-Twidwell. 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 exceeded the MTCA Method A cleanup level of 5 ug/L in 11 of the sampled wells, with concentrations ranging from 7.2 to 8400 ug/L. TPH-G concentrations exceeded the MTCA Method A cleanup level of 800 ug/L in seven of the sampled wells, with concentrations ranging from 990 to 78,000 ug/L.

In addition to petroleum components, some chlorinated compounds were detected in selected wells sampled at the three source areas. Most concentrations were near or below the practical quantitation limits. However, tetrachloroethene was detected above the MTCA Method A cleanup level for groundwater of 5 ug/L in wells KBMW-1 and KBMW-2.

Results of this project confirm that the surficial aquifer is contaminated with gasoline-range petroleum hydrocarbons, including free-phase petroleum product at the Key Bank (Sterling) and Tony's Short Stop sites. Groundwater is also contaminated with chlorinated compounds in some locations.

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

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# Table of Contents

	<u>Page</u>
Abstract.....	1
Background.....	4
Methods .....	6
Groundwater Sampling.....	6
Laboratory.....	8
Data Quality.....	9
Results.....	10
Field Observations .....	10
Analytical Results.....	13
Tony’s Short Stop/Grays Harbor Grange .....	13
Key Bank (Sterling)/Whitney’s Inc. ....	15
Brumfield-Twidwell .....	17
Remaining Wells.....	18
Discussion and Conclusions .....	22
Recommendations.....	25
References.....	26
Appendix A. Well Construction Details .....	27
Appendix B. Historical Data.....	28

## Background

Located in western Washington along U.S. Highway 12 (Figure 1), the city of 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 in the downtown Montesano area.

The Washington State Department of Ecology (Ecology) has identified several properties with known releases of petroleum products. These are Key Bank (Sterling), Tony's Short Stop, Grays Harbor Grange, P.J. MaxiMart, Brumfield-Twidwell, Grays Harbor County Shop, Jackpot Station 392, and two sites at the Montesano City Shop (Figure 1).

Between 1991 and 2004, monitoring wells were installed at each site and sampled for benzene, toluene, ethylbenzene, and xylene (BTEX), as well as total petroleum hydrocarbons as gasoline (TPH-G). Reported concentrations for TPH-G from these wells have ranged from near the detection limit (50 ug/L) to 30,000 ug/L, with the exception of the two wells at Tony's Short Stop where concentrations have consistently been much higher, at 79,000 and 192,000 ug/L in 1998. The Model Toxic Control Act (MTCA) cleanup level for TPH-G is 800 ug/L.

Monitoring wells previously installed at the above sites were used to define the current project area, which encompasses several blocks in downtown Montesano, primarily from Pioneer Avenue south along Main Street (Figure 1). Results from an investigation conducted by GeoEngineers (GeoEngineers, 2005) for Ecology defined three source areas where soil and groundwater contamination (including the presence of free-phase petroleum product) have impacted the downtown area: Tony's Short Stop/Grays Harbor Grange, Key Bank (Sterling)/Whitney's Inc., and Brumfield-Twidwell. Additional investigations are being conducted to better define the nature and extent of the contamination in these areas

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, 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.

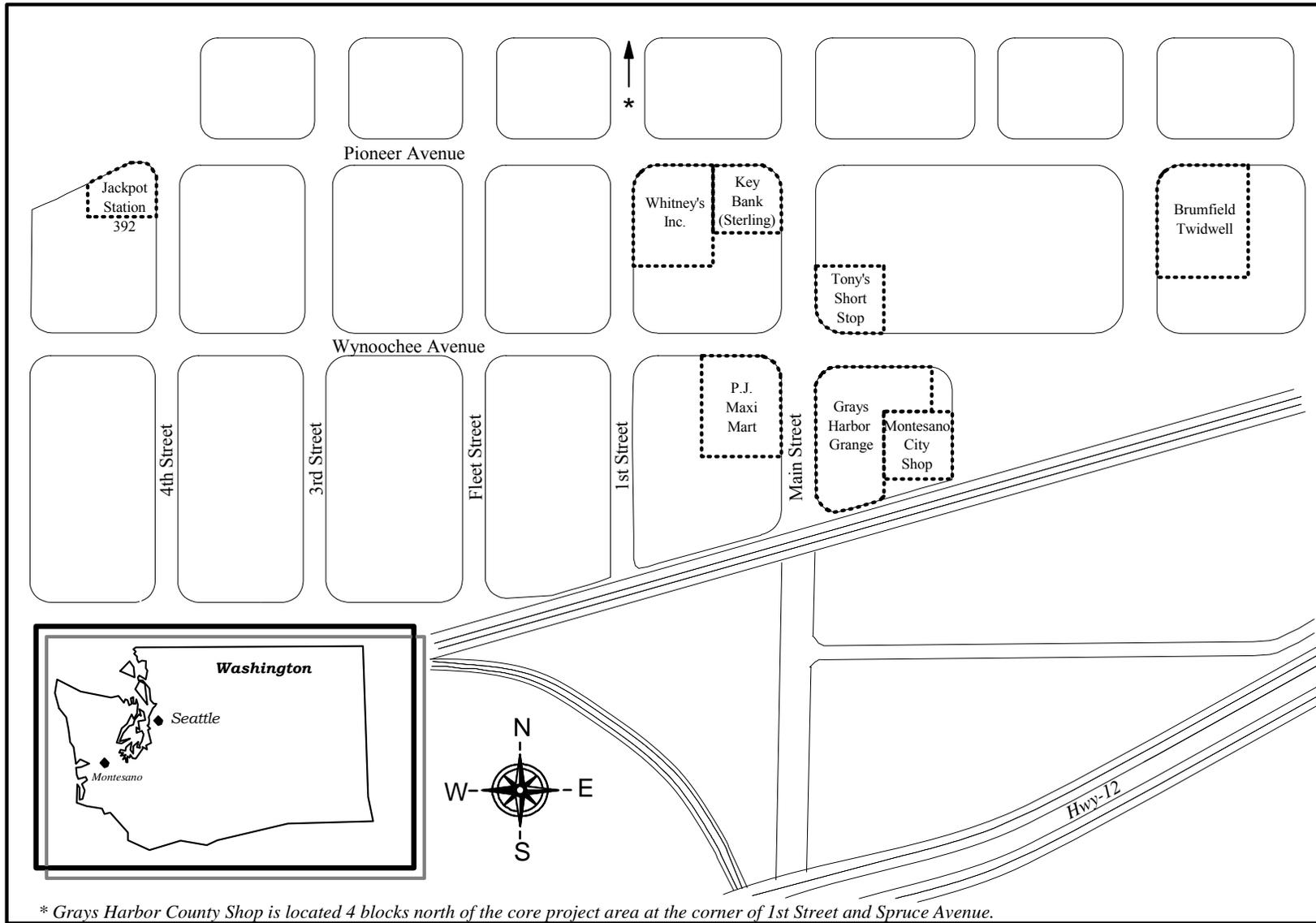


Figure 1. Montesano Groundwater Investigation Site Location Map

## Methods

### Groundwater Sampling

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The primary contaminants of concern in the project area are gasoline-range hydrocarbons. Groundwater samples were collected and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX), as well as total petroleum hydrocarbons as gasoline (TPH-G). Samples were collected from 20 monitoring wells in October 2005, and 18 monitoring wells in March 2006 (Figure 2). Samples were also collected and analyzed for a list of 72 target volatile organics compounds (VOCs) from seven of the wells. 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, including Jackpot Station 392, P.J. MaxiMart, Key Bank (Sterling), Brumfield-Twidwell, Tony's Short Stop, Grays Harbor Grange, Montesano City Shop, and Grays Harbor County Shop (Figure 2). The wells were installed between 1991 and 2004. All wells are constructed of either 2" or 4" I.D. PVC and range in depth from 8 to 25 feet, with screen lengths varying between 5 and 15 feet. Well construction details are provided in Appendix A.

Static water levels were measured in all wells 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.

Most of the monitoring wells were purged and sampled 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.

Because of the presence of free-phase petroleum product (a light non-aqueous phase liquid) in the groundwater in wells MW-2 (KBMW-2) at Key Bank (Sterling) and MW-2 (TSMW-2) at Tony's Short Stop, 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.

