



November 20, 2023

Ms. Tonya Howell  
Remedial Project Manager  
Site Remediation West Section  
Superfund and Emergency Management Division  
11201 Renner Boulevard  
Lenexa, Kansas 66219

<submitted electronically [Howell.Tonya@epa.gov](mailto:Howell.Tonya@epa.gov) and [Curry.James@epa.gov](mailto:Curry.James@epa.gov)>

Re: **Huster Substation, Findett Superfund Site, OU4 (MOD006333975), St. Charles, Missouri – Technical Memorandum on Water Quality Impacts of Remedial Measures**

Dear Ms. Howell,

As you are aware, there have been unsubstantiated suggestions that remedial measures approved by the United States Environmental Protection Agency (USEPA) and implemented by Ameren Missouri (Ameren) at the Huster Substation have had a negative impact on groundwater quality within the aquifer. To close the loop on these issues, our environmental consultant Loureiro Environmental Associates (Loureiro) has evaluated this issue and provide the attached Technical Memorandum wherein they assess the impact of each of the various technologies employed at the site. Loureiro's conclusions are summarized below and discussed more fully in the memorandum:

- The in-situ remedial activities implemented on the Substation and in areas associated with the Substation consist of ISCO, ISCR, ERD, and GETS. Each of the ISCO, ISCR, and ERD technologies have a temporary impact on groundwater quality; however, the impacts are localized to the immediate area of technology application. The GETS only impacts water levels and has no negative impact on groundwater quality.
- Relevant literature referenced herein, and available site data validate the localized nature of the impacts of these types of remedial activities on the shallow groundwater quality on the Substation and in the surrounding City well field.
- Further, as reflected in a previous submission relative to naturally occurring ammonia, remedial activity applications at the substation showed no significant changes in groundwater quality relative to untreated areas including CW-10.
- The remedial activities implemented on the Substation resulted in a 75% reduction in total cis-DCE and VC flux to the GETS system, from 2014, prior to remedial activities implementation on the Substation, through August 2023.

Also included as part of this analysis are modeling depictions prepared by GSI Environmental Inc. that assess travel times to City wells under a variety of pumping regimes. As you are aware, depending upon the combination of wells operating, groundwater divides are created which impact groundwater flow and allow for greater natural attenuation and/or treatment from the ISCO, ERD and/or ISCR barriers. Subsurface treatment walls have been installed at the substation property and offsite and are strategically located to protect the City's well system. I hope EPA finds the information useful and I am happy to arrange a conference call with our technical team if you have any questions.

For questions, please contact me at 314-488-0151.

Sincerely,

A handwritten signature in cursive script that reads "LAMeyer".

Lisa A. Meyer  
Manager, Environmental  
Ameren Missouri  
[Lmeyer2@ameren.com](mailto:Lmeyer2@ameren.com)

Cc: C. Giesmann, Ameren  
S. Knowles, Ameren  
J. Martin, Ameren

File: SharePoint

# TECHNICAL Memorandum

## Assessment of Groundwater Quality Impacts Resulting from Huster Substation Remedial Activities: Operable Unit 4 (OU4), CERCLA No. 07-2012-0026.

---

### SUMMARY

Under the supervision and direction of the United States Environmental Protection Agency (EPA), Ameren has conducted in-situ interim remedial activities in shallow groundwater at the Huster Substation (Substation) since 2014. The in-situ activities implemented on-site and in areas associated with the site consist of the following: chemical oxidation (ISCO); chemical reduction (ISCR); enhanced reductive dechlorination (ERD a.k.a. bioremediation); and a groundwater extraction and treatment system (GETS). Each of these technologies, except for the GETS, has a **temporary impact** on groundwater quality that is localized to the immediate area of technology application. This conclusion is supported by significant relevant literature and confirmed by available site data that demonstrates the localized nature of the impacts of these types of remedial activities on the shallow groundwater quality. Further, the ammonia data evaluation, previously provided to the EPA demonstrates that there were no significant changes in groundwater quality with respect to ammonia relative to untreated areas (*Ameren, 2023*). In fact, the significant groundwater quality change associated with the remedial activities at the Substation is a 75 percent (%) to 81% reduction in total 1,2-cis-dichloroethene (cis-DCE) and vinyl chloride (VC) flux to the GETS system, as measured at the GETS influent and at the primary GETS extraction well (MW-5) for the period 2014 through August 2023, respectively. Such flux reduction is depicted in Table 1.

### OBJECTIVES

This Technical Memorandum addresses the following:

1. Document the degree and extent of remedial activities (ISCO, ISCR, ERD, and GETS) applied in shallow groundwater at the Substation and associated off-site areas, and the relevant groundwater modeling performed to assess the impacts of the remedial activities on the groundwater quality at the City of St. Charles (City) water supply wells.
2. Provide literature references on the time dependent impact of the remedial activities on groundwater quality inside and outside the areas of application, with respect to Substation specific conditions and relevant regulatory criteria on water use.
3. Provide site-specific data to demonstrate consistency with observations reported in the scientific literature regarding impacts to groundwater quality from the remedial technologies implemented.
4. Document the decrease in concentration levels for cis-DCE and VC at the GETS and the continued treatment effectiveness of the remedial activities.
5. City well capture and groundwater travel times analyses under various pumping scenarios.
6. Groundwater divides areas are created under various pumping scenarios. Such areas can increase travels times to City wells which provides increased exposure within treatment zones and buffering within the aquifer to enhance attenuation and treatment of the cis-DCE and VC and associated water quality parameters.

