

# Health Consultation

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SAL'S AUTO REPAIR

NEPTUNE CITY, MONMOUTH COUNTY, NEW JERSEY

EPA FACILITY ID: NJXCRA0DX000

APRIL 4, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

SAL'S AUTO REPAIR

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EPA FACILITY ID: NJXCRA0DX000

Prepared By:

New Jersey Department of Health and Senior Services  
Public Health Protection and Emergency Preparedness  
Consumer and Environmental Health Services  
Hazardous Site Health Evaluation Program  
Under a Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

## Summary

In May 2004, the Monmouth County Health Department (MCHD) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) to determine whether indoor air concentrations of petroleum-related compounds detected in area residences and commercial properties posed a public health concern. Indoor air contaminants are believed to originate from one or more sites identified as Sal's Auto Repair site, the Former Mobil Service Station # 15-FP-8 site and the New Jersey Department of Transportation site located in Neptune City, Monmouth County, New Jersey. With oversight by the New Jersey Department of Environmental Protection (NJDEP), indoor air samples were collected during the period of May 2003 through July 2004 from 18 residential and 5 commercial properties. NJDEP continues to monitor indoor air at one commercial location (The City Grill) on a bi-annual basis with the most recent indoor air samples collected in November 2006. Benzene was identified as the primary contaminant in indoor air in 6 residential and 3 commercial properties. Toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were also identified as contaminants in indoor air for residential properties and The City Grill as detailed below. Of the evaluated properties, only The City Grill had confirmed subsurface petroleum contamination originating from one or more of the above three sites. Based on available data, it is uncertain the extent of the site-related groundwater contaminant plume and the potential extent of a vapor intrusion problem.

There are several factors which indicate that the indoor air contaminants (benzene, toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene) detected at the residential and two commercial properties, excluding The City Grill, are not attributable to site contamination. Sub-slab gas samples collected at four of the residences failed to demonstrate the presence of a vapor intrusion source. The residences and two commercial properties identified with indoor air contamination were documented by NJDEP to have non-site sources (i.e. smoking, gasoline storage, consumer activities) that may have attributed to indoor contaminant concentrations. However, until a groundwater investigation is conducted below the residential area, the absence of a site-related contaminant source cannot be confirmed. Therefore, average and maximum contaminant concentrations in indoor air were used to assess non-cancer and cancer health effects to residents (including children) and employees for past, current and future exposures.

For the past, there are completed exposure pathways as follows: inhalation of benzene to employees and residents (adults and children) for six residential and three commercial properties; inhalation of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene to employees and residents (adults and children) for two residential and one commercial properties; and inhalation of toluene to residents (adults and children) for one residential property. There is no other completed exposure pathway evident based on available data.

Benzene concentrations detected in indoor air for all sampled residences (living space areas) were below the chronic comparison value for benzene for non-cancer health effects. Therefore, non-cancer adverse health effects are not expected to occur for adults and children regarding past chronic inhalation exposures to benzene in indoor air.

The likelihood of non-cancer adverse health effects associated with acute, intermediate and chronic inhalation of benzene from past exposures for employees (the most exposed

population) at The City Grill is low. Benzene was not detected above the chronic comparison value at the two remaining commercial properties.

For past exposures, the average lifetime excess cancer risks (LECRs) (the likely scenario) to adult and child residents at homes where benzene was detected in indoor air were estimated to be 34 in 1,000,000 and 14 in 1,000,000, respectively. The maximum LECRs (an unlikely exposure scenario) to adult and child residents at homes where benzene was detected were estimated to be 84 in 1,000,000 and 35 in 1,000,000, respectively.

For past exposures, the average LECR (the likely scenario) and maximum LECR (an unlikely exposure scenario) to adult employees at The City Grill were estimated to be 64 in 1,000,000 and 96 in 1,000,000, respectively.

For past exposures, the average LECR (the likely scenario) and maximum LECR (an unlikely exposure scenario) to adult employees at the two remaining commercial properties where benzene was detected in indoor air were estimated to be 4 in 1,000,000 and 5 in 1,000,000, respectively.

It is noted that the range of average benzene concentrations for sampled residential and commercial properties slightly exceeded typical average background concentrations found in ambient air. In addition, based on average benzene concentrations, the excess cancer risks calculated for past exposures for all sampled residential and commercial properties (excluding The City Grill) are low in comparison to the background risk of all or specific cancers.

1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were detected in indoor air for two residences and The City Grill. Adverse non-cancer health effects to residents (adults and children) and employees exposed to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not expected to occur as the concentrations of these compounds in indoor air are well below the NOAEL and other health-effect related concentrations available in toxicological literature. The presence of these compounds in indoor air does not appear to originate from site-related contamination.

Toluene was detected in one residence above its chronic comparison value for non-cancer health effects in one indoor air sample. Chronic adverse non-cancer health effects for exposures to toluene may occur to individuals occupying this residence; however, the likelihood is low as the detection of toluene for this residence appears to be intermittent due to consumer activities as documented by NJDEP and not from site-related contamination.

Inhalation exposures to benzene for current and future exposures to individuals at all sampled residences and commercial properties are considered ***No Apparent Public Health Hazard***. NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate the inhalation exposure pathway at present and in the future.

Recommendations include continued monitoring of the mitigation systems at The City Grill and the Sal's Auto Repair site to ensure effective remediation of site-related contamination; routine indoor air quality monitoring for The City Grill to ensure site-related contaminant levels remain below the NJDEP's Indoor Air Screening Level (IASL) for benzene; the delineation of site-related contamination (subsurface soil and groundwater) in order to implement a permanent remedy; confirmatory sub-slab gas sampling for two residential and two commercial properties with confirmed benzene concentrations in indoor air; and NJDEP investigation of other possible sources of groundwater contamination in the area, including the abandoned auto works facility located in close proximity to residences with benzene concentrations detected in indoor air.

## Statement of Issues

In May 2004, the Monmouth County Health Department (MCHD) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) to determine whether indoor air concentrations of petroleum-related compounds detected in area residences and commercial properties posed a public health concern. Indoor air contaminants are believed to originate from one or more sites identified as Sal's Auto Repair site, the Former Mobil Service Station # 15-FP-8 site (Former Mobil Service Station) and the adjacent New Jersey Department of Transportation (NJDOT) site located in Neptune City, Monmouth County. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS reviewed environmental data and prepared this health consultation to assess the public health implications associated with petroleum-related compounds detected in indoor air.

## Background

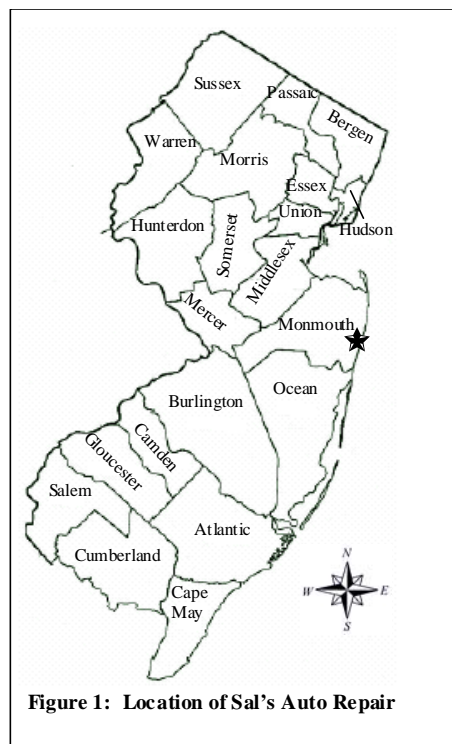
### Site Description

Sal's Auto Repair is an auto service and repair station located at 68 West Sylvania Avenue (Route 35) in a residential/commercial zoned area of Neptune City, Monmouth County (see Figure 1, Photograph 1). The property consists of one single story structure located on an asphalt and concrete paved lot. Operations at the site consist of automotive repair and maintenance.

In addition to the Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site have been identified as additional sources of petroleum-related groundwater contamination. These sites may be potential contributors of petroleum-based contaminants detected in indoor air at sampled residences and commercial properties. These sites are approximately 100 yards to the west of Sal's Auto Repair (Figure 2). There is a fourth property in close proximity to Sal's Auto Repair which has been identified as an abandoned auto works facility. There have been no investigations performed on this site according to the NJDEP.

### Site History

Sal's Auto Repair historically operated as a gasoline service station. Several leaking underground gasoline storage tanks were removed in 1993 under oversight by NJDEP's Responsible Party Remediation Element. Investigations conducted after the tanks were removed indicated soil and groundwater were significantly contaminated with petroleum-based volatile organic compounds. NJDEP directed the service station owner to investigate and clean up the



site, but the owner did not comply. In 2003 NJDEP's Remedial Response Element installed groundwater remediation systems at the Sal's Auto Repair site and at a commercial property (The City Grill) across the street to treat a plume of contaminated groundwater from the site.

The Former Mobil Service Station is located at 79 Route 35. The historical use of this property has been a gasoline station. The current property use remains as a gasoline station under new ownership. Investigations of this site were initiated in 1986 which confirm petroleum groundwater contamination below the property. Several groundwater monitoring wells were installed both on and off site as part of groundwater investigation activities.

The NJDOT site is located on the adjacent east side of the Former Mobil Service Station at the intersection of West Sylvania Avenue and Route 35. The property was purchased by NJDOT in July 1970. This site was historically used as a gas station, possibly dating back to the pre-1950s. The site is currently grass covered and undeveloped. As part of investigations being conducted on the adjacent Former Mobil Service Station property, four underground petroleum storage tanks (two 4,000 gallon and two 3,000 gallon) were identified on this property in September 2004. Information pertaining to the date gasoline dispensing operations ceased was not available.

In March 2003, NJDEP responded to a call regarding employee complaints from petroleum odors at the La Cantina Restaurant (currently The City Grill). The NJDEP investigation indicated elevated readings on field monitoring equipment within the sump system at the restaurant. Two large blowers were subsequently installed in April 2003 in an unsuccessful attempt to vent the basement area of the restaurant. In a letter dated May 1, 2003, the responsible party (ExxonMobil) was directed by NJDEP to mitigate petroleum vapors from The City Grill. As part of this directive, a sub-slab soil vapor recovery and groundwater mitigation system was installed in June/July 2003 to treat subsurface soil gas and groundwater contamination and mitigate petroleum vapors from the restaurant. In addition several wells were installed on and around The City Grill property to monitor and evaluate groundwater contamination.

Based on the extent of petroleum-related groundwater contamination and concerns of the indoor air quality of The City Grill, the NJDEP expanded the investigation to determine if the indoor air quality of nearby residences and commercial properties in the surrounding area were impacted. NJDEP collected indoor air samples during the period of May 2003 through July 2004 at 18 residential and 5 commercial properties. NJDEP continues to monitor indoor air at The City Grill on a bi-annual basis to confirm the effectiveness of the mitigation system with the most recent samples collected in November 2006. Results of indoor air sampling indicated that nine residences and four commercial properties had detections of petroleum-related compounds, primarily benzene.

### **Site Visit**

On December 21, 2004 staff performed a site visit of the Sal's Auto Repair site. Present were Tariq Ahmed of the NJDHSS and representatives from the NJDEP. The site is bordered by



residential properties to the north; The City Grill and residential properties to the south; and commercial and residential properties to the east and west.

Sal's Auto Repair is comprised of a single story building with two garage bays where vehicle servicing is performed (see Photograph 1). The two closest residences sampled under the indoor air evaluation are located on the adjacent properties within 50 to 100 feet to the north of the site.

Representatives of the NJDEP led the inspection of the mitigation systems present at Sal's Auto Repair and The City Grill. The Sal's Auto Repair mitigation system consists of a groundwater recovery from several wells surrounding the property and one sump well with the Sal's Auto Repair building. This system draws in groundwater where it enters an equalization tank then is passed through two filtration units and two aqueous-phase carbon beds (in-series) prior to being discharged to the storm sewer (see Photograph 2). The head-space within the equalization tank is exhausted through a vapor-phase carbon unit to capture any petroleum-related contaminants volatilized out of the groundwater influent during system operation. This system is housed within a steel shed located along the northern boundary of Sal's Auto Repair property (see Photograph 3).