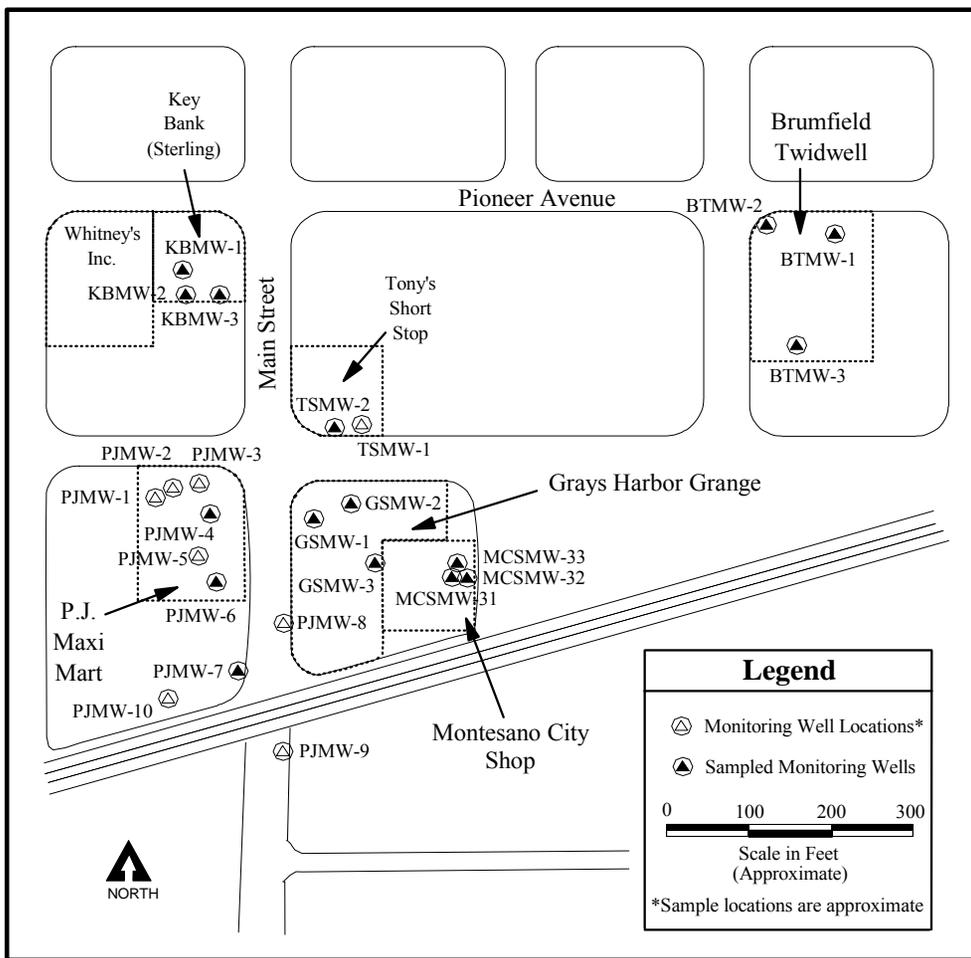
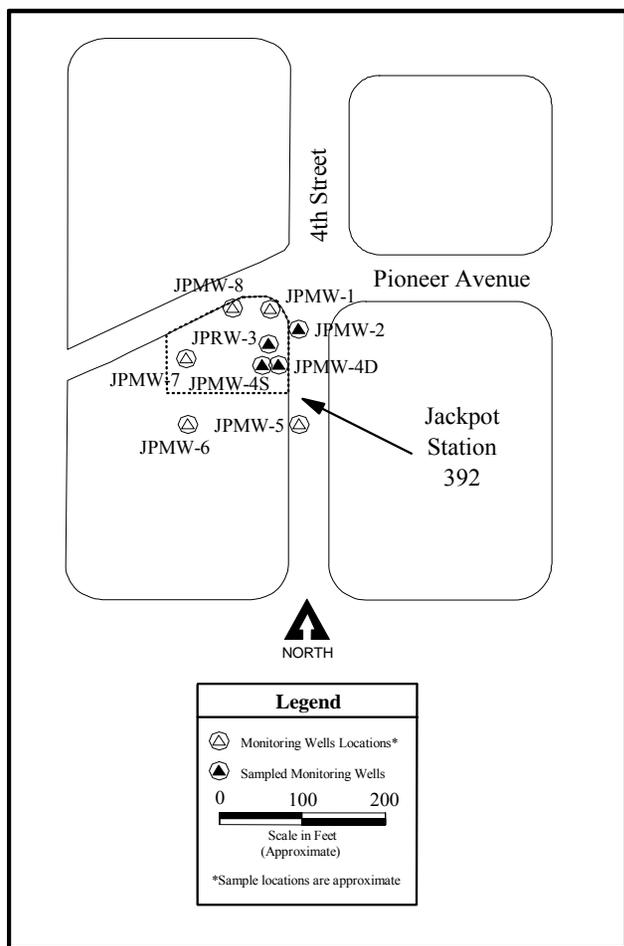


Figure 2. Montesano Groundwater Investigation - Monitoring Wells and Sample Locations

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. This purge water was transported and disposed of in accordance with Washington State Dangerous Waste Regulations (Chapter 173-303 WAC).

## Laboratory

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Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. All groundwater samples were analyzed for the gasoline-range hydrocarbons of benzene, toluene, ethylbenzene, and xylene (BTEX) as well as total petroleum hydrocarbons as gasoline (TPH-G). In October 2005, seven samples were analyzed for volatile organics (VOCs). In March 2006, six samples were analyzed for VOCs.

Table 1. Field and Laboratory Methods.

Parameter	Method	Reference	Reporting Limit
<i>Field</i>			
Water Level	Solinst Water Level Meter	NA	±0.03 feet
pH	Orion 25A Field Meter	NA	±0.1 std. units
Temperature	YSI 3510 Temperature Probe	NA	±0.1 °C
Specific Conductance	YSI 3520 Conductivity Cell	NA	±10 umhos/cm
<i>Laboratory</i>			
BTEX	EPA SW-846 Method 8021B	U.S. EPA 1996	1 ug/L
TPH-G	TPH-Gx	Ecology 2003	0.14 mg/L
VOCs	EPA SW-846 Method 8260B	U.S. EPA 1996	1-5 ug/L

## 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, MCSMW-33, and KBMW-2 in October 2005, and wells GSMW-2, KBMW-3, and BTMW-2 in March 2006. 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 (ug/L) for October 2005.

Sample ID	GS MW-2	GS MW-2A	RPD	MCS MW-33	MCS MW-33A	RPD	KB MW-2	KB MW-2A	RPD
	ug/L	ug/L	%	ug/L	ug/L	%	ug/L	ug/L	%
Benzene	54	54	0	294	321	9	510	370	32
Toluene	1U	1U	--	1U	5U	--	3200	2200	37
Ethylbenzene	1U	1U	--	1U	5U	--	610	480	24
m- & p-xylene	2U	2U	--	2U	10U	--	1900	1500	24
o-xylene	1U	1U	--	1U	5U	--	910	710	25
TPH-G	140 U	140 U	--	160	700 U	--	26,000	29,000	11

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

Table 3. Relative Percent Difference (RPD) of Duplicate Sample Results (ug/L) for March 2006.

Sample ID	GS MW-2	GS MW-2A	RPD	KB MW-3	KB MW-3A	RPD	BT MW-2	BT MW-2A	RPD
	ug/L	ug/L	%	ug/L	ug/L	%	ug/L	ug/L	%
Benzene	394	334	16	56	56	0	170	140	19
Toluene	4.6	3.6	24	14	13	7	150	130	14
Ethylbenzene	33	31	6	75	70	7	650	600	8
m- & p-xylene	23	19	19	68	58	16	2000 E	1700 E	--
o-xylene	11	9.6	14	64	60	6	770 E	710	--
TPH-G	340	310	9	3000	2700	11	15,000	15,000	0

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

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

In October 2005, the RPD for duplicate samples from monitoring wells GSMW-2, MCSMW-33, and KBMW-2 ranged from 0% to 37%. In March 2006, the RPD of duplicate samples collected from wells GSMW-2, KBMW-3, and BTMW-2 was smaller, with the calculated RPD being 24% or below as shown in Table 3. Due to high BTEX concentrations, some results are 'E' qualified because the concentration exceeded the known calibration range and no dilution value was available for the analyte. RPDs were not calculated for these duplicate results. Data met the measurement quality objectives established in the Quality Assurance Project Plan (Marti, 2004).