## 1. REMEDIAL TECHNOLOGIES IMPLEMENTED IN SHALLOW GROUNDWATER AT SUBSTATION AND IN ASSOCIATED AREAS OFF THE SUBSTATION PROPERTY:

A general description of the four remedial technologies implemented in the shallow groundwater at the Substation are provided below:

- 1.1. **ISCO** (in-situ chemical oxidation) typically involves reduction/oxidation (redox) reactions that chemically convert contaminants in soil and groundwater to compounds that are more stable, less mobile or inert. ISCO is an aggressive remediation technology that has been applied to a wide range of volatile and semi-volatile contaminants, including dense non-aqueous phase liquid (DNAPL) source zones and the dissolved-phase chemicals emanating from source zones. The oxidizing agents most used for treatment of contaminants in soil and groundwater are hydrogen peroxide, catalyzed hydrogen peroxide, potassium permanganate, sodium permanganate, sodium persulfate, and ozone. Each oxidant has advantages and limitations. Sodium persulfate was the oxidant selected for use in the shallow groundwater at the Substation due to its relative longevity and reactivity with the contaminants and other materials requiring oxidation at the Substation (e.g., added vegetable oils to promote biodegradation in areas of the Substation). Potassium permanganate was also applied, exclusively, to the unsaturated clays above the water table at the Substation; since the permanganate was not applied or did not leach into the shallow groundwater<sup>1</sup>, it is not discussed further in this memorandum.
- 1.2. **ISCR** (in-situ chemical reduction) places a reductant or reductant-generating material in the subsurface to degrade organic compounds to stable or inert compounds. It can also immobilize metals by adsorption or precipitation and degrades non-metallic oxyanions. The most applied reductant is zero valent iron (ZVI), which is used to remediate halogenated ethenes and certain ethanes, energetics, and some metals/metalloids. Other reductants that are used to address metals include ferrous iron, sodium dithionite, sulfide salts (calcium polysulfide), and hydrogen sulfide. EHC® was selected for application at the Substation; EHC® consists of a blend of ZVI and an organic food source to promote complementary biological degradation of the primary chlorinated ethenes present at the Substation, cis-DCE and VC. ISCR is often applied as permeable reactive barriers (PRBs). A PRB is a subsurface emplacement of reactive materials through which a dissolved contaminant must move as it flows, typically under a natural hydraulic gradient. Treated water exits the downgradient side of the PRB. PRBs can be installed as permanent or semi-permanent units. There are several methods to install PRBs, and at the Substation injection techniques were used to construct the subsurface PRBs. Injection points are spaced to provide overlapping radii of influence between them, forming a free-standing treatment zone. The design width of the treatment zone (i.e., number of lines of injection points perpendicular to groundwater flow) is based on the radius of injection and in providing sufficient residence time within the PRB to allow the contaminants to be reduced in concentration from the levels measured approaching the PRB to the site-specific goals for the PRB treatment.
- 1.3. **ERD** (enhanced reductive dechlorination/bioremediation) uses natural microorganisms existing within the aquifer and, in some cases, added to the aquifer to degrade organic contaminants on soil and in groundwater. Microorganisms break down the contaminants by using them as an energy source or co-metabolizing them using an alternate energy source. A delivery system that provides one or more of the following is generally required: an energy source (electron donor, typically vegetable oils), an electron acceptor (in this case the cis-DCE and VC), and nutrients. Other types of microbial electron acceptor classes can be involved in bioremediation, such as oxygen-, nitrate-, manganese-, iron (III)-, sulfate-, or carbon dioxide-

---

<sup>1</sup> Permanganate can leave a distinctive pink/purple hue should the material permeate into groundwater. No such discoloration was observed during follow up monitoring events.

reducing. Generally, electron donors, electron acceptors and nutrients are the most critical components of any delivery system. At some sites with chlorinated hydrocarbon contamination, it is necessary to introduce specialty natural microorganisms, if not present at the site already in sufficient numbers. This form of enhanced biodegradation is known as bioaugmentation. Bioaugmentation was applied at the Substation.

1.4. **GETS** (groundwater extraction and treatment system) uses extraction wells to pump affected groundwater to an aboveground treatment system that removes the contaminants from the recovered groundwater. Not only does the system treat affected groundwater, but pumping from the extraction wells helps to prevent the migration of affected groundwater that would otherwise move in the direction of the natural hydraulic gradient. In the case of the Substation GETS, the system is comprised of (a) three extraction wells, MW-5, MW-6, and MW-7, all screened from approximately 35 to 45 feet (ft) below ground surface (bgs), and (b) an aboveground low profile sieve air stripper to remove cis-DCE and VC from the extracted groundwater. The GETS Design Package (GSI, 2013) calculated that the air stripper could remove greater than 99.9 % of cis-DCE and VC in the recovered groundwater. Treated groundwater is then discharged to a nearby, onsite drainage ditch in accordance with a National Pollutant Discharge Elimination System (NPDES) permit issued to Ameren by the Missouri Department of Natural Resources (MDNR).

## 2. **IMPLEMENTATION OF THE SELECTED REMEDIAL TECHNOLOGIES IN SHALLOW GROUNDWATER AT THE SUBSTATION AND EXPECTATIONS ON IMPACTS TO GROUNDWATER QUALITY:**