The mitigation systems present at The City Grill incorporate groundwater and sub-slab vapor recovery. The groundwater mitigation system consists of recovery from two sumps located in the basement of The City Grill. The groundwater system is the same design as that observed at Sal's Auto Repair. The sub-slab vapor recovery system incorporates vapor extraction from the two groundwater sumps to draw vapors captured within the head-space of the sumps. The vapors pass through three vapor phase carbon beds connected in-series prior to being discharged to the atmosphere (see Photographs 4 and 5).

The Former Mobil Service Station and adjacent NJDOT sites were also inspected during the site visit. The Former Mobil Service Station site was noted to be in operation as a gas station, and the NJDOT site was noted to be a grass covered lot (see Photograph 6). Several groundwater monitoring wells were observed on Sal's Auto Repair, Former Mobil Station, NJDOT property, The City Grill and the commercial property immediately to the south of the Former Mobil Station.

## **Demographics**

Using the 2000 United States Census data, the ATSDR estimates that approximately 15,200 people live within a one-mile radius of the Sal's Auto Repair site (see Figure 3).

## **Environmental Contamination**

An evaluation of site-related environmental contamination consists of a two tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures. First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If

concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COC), are selected for further evaluation. Contaminant levels above environmental guideline CVs do not mean that adverse health effects are likely, but that a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

### **Environmental Guideline Comparison**

There are a number of CVs available for the screening environmental contaminants to identify COCs. These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10<sup>-6</sup>) persons exposed during their lifetime (70 years). In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water; USEPA Region 3 Risk-Based Concentrations (RBCs). RBCs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Quotient of 1, or lifetime excess cancer risk of one in one million, whichever results in a lower contaminant concentration) in water, air, biota, and soil; and NJDEP Indoor Air Screening Levels (IASL) for air.

Substances exceeding applicable environmental guideline CVs were identified as COCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations. Contaminants which are known or suspected carcinogens, such as benzene, are considered COCs and are compared directly with health-based comparison values in the Public Health Implications of Completed Exposure Pathways section.

### **Indoor Air**

During the period of May 2003 through July 2004, indoor air investigations were conducted at 18 residential and 5 commercial properties to determine if petroleum-related groundwater contamination from Sal's Auto Repair, Former Mobil Service Station and the NJDOT sites were impacting indoor air quality. Ambient air samples from the investigation area were also collected to determine background concentrations. NJDEP continues to monitor indoor air at The City Grill on a bi-annual basis to confirm the effectiveness of the mitigation system with the most recent samples collected in November 2006. Results of indoor air sampling indicated that petroleum-related compounds were detected at nine residences and four commercial properties. All samples were collected over a 24-hour period using SUMMA® canisters and analyzed for volatile organic compounds (VOCs) using USEPA Method TO-15.

Benzene was detected in indoor air at six residences with concentrations ranging from 1.8 to 14 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Benzene was detected in indoor air at two commercial properties with concentrations ranging from 1.8 to 3  $\mu\text{g}/\text{m}^3$ . Benzene was detected in indoor air at The City Grill with concentrations ranging from 20 to 63  $\mu\text{g}/\text{m}^3$  (pre-mitigation) and 1.2 to 31 (estimated)  $\mu\text{g}/\text{m}^3$  (post-mitigation July 2003). Ambient air concentrations ranged from non-detect to 1.8  $\mu\text{g}/\text{m}^3$  for The City Grill area and were non-detect in residential areas.

Methyl tert-butyl ether (MTBE) was detected in indoor air at six residences and three commercial properties (including The City Grill) with concentrations ranging from 1.8 to 58  $\mu\text{g}/\text{m}^3$ ; ambient air concentrations of MTBE ranged from 1.8 to 16  $\mu\text{g}/\text{m}^3$ .

1,2,4-trimethylbenzene was detected in indoor air at two residences and The City Grill with concentrations ranging from 1.3 to 170  $\mu\text{g}/\text{m}^3$ ; it was not detected in ambient air.

1,3,5-trimethylbenzene was detected in indoor air at one residence and The City Grill with concentrations ranging from 1.2 to 59  $\mu\text{g}/\text{m}^3$ ; it was not detected in ambient air.

Ethylbenzene was detected in indoor air at four residences and three commercial properties (including The City Grill) with concentrations ranging from non-detect to 6.1  $\mu\text{g}/\text{m}^3$ ; it was not detected in ambient air.

Xylenes (total) were detected in indoor air at nine residences and three commercial properties (including The City Grill) with concentrations ranging from non-detect to 32.3  $\mu\text{g}/\text{m}^3$ ; it was not detected in ambient air.

Toluene was detected in indoor air at 12 residences and three commercial properties (including The City Grill) with concentrations ranging from 2.3 to 45  $\mu\text{g}/\text{m}^3$ ; ambient air concentrations of toluene ranged from non-detect to 2.3  $\mu\text{g}/\text{m}^3$ .

It is noted that one residence had detections of toluene (1,500  $\mu\text{g}/\text{m}^3$ ) and n-hexane (1,200  $\mu\text{g}/\text{m}^3$ ) on September 17, 2003. However, both compounds were not detected in two follow-up samples collected in March 2004 at this residence. Therefore, the detection of toluene and n-hexane for this residence appears to be an anomaly likely due to consumer activities (i.e. smoking) and has been separated from the toluene data summary as a single occurrence. NJDEP noted there was an active smoker at this residence during the September 2003 sampling event.

A summary of analytical results for indoor air is presented in Tables 1 through 4.

It is noted that, with the exception of The City Grill, sample interferences for the indoor air results at the six residences and two commercial properties were present in the following forms: 1) the presence of gasoline storage in the sampling area at one residence, 2) recent painting activities at one residence and 3) NJDEP documentation of consumer activities as contaminant sources (including smoking) at four residences and two commercial properties. One residential property was excluded from evaluation due to sample bias related to the potential of residual contamination associated with the removal of a leaking underground heating oil tank.

Benzene is a known carcinogen and above its respective CV, therefore, it is considered a COC. Currently, there are no environmental CVs available for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene. The EPA National Center for Environmental Assessment no longer supports the toxicological data for these compounds; thus, they have been removed from the RBC tables. In the absence of environmental CVs, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene have been included as COCs due to available toxicological information. Concentrations of MTBE, ethylbenzene, toluene, and xylenes (total) detected in indoor air at residential and commercial properties did not exceed applicable environmental CVs; therefore, they are not considered COCs.

Toluene was detected above its respective CV at one residence in September 2003 and not detected in two follow-up samples in March 2004. Therefore, it is considered a COC for this residence only. N-hexane was also detected at this residence in September 2003 at  $1,200 \mu\text{g}/\text{m}^3$  but did not exceed its respective CV of  $2,000 \mu\text{g}/\text{m}^3$  and is, therefore, not considered a COC.

Several non-petroleum-related VOCs were detected at elevated concentrations in nine residential and four commercial properties. These VOC compounds include acetone, 1,3-butadiene, chloroform, 1,4-dichlorobenzene, methylene chloride, tetrachloroethylene (PCE), and trichloroethylene. These compounds are found in various consumer products such as dry cleaned clothing, cigarette smoke, pesticides, building materials, carpet glues, and various cleaning products. NJDEP concluded that the presence of these compounds in indoor air samples was likely the result of ambient concentrations and/or consumer activities. Since these compounds are not associated with site-related contamination, they have not been included for further evaluation.

### Background Sources

The range of average benzene concentrations detected at residential and commercial sample locations slightly exceeded average benzene concentrations found in ambient air for Monmouth County, New Jersey. Based on modeled air data, the 1999 estimate for benzene concentrations in ambient air for Monmouth County was approximately  $1 \mu\text{g}/\text{m}^3$ . Ambient air concentrations of benzene for Monmouth County were estimated to come from on-road mobile sources (40%) and from background sources (36%) (EPA 1999). Benzene emissions occur from a number of common sources including various consumer products (e.g. paint solvents, cigarette smoke, adhesives), home construction materials, gasoline service stations and combustion vehicles (ATSDR 1997; EPA 1988; NIH 2002).

Typical background concentrations of 1,2,4-trimethylbenzene within US homes and ambient air range from approximately  $10$  to  $12 \mu\text{g}/\text{m}^3$  and  $3$  to  $6 \mu\text{g}/\text{m}^3$ , respectively. The primary use of 1,2,4-trimethylbenzene is as a gasoline additive, which comprises roughly 99% of its production volume. Emission sources of 1,2,4-trimethylbenzene include solvents, cleaners, pesticides, gasoline, vehicle combustion, dyes, fragrances, sterilizing agents, degreasing agents, printing operations and inks (EPA 1988, 1994). Typical background concentrations of 1,3,5-trimethylbenzene within US homes and ambient air range from approximately  $3$  to  $8 \mu\text{g}/\text{m}^3$  and  $3$  to  $15 \mu\text{g}/\text{m}^3$ , respectively. The main use of 1,3,5-trimethylbenzene is as an industrial solvent. Emissions occurring in homes can originate from various sources such as dyes, paint solvents,

home construction materials, vehicle combustion and gasoline or petroleum storage (EPA 1988, 1994; NIH 2002).

Background concentrations of toluene in ambient air in the United States vary greatly from 3 to 140  $\mu\text{g}/\text{m}^3$  for urban and suburban areas with average concentrations estimated at 50  $\mu\text{g}/\text{m}^3$  (NIH 2002). Background concentrations of toluene is generally higher in urban compared to rural areas, which is likely due to the increase in commercial/industrial operations and consumer products typical of urban areas. Vehicle exhaust is typically the most common source of ambient concentrations. Emissions occurring in homes can originate from various sources such as paint, paint solvents, cigarette smoke, spot removers, home construction materials, vehicle combustion and gasoline or petroleum storage (EPA 1988, 1994; NIH 2002).

Table 5 presents a list of consumer sources and typical ambient air background concentrations of compounds found in indoor air at the residential and commercial sample locations. A list of published information sources for homeowners and business owners on how to reduce sources of indoor air pollution and measures to improve indoor air quality has been included in Appendix A.

### **Sub-slab Gas**

Based on the results obtained from indoor air samples, the NJDEP identified five residences where investigation of sub-slab gas was required based on benzene concentrations in indoor air. Sub-slab samples were collected to determine if there were site-related contaminants below the residences to act as a source of vapor intrusion.

Analytical results indicate that there were no detections of site-related contaminants in sub-slab gas for four of the five residences sampled. Non site-related compounds (methylene chloride and acetone) were detected in sub-slab gas for two residences at levels below the NJDEP soil gas screening levels. NJDEP concluded that these compounds are not associated with the contaminant source from the three sites being investigated.

The fifth residence is listed on the NJDEP's New Jersey Known Contaminated Site List (KCSL) for subsurface soil and groundwater petroleum-related contamination due to a leaking underground heating oil tank. Following remediation, NJDEP issued a No Further Action letter on March 12, 2001 for this property. It is noted that MTBE and toluene were detected in sub-slab gas at 26  $\mu\text{g}/\text{m}^3$  and 38  $\mu\text{g}/\text{m}^3$ , respectively. These contaminants were below the NJDEP Residential Soil Gas Screening Level for MTBE (78  $\mu\text{g}/\text{m}^3$ ) and toluene (260,000  $\mu\text{g}/\text{m}^3$ ) (NJDEP 2006). The sub-slab gas contaminants at this residence are likely attributable to residual contamination associated with the leaking underground heating oil tank. This property has been excluded from further evaluation.

A summary of the residences sampled and the compounds detected for sub-slab samples is presented in Table 6.

## Groundwater

Groundwater investigations were initiated at the Sal's Auto Repair site during the initial investigation in 1993 then resumed under the direction of the NJDEP in the early 2000s. NJDEP has combined groundwater investigations for the Former Mobil Service Station site and the adjacent NJDOT site as they are in close proximity to one another and contaminants from both sites fall under the same petroleum constituents. Based on information provided to NJDHSS there are 13 groundwater monitoring wells associated with the Sal's Auto Repair site and a combined total of 17 groundwater monitoring wells associated with the Former Mobil Service Station and NJDOT sites. Eight groundwater monitoring wells (including a groundwater sump) are located on The City Grill property as part of the Former Mobil Service Station/NJDOT and Sal's Auto Repair investigation areas. Groundwater is noted to be five to seven feet below grade and flows towards the south-southwest. Available groundwater data for the Former Mobil Service Station/NJDOT, Sal's Auto Repair, and The City Grill investigation areas span the period of February 1993 through April 2004 and is summarized by area in Table 7.