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 it had been cleaned. BTEX and TPH-G were not detected in any of the rinsate blanks.

Overall, a review of the data quality control and quality assurance from laboratory case narratives indicates analytical performance was good. The reviews include descriptions of analytical methods, holding times, instrument calibration checks, blank results, surrogate recoveries, and laboratory control samples. No problems were reported that compromised the usefulness or validity of the sample results; therefore, no data were rejected and all results were 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](http://www.ecy.wa.gov/eim/index.htm)

## Results

### Field Observations

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Depth-to-water of each monitoring well was measured prior to purging. End-of-purge pH and 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 actual groundwater conditions.

Completion depths for the monitoring wells range from approximately 8 to 25 feet. Depth-to-groundwater below the land surface ranged from about 6 to 18 feet in October 2005 and 3 to 16 feet in March 2006. Water levels fluctuated about ½ foot to about 3 feet during the monitoring period. A water table elevation map has not been plotted for this monitoring period because of multiple factors that may be affecting water level measurements, such as the presence of free-phase petroleum product in wells KBMW-2 and TSMW-2, a vapor extraction system operating at P.J. MaxiMart, and excavation and removal of soils at Tony's Shortstop and Brumfield-Twidwell. General groundwater flow direction determined during previous monitoring is to the south and southeast, toward the Chehalis River.

During the monitoring period, the pH of groundwater had an average range of 5.7 to 7.1. Specific conductivity measurements ranged from 124 to 543 umhos/cm over the 2005-06 monitoring period. Groundwater temperatures measured in the flow cell averaged 17.4°C in October and 14°C in March.

Table 4. Summary of Field Parameter Results for October 2005 and March 2006.

Monitoring Well Sample ID	Total Depth (feet) <sup>1</sup>	Depth-to-Water Below Ground Surface (feet)		pH (standard units)		Specific Conductivity (umhos/cm)		Purge Volume (gallons)	
		10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
<i>Grays Harbor County Shop</i>									
GHCSMW-1	7.63	6.1	3.07	--	5.72	--	251	--	2.75 <sup>(1)</sup>
<i>Jackpot Station</i>									
JPMW-2	15	8.11	7.77	6.6	6.35	263	283	3	3 <sup>(1)</sup>
JPRW-3	14.5	9.56	--	6.55	--	416	--	4.5	--
JPMW-4S	15	10.34	--	5.9	--	374	--	2 <sup>(1)</sup>	--
JPMW-4D	25	17.37	15.59	6.13	7.01	303	282	2 <sup>(1)</sup>	2 <sup>(1)</sup>
<i>Brumfield-Twidwell</i>									
BTMW-1	25	15.13	12.11	6.95	5.75	124	124	3	5
BTMW-2	24.9	15.8	12.09	6.5	6.34	207	311	5	4.5
BTMW-3	22.3	12.81	11.45	6.67	6.20	208	204	4	4
<i>Key Bank (Sterling)/Whitney's Inc.</i>									
KBMW-1	21.9	18.25	16.29	6.68	5.97	233	167	3.5	4
KBMW-2	20.16	Product	14.37	--	--	--	--	--	--
KBMW-3	20.1	16.94	14.61	6.63	6.29	330	543	3.5	4
<i>P.J. MaxiMart</i>									
PJMW-4	20	12.76	10.69	6.29	7.96	148	147	2.5	3.5
PJMW-6	22.5	VES	VES	6.45	6.43	133	126	3.5	4
PJMW-7	18	VES	VES	6.6	6.21	157	157	4	4
<i>Tony's Short Stop</i>									
TSMW-2	19.2	Product	--	--	--	--	--	--	--
<i>Grays Harbor Grange</i>									
GSMW-1	22.7	11.17	9.41	6.38	6.15	220	176	3	3.5
GSMW-2	21.7	11.06	9.73	6.33	6.51	212	275	3	3.5
GSMW-3	17.7	7.04	6.34	6.83	6.04	323	345	4	4.5
<i>Montesano City Shop</i>									
MCSMW-31	12.5	6.0	5.25	6.88	6.16	308	330	3.5	4
MCSMW-32	12.5	6.71	5.15	6.63	6.40	279	304	3	5.5
MCSMW-33	12.1	7.26	5.66	6.31	6.23	283	287	4	6

-- Not measured

<sup>1</sup> Purged dry

Product: Free-phase petroleum product present in the groundwater.

VES: Wells are part of a vapor extraction system. The VES was running at the time of water level measurement.

Although the monitoring wells were purged at a low flow rate, water levels dropped in the four wells at Jackpot Station 392 and the one well at the Grays Harbor County Shop to the point that the pump had to be shut off to allow the water in the wells to recover prior to sampling. Well logs in these two areas indicate that the site geology in the screened interval is composed of silt and silty sands.

Wells at the Montesano City Shop (MCSMW-31, MCSMW-32, and MCSMW-33), Grays Harbor Grange (GSMW-2), P.J. MaxiMart (PJMw-7), and Jackpot Station 392 (JPRW-3) had mild petroleum odors. In March 2006, purge water from Brumfield-Twidwell (BTMW-2) had a strong petroleum odor and a visible sheen on the surface of the purge water. In October 2005, free-phase petroleum product was present in water bailed from wells TSMW-2 at Tony's Shortstop and KBMW-2 at Key Bank (Sterling). Free-phase petroleum product was not present in water bailed from well KBMW-2 in March 2006.

## Analytical Results

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

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, Key Bank (Sterling)/ Whitney's Inc., and Brumfield-Twidwell. Results for these source areas are presented graphically in Figures 3 and 4. Table 10 presents results for the remaining wells, which are located at Jackpot Station 392, P.J. MaxiMart, Montesano City Shop, and Grays Harbor County Shop.

### 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 well MW-2 (TSMW-2) at Tony's Short Stop in October 2005. This well, 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). This well could not be sampled in March 2006 because of water and mud that had accumulated in the outer protective casing.

Table 5. BTEX and TPH-G Results (ug/L) for Tony's Short Stop and Grays Harbor Grange for October 2005 and March 2006.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 ug/L		1000 ug/L		700 ug/L		1000 ug/L				800 (1000*) ug/L	
Date:	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
<i>Tony's Short Stop</i>												
TSMW-2	<b>8400</b>	--	<b>15,400</b>	--	<b>1500</b>	--	<b>5900</b>	--	<b>2400</b>	--	<b>78,000</b>	--
<i>Grays Harbor Grange</i>												
GSMW-1	<b>420</b>	1 U	<b>690</b>	1 U	<b>370</b>	<b>6.3</b>	<b>930</b>	<b>11</b>	<b>420</b>	<b>9.1</b>	<b>7700</b>	<b>200</b>
GSMW-2	<b>54</b>	<b>394</b>	1 U	<b>4.6</b>	1 U	<b>33</b>	2 U	<b>23</b>	1 U	<b>11</b>	140 U	<b>340</b>
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 ug/L if benzene is not detectable in groundwater.

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

**Bolded** – Analyte was detected.

Shaded – Values are greater than MTCA Cleanup Levels

-- Not sampled.

Monitoring wells at the Grays Harbor Grange, MW-1 (GSMW-1) and MW-2 (GSMW-2), downgradient of Tony's Short Stop, had much lower BTEX and TPH-G concentrations. In well GSMW-1, benzene, xylene, and TPH-G exceeded the cleanup levels in October 2005. Toluene and ethylbenzene were also detected in this well at elevated concentrations, but below the cleanup levels. In March 2006, the BTEX and TPH-G concentrations decreased considerably in well GSMW-1. Benzene was the only contaminant detected in well GSMW-2 in October. In March, BTEX and TPH-G were all detected in this well. Benzene exceeded the cleanup level in this well during both sample rounds.

Table 6. Summary of VOC Results (ug/L) for Monitoring Wells at Tony's Short Stop and Grays Harbor Grange for October 2005 and March 2006.