### 2.1. **ISCO**

#### 2.1.1. ***Chemistry of Alkaline Activated Persulfate.***

The persulfate anion is a strong oxidant; however, the persulfate anion typically has slow oxidative kinetics at ordinary temperatures for most contaminant species and really can only be applied to a limited number of contaminants, such as trichloroethene (TCE) or xylene, to be effective. As a result, persulfate is typically “activated” to oxidize most contaminants of concern. Alkaline activated persulfate forms oxidative radical species, reductants, and nucleophiles. This multi-radical attack allows the treatment of chlorinated ethenes (TCE, perchloroethene [PCE], cis-DCE, and VC), 1,4-dioxane, petroleum hydrocarbons, pesticides, as well as more recalcitrant compounds including chlorinated methanes, such as carbon tetrachloride, and chlorinated ethanes, such as 1,1,1-trichloroethane. Alkaline activated sodium persulfate was applied at the Substation. Residual effects from the persulfate application are elevated pH (greater than pH of 10.5 is required for activation), sodium ion, and sulfate ion. SDS’s for sodium persulfate and sodium hydroxide (activator) are included in Attachment A. The effects are contained within the local area of application and are either quickly flushed from the system via natural or induced groundwater flow (e.g., sodium), or quickly react with the natural soils and are thereby eliminated from the groundwater. Further, the localized geochemical changes to the groundwater can cause the dissolution of some of the metals that naturally exist in the soils. However, once outside the local area of geochemical changes (typically within several feet of the chemical application), the dissolved natural metals precipitate back onto the natural soils and are thereby eliminated from the flowing groundwater (*Kemps, et. al., 2010*).

#### 2.1.2. ***Frequency, Locations, Quantities of ISCO Amendments Added to Substation.***

ISCO, using alkaline activated persulfate, in shallow groundwater was applied at the Substation, primarily in 2023, Table 2 documents the timing and dosages of the ISCO

amendments applied at the Substation. Figure 1 presents the well locations where the ISCO was applied. The total amounts of ISCO amendments applied into the shallow groundwater within the Substation from 2014 through September of 2023 was approximately 216,000 pounds (lbs.) of sodium persulfate and 336,000 lbs. of sodium hydroxide. An additional approximate persulfate mass of 23,700 lbs. was applied in 2014 to the area north of the Substation in the vicinity of CW-5, through temporary injection points.

### **2.1.3. *Literature review of expected impacts of the ISCO on area water quality relative to regulatory criteria for water use.***

As documented in the *Interstate Technology and Regulatory Council's (ITRC) ISCO guidance document (2005)*, adding an oxidant to groundwater may result in secondary impacts to water quality. However, as noted in the ITRC guidance document, any potential secondary impacts to water quality are localized and short term due to the buffering capacity of the aquifer soils. For ISCO injections using alkaline activated sodium persulfate, expected secondary groundwater impacts would include a temporary elevated pH of the groundwater due to the addition of the sodium hydroxide. However, the pH will reduce back to background levels over a typical period of 1 to 4 months following injection, as the hydroxide will be expended by the formation of acid from the dissociation of the persulfate. There will also be a temporary mobilization of metals due to the changes in the geochemistry (pH and Eh) caused by the addition of the oxidizing agent; however, the natural buffering capacity of the aquifer soils aid the return of the groundwater pH to background levels and reprecipitation of the metals onto the natural soils. In most cases, field and laboratory data have shown that the metals liberated by oxidation are readily attenuated back to background conditions.

## **2.2. *ISCR***

### **2.2.1. *Chemistry of EHC®.***

EHC® is comprised of a synergistic mixture of micro-scale ZVI and a solid organic carbon source, stimulating both abiotic and biotic dechlorination mechanisms. The small ZVI particles (i.e., < 100 µm) provide substantial reactive surface area that stimulates direct chemical dechlorination of the chlorinated ethenes via primarily beta elimination. During beta elimination, transient short-lived byproducts include chloroacetylenes and acetylene (seldom detected in groundwater due to their short life span). Furthermore, ferrous iron is released into the groundwater. As the dissolved iron travels into areas with higher redox potential, it will precipitate out as numerous ferrous and ferric precipitates, including, but not limited to iron oxide and sulfide. These ferrous iron precipitates have also been proven to be reactive with chlorinated ethenes and can stimulate abiotic dechlorination mechanisms in an extended area downgradient of the PRBs.

EHC® will rapidly create strong reducing conditions, the ZVI particles will scavenge oxygen as they undergo oxidation promoting a drop in the redox potential of the groundwater passing through the PRB. The EHC® also promotes biotic dechlorination reactions, as the bacteria ferment the organic portion of EHC®, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic, and butyric acids, which diffuse from the site of fermentation into the groundwater and serve as electron donors for other bacteria, including dehalogenators. This addition of organic carbon can promote conventional stepwise reductive dechlorination reactions, whereas the dominant abiotic pathway observed in contact with ZVI and ferrous iron precipitates (beta elimination) minimizes the generation of byproducts. Accordingly, as the ZVI is fixed

in place, and the temporary enhanced biodegradation is very localized to the vicinity of the PRB, the byproducts are primarily dissolved iron and ethene. The dissolved iron rapidly reacts with the natural soils and electron acceptors in the groundwater to form immobile precipitates (as discussed above). Therefore, there are no net significant impacts to groundwater quality expected with the EHC® PRBs, when the design residence time within the PRBs is achieved, other than a very localized decrease in redox potential and metals mobilization in the vicinity of the PRBs. An SDS for EHC® is included in Attachment A.

**2.2.2. Frequency, Locations, Quantities of ISCR Amendments Added to Substation.**

EHC® has been applied in shallow groundwater at the Substation and associated off-site areas since in-situ remedial activities began in 2014. Table 2 documents the timing and dosages of the ISCR amendments applied at the Substation and in off-site areas. Figure 2 presents the well locations where the ISCR was applied for each injection event. The total amounts of EHC® applied into the shallow groundwater from 2014 through August of 2023 on the Substation or immediate vicinity was approximately 142,000lbs. An additional approximately 68,000 lbs. were applied as PRBs outside the immediate area of the Substation.