The data indicates the presence of benzene, toluene, ethylbenzene, xylenes, and MTBE in groundwater. A collective summary of the concentrations of petroleum-related contaminants from the three areas of investigation above is as follows:

<b>Collective Groundwater Results February 1993 – April 2004</b>			
<b>Contaminant</b>	<b>Number of Samples</b>	<b>Average Concentration (ug/l)<sup>(a)</sup></b>	<b>Range of Concentrations (ug/l)</b>
Benzene	264	187	ND – 4,090
Toluene		714	ND – 21,500
Ethylbenzene		1,501	ND – 3,930
Total Xylenes		864	ND – 9,440
MTBE		491	ND – 16,500

(a) – micrograms per liter

Groundwater concentrations for the Former Mobil Service Station/NJDOT sites were historically the highest during the 1993 sample period and show a declining trend; however, some elevated concentration fluctuations have been observed in 2001. The major source of MTBE in groundwater appears to be the Former Mobil Service Station/NJDOT sites.

To date groundwater contamination has not been delineated in the residential areas surrounding the three sites.

The above contaminants have exceeded the applicable CVs as shown in Table 7 and are, therefore, considered COCs.

## Summary of Contaminants of Concern

The COCs in groundwater for the Sal's Auto Repair site are benzene, ethylbenzene, toluene, total xylenes and MTBE. The COCs in indoor air are benzene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene. Toluene is also considered a COC for one residence.

## Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern. Site-specific exposure doses can be calculated and compared with health guideline comparison values.

## Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

The evaluated exposure pathways for site-related contaminants are presented in Table 8.

### *Completed Exposure Pathways*

Inhalation of petroleum compounds in indoor air (past). For the past, there is a completed exposure pathway regarding exposure to benzene in indoor air to children and adults at six residences and to adult employees and patrons at three commercial properties located in the vicinity of the Sal's Auto Repair, the Former Mobil Service Station, and the NJDOT sites. However, the only case confirmed by NJDEP where site-related petroleum contamination was confirmed to act as a vapor intrusion source is to indoor air at The City Grill restaurant. NJDEP identified bias sources (i.e., gasoline cans, smoking, and consumer activities) for all sampled residences and the remaining two commercial properties. Additionally, confirmatory sub-slab

gas samples collected at four of the six residences failed to determine the presence of a site-related vapor intrusion source.

NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate this exposure pathway at present and in the future.

For the past, there is a completed exposure pathway regarding exposure to toluene in indoor air to children and adults at one residence located in the vicinity of the Sal's Auto Repair site. Toluene was detected at this residence for one sampling event; however, it was not detected in two confirmatory samples at this residence indicating the source is not continually present and possibly a one-time occurrence likely due to consumer activities. NJDEP indicated an active smoker was present at this residence.

Based on available data, it is uncertain the extent of the site-related groundwater contaminant plume and the potential extent of a vapor intrusion problem.

#### *Eliminated Pathways*

Ingestion of groundwater (past, present, future). According to information obtained from a well search, NJDEP has verified that there are no domestic or public supply wells located immediately downgradient of the site. As such, there were no completed exposures via this pathway.

#### **Public Health Implications of Completed Exposure Pathways**

Once it has been determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed exposure pathway), the next step in the public health assessment process is the calculation of site-specific exposure doses. This is called a health guideline comparison which involves looking more closely at site-specific exposure conditions, the estimation of exposure doses, and comparison to health guideline CVs. Health guideline CVs are based on data drawn from the epidemiologic and toxicologic literature and often include uncertainty or safety factors to ensure that they are amply protective of human health.

Benzene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are the COCs in the completed exposure pathway. Toluene is a COCs in the completed exposure pathway for one residence. The maximum and average benzene concentrations detected in indoor air were used to assess the risk of non-cancer and cancer health effects to residents (children and adults) and adult employees for past, current and future exposures. Toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not known to be carcinogenic; therefore, maximum and average benzene concentrations detected in indoor air were used to assess the risk of non-cancer health effects. Toxicological summaries for the benzene, toluene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene are provided in Appendix B.



## *Non-Cancer Health Effects*

To assess non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15-364 days); and chronic (365 days or more).

When MRLs for specific contaminants are unavailable, other health based comparison values such as the USEPA's Reference Concentration (RfC) are used. The RfC is an estimate of a daily inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

### Indoor Air - Toluene

Resident Exposures (past, current, future). The chronic MRL of 300  $\mu\text{g}/\text{m}^3$  for toluene was exceeded at one residence at 1,500  $\mu\text{g}/\text{m}^3$ . There were no other toluene concentrations exceeding the chronic MRL for the sampled residences. The chronic MRL is based on a continuous exposure of 365 days or greater. The chronic MRL is based on the Lowest Observable Adverse Effects Level (LOAEL) of approximately 132,000  $\mu\text{g}/\text{m}^3$  producing color vision impairment in Croatian workers exposed to toluene vapors from printing operations (ATSDR 2000). The LOAEL adjusted from an occupational exposure to a continuous exposure is approximately 31,400  $\mu\text{g}/\text{m}^3$ . The chronic MRL incorporates a safety factor of approximately 400 to account for various uncertainties, i.e., use of the LOAEL, human variability (including sensitive populations such as children), and converting from an occupational to a continuous exposure (ATSDR 2000). The toluene concentration observed at this residence is approximately 21 times lower than the LOAEL adjusted for continuous exposure.

Chronic adverse non-cancer health effects for exposures to toluene may occur to individuals occupying this residence; however, the likelihood is low as analytical data does not indicate toluene is continually present within this residence. Results of two follow-up samples collected in March 2004 indicate toluene and other site-related contaminants were not detected. Therefore, the detection of toluene for this residence appears to be an anomaly likely due to consumer activities (i.e. smoking) as documented by NJDEP and not from site-related contamination.

### Indoor Air - Trimethylbenzene Isomers

Employee and Resident Exposures (past, current, future). In the absence of MRLs for 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene, available toxicological literature was used to assess non-cancer health effects. 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were detected in the two residences and The City Grill at concentrations ranging from 3.9 to 170  $\mu\text{g}/\text{m}^3$  and 1 to 59  $\mu\text{g}/\text{m}^3$ , respectively. Sub-slab gas results from samples collected from below the residences did not indicate the presence of these compounds.

Studies of painters chronically exposed for several years to solvents (49,000 to 295,000  $\mu\text{g}/\text{m}^3$ ) containing 50% 1,2,4-trimethylbenzene and 30% 1,3,5-trimethylbenzene indicated signs of vertigo, nervousness, tension, anxiety, asthmatic bronchitis, and anemia (CEPA 2001, EPA 1994). Additionally, this compound may cause alternations in blood clotting (EPA 1994). Animal studies involving rats exposed to several concentrations of an isomer mixture of trimethylbenzenes for four weeks established a No Observable Adverse Effect Level (NOAEL) of 123,000  $\mu\text{g}/\text{m}^3$  (MADEP 2004). A chronic study involving rats exposed to isomer mixture of trimethylbenzenes at approximately 8,000,000  $\mu\text{g}/\text{m}^3$  for four months showed decreased weight gain, lymphopenia (low number of lymphocytes in blood) and neutrophilia (an increase in neutrophil granulocytes in the blood) (EPA 1994). Both lymphocytes and neutrophils are types of white blood cells which serve the body's immunity system.

Adverse non-cancer health effects to residents exposed to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not expected to occur as the concentrations of these compounds detected in indoor air are well below the NOAEL and other chronic health-effect related concentrations available in toxicological literature.

#### Indoor Air - Benzene

Resident Exposures (past). The chronic MRL of 10  $\mu\text{g}/\text{m}^3$  for benzene was exceeded at one residence (basement 14  $\mu\text{g}/\text{m}^3$ ) identified as an apartment building. There were no other benzene concentrations exceeding the MRLs listed above for the sampled residences. The chronic MRL is based on a continuous exposure of 365 days or greater. The chronic MRL is based on results of Benchmark Dose (BMD) modeling of B cell blood counts of workers in shoe manufacturing facilities in Tianjin, China (ATSDR 2006). The lower 95% confidence limit of the BMD was calculated to determine the Benchmark Concentration Limit (BMCL) of approximately 320  $\mu\text{g}/\text{m}^3$  for the health end point of significantly decreased B cell counts in human blood. The BMCL was adjusted from an intermittent to a continuous exposure then reduced by a safety factor of 10 to account for human variability (including sensitive populations such as children) to derive the chronic MRL. The benzene concentration in the indoor air of the basement of this residence is approximately 23 times lower than the BMCL.

Chronic adverse health effects for exposures to benzene for this residence may occur; however, the likelihood is low as the contaminant was detected in a non-living space (basement). Additionally, factors which indicate that an exposure originating from *site-related* contamination is not likely is as follows: 1) benzene was not detected in two indoor air samples collected in March 2004 from the apartment floor (living space) level; and 2) there were no detections of volatile organic compounds in the September 2004 sub-slab gas sample indicating a vapor intrusion source is not present below this residence. Due to the lack of a vapor intrusion source, it is likely that the benzene concentrations in the basement are from non-site related sources (i.e. consumer activities) or ambient air sources. It is noted that two prior sample results from the basement were invalid due to gasoline storage activities in this area.

Resident Exposures (current, future). NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This

includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate this exposure pathway at present and in the future.

Employee Exposures. Exposure assumptions for employees at the three commercial properties where benzene was detected in indoor air were based on business hours of operation. Using a time-weighted average (TWA)<sup>1</sup>, average benzene concentrations were adjusted as follows (see Table 9):

$$\text{TWA} = \Sigma C \times \text{ET}/24$$

where, C = concentration of benzene in indoor air

ET = exposure time (assumed at 12 hours per day)

*Employee/Patron Exposures – Commercial Properties (past).* The TWA benzene concentrations detected in the two commercial properties (excluding The City Grill) were below the chronic MRL of 10 µg/m<sup>3</sup> (see Table 9). Therefore, non-cancer health effects to employees and patrons for past exposures are not expected to occur.

*Employee/Patron Exposures – The City Grill (past: pre-mitigation).* The average and maximum TWA benzene concentration detected in the basement storage area prior to the installation of the mitigation system (July 2003) was 21 µg/m<sup>3</sup> and 31.5 µg/m<sup>3</sup>, respectively (see Table 9). The average TWA benzene concentration exceeds the chronic and intermediate MRLs of 10 µg/m<sup>3</sup> and 20 µg/m<sup>3</sup>, respectively. The intermediate MRL is based on the LOAEL of approximately 6,000 µg/m<sup>3</sup>. The intermediate MRL incorporates a safety factor of 300 to account for various uncertainties, i.e., use of the LOAEL, human variability (including sensitive populations such as children), extrapolation from animal studies to humans and converting from an occupational to a continuous exposure (ATSDR 2006). The LOAEL is based on animal studies using mice where significant delayed splenic lymphocyte reaction to foreign antigens (i.e. delayed response of the immunity system) was noted (ATSDR 2006). The LOAEL adjusted for human exposure when extrapolating from animal studies is approximately 2,000 µg/m<sup>3</sup>. The average TWA benzene concentration (the likely exposure scenario) is approximately 100 times lower than the intermediate LOAEL adjusted for human exposure and approximately 15 times lower than the BMCL for chronic exposures. Therefore, intermediate and chronic non-cancer adverse health effects were possible for past exposures to benzene in indoor air for employees at The City Grill; however, since the basement is accessed on an intermittent basis, the likelihood is low.