Volatile Organic Compounds	TSMW-2		GSMW-1		GSMW-2	
	10/05	3/06	10/05	3/06	10/05	3/06
Vinyl Chloride	40 UJ		40 U	1 U	4 UJ	1 U
1,1-Dichloroethane	20 UJ	--	20 U	1 U	2 UJ	<b>0.37 J</b>
1,1,1-Trichloroethane	100 UJ	--	100 U	1 U	10 U	<b>0.38 J</b>
Trichloroethene	40 UJ	--	40 U	1 U	4 U	<b>0.26 J</b>
Tetrachloroethene	40 UJ	--	40 U	<b>0.51 J</b>	<b>1 J</b>	<b>1.2</b>
Isopropylbenzene (Cumene)	<b>81</b>	--	<b>32 J</b>	<b>1.7</b>	<b>0.74 J</b>	<b>4.9</b>
n-Propylbenzene	40 U	--	<b>130</b>	<b>4</b>	4 U	<b>8.3</b>
1,3,5-Trimethylbenzene	<b>459</b>	--	<b>132</b>	<b>2.1</b>	4 U	<b>7.6</b>
Tert-Butylbenzene	<b>67 J</b>	--	100 U	1 U	10 U	1 U
1,2,4-Trimethylbenzene	<b>1510</b>	--	<b>446</b>	<b>18</b>	10 U	<b>19</b>
Sec-Butylbenzene	40 U	--	40 U	<b>0.52 J</b>	4 U	<b>0.50 J</b>
p-Isopropyltoluene	<b>50 J</b>	--	100 U	<b>0.17 J</b>	10 U	<b>0.17 J</b>
n-Butylbenzene	<b>70 J</b>	--	100 U	1 U	10 U	<b>0.19 J</b>
Naphthalene	<b>205</b>	--	100 U	<b>2.5 J</b>	10 U	<b>6.8</b>

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

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

UJ – Analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

**Bolded** – Analyte was detected.

-- Not sampled.

Samples for a target list of 72 volatile organic compounds (VOCs) were also collected from wells TSMW-2, GSMW-1, and GSMW-2 during this monitoring period. Samples for VOCs were collected from these wells because of the possible historical use of Tony's Short Stop as a service station. In addition to other petroleum-related contaminants, some chlorinated compounds – such as 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene and tetrachloroethene – 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 below the practical quantitation limit of 1 ug/L.

## Key Bank (Sterling)/Whitney's Inc.

Two of the three monitoring wells located at Key Bank (Sterling) also had high concentrations of BTEX and TPH-G in the groundwater samples (Table 7). Monitoring well KBMW-2, which had free-phase petroleum product in the groundwater in October 2005, exceeded MTCA cleanup levels for benzene, toluene, xylene, and TPH-G during both sample rounds. Benzene, ethylbenzene, xylene, and TPH-G concentrations also exceeded the cleanup levels in KBMW-3 in October. By March 2006, concentrations had decreased and only benzene and TPH-G exceeded the standards. TPH-G and benzene were also detected in well KBMW-1 in March, with the benzene concentration above the cleanup level.

Table 7. BTEX and TPH-G Results (ug/L) for Key Bank (Sterling) for October 2005 and March 2006.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 ug/L		1000 ug/L		700 ug/L		1000 ug/L				800 (1000*) ug/L	
Date:	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
KBMW-1	1 U	<b>12</b>	1 U	1 U	1 U	1 U	2U	2 U	1 U	1 U	140 U	<b>240</b>
KBMW-2	<b>510</b>	<b>360</b>	<b>3200</b>	<b>2400 E</b>	<b>610</b>	<b>460</b>	<b>1900</b>	<b>1300</b>	<b>910</b>	<b>660</b>	<b>26,000</b>	<b>15,000</b>
KBMW-3	<b>220</b>	<b>56</b>	<b>110</b>	<b>14</b>	<b>700</b>	<b>75</b>	<b>1400</b>	<b>68</b>	<b>570</b>	<b>64</b>	<b>17,000</b>	<b>3000</b>

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

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

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

**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. The Key Bank site is located next to Whitney's Inc., which has an auto repair and painting shop. In addition to other petroleum-related contaminants, the chlorinated compounds of cis-1,2-dichloroethene (8 J<sup>1</sup> to 3.4 ug/L), 1,2-dichloroethane (0.92 J to 2.7 ug/L), trichloroethene (0.44 J to 4 ug/L), and tetrachloroethene (8.1 to 9.2 J ug/L) were detected in the wells (Table 8). Tetrachloroethene concentrations exceeded the MTCA Method A cleanup level for groundwater of 5 ug/L in wells KBMW-1 and KBMW-2.

<sup>1</sup> J – Analyte was positively identified. The associated numerical result is an estimate.

Table 8. Summary of VOC Results (ug/L) for Monitoring Wells at Key Bank (Sterling) for October 2005 and March 2006.

Volatile Organics Compounds	KBMW-1		KBMW-2		KBMW-3	
	10/05	3/06	10/05	3/06	10/05	3/06
Vinyl Chloride	2 U	1 U	40 UJ	1 U	20 U	1 U
Chloromethane	5 U	1 U	100 UJ	<b>3.7 J</b>	50 U	1 U
Acetone	4 U	<b>12</b>	80 UJ	10 U	40 U	<b>42</b>
Trans-1,2-Dichloroethene	1 U	1 U	20 UJ	1 U	10 U	<b>0.50 J</b>
Cis-1,2-Dichloroethene	2 U	1 U	40 UJ	1 U	<b>8 J</b>	<b>3.4</b>
1,2-Dichloroethane	<b>1.1 J</b>	<b>0.92 J</b>	40 UJ	<b>2.7</b>	20 UJ	<b>1.2</b>
Trichloroethene	2 U	<b>0.44 J</b>	40 UJ	1 U	20 UJ	<b>4</b>
4-Methyl-2-Pentanone	10 U	<b>0.73 J</b>	200 UJ	<b>11</b>	100 UJ	<b>0.57 J</b>
Tetrachloroethene	2 U	<b>8.7</b>	<b>9.2 J</b>	<b>8.1</b>	20 UJ	1 U
Isopropylbenzene (Cumene)	2 U	<b>1.2</b>	<b>53</b>	<b>124</b>	<b>79</b>	<b>21</b>
n-Propylbenzene	2 U	<b>0.60 J</b>	40 U	<b>362</b>	20 U	<b>25</b>
1,3,5-Trimethylbenzene	2 U	<b>0.11 J</b>	<b>309</b>	<b>689</b>	<b>301</b>	<b>21</b>
Tert-Butylbenzene	5 U	1 U	<b>54 J</b>	<b>0.82 J</b>	50 U	<b>0.34 J</b>
1,2,4-Trimethylbenzene	5 U	1 U	<b>944</b>	<b>2220</b>	<b>976</b>	<b>46</b>
Sec-Butylbenzene	<b>1.2 J</b>	<b>0.63 J</b>	<b>38 J</b>	<b>25</b>	<b>25</b>	<b>9.4</b>
p-Isopropyltoluene	5 U	1 U	<b>50 J</b>	<b>28</b>	<b>29 J</b>	<b>1.8</b>
n-Butylbenzene	<b>3.2 J</b>	<b>0.32 J</b>	<b>87 J</b>	<b>53</b>	<b>50 J</b>	<b>5.7</b>
Naphthalene	5 U	<b>3.2 J</b>	<b>560</b>	<b>978</b>	<b>670</b>	<b>90</b>
1,2,3-Trichlorobenzene	5 U	<b>2.7 J</b>	100 U	5 U	50 U	5 U

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

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

UJ – Analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

**Bolded** – Analyte was detected.

## Brumfield-Twidwell

Of the three wells sampled at the Brumfield-Twidwell site, only monitoring well BTMW-2 contained petroleum-related contaminants in the groundwater samples (Table 9). This well had a strong petroleum odor and sheen on the surface of the purged water. Of the contaminants detected, benzene, xylene, and TPH-G exceeded the cleanup levels during both sample rounds.

Table 9. BTEX and TPH-G Results (ug/L) for Brumfield-Twidwell for October 2005 and March 2006.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 ug/L		1000 ug/L		700 ug/L		1000 ug/L				800 (1000*) ug/L	
Date:	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
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	<b>48</b>	<b>170</b>	<b>31</b>	<b>150</b>	<b>275</b>	<b>650</b>	<b>905</b>	<b>2000 E</b>	<b>330</b>	<b>770 E</b>	<b>11,000</b>	<b>15,000</b>
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

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

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

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

**Bolded** – Analyte was detected.

**Shaded** – Values are greater than MTCA Cleanup Levels

Well BTMW-3 was also sampled for VOCs during both sample rounds because VOCs had been detected in the site soils during the excavation and removal activities in 2006. Tetrachloroethene was the only VOC detected in well BTMW-3 at an estimated concentration of 0.34 ug/L in March 2006.