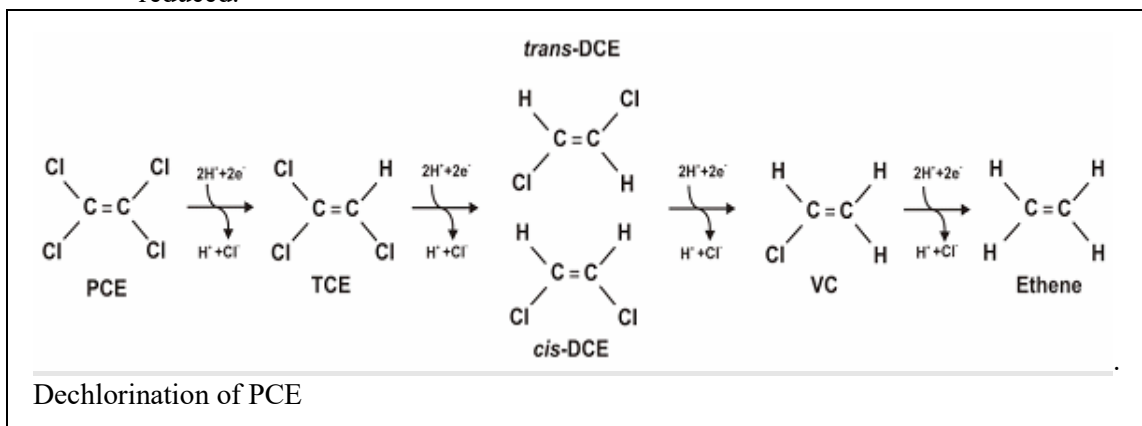
**2.2.3. Literature review of expected impacts of the ISCR on area water quality relative to regulatory criteria for water use.**

As documented in the *ITRC PRB guidance document (2011)*, reduced geochemical conditions, as a result of the ZVI barrier, has the potential to increase the mobility of some metals such as iron, manganese, and other heavy metals in the immediate vicinity of the PRB. However, once, beyond the immediate vicinity of the PRB (i.e., on the order of several feet) geochemical conditions will return to background conditions, the metals are expected to reprecipitate onto the natural soils.

**2.3. ERD**

**2.3.1. Chemistry of Bioaugmentation for Chlorinated Ethenes**

During anaerobic biodegradation of chlorinated compounds, sequential removal of chloride ions is generally observed. The figure below demonstrates the dechlorination of PCE to TCE to cis-DCE (or trans-DCE) to VC to the final degradation product, ethene. In this reaction, hydrogen, the electron donor, typically derived from an added vegetable oil, is oxidized while the chlorinated ethene, the electron acceptor, is reduced.



The anaerobic reductive dechlorination of the more highly chlorinated (more oxidized) hydrocarbons, such as PCE and TCE, occurs more readily than the dechlorination of

chlorinated hydrocarbons that already are somewhat reduced (less oxidized), such as cis-DCE and VC. Therefore, it is important to determine as part of the planning stage whether Dehalococcoides or other species capable of completely reducing PCE or TCE to ethene are present and are of sufficient quantity to ensure the process does not stall at cis-DCE and /or VC. If necessary, the site can be bioaugmented with Dehalococcoides Ethenogenes cultures to enable or accelerate degradation to ethene. It was determined during the initial design stage for a bioremediation application at the Substation that bioaugmentation was required for the cis-DCE and VC present in shallow groundwater.

Bioaugmentation is considered as a remediation alternative at a site with an insufficient population of microorganisms, or an insufficiently active population, to perform complete biodegradation of the contaminants of concern. Bioaugmentation is performed by injection of natural but non-native microorganisms into the target treatment area. In addition, the subsurface must contain adequate amounts of nutrients to sustain the microbial population. However, rapid microbial growth in response to organic substrate / vegetable oil (electron donor) addition can create an additional nutrient demand. Nutrients generally added include nitrogen and phosphorus. At the Substation, *Miracle-Gro Water-Soluble All-Purpose Plant Food*, a common additive found in home improvement stores and plant nurseries, was added in the bioremediation areas to supply additional nutrients into the groundwater during the bioaugmentation applications. This amendment has an NPK ratio of 24-8-16, which means that it contains 24 percent nitrogen, 8 percent phosphorus and 16 percent potassium. Attachment A includes SDS's for all the amendments used in the bioaugmentation applications at the Substation.

### **2.3.2. *Frequency, Locations, Quantities of ERD Amendments Added to Substation.***

ERD amendments (vegetable oil, nutrients and Dehalococcoides) have been applied into shallow groundwater within the Substation since in-situ remedial activities began in 2014. Table 2 documents the timing and dosages of the ERD amendments applied at the Substation. Figure 1 presents the well locations where the ERD was applied for each injection event. The total amounts of ERD amendments applied into the shallow groundwater since 2014 through September 2023 was approximately 42,000 lbs. of vegetable oils, 26 lbs. of nutrients, and approximately 520 liters (L) of a Dehalococcoides blend. In addition, 15 lbs. of sodium bicarbonate were applied as a pH buffer.