The maximum TWA benzene concentration (an unlikely exposure scenario) is approximately equal to or slightly exceeds the acute MRL of 30 µg/m<sup>3</sup>. The acute MRL is based on the LOAEL of approximately 9,000 µg/m<sup>3</sup> from animal studies using mice where depressed peripheral lymphocytes and mitogen-induced blastogenesis of femoral B-lymphocytes (i.e. impairment and stimulation of the immunity system) was noted (ATSDR 2006). The MRL incorporates a safety factor of 300 to account for various uncertainties, i.e., use of the LOAEL, human variability (including sensitive populations such as children), extrapolation from animal

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<sup>1</sup>Average estimate of exposure over the business hours of operation based on a 24 hour day.

studies to humans and converting from an occupational to a continuous exposure (ATSDR 2006). The maximum TWA benzene concentration is approximately 300 times lower than the LOAEL. Therefore, acute non-cancer adverse health effects were possible for past exposures to benzene in indoor air for employees at The City Grill; however, since the basement is accessed on an intermittent basis and the maximum TWA concentrations were well below the LOAEL, the likelihood is low.

Since there is no data on benzene concentrations for the restaurant patron area prior to the installation of the mitigation system in July 2003, the risk for non-cancer health effects to occur to employees is unknown for the past exposures. Inhalation exposure would be considered uninterrupted during working hours in the restaurant area when compared to the basement area. Based on the benzene concentration observed in the basement area prior to mitigation, past concentrations in the restaurant may have exceeded the chronic MRL; therefore, chronic non-cancer adverse health effects may have occurred to employees for past exposures. The risk for non-cancer health effects to occur to patrons is considered negligible for past exposures as their exposure is short and on an intermittent non-daily basis.

*Employee/Patron Exposures – The City Grill (past: post-mitigation).* The average TWA benzene concentration (the likely exposure scenario) detected in the basement storage area was  $3.2 \mu\text{g}/\text{m}^3$  following the installation of the mitigation system. The TWA benzene concentration for the restaurant patron area at  $2.7 \mu\text{g}/\text{m}^3$  based on one sampling event after the installation of the mitigation system (see Table 9). These concentrations do not exceed any MRL for benzene. Therefore, non-cancer health effects are not expected to occur to employees or patrons after the initiation of mitigation measures in July 2003.

Employee/Patron Exposures (current, future). NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate this exposure pathway at present and in the future.

### *Cancer Health Effects*

The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 46 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 and 10 in 100 (SEER 2005). Typically, health guideline CVs developed for carcinogens are based on one excess cancer case per 1,000,000 individuals. ATSDR considers estimated cancer risks of less than one additional cancer case among one million persons exposed as insignificant or no increased risk (expressed exponentially as  $10^{-6}$ ).

According to the United States Department of Health and Human Services (USDHHS), benzene is a known human carcinogen.

### Indoor Air - Benzene

The risk of cancer was evaluated for occupants of residences and employees of commercial properties sampled during the May 2003 through July 2004 indoor air investigation period. Cancer exposure doses were calculated using the following formula:

$$\text{Cancer Exposure Dose (mg/kg/day)} = \frac{C \times IR \times EF}{BW} \times \frac{ED}{AT}$$

where C = concentration of benzene in air (mg/m<sup>3</sup>);  
IR = inhalation rate (m<sup>3</sup>/hour);  
EF = exposure factor representing the site-specific exposure scenario;  
ED = exposure duration (year);  
BW = body weight (kg); and  
AT = averaging time (year).

The following site specific assumptions and recommended exposure factors (EPA 2002) were used to calculate the contaminant dose based on the maximum potential period of exposure:

#### **Assumptions for Calculating Adult and Child Exposure Dose**

<b>Exposed Population</b>	<b>IR (m<sup>3</sup>/hour)</b>	<b>EF<sup>(a)</sup> (unitless)</b>	<b>ED (years)</b>	<b>BW (kg)</b>	<b>AT (years)</b>
Child <sup>(b)</sup>	12	1	18	33	70 <sup>(d)</sup>
Adult <sup>(b)</sup>	20	1	54	70	70 <sup>(d)</sup>
Adult <sup>(c)</sup>	20	1	53	70	70 <sup>(d)</sup>

- (a) Exposure factor of 1 equals a continuous exposure frequency of 24 hours per day.
- (b) Specifies the maximum exposure duration based on assumed potential exposure period is 1950 through 2004. For child the maximum exposure potential is calculated for 18 years.
- (c) The City Grill - Specifies the maximum exposure duration based on assumed potential exposure period is 1950 through 2003. Mitigation measures were initiated in July 2003.
- (d) Represents a lifetime exposure.

The LECR for adults was calculated by multiplying the cancer exposure dose by the cancer slope factor (CSF). The CSF is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., (mg/kg/day)<sup>-1</sup>.

The onset of exposure to site-related contaminants is based on available information regarding operational periods of Sal's Auto Repair, the Former Mobil Service Station and the NJDOT property. In this case, the NJDOT property appears to have operated as a gasoline service station dating back to the late 1940s. Since there is no method to determine when groundwater became impacted from site operations and the onset of potential vapor intrusion into surrounding residences and commercial properties, the worst-case scenario has been assumed for exposure calculations. The onset of exposure is conservatively estimated to begin at approximately the year 1950 for both residents and employees.

The average benzene concentrations and the maximum exposure period were used to calculate the average LECR, which represents the likely exposure scenario to adults and children. The maximum benzene concentrations and the maximum exposure period were used to calculate the maximum LECR, which represents an unlikely exposure scenario to adults and children. The maximum and average benzene concentrations in indoor air were obtained from the May 2003 through July 2004 sampling events. The potential period for exposure is assumed to be from 1950 to July 2004 for residents and employees. The potential period for employee exposure at The City Grill is assumed to be from 1950 to the initiation of mitigation measures in July 2003.

Resident Exposures (past). The calculated LECRs for residents based on the maximum and average benzene concentrations from available data are presented in Table 10.

Based on the average benzene concentrations detected in indoor air (the likely exposure scenario), LECRs were estimated to be 34 in 1,000,000 for adults and 14 in 1,000,000 for children occupying the six residences where benzene was detected.

Based on the maximum benzene concentrations detected in indoor air (an unlikely exposure scenario), LECRs were estimated to be 84 in 1,000,000 for adults and 35 in 1,000,000 for children occupying the six residences where benzene was detected.

The benzene concentrations for the six residences is either within or slightly exceeding the typical average background concentrations found in US homes and ambient air. In addition, based on the average concentration, the excess cancer risks calculated for past exposures for all sampled residences are low in comparison to the background risk of all or specific cancers. Although the risk for individuals to develop cancer for past exposure to benzene in indoor air is low, NJDEP is requiring remedial actions for the contaminated sites to reduce soil and groundwater contamination to levels where it does not pose the threat as a source of vapor intrusion to the surrounding residences.

There are several factors which indicate that the benzene concentrations detected in indoor air at the residences are not attributable to site contamination. Sub-slab gas samples collected at four of the residences failed to demonstrate the presence of a vapor intrusion source. All six residences were documented by NJDEP to have consumer sources (i.e. smoking, gasoline storage, consumer activities) that may have attributed to indoor benzene concentrations.

Employee Exposures (past). The calculated LECRs for employees of the two commercial properties (excluding The City Grill) are based on the maximum and average benzene concentrations from available data (see Table 10). Employees were evaluated since they are considered the most exposed population for these establishments.

Based on the average (the likely scenario) and maximum (an unlikely exposure scenario) benzene concentrations detected in indoor air, LECRs were estimated to be 4 in 1,000,000 and 5 in 1,000,000 for adult employees at the two commercial properties where benzene was detected.

Employee Exposures – The City Grill (past). The calculated LECRs for The City Grill employees are based on the maximum and average benzene concentrations from available data (see Table 10). Employees were evaluated since they are considered the most exposed population for this establishment.

Based on the average (the likely scenario) and maximum (an unlikely exposure scenario) benzene concentrations detected in indoor air, LECRs were estimated to be approximately 64 in 1,000,000 and 96 in 1,000,000 for adult employees.

Resident/Employee Exposures (current and future). NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate the inhalation exposure pathway at present and in the future.

### **Child Health Considerations**

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they eat and breathe more than adults. They also play outdoors and often bring food into contaminated areas. They are shorter than adults, which mean they breathe dust, soil and heavy vapors closer to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. It should be noted that the most sensitive endpoint for non-cancer health effects is significantly decreased B cell counts in human blood, as observed in an adult population working in shoe manufacturing facilities (ATSDR 2006).

The potential health risk from elevated indoor air concentrations of benzene to children living in the vicinity of the Sal's Auto Repair site, the Former Mobil Service Station site and the NJDOT site was evaluated. The maximum indoor benzene levels exceeded the chronic MRL in one sample at one residence (apartment complex). Exposures at this residence are not likely as benzene was detected in a non-living space (basement); however, benzene was not detected in two samples from living spaces. Therefore, adverse non-cancer health effects are not expected to occur. Although uncertainty factors are incorporated into the MRL to protect sensitive populations such as children, toxicological data specific to child exposures to benzene were not available to evaluate adverse health effects in children with developing nervous systems.

Concerning cancer effects, for the six residences where benzene was detected, the LECR estimate based on the average benzene concentrations (the likely exposure scenario) was determined to be 14 in 1,000,000 which is considered low. The presence of a vapor intrusion source was not identified in sub-slab gas samples for five of the residences. All six residences

were documented by NJDEP to have consumer sources (i.e. smoking, gasoline storage) that may have attributed to indoor benzene concentrations.

Toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not known to be carcinogenic. Adverse non-cancer health effects to children exposed to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not expected to occur as the concentrations of these compounds detected in indoor air are well below the NOAEL and other health-effect related concentrations available in toxicological literature.

Toluene was detected in one residence above its respective chronic MRL for one sample. Chronic adverse health effects for exposures to toluene may occur to individuals occupying this residence; however, the likelihood is low as analytical results of two follow-up samples collected in March 2004 indicate toluene was not detected. Therefore, the detection of toluene for this residence appears to be an anomaly likely due to consumer activities (i.e. smoking) as documented by NJDEP and not from site-related contamination.

NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate the inhalation exposure pathway at present and in the future.

## **Conclusions**

As part of remedial investigation activities overseen by the NJDEP for the Sal's Auto Repair site, the Former Mobil Service Station site and the NJDOT site, an investigation was conducted to determine if subsurface environmental contamination originating from these sites was impacting the indoor air quality of surrounding residential and commercial properties. Indoor air samples were collected during the period of May 2003 through July 2004 from 18 residential and 5 commercial properties. NJDEP continues to monitor indoor air at The City Grill on a bi-annual basis to confirm the effectiveness of the mitigation system with the most recent samples collected in November 2006. The results indicated that benzene was detected above the health CV for six residences and three commercial properties. Toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were also identified as contaminants in indoor air for residential properties and The City Grill as detailed below. Of the evaluated properties, only The City Grill had confirmed subsurface petroleum contamination directly related to the three NJDEP sites. Based on available data, it is uncertain the extent of the site-related groundwater contaminant plume and the potential extent of a vapor intrusion problem.

There are several factors which indicate that the indoor air contaminants (benzene, toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene) detected at the residential and two commercial properties, excluding The City Grill, are not attributable to site contamination. Sub-slab gas samples collected at four of the residences failed to demonstrate the presence of a vapor intrusion source. The residences and two commercial properties identified with indoor air contamination were documented by NJDEP to have non-site sources (i.e. smoking, gasoline



storage, consumer activities) that may have attributed to indoor contaminant concentrations. However, until a groundwater investigation is conducted below the residential area, the absence of a site-related contaminant source cannot be confirmed. Therefore, average and maximum contaminant concentrations in indoor air were used to assess non-cancer and cancer health effects to residents (including children) and employees for past, current and future exposures.

For the past, there are completed exposure pathways as follows: inhalation of benzene to employees and residents (adults and children) for six residential and three commercial properties; inhalation of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene to employees and residents (adults and children) for two residential and one commercial properties; and inhalation of toluene to residents (adults and children) for one residential property. There is no other completed exposure pathway evident based on available data.