## Remaining Wells

Monitoring wells were also sampled at Jackpot Station 392, P.J. MaxiMart, Montesano City Shop, and Grays Harbor County Shop. Jackpot Station and P.J. MaxiMart sites have had additional groundwater monitoring as part of recent remedial activities. Therefore, only selected wells were sampled at these locations in October 2005 and March 2006. Analytical results for the remaining wells for this monitoring period are shown in Table 10.

Table 10. BTEX and TPH-G Results (ug/L) for Jackpot Station, P.J. MaxiMart, Montesano City Shop, and Grays Harbor County Shop for October 2005 and March 2006.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 ug/L		1000 ug/L		700 ug/L		1000 ug/L				800 (1000*) ug/L	
Date:	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
<i>Jackpot Station</i>												
JPMW-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
JPRW-3	<b>12</b>	--	1 U	--	<b>17</b>	--	<b>6</b>	--	<b>1.2</b>	--	<b>990</b>	--
JPMW-4S	1 U	--	1 U	--	<b>8.9</b>	--	2 U	--	<b>3.1</b>	--	<b>3100</b>	--
JPMW-4D	<b>7.2</b>	<b>14</b>	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
<i>P.J. MaxiMart</i>												
PJMW-4	1 U	1 U	<b>3.5</b>	<b>12</b>	1 U	<b>26</b>	<b>33</b>	<b>151</b>	<b>33</b>	<b>28</b>	<b>340</b>	<b>800</b>
PJMW-6	1 U	1 U	1 U	1 U	<b>2.8</b>	<b>2.1</b>	<b>3</b>	2 U	<b>1.6</b>	1 U	140 U	140 U
PJMW-7	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
<i>Montesano City Shop</i>												
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	<b>149</b>	1 U	1 U	1 U	<b>1.1</b>	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-33	<b>294</b>	1 U	1 U	1 U	1 U	1 U	2 U	<b>2.2</b>	1 U	<b>1.1</b>	<b>160</b>	140 U
<i>Grays Harbor County Shop</i>												
GHCSMW-1	--	1 U	--	1 U	--	1 U	--	2 U	--	1 U	--	140 U

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

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

**Bold** – Analyte was detected.

Shaded values are greater than MTCA Cleanup Levels

-- Not sampled.

Petroleum-related contaminants were detected in three of the wells at the Jackpot Station. Groundwater cleanup levels were exceeded for benzene in wells JPRW-3 and JPMW-4D. Ethylbenzene, xylene, and TPH-G were detected in samples from wells JPRW-3 and JPMW-4S. TPH-G exceeded the cleanup levels in these wells in October 2005. Wells JPRW-3 and JPMW-4S were not sampled in March 2006.

Of the three wells sampled at the P.J. MaxiMart site, petroleum-related contaminants were detected in wells PJMW-4 and PJMW-6, as shown in Table 10. Well PJMW-6, which is part of the operating vacuum extraction system, had much lower concentrations. Of the contaminants detected, none exceeded the cleanup levels during this 2005-06 monitoring period.

In the Montesano City Shop wells, benzene was the primary contaminant detected in wells MCSMW-32 and MCSMW-33 in October at concentrations that exceeded the cleanup level of 5 ug/L. Low concentrations of ethylbenzene, xylene, and TPH-G were also detected. Benzene was not detected in these wells in March.

Results for the three source areas, P.J. MaxiMart, and the Montesano City Shop are shown in Figures 3 and 4. Figure 3 shows BTEX concentrations for the central part of the project area for October 2005 and March 2006. Figure 4 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.

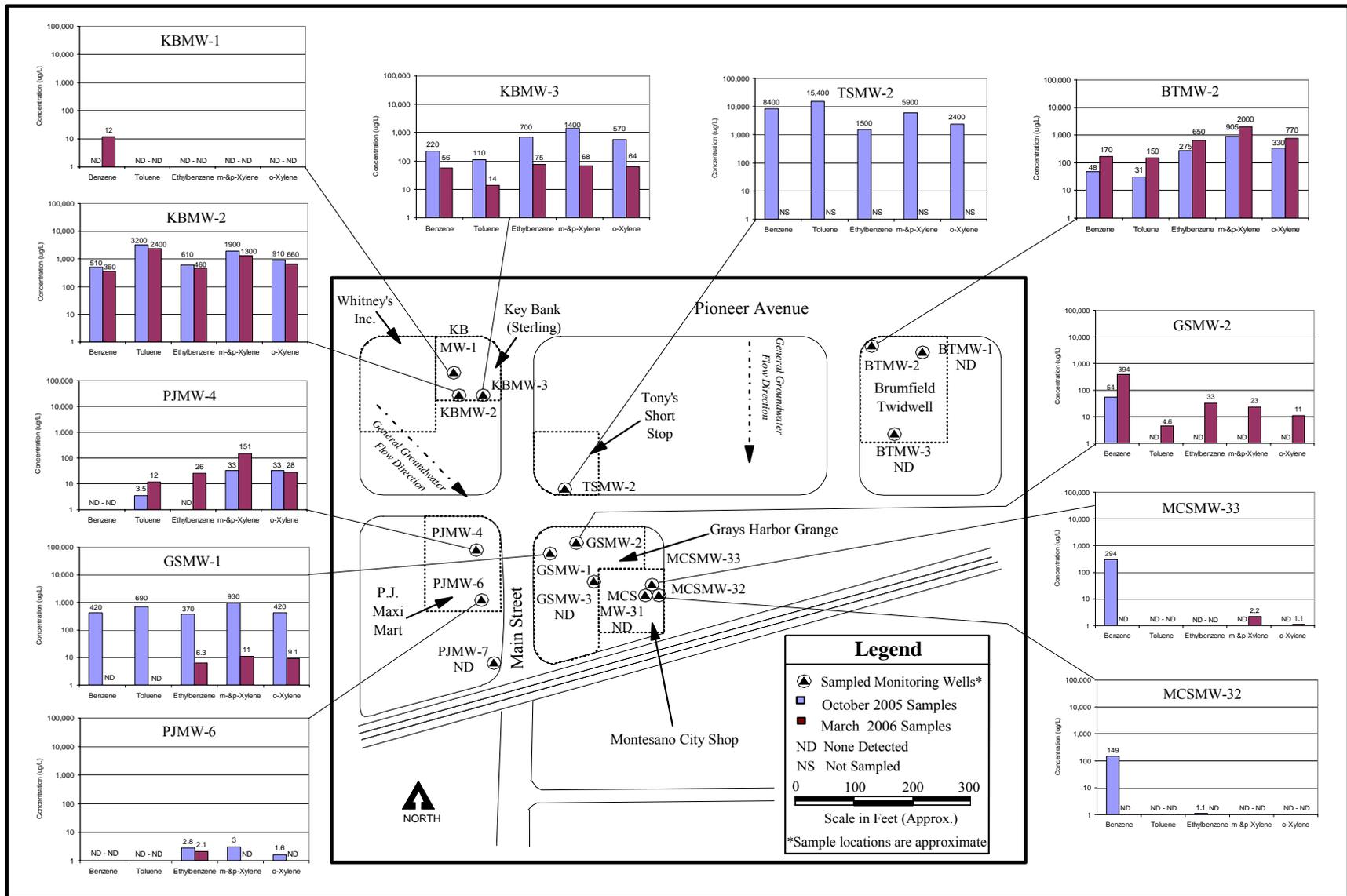


Figure 3. Montezano Groundwater Investigation - BTEX Results (ug/L- log scale) October 2005 and March 2006