### **2.3.3. *Literature review of expected impacts of the ERD on area water quality relative to regulatory criteria for water use.***

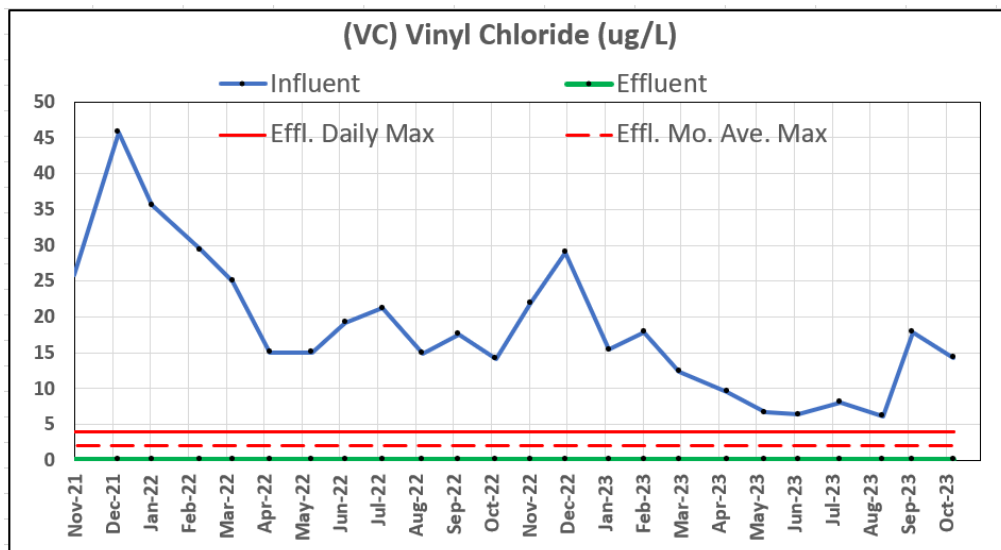
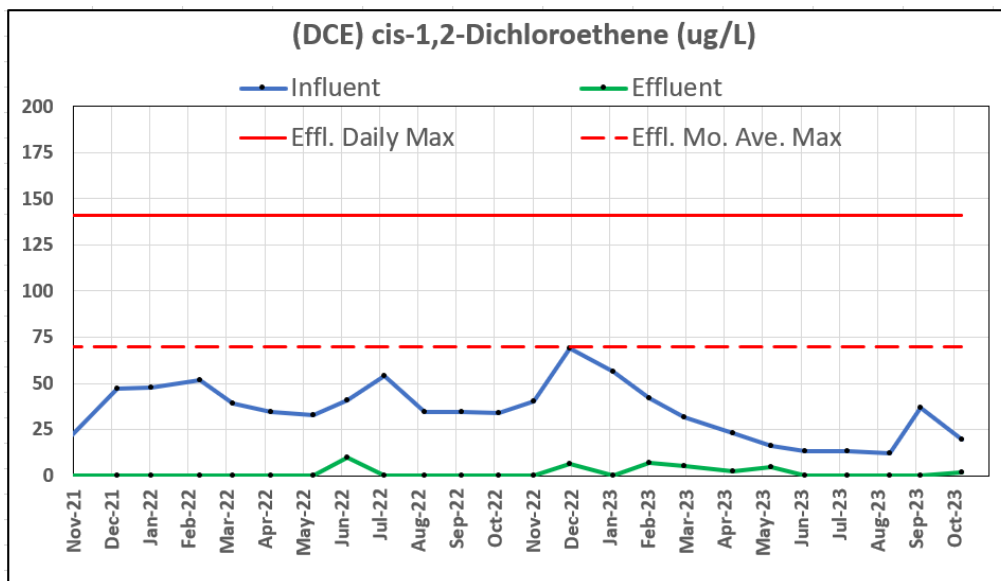
ERD has very similar impacts on secondary water quality compared to ISCO and ISCR remediation technologies. As discussed above, amendments added in ERD can cause reducing conditions within an aquifer system, which can decrease the concentrations of available oxygen, nitrate, and sulfate and increase the concentrations of dissolved iron, manganese, methane, sulfide, and organic carbon (*Borden et al., 2015*). In addition, ERD may reduce the pH observed in the area of amendment injection, as a result of the creation of fatty acids and carbonic acid, which is why buffering solution is sometimes added during substrate injections. Changes in the geochemistry (i.e., reducing geochemical conditions, changes in the pH, etc.) can also increase the mobility of some metals. As noted in the *Borden et al. (2015)* study, most secondary water quality impacts from ERD are limited, with impacted groundwater unlikely to adversely impact potable water supplies.



## 2.4. GETS

Groundwater extraction systems are designed to improve the water quality within an aquifer system, not adversely impact it. Extraction of groundwater can lower the water levels in an aquifer, which can have an impact on the availability of water in an aquifer. However, due to the elevated transmissivity of the alluvial aquifer system beneath the Substation, pumping from the GETS extraction wells does not create enough drawdown to impact the use of any City supply wells. The City wells pump between 500 to 2000 gallons per minute (gpm), and those pumping rates do not draw down the aquifer enough to appreciably impact the available water in the aquifer. Comparatively, the GETS extraction wells operate at pumping rates of 5 to 50 gpm.

A comparison of the 2014 average combined cis-DCE and VC micromoles to the 2023 average (through August) demonstrates a 75% decrease in the GETS influent cis-DCE and VC, as shown in Table 1. The following figures show a comparison of the influent and effluent data from the GETS for 2021-2023, reflecting the decrease in concentration levels for cis-DCE and VC and the continued treatment effectiveness of the GETS.



### **3. RELEVANT MODELING PERFORMED ASSOCIATED WITH THE SITE REMEDIAL ACTIVITIES, GROUNDWATER QUALITY, AND GETS AND CITY WELL CAPTURE AND TRAVEL TIMES ANALYSES**

As contained in previous submittals to EPA (*Ameren, 2023; GSI, 2013*), a numerical model consistent with the conceptual model was constructed using Groundwater Vistas (Version 8.30, Build 7; ESI Inc.). The original model has been expanded into 13 numerical layers to account for the solutes penetrating part of the lower aquifer unit and the varying screen depths of both City and groundwater extraction wells. The updated 13-layer model, used in this evaluation, consists of the following:

- Layer 1 represents the confining layer (hydraulic conductivity of  $3 \times 10^{-2}$  feet per day [ft/d]);
- Layers 2 through 5 represent the upper transmissive zone (hydraulic conductivity of 312 ft/d);
- Layers 6 through 13 represent the lower transmissive zone (hydraulic conductivity of 397 ft/d).