Benzene was detected in indoor air above the ATSDR chronic MRL for one residence (apartment complex) in the basement (non-living space); however, benzene was not detected in two samples collected from living space areas of this residence. Therefore, non-cancer health effects associated with inhalation exposures to benzene are not expected to occur to adults and children at this residence. Additionally, sub-slab gas samples did not indicate a vapor intrusion source was present. Non-cancer health effects are not expected to occur to adults and children at remaining sampled residences as benzene was not detected in indoor air above the chronic MRL.

The likelihood of non-cancer adverse health effects associated with acute, intermediate and chronic inhalation of benzene from past exposures for employees (the most exposed population) at The City Grill is low. Benzene was not detected above the chronic comparison value at the two remaining commercial properties.

For past exposures, the average LECRs (the likely scenario) to adult and child residents at homes where benzene was detected in indoor air were estimated to be 34 in 1,000,000 and 14 in 1,000,000, respectively. The maximum LECRs (an unlikely exposure scenario) to adult and child residents at homes where benzene was detected were estimated to be 84 in 1,000,000 and 35 in 1,000,000, respectively.

For past exposures, the average LECR (the likely scenario) and maximum LECR (an unlikely exposure scenario) to adult employees at The City Grill were estimated to be 64 in 1,000,000 and 96 in 1,000,000, respectively.

For past exposures, the average LECR (the likely scenario) and maximum LECR (an unlikely exposure scenario) to adult employees at the two remaining commercial properties where benzene was detected in indoor air were estimated to be 4 in 1,000,000 and 5 in 1,000,000, respectively.

It is noted that the range of average benzene concentrations for sampled residential and commercial properties slightly exceeded typical average background concentrations found in ambient air. In addition, based on average benzene concentrations, the excess cancer risks calculated for past exposures for all sampled residential and commercial properties (excluding The City Grill) are low in comparison to the background risk of all or specific cancers.

Toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not known to be carcinogenic. 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were detected in indoor air for two residences and The City Grill. Adverse non-cancer health effects to children exposed to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are not expected to occur as the concentrations of these compounds detected in indoor air are well below the NOAEL and other health-effect related concentrations available in toxicological literature. The presence of these compounds in indoor air does not appear to originate from site-related contamination.

Toluene was detected in one residence above its respective chronic MRL for one sample. Chronic adverse health effects for exposures to toluene may occur to individuals occupying this residence; however, the likelihood is low as the exposure appears to be intermittent. Analytical results of two follow-up samples collected in March 2004 indicate toluene was not detected. Therefore, the detection of toluene for this residence appears to be an anomaly likely due to consumer activities as documented by NJDEP and not from site-related contamination.

Inhalation exposures to benzene, toluene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene for current and future exposures to individuals at all sampled residences and commercial properties are considered ***No Apparent Public Health Hazard***. NJDEP is requiring remediation of the petroleum contamination in groundwater and installation of sub-slab vapor recovery associated with Sal's Auto Repair site, the Former Mobil Service Station site and the adjacent NJDOT site. This includes remediation of site-related contamination below The City Grill property. These remediation and mitigation measures should interrupt or eliminate the inhalation exposure pathway at present and in the future.

### **Recommendations**

1. The NJDEP should continue monitoring the mitigation systems located at The City Grill and Sal's Auto Repair site by NJDEP to ensure systems are effectively remediating subsurface groundwater and soil gas contamination to reduce the threat of vapor intrusion.
2. The NJDEP should perform routine indoor air quality monitoring for The City Grill to ensure site-related contaminant levels remain below the NJDEP's NRIASL for benzene to protect employees and patrons.
3. Delineation of site-related groundwater contamination (including residential areas) by NJDEP to ensure a permanent remedy should be implemented to abate subsurface contamination to levels below the applicable regulatory cleanup criteria. Future indoor air evaluation at select residences and/or commercial properties should be considered by NJDEP based on groundwater contaminant concentrations.
4. Groundwater sampling should be performed below the all residences and commercial properties where benzene was detected to confirm benzene concentrations in groundwater are below NJDEP's Groundwater Screening Levels to protect against vapor intrusion.

5. Sub-slab gas sampling should be performed by NJDEP at the two residential and two commercial properties which had confirmed benzene concentrations in indoor air above the IASL to determine if there is a site-related vapor intrusion source present.
6. NJDEP should investigate possibility of other sources of groundwater contamination in the area, including the abandoned auto works facility located in close proximity to residences with benzene concentrations detected in indoor air.

### **Public Health Action Plan (PHAP)**

The purpose of a PHAP is to ensure that this Health Consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the NJDHSS and ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and NJDHSS are as follows:

#### **Public Health Actions Taken**

1. Indoor air levels of site-related contaminants for the May 2003 through November 2006 sampling period have been reviewed and evaluated by the NJDHSS to determine human exposure pathways and public health issues.
2. NJDHSS had provided education materials on exposure to petroleum-related compounds and the health consultation process to the MCHD in May 2004.

#### **Public Health Actions Planned**

1. Copies of this health consultation will be provided to the Monmouth County Health Department and residents.
2. The NJDHSS and the ATSDR will review and evaluate future indoor air data for sampled residences and commercial properties if requested by area residents and/or NJDEP.

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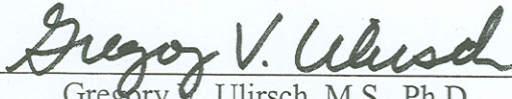
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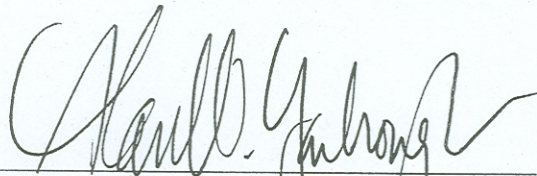
## CERTIFICATION

The health consultation for the Sal's Auto Repair site, Neptune City, Monmouth County, New Jersey was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the cooperative agreement partner.



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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.



Alan Yarbrough  
Team Leader, CAT, SPAB, DHAC  
Agency for Toxic Substances and Disease Registry

**Table 1**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Indoor Air Results**  
**Evaluation of Detected Benzene Concentrations With Health Guideline Comparison Values**  
**Sample Data: May 2003 through November 2006**

Confirmed Benzene Concentrations	Number of Sample Detections	Locations Exceeding MRL	Range of Concentrations ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	Average Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(b)</sup>	CREG ( $\mu\text{g}/\text{m}^3$ ) <sup>(c)</sup>	ATSDR MRLs <sup>(d)</sup> ( $\mu\text{g}/\text{m}^3$ )		NJDEP IASL <sup>(e)</sup>
						Chronic	Acute	
Residential (6 residences) <sup>(f)</sup>	7 <sup>(g)</sup>	1	<b>1.8 - 14</b>	<b>5.7</b>	0.1	10	30	2
Ambient Air (residential areas)	0	NA	ND	ND				
Commercial (2 properties) <sup>(h)</sup>	2 <sup>(i)</sup>	0	<b>1.8 - 3</b>	<b>2.4</b>				
The City Grill (patron area)	4	0	<b>3.5 - 5.4</b>	<b>4.9</b>				
The City Grill (basement)	10 [2] <sup>(j)</sup>	1 [2]	<b>1.2 - 31 J</b> <b>[20 - 63]</b>	<b>6.3</b> <b>[41.5]</b>				
Ambient Air (The City Grill)	4	NA	<b>ND - 1.8</b>	<b>1.1</b>				

- (a) - Micrograms per cubic meter of air  
(b) - Average of detected concentrations  
(c) - Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guideline: estimated benzene concentration that would be expected to cause no more than one excess cancer in a million (10<sup>6</sup>) persons exposed during their lifetime (70 years).  
(d) - Agency for Toxic Substances and Disease Registry Minimal Risk Levels: Acute = 1 to 14 day exposure; Chronic = greater than 365 day exposure.  
(e) - New Jersey Department of Environmental Protection Indoor Air Screening Level (residential and non-residential) for benzene.  
(f) - One residence excluded from evaluation due to sample bias from residual petroleum contamination associated with the May 2000 removal of a leaking 550 gallon No. 2 heating oil underground storage tank.  
(g) - September 17, 2003 and March 16, 2004 data excluded for one residence due to gasoline storage activities in sampling area; April 21, 2004 data excluded for one residence due to recent home improvement activities.  
(h) - Excluding The City Grill  
(i) - Consumer activities noted as potential interference (i.e. painting, smoking).  
(j) - Bracketed values represent sample information and concentrations prior to initiating mitigation measures in July 2003.  
J - Estimated value  
ND - Not Detected; NA - Not Applicable; Bold values indicate an exceedence of a comparison value.



**Table 2**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Indoor Air Results**  
**Evaluation of Detected Methyl-tert-butyl Ether Concentrations With Environmental Guideline**  
**Comparison Values**  
**Sample Data: May 2003 through November 2006**

Sample Location with Confirmed MTBE Concentrations	Number of Sample Detections	Range of Concentrations ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	Average Concentration ( $\mu\text{g}/\text{m}^3$ )	ATSDR EMEG <sup>(e)</sup> Intermediate/Chronic ( $\mu\text{g}/\text{m}^3$ )	USEPA RfC <sup>(f)</sup> ( $\mu\text{g}/\text{m}^3$ )	Exceedence of EMEG/RfC	COC <sup>(g)</sup>
Residential (6 Residences)	7 <sup>(a, b)</sup>	1.8 - 58	11.2	2,000	3,000	No	No
Ambient Air (Residential Locations)	2	1.9 - 3	3				
Commercial (2 properties) <sup>(d)</sup>	2	6.9 - 13	10				
The City Grill (Basement)	3	2.7 - 3.6	3.1				
Ambient Air (The City Grill)	4	ND - 16	5.3				

(a) - Micrograms per cubic meter of air

(b) - September 17, 2003 and March 16, 2004 excluded for one residence due to non-site related sources in sampling area (i.e. gasoline cans in basement).

(c) - Consumer activities noted as potential interference for four sampled residences.

(d) - Excluding The City Grill.

(e) - Agency for Toxic Substance and Disease Registry's Environmental Media Evaluation Guideline

(f) - United States Environmental Protection Agency's Reference Concentration: An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

(g) - Contaminant of Concern

ND - Not Detected

**Table 3**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Indoor Air Results**  
**Evaluation of Other Petroleum Related Compounds With Environmental Guideline Values**  
**Sample Data: May 2003 through November 2006**

Sample Location with Confirmed Contaminant Concentrations	Number of Sample Detections	Contaminant	Range of Concentrations ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	Average Concentration ( $\mu\text{g}/\text{m}^3$ )	Env. GV <sup>(b)</sup>	Contaminant of Concern
Residential (2 Residences)	2 <sup>(c)</sup>	1,2,4-Trimethylbenzene	10 - 170	90	NA	Yes
Residential (1 Residence)	1 <sup>(c)</sup>	1,3,5-Trimethylbenzene	59	59		
Ambient Air (Residential Locations)	0	1,2,4-Trimethylbenzene	ND	ND		
		1,3,5-Trimethylbenzene	ND	ND		
The City Grill (patron area)	2	1,2,4-Trimethylbenzene	3.7 - 4	3.9		
	2	1,3,5-Trimethylbenzene	0.98 - 1.2	1		
The City Grill (Basement)	3	1,2,4-Trimethylbenzene	1.3 - 6.7	4		
Ambient Air (The City Grill)	0	1,2,4-Trimethylbenzene	ND	ND		
		1,3,5-Trimethylbenzene	ND	ND		

(a) - micrograms per cubic meter of air

(b) - Environmental Guideline Comparison Value – None available.

(c) - Consumer activities noted as potential interference.