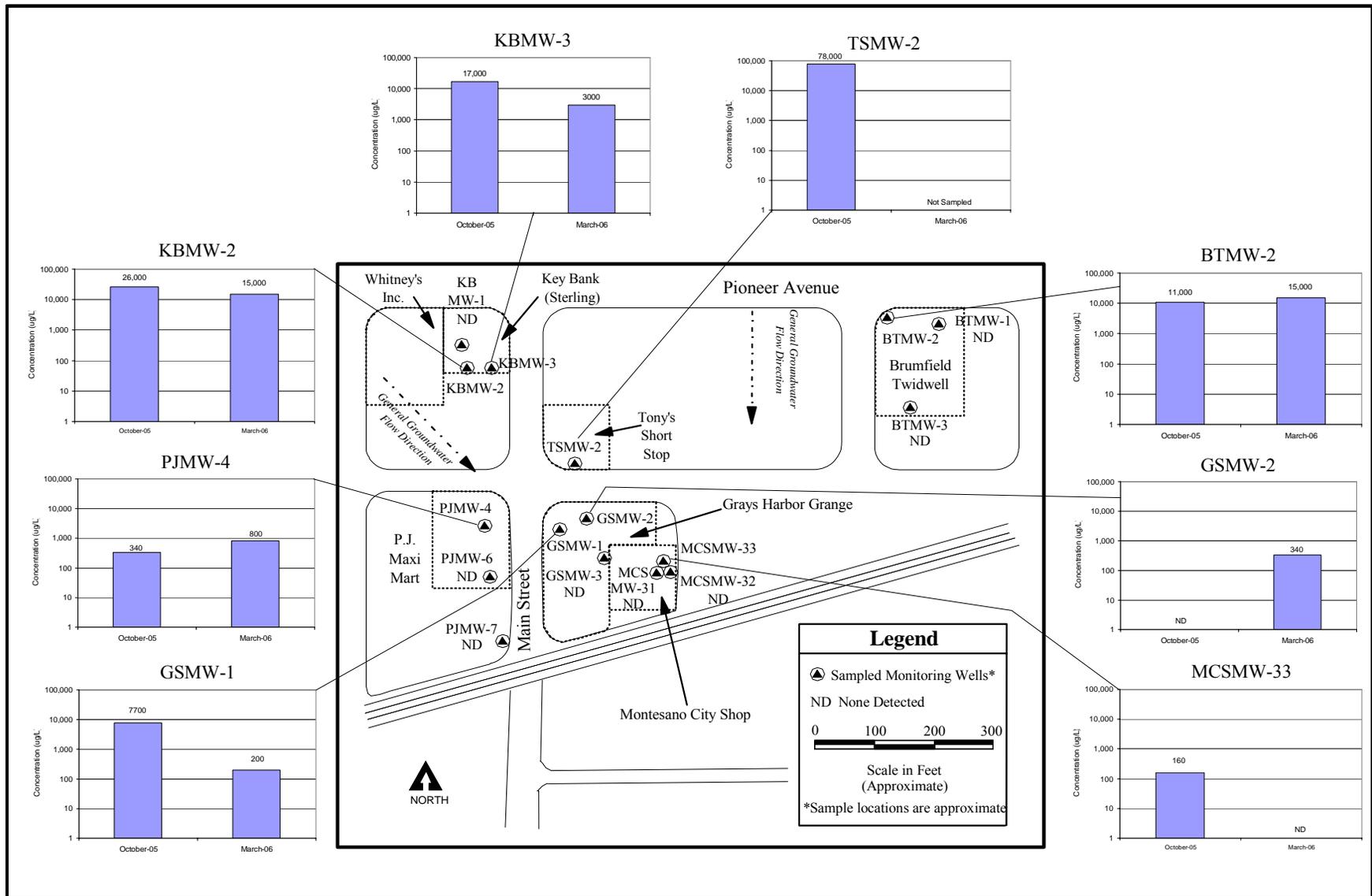


Figure 4. Montesa Groundwater Investigation - TPH-G Results (ug/L - log scale) October 2005 and March 2006

## Discussion

During the October 2005 and March 2006 sampling, the highest concentrations of gasoline-range petroleum hydrocarbons were detected in monitoring wells at the three source areas: Tony's Short Stop/Grays Harbor Grange (TSMW-2, GSMW-1), Key Bank (Sterling)/Whitney's Inc. (KBMW-2, KBMW-3), and Brumfield-Twidwell (BTMW-2). BTEX and TPH-G concentrations in samples collected from these wells exceeded the Model Toxic Control Act (MTCA) cleanup levels. Table 11 provides a summary of those wells where contaminant concentrations exceeded the cleanup levels. For comparison, a summary of historical data for this project is presented in Appendix B.

Table 11. BTEX and TPH-G Concentrations (ug/L) that Exceeded MTCA Method A Cleanup Levels for Groundwater during October 2005 and March 2006.

Analyte:	Benzene		Toluene		Ethylbenzene		m- & p- Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 ug/L		1000 ug/L		700 ug/L		1000 ug/L				800 (1000*) ug/L	
Date:	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06	10/05	3/06
<i>Tony's Short Stop</i>												
TSMW-2	<b>8400</b>	--	<b>15,400</b>	--	<b>1500</b>	--	<b>5900</b>	--	<b>2400</b>	--	<b>78,000</b>	--
<i>Grays Harbor Grange</i>												
GSMW-1	<b>420</b>	1 U	<b>690</b>	1 U	<b>370</b>	<b>6.3</b>	<b>930</b>	<b>11</b>	<b>420</b>	<b>9.1</b>	<b>7700</b>	<b>200</b>
GSMW-2	<b>54</b>	<b>394</b>	1 U	<b>4.6</b>	1 U	<b>33</b>	2 U	<b>23</b>	2 U	<b>11</b>	140 U	<b>340</b>
<i>Key Bank (Sterling)/Whitney's Inc.</i>												
KBMW-1	1 U	<b>12</b>	1 U	1 U	1 U	1 U	2U	2 U	1 U	1 U	140 U	<b>240</b>
KBMW-2	<b>510</b>	<b>360</b>	<b>3200</b>	<b>2400 E</b>	<b>610</b>	<b>460</b>	<b>1900</b>	<b>1300</b>	<b>910</b>	<b>660</b>	<b>26,000</b>	<b>15,000</b>
KBMW-3	<b>220</b>	<b>56</b>	<b>110</b>	<b>14</b>	<b>700</b>	<b>75</b>	<b>1400</b>	<b>68</b>	<b>570</b>	<b>64</b>	<b>17,000</b>	<b>3000</b>
<i>Brumfield-Twidwell</i>												
BTMW-2	<b>48</b>	<b>170</b>	<b>31</b>	<b>150</b>	<b>275</b>	<b>650</b>	<b>905</b>	<b>2000 E</b>	<b>330</b>	<b>770 E</b>	<b>11,000</b>	<b>15,000</b>
<i>Jackpot Station</i>												
JPRW-3	<b>12</b>	--	1 U	--	<b>17</b>	--	<b>6</b>	--	<b>1.2</b>	--	<b>990</b>	--
JPMW-4S	1 U	--	1 U	--	<b>8.9</b>	--	2 U	--	<b>3.1</b>	--	<b>3100</b>	--
JPMW-4D	<b>7.2</b>	<b>14</b>	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
<i>Montesano City Shop</i>												
MCSMW-32	<b>149</b>	1 U	1 U	1 U	<b>1.1</b>	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-33	<b>294</b>	1 U	1 U	1 U	1 U	1 U	2 U	<b>2.2</b>	1 U	<b>1.1</b>	<b>160</b>	140 U

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

-- Not sampled

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

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

**Bolded** – Analyte was detected.

Shaded – Values are greater than MTCA Cleanup Levels

Figure 5 shows TPH-G concentration contours in groundwater for October 2005. In addition to Ecology's groundwater sampling program, other investigations have been conducted for Ecology in the project area by GeoEngineers. These have included the completion of direct-push borings in October 2005 at and between the three source areas (GeoEngineers, 2006). Analytical data of groundwater samples collected from these borings has been used to shape the TPH-G concentration contours in Figure 5. Based on the results of these investigations, new monitoring wells were installed to better define the extent of the contamination at the three source areas. Preliminary review of groundwater results collected in the fall of 2006 from the existing and new monitoring wells is consistent with the October 2005 contour geometry.