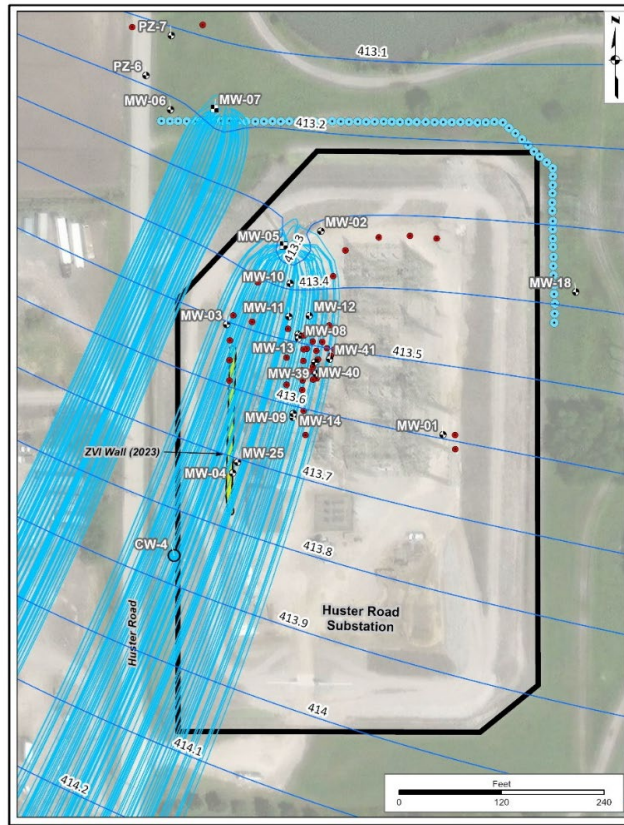
The model was used to demonstrate the following:

- GETS capture zone was sufficient to entrain 100% of the groundwater in the vicinity of where ISCO and ERD were implemented on the Substation.
- Travel times from the source area to the various City wells are sufficiently long enough for secondary groundwater quality to revert to equilibrium conditions before being captured by a City well.
- Calculation of residence times (travel times) across the EHC® barriers indicates the ISCR (EHC® barrier) is sufficiently constructed to support dechlorination of cis-DCE and VC, under historical City well pumping rates.
- Groundwater divides are created when multiple City wells are pumped simultaneously, which modeling demonstrates through increased travel times to City wells.

#### **3.1. GETS CAPTURE ZONE UNDER A TYPICAL CITY WELL PUMPING SCENARIO**

The groundwater transport model was used to determine the capture zone of the GETS under a typical City well pumping regime and pumping rates for the GETS recovery wells for the period 2014 to 2018. Below is a summary of the wells and the associated pumping rates for each well:

- City Wells: CW-7 - 870 gpm, CW-9 - 1740 gpm, and CW-10 – 870 gpm
- GETS Recovery Wells: MW-05 – 25 gpm and MW-07 – 10 gpm



As shown on the figure above, the capture zone for MW-05 encompasses 100% of the central portion of the facility, corresponding to the application area where the majority of the ISCO and ERD amendments were injected into the shallow aquifer. Note that several injection points are located outside of the capture zone of MW-05 or MW-07; however, MW-05 still captures approximately 90% of the total area where injections have occurred.

### 3.2. TRAVEL TIMES UNDER VARIOUS CITY WELL PUMPING SCENARIOS

The groundwater transport model was used to estimate travel times from the areas where remediation activities occurred to the nearest City well under various pumping scenarios. As discussed above, changes in the secondary water quality as a result of the remediation technologies are usually very localized and short-lived. Accordingly, if the model predicts longer travel times from the remediation areas to the City wells, then the buffering capacity of the aquifer materials will have an even greater time to reverse any secondary water quality impacts and return groundwater to its natural equilibrium condition. Additionally, travel times were calculated using the layers of the model (Layers 3-5) corresponding to the depth interval of approximately 35 to 45 ft bgs, which is where impacts from the Substation is mostly located and the zone where most of the remediation technologies were applied.

Pumping regimes and pumping rates of the City wells were based on historical annual and monthly data obtained from the City for the period 2004 to 2023, as well as pump capacity information obtained from the City. In addition, current or recent City well pumping regimes (e.g., pumping at CW-4) were also considered in this evaluation. As discussed below, when multiple City wells are pumping, groundwater divides are created, and very little groundwater flow is occurring in the zones immediately proximate to the groundwater divides.

Below is a summary of five scenarios that were modeled, and the summary provides which wells were pumping and their associated pumping rate in each scenario. Discussion of the travel times and groundwater divides is provided further below.

### PUMPING SCENARIO SUMMARIES

<b>Well ID</b>	<b>Scenario 1 Pumping Rates (gpm)</b>	<b>Scenario 2 Pumping Rates (gpm)</b>	<b>Scenario 3 Pumping Rates (gpm)</b>	<b>Scenario 4 Pumping Rates (gpm)</b>
MW-05	42	42	42	42
MW-07	14	14	14	14
CW-4	0	0	1,129	0
CW-6	0	700	0	0
CW-7	0	0	0	870
CW-8	0	700	0	0
CW-9	0	0	0	1,740
CW-10	870	0	0	870

### **3.3. DISCUSSION OF TRAVEL TIME RESULTS**

**3.3.1. Scenario 1- Treatment Area to CW-10:** In this scenario, the model assumes that CW-10 was the only City well operating. As shown in the figure below, the travel time from the primary Substation source area, where ISCO and ERD injections occurred, to CW-10 is approximately **1,200 days**. The travel time from the ISCR barrier and the ERD injection areas on the east side of the Substation to CW-10 is approximately **800 days**.