ND - Not Detected

NA – None Available

**Table 4**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Indoor Air Results**  
**Evaluation of Detected Ethylbenzene, Toluene, and Total Xylene Concentrations**  
**With Environmental Guideline Comparison Values**  
**Sample Data: May 2003 through November 2006**

Sample Location with Confirmed Concentrations	Number of Samples	Number of Sample Detections	Contaminant	Range of Concentrations ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	Average Concentration ( $\mu\text{g}/\text{m}^3$ )	CV <sup>(e)</sup> ( $\mu\text{g}/\text{m}^3$ )	Exceedence of CV	COC <sup>(h)</sup>
4 Residences <sup>(b,c)</sup>	7	4	Ethylbenzene	ND – 6.1	2.3	1,000 (RfC) <sup>(f)</sup>	No <sup>(i)</sup>	No <sup>(i)</sup>
12 Residences <sup>(b,c)</sup>	17	12	Toluene	2.3 – 37	11.8	300 (EMEG) <sup>(g)</sup>		
1 Residence <sup>(i)</sup>	3	1	Toluene	ND – <b>1,500</b>	NA	300 (EMEG)		
9 Residences <sup>(b,c)</sup>	16	11	Xylenes (total)	ND – 32.3	7	200 (EMEG)		
Commercial (2 properties) <sup>(d)</sup>	4	1	Ethylbenzene	ND - 2.5	1.2	1,000 (RfC)		
		4	Toluene	4.1 – 16	7.3	300 (EMEG)		
		3	Xylenes (total)	5.8 – 11.1	8.5	200 (EMEG)		
The City Grill (Patron Area)	3	2	Ethylbenzene	0.96 – 2.5	1.2	1,000 (RfC)		
		3	Toluene	3.3 – 9.4	6	300 (EMEG)		
		3	Xylenes (total)	2.3 – 8.8	4.9	200 (EMEG)		
The City Grill (Basement)	10	4	Ethylbenzene	ND – 2.9	0.6	1,000 (RfC)		
		8	Toluene	ND – 45	10.2	300 (EMEG)		
		7	Xylenes (total)	ND – 15.7	3.8	200 (EMEG)		
Ambient Air	4	0	Ethylbenzene	ND	ND	NA		
		2	Toluene	ND – 2.3	0.95			
		0	Xylenes (total)	ND	ND			

(a) - Micrograms per cubic meter of air; (b) - September 17, 2003 and March 16, 2004 data excluded for one residence due to gasoline storage activities in sampling area; April 21, 2004 data excluded for one residence due to recent home improvement activities.

(c) - Consumer activities noted as potential interference for four sampled residences.; (d) - Excluding The City Grill.; (e) – Comparison Values

(f) - United States Environmental Protection Agency's Reference Concentration: An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

(g) - Agency for Toxic Substance and Disease Registry's Environmental Media Evaluation Guideline; (h) - Contaminant of Concern

(i) – Note: One residence had a detection of Toluene at 1,500  $\mu\text{g}/\text{m}^3$  on September 17, 2003 and is considered a COC for this residence. Toluene was not detected in two follow-up samples at this residence. Therefore, the toluene detection for this residence is considered an anomaly likely due to consumer activities and has been separated from the data summary as a single occurrence. NJDEP noted there was an active smoker at this residence during the September 2003 sampling event.

ND - Not Detected

**Table 5: Uses and Typical U.S. Background Concentration of Selected Chemicals Detected in Residential and Commercial Indoor Air Samples near the Sal's Auto Repair Site, Neptune City, Monmouth County, NJ**

<b>Chemical</b>	<b>Usage<sup>a</sup></b>	<b>Sources of Common Exposure<sup>b</sup></b>	<b>Background Concentrations (<math>\mu\text{g}/\text{m}^3</math>)<sup>c</sup></b>
<b>Acetone</b>	Solvent; paint strippers; rubber cement; cleaning fluids; nail polish remover.	See Usage.	2 - 80 <sup>d</sup> ; 16 <sup>g</sup> ; 19 (indoor) <sup>g</sup>
<b>Benzene</b>	Solvents, gasoline, resins and plastics; nylon; paints; adhesives (especially carpet); printing; pesticides; detergents/disinfectants; dyes; photographic processing	Gasoline emissions; cigarette smoke; paints and adhesives; particle board and wood composites; wood smoke	1 (average outdoor – Monmouth County, New Jersey) <sup>h</sup>
<b>1,3-Butadiene</b>	Intermediate (potential impurity) in many plastics and polymers; fungicides; latex paint; acrylics; fuel formulations	Vehicle emissions; tobacco smoke; wood fires; waste incinerators; electric wire coatings; thermal degradation of plastics	0.38 (indoor) 14 (cigarette smoke) <sup>d</sup>
<b>Chloroform</b>	Refrigerant manufacturing; raw material for polytetrafluoroethylene plastics; insecticidal fumigant; solvent; cleansing agent in fire extinguishers; by-product in chlorination of potable water; former use in cough syrup, toothpastes, and toothache compounds..	Bathroom showers using chlorinated water; see Usage.	10-500 (10 min shower) <sup>d</sup> ; 0.5 - 4 <sup>d</sup> ; 0.1 - 2 <sup>g</sup>
<b>1,4 - Dichlorobenzene</b>	Deodorant; pesticide; resins and plastics; solvent; dyes; degreaser; wood preservative; motor oils; paint	Mothballs; toilet deodorants; air fresheners; tobacco smoke; pesticide application	3.45 (indoor non-smoker) <sup>d</sup> ; 10.22(indoor smoker) <sup>d</sup> ; 1 - 4 (average outdoor) <sup>d</sup> 0.08-240 (indoor - study) <sup>g</sup>
<b>Ethylbenzene</b>	Production of synthetic rubber; general and resin solvent; gasoline additive.	Self-serve gasoline fill-ups; vehicle emissions; painting; new or remodel construction.	1 - 12 (outdoor - average) <sup>d</sup>
<b>n-Hexane</b>	Gasoline; rubber cement; typing correction fluid; perfume aerosols; cleaning agent; paint diluent; alcohol denaturant; solvent in extraction of soybean oil, cottonseed oil and other seed oils. Constituent in natural gas.	Combustion of motor fuels, heating oil fuels or other petroleum products; natural gas; glues, stains, paints, varnishes, adhesives, and cleaning agents.	14 (average outdoor) <sup>d</sup> ; 7 <sup>g</sup>
<b>Methylene Chloride</b>	Industrial solvent; hairspray; paint strippers; spray paint; rug cleaners; insecticides; furniture polish.	See Usage	Less than 10 <sup>d</sup> ; 0.17 (average) <sup>g</sup>
<b>Methyl t-Butyl Ether (MTBE)</b>	Used as an octane booster in gasoline (gasoline refinement)	Automobile gasoline refueling; inside automobiles when driving; refueling lawn mowers; chain-saws; or other gasoline-powered equipment	3.6 (median) <sup>d</sup> ; Less than 1 (estimated average) <sup>f</sup>

**Table 5: (Cont'd.)**

<b>Chemical</b>	<b>Usage<sup>a</sup></b>	<b>Sources of Common Exposure<sup>b</sup></b>	<b>Background Concentrations (<math>\mu\text{g}/\text{m}^3</math>)<sup>c</sup></b>
<b>Tetrachloroethylene (PCE)</b>	Solvent; degreaser; dry cleaning and textile production; water repellants; pharmaceuticals; pesticides; refrigerants; insulating fluids; correction fluid (e.g., white out) and inks; adhesives	Dry cleaned garments; paint removers; fabric cleaning products (e.g., stain removers, etc.); lubricants; wood products	1-4 (average) <sup>d</sup> ; 7 (average) <sup>g</sup>
<b>1,2,4-Trimethylbenzene</b>	Dyes, fragrances, and plastics; solvent and paint thinner; sterilizing agent; degreaser; gasoline additive; synthetic wood products.	Self-serve gasoline fill-ups; indoor painting or printing	10-12 (indoor) <sup>d</sup> 2.8 - 5.9 (outdoor) <sup>f</sup>
<b>1,3,5-Trimethylbenzene</b>	Building materials; Dyes; UV inhibitor in plastics; solvent and paint thinner; gasoline additive.	Self-serve gasoline fill-ups; indoor painting or printing; new or remodel construction.	3-8 (indoor) <sup>d</sup> 3-15 (outdoor) <sup>d</sup>
<b>Toluene</b>	Manufacture of benzoic acid, explosives, dyes, artificial leather, perfumes; solvent for paints, lacquers, gums, and resins; printing inks; gasoline additive; spot removers; cosmetics; antifreeze; adhesive solvent in plastic toys and model airplanes.	Self-serve gasoline fill-ups; vehicle emissions; cigarette smoke; consumer products; nail polish; indoor painting; new or remodel construction (carpets).	3 - 140 (outdoor) <sup>d</sup> 42 (outdoor - average) <sup>d</sup> 20 – 60 $\mu\text{g}/\text{cigarette}$ <sup>d</sup>
<b>Xylenes (Total)</b>	Manufacture of benzoic acid; dyes, hydrogen peroxide, perfumes, insect repellants, epoxy resins, pharmaceuticals, paints, varnishes, general solvent for adhesives and paints; gasoline additive; used in leather industry.	Self-serve gasoline fill-ups; vehicle emissions; indoor painting; new or remodel construction.	17 (outdoor - average) <sup>d</sup>

<sup>a</sup>National Library of Medicine's (NLM) Hazardous Substances Data Bank (HSDB)

<sup>b</sup>ATSDR Toxicological Profile

<sup>c</sup>The background concentrations presented are not specific to the Sal's Auto Repair site in particular, but are presented to provide the homeowner some perspective as to levels typically found in U.S. homes

<sup>d</sup>HSDB, 2002, at [www.toxnet.nlm.nih.gov](http://www.toxnet.nlm.nih.gov)

<sup>e</sup>Chemical profiles at [www.scorecard.org](http://www.scorecard.org)

<sup>f</sup>EPA, 1988

<sup>g</sup>Tox Profile at [www.atsdr.cdc.gov](http://www.atsdr.cdc.gov)

<sup>h</sup>EPA, 1999

**Table 6**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Residential Sub-Slab Gas Results**  
**Sample Date: September 1, 2004**

Sample Location	Number of Samples	Contaminant	Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	NJDEP Health-Based Soil Gas Screening Levels ( $\mu\text{g}/\text{m}^3$ )
2 Residences	1	ND	-	-
1 Residence	1	Methylene Chloride	35	190
1 Residence	2	Acetone	210	160,000
		Methylene Chloride	26	190
1 Residence <sup>(b)</sup>	1	Acetone	130	160,000
		MTBE	26	78
		n-Hexane	160	10,000
		Toluene	38	21,000

(a) micrograms per cubic meter of air

(b) Contaminants found at this residence are likely the result of residual petroleum contamination associated with the May 2000 removal of a leaking 550 gallon No. 2 heating oil underground storage tank. This property has been excluded from further evaluation.