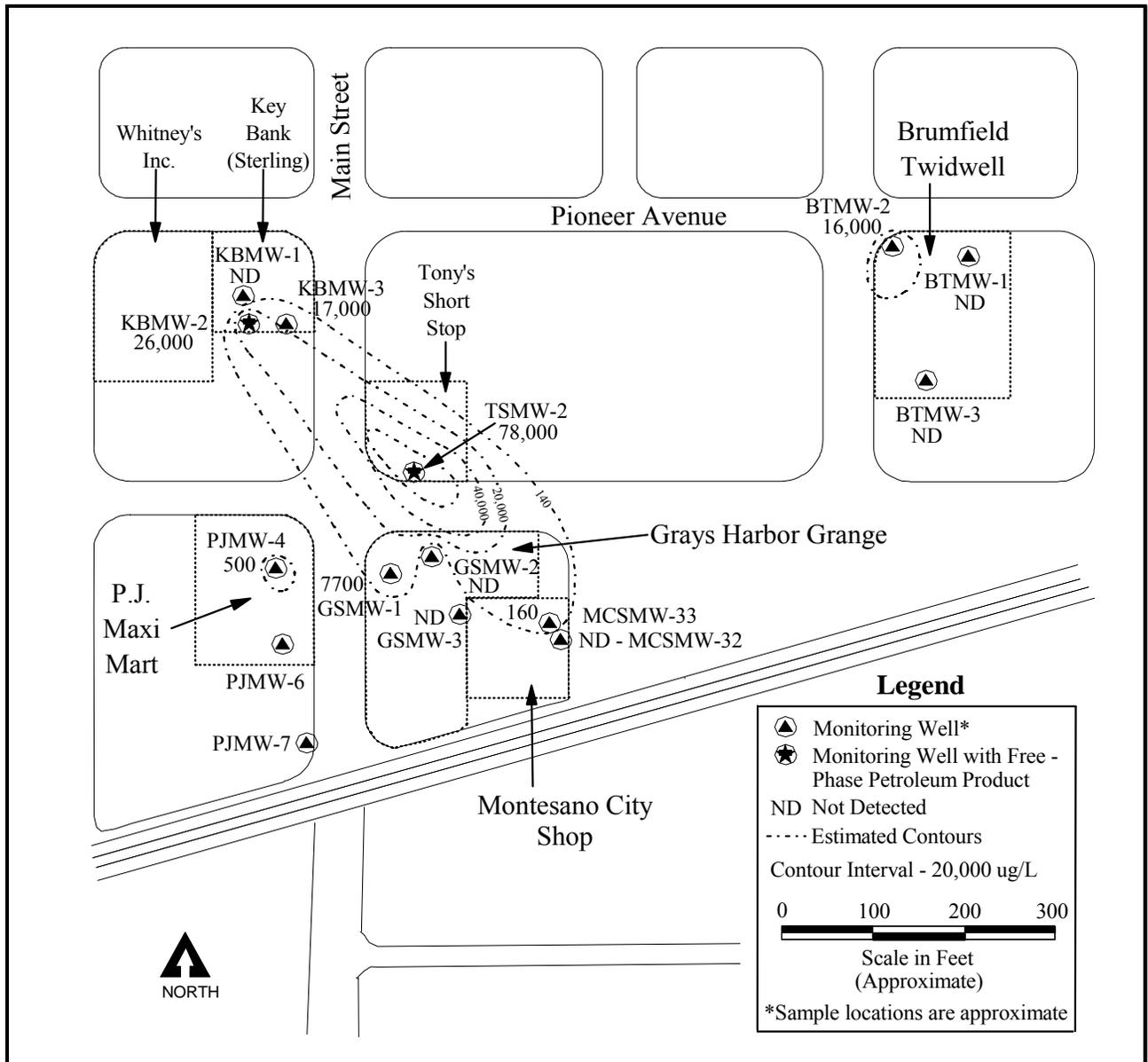


Figure 5. Montasano Groundwater Investigation - TPH-G Concentrations (ug/L) October 2005

In October 2005, benzene concentrations exceeded the MTCA Method A cleanup level of 5 ug/L in 11 of the sampled wells over the project area. Benzene concentrations in these wells ranged from 7.2 to 8400 ug/L. In March 2006, benzene concentrations exceeded the standard in six of the sampled wells with concentrations ranging from 12 to 394 ug/L. TPH-G concentrations exceeded the cleanup level of 800 ug/L in seven of the sampled wells in October and three wells in March. Concentrations ranged from 990 to 78,000 ug/L in October and 3000 to 15,000 ug/L in March.

Well TSMW-2, which has the highest benzene and TPH-G concentrations, was not sampled in March 2006 because of water and mud that had accumulated in the outer protective casing. BTEX and TPH-G concentrations in well TSMW-2 were similar to those detected in October 2004.

Wells GSMW-1 and GSMW-2, which are downgradient of Tony's Short Stop, had much lower BTEX and TPH-G concentrations. Concentrations in well GSMW-1 had increased between October 2004 and October 2005. However, in March 2006 concentrations had decreased considerably in this well, possibly due to the above normal winter rainfall that occurred in January 2006. Monthly total precipitation measured in Olympia was almost double the mean precipitation recorded for that month (Western Regional Climate Center, [www.wrcc.dri.edu/index.html](http://www.wrcc.dri.edu/index.html)). In well GSMW-2, benzene was the only analyte detected in October 2005 at a concentration of 54 ug/L. In March 2006, the benzene concentration had increased to 394 ug/L, and the remainder of the analytes were also detected.

In October 2005, benzene was detected in the Montesano City Shop wells MCSMW-32 and MCSMW-33. Benzene had been detected in well MCSMW-33 at concentrations of 980 and 1500 ug/L the previous year. The elevated concentrations of benzene in the absence of the other BTEX analytes may indicate the front edge of a contaminant plume. Benzene was not detected in March 2006. The Montesano City Shop also appears to be hydraulically downgradient of Tony's Short Stop/Grays Harbor Grange (Marti, 2006).

Wells KBMW-2 and KBMW-3 at the Key Bank (Sterling)/Whitney's site had BTEX and TPH-G concentrations that exceeded the MTCA cleanup levels in October 2005. As with other wells throughout the project area, concentrations in both of these wells decreased between the October 2005 and March 2006 sampling. In contrast, benzene and TPH-G, which had not been detected in well KBMW-1 in October, were present in March at concentrations of 12 and 240 ug/L, respectively. Free-phase petroleum product, which was present in well KBMW-2 in October, was not apparent in March. Overall, the apparent product thickness has reflected the seasonal changes in the water table. The measured product thickness has increased as the water level in the monitoring well declined, and decreased as the water level rose. This pattern is consistent with floating product behavior (Ballester, 1994).

BTEX and TPH-G concentrations in Brumfield-Twidwell well BTMW-2 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.

Some chlorinated compounds – such as 1,2-dichloroethane, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene – were detected in select wells sampled at the three source areas. Most concentrations were near or below the practical quantitation limits. However, in wells KBMW-1 and KBMW-2 tetrachloroethene was detected above the MTCA Method A cleanup level for groundwater of 5 ug/L. All properties where VOC samples were collected are on, or adjacent to, properties that have been, or still are, used as service stations.

## Conclusions

Water quality results over the 2005-06 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 likely came from leaking tanks and piping over time. There is evidence that some areas are also contaminated with chlorinated compounds. Because of the potential for contaminants to migrate downgradient from source areas, and preliminary evidence that suggests that migration is occurring, additional investigations are being conducted to better define the nature and extent of the contamination at the three source areas: Tony's Short Stop/Grays Harbor Grange, Key Bank (Sterling)/Whitney's Inc., and Brumfield-Twidwell.

## Recommendations

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

- New monitoring wells have been installed at Tony's Short Stop as part of a remediation. With the installation of these new wells, existing wells MW-1 (TSMW-1) and MW-2 (TSMW-2) should be decommissioned.
- Additional investigation is needed at the Key Bank (Sterling) site to determine the source of free-phase petroleum product and chlorinated compounds in the groundwater.
- Sampling should continue at monitoring wells associated with, and downgradient of, the three source areas – Tony's Short Stop/Grays Harbor Grange, Key Bank (Sterling)/Whitney's Inc., and Brumfield-Twidwell – to collect additional data from wells that had contaminants exceeding MTCA cleanup levels.
- Sampling should continue and be expanded for volatile organic compounds (VOCs) to define the extent of contamination.
- Nine new monitoring wells were installed in May 2006 to address data gaps in the existing monitoring network. These wells should be included in future sampling efforts.
- Additional wells have been installed at Tony's Short Stop and Brumfield-Twidwell as part of cleanup activities. Once preliminary data become available, consider including some of these new wells in Ecology's monitoring network.

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## Appendix A. Well Construction Details

Table A-1. Montesano Well Construction Details.