**3.3.2. Scenario 2 – Barrier Walls to CW-6:** For Scenario 2, the model assumes that CW-6 and CW-8 are both operating, which represents the current City flow regime as of October 12, 2023. Multiple ISCR barriers have been installed to treat groundwater near CW-6. As shown in the figure below, travel times from the ISCR barriers to CW-6 range as follows:

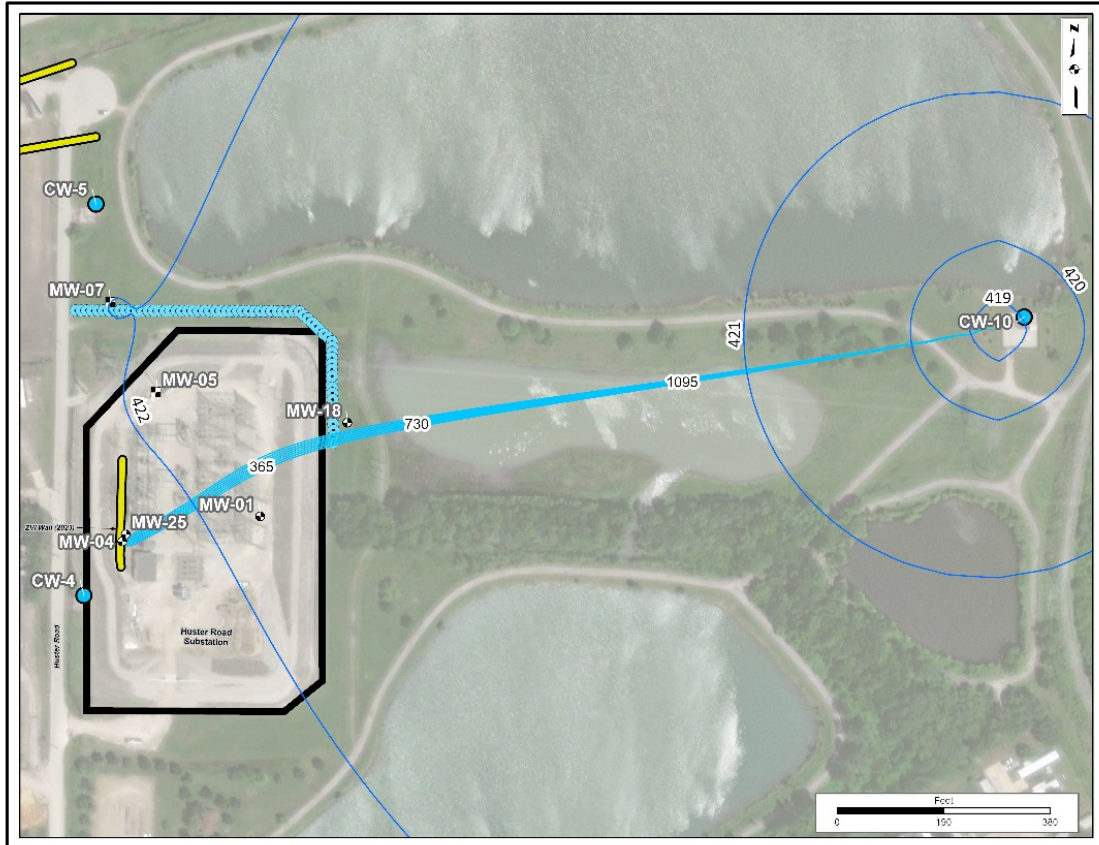
- southern ISCR barrier in the vicinity of PZ-11 and PZ-23: approximately **7 days**;
- western ISCR barrier in the vicinity of PZ-22: approximately **7 days**;
- northern ISCR barrier approximately 150 ft north of CW-6: approximately **25 days**.

As shown below in the second figure for Scenario 2, the ISCO injection treatment area in the central portion of the Substation is captured by MW-05. Additionally, travel times from the ISCR barrier and the ERD injections located on the east side of the Huster Substation to CW-8 are generally **greater than 1000 days**.