ND – None Detected

MTBE – Methyl-tert-butyl Ether

**Table 7**

**Sal's Auto Repair Site, Neptune City, Monmouth County**

**Groundwater - Environmental Guideline Comparison Value Evaluation**

Contaminant	Former Mobil Service Station/NJDOT February 1993 - April 2004			Sal's Auto Repair October/December 2003			The City Grill Property <sup>(2)</sup> March/May 2003			ATSDR CV <sup>(3)</sup> (ug/l)	COC <sup>(7)</sup>
	Number of Samples	Range of Concentrations (ug/l) <sup>(1)</sup>	Mean Concentration (ug/l)	Number of Samples	Range of Concentrations (ug/l)	Mean Concentration (ug/l)	Number of Samples	Range of Concentrations (ug/l)	Mean Concentration (ug/l)		
Benzene	233	ND - <b>4,090</b>	<b>146</b>	8	<b>2 - 2,270</b>	<b>1,016</b>	23	ND - <b>2,120</b>	<b>318</b>	0.6 <sup>(4)</sup>	<b>Yes</b>
Toluene		ND - <b>13,600</b>	<b>453</b>		ND - <b>21,500</b>	<b>8,549</b>		ND - <b>9,290</b>	<b>629</b>	200 <sup>(5)</sup>	<b>Yes</b>
Ethylbenzene		ND - <b>1,630</b>	145		ND - <b>3,930</b>	<b>1,393</b>		ND - <b>1,970</b>	235	700 <sup>(6)</sup>	<b>Yes</b>
Total Xylenes		ND - <b>9,440</b>	656		ND - <b>20,100</b>	<b>6,852</b>		ND - <b>8,530</b>	893	6,000 <sup>(5)</sup>	<b>Yes</b>
MTBE		ND - <b>16,500</b>	556		ND - 5	1		ND - 48	5	3,000 <sup>(5)</sup>	<b>Yes</b>

(1) - Micrograms per liter

(2) - Expanded investigation area for the Former Mobil Service Station/NJDOT and Sal's Auto Repair sites

(3) - Agency for Toxic Substance and Disease Registry's Comparison Value

(4) - Agency for Toxic Substance and Disease Registry's Cancer Risk Evaluation Guide

(5) - Agency for Toxic Substance and Disease Registry's Environmental Media Evaluation Guide

(6) - Agency for Toxic Substance and Disease Registry's Lifetime Health Advisory

(7) - Contaminant of Concern

(8) - No further evaluation required

**Bold font represents an exceedance of the environmental guideline comparison value**

**Table 8****Sal's Auto Repair, Neptune City, Monmouth County****Evaluated Exposure Pathways**

Source	Pathway	Exposure Pathway Elements				Pathway Classification
		Environmental Medium	Point of Exposure	Route of Exposure	Exposed Population	
Indoor Air	Insufficient Data	Indoor Air	Residences	Inhalation	Local Residents	Past – Completed Current & Future - Interrupted
			Commercial Properties		Employees & Patrons	
Contaminated Subsurface Media	Soil Gas & Groundwater	Indoor Air (Vapor Intrusion)	The City Grill	Inhalation	Employees & Patrons	Past – Completed Current & Future - Interrupted



**Table 9**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Summary of Indoor Air Results**  
**Comparison of Time-Weighted Average Indoor Air Benzene Concentrations With Health Guideline**  
**Comparison Values**  
**Sample Data: May 2003 through November 2006**

Confirmed Benzene Concentrations	Average Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )	Daily Estimated Exposure (hrs/day)	TWA <sub>a</sub> Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(b)</sup>	TWA <sub>m</sub> Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(c)</sup>	CREG ( $\mu\text{g}/\text{m}^3$ ) <sup>(d)</sup>	ATSDR MRLs <sup>(e)</sup> ( $\mu\text{g}/\text{m}^3$ )		NJDEP IASL <sup>(f)</sup>
							Chronic	Acute	
Commercial (2 properties) <sup>(g)</sup>	2.4	3	12	<b>1.2</b>	<b>1.5</b>	0.1	10	30	2
The City Grill (patron area)	5.4	5.4		<b>2.7</b>	<b>2.7</b>				
The City Grill (basement)	6.3 [41.5] <sup>(h)</sup>	31 J [63]		<b>3.2</b> [21]	<b>16</b> [31.5]				

(a) - Micrograms per cubic meter of air

(b) - Time-Weighted Average based on average concentrations.

(c) - Time-Weighted Average based on maximum concentrations.

(d) - Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guideline: estimated benzene concentration that would be expected to cause no more than one excess cancer in a million (10-6) persons exposed during their lifetime (70 years).

(e) - Agency for Toxic Substances and Disease Registry Minimal Risk Levels: Acute = 1 to 14 day exposure; Chronic = greater than 365 day exposure.

(f) - New Jersey Department of Environmental Protection Indoor Air Screening Level (residential and non-residential) for benzene.

(g) - Excluding The City Grill

(h) - Bracketed values represent sample information prior to initiating mitigation measures in July 2003.

J - Estimated value

Bold values indicate an exceedence of a comparison value.

**Table 10**  
**Sal's Auto Repair, Neptune City, Monmouth County**  
**Calculated Lifetime Excess Cancer Risk (LECR) for Past Exposures**  
**Based on Indoor Air Results For Benzene**  
**Sample Data: May 2003 through November 2006**

Sample Location	Exposed Population	Exposure Duration (Years)	Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>(a)</sup>	USEPA CSFi <sup>(b)</sup> ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>-1</sup>	Exposure Dose ( $\text{mg}/\text{kg}/\text{day}$ )	LECR Average (maximum)
Residential (6 residences)	Adult	54	5.7 (14) <sup>(c)</sup>	0.027	$1.3 \times 10^{-3}$ * ( $3.1 \times 10^{-3}$ )*	$3.4 \times 10^{-5}$ ( $8.4 \times 10^{-5}$ )
	Child	18			$5.3 \times 10^{-4}$ ** ( $1.3 \times 10^{-3}$ )**	$1.4 \times 10^{-5}$ ( $3.5 \times 10^{-5}$ )
Commercial (2 properties)	Adult Employee	54	$1.2$ <sup>(d)</sup> (1.5)		$1.4 \times 10^{-4}$ *** ( $1.7 \times 10^{-4}$ )**	$4 \times 10^{-6}$ ( $5 \times 10^{-6}$ )
The City Grill	Adult Employee	53	$21$ <sup>(d)</sup> (31.5)		$2.4 \times 10^{-3}$ *** ( $3.5 \times 10^{-3}$ )**	$6.4 \times 10^{-5}$ ( $9.6 \times 10^{-5}$ )

(a) - micrograms per cubic meter of air

(b) - Cancer slope factor for human inhalation exposure

(c) - Maximum values are indicated in parenthesis.

(d) - Benzene concentrations were adjusted to reflect Time Weighted Average exposure concentrations based on business hours of operation.

\* Maximum and Average Adult Residential Exposure Assumptions:  $20 \text{ m}^3/\text{day}$ , 365 days per year exposure frequency at 24 hours per day, 70 years averaging time, 70kg body weight (USEPA 2002d).

\*\* Maximum and Average Child Residential Exposure Assumptions:  $12 \text{ m}^3/\text{day}$ , 365 days per year exposure frequency at 24 hours per day, 70 years averaging time, 32.7kg body weight (USEPA 2002d).

\*\*\* Maximum and Average Adult Employee Exposure Assumptions:  $20 \text{ m}^3/\text{day}$ , 365 days per year exposure frequency at 12 hours per day, 70 years averaging time, 70kg body weight (USEPA 2002d).

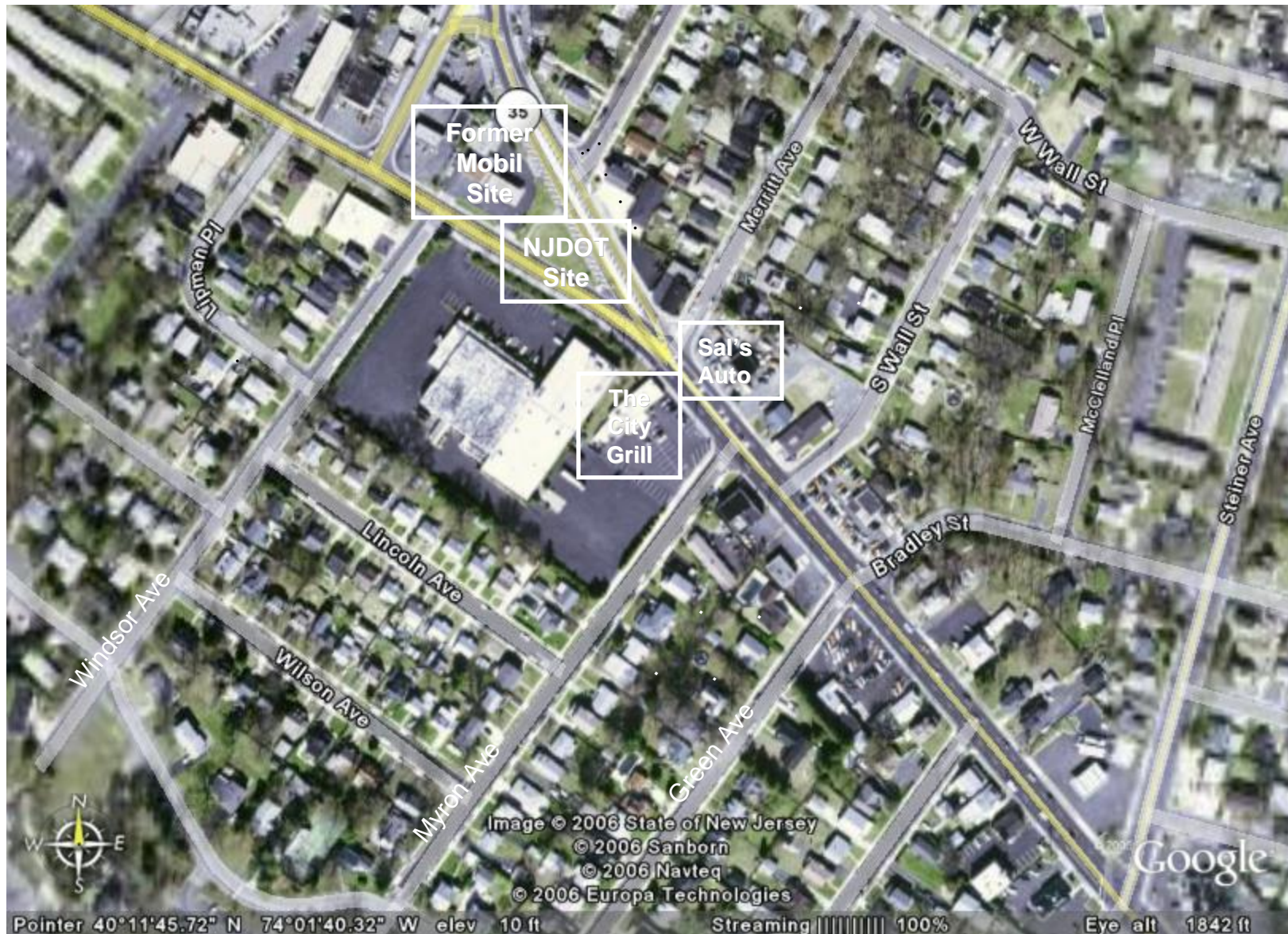
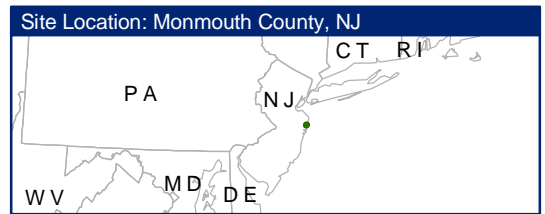
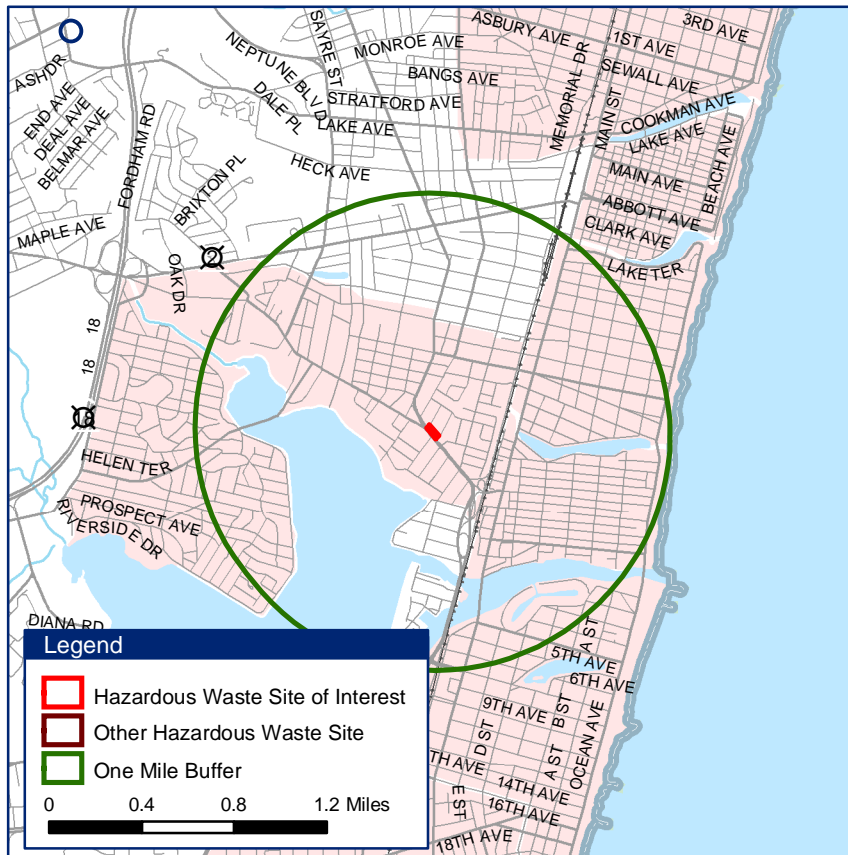


Figure 2: Photograph showing Sal's Auto Repair, the Former Mobil Site, the New Jersey Department of Transportation site and the surrounding residential areas.