Monitoring Well	Address	Well Installed	Well #	Well Type	Total Depth (feet)	Screen Interval (feet)
GHCSMW-1	310 Spruce Ave.	1991	MW-1	2" PVC	7.63	2.5-7.5
JPMW-1	501 W. Pioneer	2004	MW-1	2" PVC	16.5	4.5-14.5
JPMW-2		2004	MW-2	2" PVC	15.5	4.5-14.5
JPRW-3		2004	RW-3	4" PVC	14.5	5-15
JPMW-4S		2004	MW-4S	2" PVC	16.5	5-15
JPMW-4D		2004	MW-4D	2" PVC	26.5	20-25
JPMW-5		2004	MW-5	2" PVC	15.5	5-15
JPMW-6		2004	MW-6	2" PVC	14.5	4.5-14.5
JPMW-7		2004	MW-7	2" PVC	15.5	5.5-15.5
JPMW-8		2004	MW-8	2" PVC	15.5	5-13.5
BTMW-1	301 E. Pioneer	2000	MW-1	2" PVC	23.30	10-25
BTMW-2		2000	MW-2	2" PVC	25	10-25
BTMW-3		2000	MW-3	2" PVC	22.28	10-25
KBMW-1	301 S. Main	1998	MW-1	2" PVC	21.97	10-20
KBMW-2		1998	MW-2	2" PVC	20.16	10-20
KBMW-3		1998	MW-3	2" PVC	20.17	10-20
PJMW-1	405 S. Main	1995	MW-1	4" PVC	20	5-20
PJMW-2		1995	MW-2	4" PVC	20	5-20
PJMW-3		1995	MW-3	4" PVC	20	5-20
PJMW-4		1995	MW-4	4" PVC	20	8-20
PJMW-5		1995	MW-5	4" PVC	16	6-16
PJMW-6		1995	MW-6	4" PVC	20	3-20
PJMW-7		1995	MW-7	4" PVC	18	2-17.5
PJMW-8		1995	MW-8	2" PVC	18.5	3.5-18.5
PJMW-9		1995	MW-9	2" PVC	18	3.5-18.5
PJMW-10		1995	MW-10	2" PVC	15	5-15
TSMW-2	326 S. Main	1996	MW-2	2" PVC	18.77	5-20
GSMW-1	412 S. Main	2003	MW-1	2" PVC	22.70	7-22
GSMW-2		2003	MW-2	2" PVC	21.74	7-21
GSMW-3		2003	MW-3	2" PVC	17.73	6-17
MCSMW-31	201 S. River	--	MW-31	2" PVC	12.42	--
MCSMW-32		--	MW-32	2" PVC	11.87	--
MCSMW-33		--	MW-33	2" PVC	12.11	--

--: Information is not available.

## Appendix B. Historical Data

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

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

\* = Data are not available for these wells.

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

**Bolded** = Analyte was detected.

Table B-2. Ecology BTEX and TPH-G Results (ug/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	
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	<b>3.5</b>	1 U	1 U	1 U
JPRW-3		<b>17</b>	<b>4.1 J</b>	<b>12</b>	--	1 U	1 U	1 U	--	<b>55</b>	<b>17 J</b>	<b>17</b>	--
JPMW-4S		1 U	<b>10</b>	1 U	--	1 U	5 U	1 U	--	<b>11</b>	<b>6.3</b>	<b>8.9</b>	--
JPMW-4D		<b>12</b>	<b>15</b>	<b>7.2</b>	<b>14</b>	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	<b>120</b>	<b>65</b>	<b>3.5</b>	<b>12</b>	<b>130</b>	<b>73</b>	1 U	<b>26</b>
PJMW-5		1 U	--	--	--	1 U	--	--	--	1 U	--	--	--
PJMW-6		1 U	5 U	1 U	1 U	1 U	<b>11</b>	1 U	1 U	<b>0.78 J</b>	<b>45</b>	<b>2.8</b>	<b>2.1</b>
PJMW-7		<b>0.92 J</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U	<b>25</b>	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		<b>75</b>	20 U	<b>48</b>	<b>170</b>	<b>23</b>	20 U	<b>31</b>	<b>150</b>	<b>430</b>	<b>58</b>	<b>275</b>	<b>650</b>
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	<b>2.2</b>	1 U	<b>12</b>	1 U	1 U	1 U	1 U	1 U	<b>0.82 J</b>	1 U	1 U
KBMW-2		--	<b>338</b>	<b>510</b>	<b>360</b>	--	<b>3,320</b>	<b>3,200</b>	<b>2,400 E</b>	--	<b>654</b>	<b>610</b>	<b>460</b>
KBMW-3		<b>160</b>	<b>118</b>	<b>220</b>	<b>56</b>	<b>82</b>	<b>58 J</b>	<b>110</b>	<b>14</b>	<b>430</b>	<b>331</b>	<b>700</b>	<b>75</b>
TSMW-1		--	--	--	--	--	--	--	--	--	--	--	--
TSMW-2		<b>8500</b>	--	<b>8400</b>	--	<b>13,000 J</b>	--	<b>15,400</b>	--	<b>1300</b>	--	<b>1500</b>	--
GSMW-1		<b>5.1</b>	10 U	<b>420</b>	1 U	1 U	10 U	<b>690</b>	1 U	<b>1.3</b>	<b>91</b>	<b>370</b>	<b>6.3</b>
GSMW-2		<b>54</b>	<b>140</b>	<b>54</b>	<b>394</b>	2 U	10 U	1 U	<b>4.6</b>	2 U	<b>15</b>	1 U	<b>33</b>
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	<b>149</b>	1 U	<b>3.7</b>	1 U	1 U	1 U	1 U	1 U	<b>1.1</b>	1 U
MCSMW-33		<b>980 J</b>	<b>1,500</b>	<b>294</b>	1 U	10 U	50 U	1 U	1 U	10 U	<b>56</b>	1 U	1 U

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

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

-- = Not Sampled.

**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
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	<b>150</b>	140 U	140 U	140 U
JPRW-3	<b>55</b>	<b>29 J</b>	<b>6</b>	--	1 U	1 U	<b>1.2</b>	--	<b>1,400</b>	<b>470 J</b>	<b>990</b>	--
JPMW-4S	2 U	10 U	2 U	--	<b>2</b>	5 U	<b>3.1</b>	--	<b>2,100</b>	<b>1,700</b>	<b>3100</b>	--
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	<b>550</b>	<b>340</b>	<b>33</b>	<b>151</b>	<b>210</b>	<b>130</b>	<b>33</b>	<b>28</b>	<b>4,200</b>	<b>3,300</b>	<b>340</b>	<b>800</b>
PJMW-5	2 U	--	--	--	1 U	--	--	--	140 U	--	--	--
PJMW-6	<b>1.9 J</b>	<b>100</b>	<b>3</b>	2 U	1 U	<b>38</b>	<b>1.6</b>	1 U	140 U	<b>1,100</b>	140 U	140 U
PJMW-7	<b>11</b>	2 U	2 U	2 U	1 U	1 U	1 U	1 U	<b>650</b>	<b>310</b>	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	<b>1280</b>	<b>300</b>	<b>905</b>	<b>2000E</b>	<b>310</b>	<b>160</b>	<b>330</b>	<b>770E</b>	<b>14,000</b>	<b>1,500J</b>	<b>11,000</b>	<b>15,000</b>
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	1 U	1 U	1 U	140 U	140 U	140 U	<b>240</b>
KBMW-2	--	<b>2290</b>	<b>1900</b>	<b>1300</b>	--	<b>977</b>	<b>910</b>	<b>660</b>	--	<b>56,000</b>	<b>26,000</b>	<b>15,000</b>
KBMW-3	<b>700 J</b>	<b>354</b>	<b>1400</b>	<b>68</b>	<b>280</b>	<b>218</b>	<b>570</b>	<b>64</b>	<b>12,000</b>	<b>4,700</b>	<b>17,000</b>	<b>3000</b>
TSMW-2	<b>5,300</b>	--	<b>5,900</b>	--	<b>2,000</b>	--	<b>2,400</b>	--	<b>81,000</b>	--	<b>78,000</b>	--
GSMW-1	<b>9.6</b>	<b>180</b>	<b>930</b>	<b>11</b>	1 U	<b>120</b>	<b>420</b>	<b>9.1</b>	<b>110 J</b>	<b>2,200</b>	<b>7,700</b>	<b>200</b>
GSMW-2	4 U	20 U	2 U	<b>23</b>	2 U	10 U	1 U	<b>11</b>	140 U	<b>170</b>	140 U	<b>340</b>
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	<b>2.2</b>	10 U	50 U	1 U	<b>1.1</b>	<b>220</b>	<b>730</b>	<b>160</b>	140 U

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

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

-- = Not Sampled.

**Bolded** = Analyte was detected.