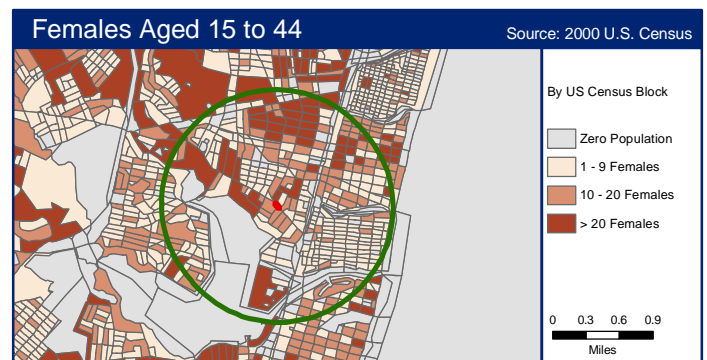
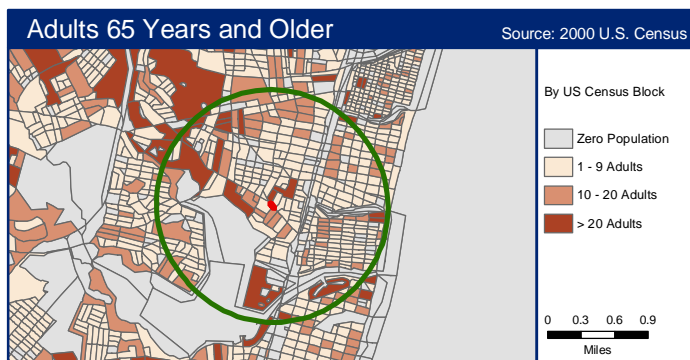
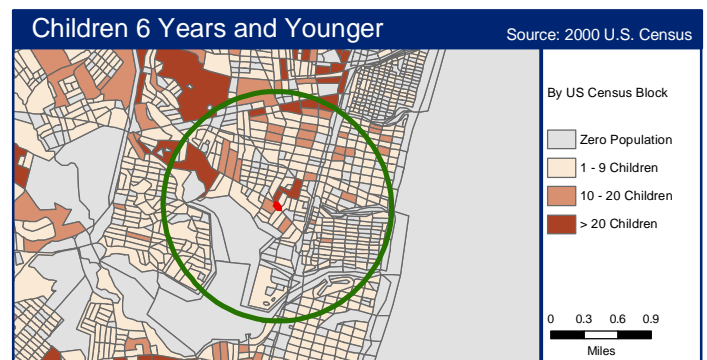
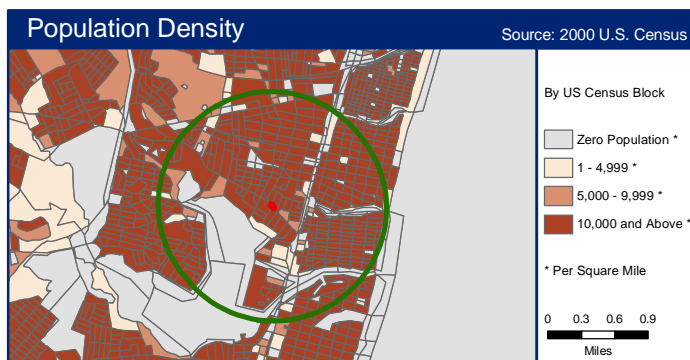


**Demographic Statistics**  
 Within One Mile of Site\*

Total Population	15,205
White Alone	12,159
Black Alone	2,072
Am. Indian & Alaska Native Alone	32
Asian Alone	163
Native Hawaiian & Other Pacific Islander Alone	2
Some Other Race Alone	450
Two or More Races	327
Hispanic or Latino**	1,219
Children Aged 6 and Younger	1,236
Adults Aged 65 and Older	2,388
Females Aged 15 to 44	3,112
Total Housing Units	7,394

Base Map Source: Geographic Data Technology, May 2005.  
 Site Boundary Data Source: ATSDR Public Health GIS Program, May 2005.  
 Coordinate System (All Panels): NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Demographics Statistics Source: 2000 U.S. Census  
 \* Calculated using an area-proportion spatial analysis technique  
 \*\* People who identify their origin as Hispanic or Latino may be of any race.



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Figure 3: Demographic Information of the Sal's Auto Repair site based on 2000 U.S. Census.



Photograph 1: Sal's Auto Repair.



Photograph 2: Two aqueous-phase carbon beds for the groundwater treatment system on the Sal's Auto Repair site.



Photograph 3: Groundwater treatment system on the Sal's Auto Repair site.



Photograph 4: Groundwater extraction and vapor head-space recovery points for the treatment system located on The City Grill property.



Photograph 5: Vapor-phase carbon treatment drums for the sub-slab vapor recovery system located on The City Grill property.



Photograph 6: Location of The City Grill with the Mobil Service Station visible in the background. The New Jersey Department of Transportation site is the triangular grass-covered patch in front of the Mobil station.

## **Appendix A**

### **Indoor Air Quality Information Sources**



The following sources of information are provided as a reference to homeowners and business owners regarding actions and preventative measures on how to help improve the quality of indoor air within their homes or workplace.

“Healthy Indoor Air for America’s Homes – Indoor Air Hazards Every Homeowner Should Know About.” USEPA. EPA 402-K-98-002. June 2002 available at:  
<http://www.montana.edu/wwwcxair/>

“The Inside Story – A Guide to Indoor Air Quality.” USEPA. EPA 402-K-93-007. April 1995 available at:  
<http://www.epa.gov/iaq/pubs/index.html>

“Health Buildings, Health People: A Vision for the 21<sup>st</sup> Century.” USEPA. EPA 402-K-01-003. October 2001 available at:  
<http://www.epa.gov/iaq/pubs/index.html>

“Indoor Air Pollution: An Introduction for Health Professionals.” USEPA. EPA 402-R-94-007. 1994 available at:  
<http://www.epa.gov/iaq/pubs/index.html>

“What You Should Know About Using Paint Strippers.” Consumer Product Safety Commission. CPSC Publication # F-747-F-95-002. February, 1995 available at:  
[www.cpsc.gov/cpscpub/pubs/423.html](http://www.cpsc.gov/cpscpub/pubs/423.html)

“Healthy Indoor Painting Practices.” USEPA. EPA 744-F-00-001. May 2000 available at:  
[www.cpsc.gov/cpscpub/pubs/456.pdf](http://www.cpsc.gov/cpscpub/pubs/456.pdf)

Many of these sources are available in print through the website contact or through:

New Jersey Department of Health and Senior Services  
Indoor Environments Program  
PO Box 369  
Trenton, NJ 08625-0369  
609-631-6749  
Access on line at:<http://www.state.nj.us/health/eoh/tsrp/index.html>

**Appendix B**  
**Toxicological Summaries**

The toxicological summary provided in this appendix is based on ATSDR's ToxFAQs (<http://www.atsdr.cdc.gov/toxfaq.html>), NJDHSS Fact Sheets, and USEPA Chemical Fact Sheets. Health effects are summarized in this section for the chemical of concern found in indoor air at residences and commercial properties located near the Sal's Auto Repair site. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

***Benzene*** Benzene is a widely used chemical formed from both natural processes and human activities. It is highly flammable liquid at room temperature. It evaporates easily into the air and has a sweet odor. Benzene is one of the top 20 chemicals used in the United States industry. Industries mix benzene with other chemicals to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

Breathing very high levels of benzene can cause death while breathing high concentrations of benzene can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. Long-term exposure to benzene (365 days or longer) can cause harmful effects on the bone marrow, can cause a decrease in red blood cells leading to anemia, and can cause excessive bleeding. Benzene can cause impairment of the immunity system increasing the chance of infection. Studies have shown some women exposed to high levels of benzene in air for many months had irregular menstrual periods and a reduced size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men. Studies have shown that pregnant animals exposed to benzene in air resulted in low birth weights, delayed bone formation, and bone marrow damage.

The United States Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

***1,2,4-Trimethylbenzene*** 1,2,4-Trimethylbenzene, also called TMB or pseudocumene, is primarily used as a gasoline additive, which comprises roughly 99% of its production volume. Other uses of 1,2,4-trimethylbenzene include solvents, cleaners, pesticides, gasoline, vehicle combustion, dyes, fragrances, sterilizing agents, degreasing agents, printing operations and inks. It is a colorless flammable liquid with a distinct odor. It occurs naturally in coal tar and petroleum crude oil.

Breathing high concentrations can irritate the lungs, cause coughing, shortness of breath, headache, fatigue, dizziness, confusion, and lightheadedness. Breathing very high concentrations can lead to a build-up of fluid in the lungs (pulmonary edema). Long-term exposure to 1,3,5-trimethylbenzene can cause an asthma-like condition including shortness of

***1,3,5-Trimethylbenzene*** 1,3,5-Trimethylbenzene, also called Mesitylene, has various uses in industry and by consumers as an intermediate in dye manufacturing, solvent, paint thinner and as an antioxidant in plastics, adhesives, rubber and waxes. It is a colorless flammable liquid with a distinct odor. Breathing high concentrations can irritate the lungs, cause coughing, shortness of breath, headache, fatigue, dizziness, confusion, and lightheadedness. Breathing very high concentrations can lead to a build-up of fluid in the lungs (pulmonary edema). Long-term exposure to 1,3,5-trimethylbenzene can cause an asthma-like condition including shortness of breath, wheezing, cough, and/or chest tightness. 1,3,5-Trimethylbenzene is not known to cause cancer.

**Toluene** Toluene occurs naturally in crude oil and is a component in gasoline and other fuels. It is also used in making various products including paints, paint thinners, fingernail polish, lacquers, adhesives, rubber, and in some printing and leather tanning processes. It is a colorless liquid with a distinctive smell. Toluene may affect the nervous system. Breathing low to moderate levels in air can cause tiredness, confusion, weakness, memory loss, nausea, loss of appetite, and hearing/color vision loss. These symptoms usually disappear when the exposure is stopped. Inhaling high levels of toluene in a short period can make a person feel light-headed, dizzy, or sleepy. It can also cause unconsciousness or death. High levels of toluene may also affect kidney function. The health effects seen in children exposed to toluene are similar to those effects seen in adults. Breathing very high levels during pregnancy can cause birth defects, mental handicaps, and growth abnormalities in children. Toluene is not known to cause cancer.

## **Appendix C**

### **ATSDR Conclusion Categories**

## Summary of ATSDR Conclusion Categories

Category	Definition
1: Urgent Public Health Hazard	Applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects and require quick intervention to stop people from being exposed.
2: Public Health Hazard	Applies to sites that have certain physical hazards or evidence of chronic, site-related exposure to hazardous substances that could result in adverse health effects.
3: Indeterminate Public Health Hazard	Applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard.
4: No Apparent Public Health Hazard	Applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels expected to cause adverse health effects.
5: No Public Health Hazard	Applies to sites where no exposure to site-related hazardous substances exists.

## **Appendix D**

### **ATSDR Glossary of Terms**

## **ATSDR Glossary of Terms**

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-ATSDR (1-888-422-8737).

The glossary can be accessed online at <http://www.atsdr.cdc.gov/glossary.html>

Other glossaries and dictionaries:

Environmental Protection Agency (<http://www.epa.gov/OCEPATERMS/>)

National Center for Environmental Health (CDC)  
(<http://www.cdc.gov/nceh/dls/report/glossary.htm>)

National Library of Medicine (NIH)  
(<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>)

For more information on the work of ATSDR, please contact:

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Agency for Toxic Substances and Disease Registry  
1600 Clifton Road, N.E. (MS E-60)  
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Telephone: (404) 498-0080