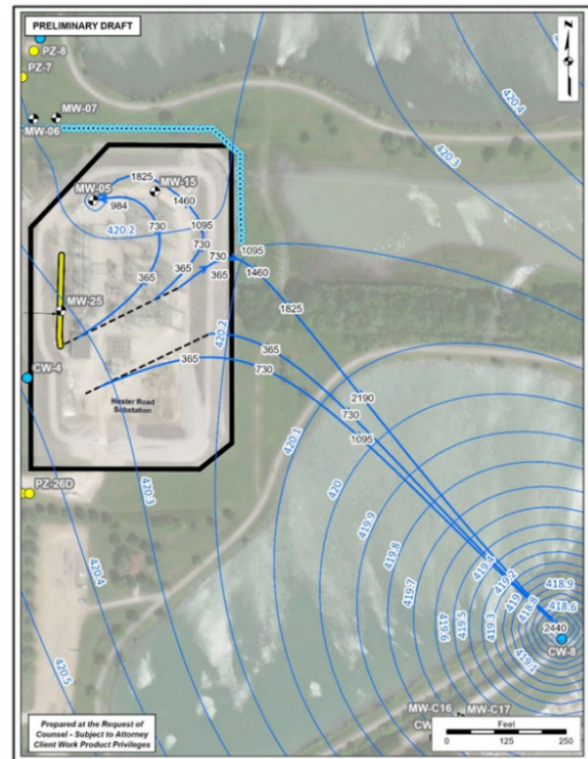
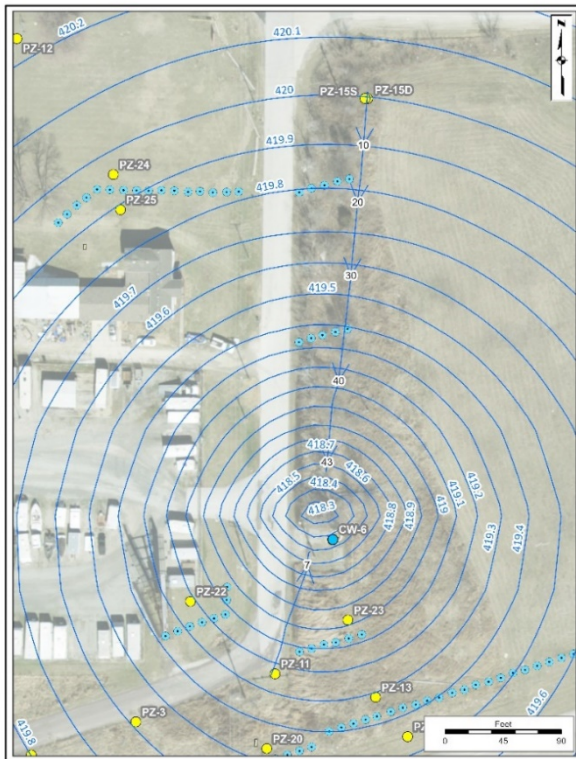
**3.3.3. Scenario 3 – CW-4 Operated Exclusively:** Scenario 3 represents a pumping scenario observed in August 2023, where CW-10 was shut off, and CW-4 was the only City well pumping. The model assumes that CW-4 is pumping at 1,129 gpm, which was the pumping rate observed at CW-4 under this scenario. As shown in the figure below, travel times from the ISCR barrier located along the western side of the substation to CW-4 is approximately **14 days**.

**3.3.4. Scenario 4 – CW-7, CW-9 and CW-10 Operating:** Scenario 4 represents the pumping scenario observed in 2021 and 2022, where CW-7, CW-9, and CW-10 are pumping. As shown in the figure below, CW-9 almost exclusively captures groundwater traveling from the northern ISCR barriers, including the ISCR barrier just north of Highway 370. The travel time from the northernmost ISCR barrier to CW-9 is at least **20 days**.

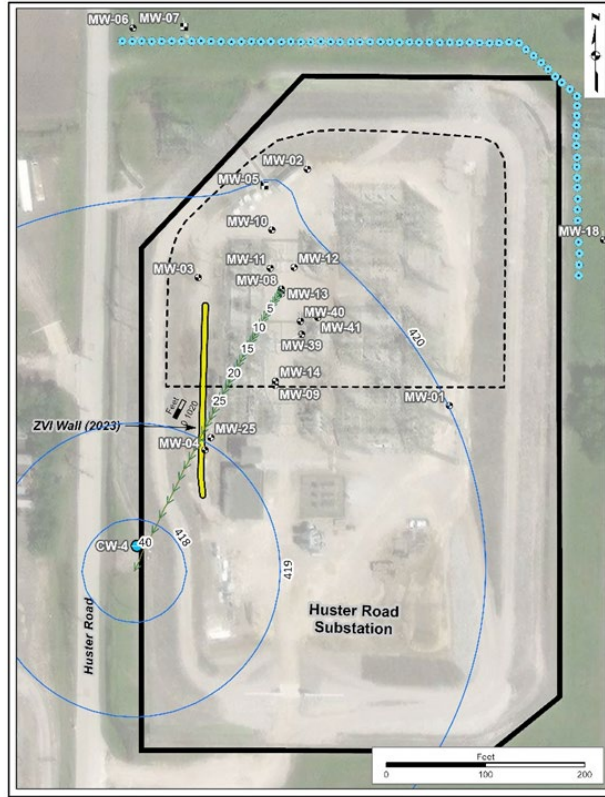
**SCENARIO 1 FIGURE: CW-10 PUMPING ONLY**



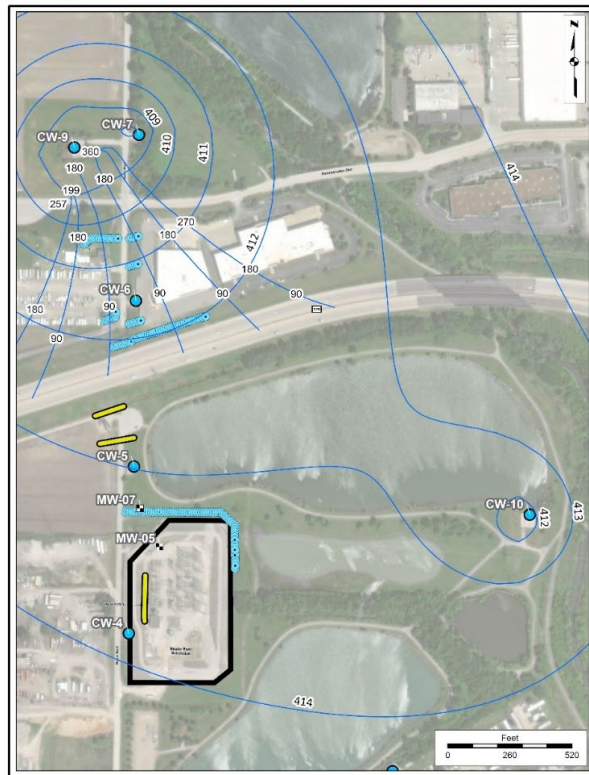
**SCENARIO 2 FIGURES: CW-6 AND CW-8 PUMPING.**



**SCENARIO 3 FIGURE: CW-4 PUMPING ONLY**



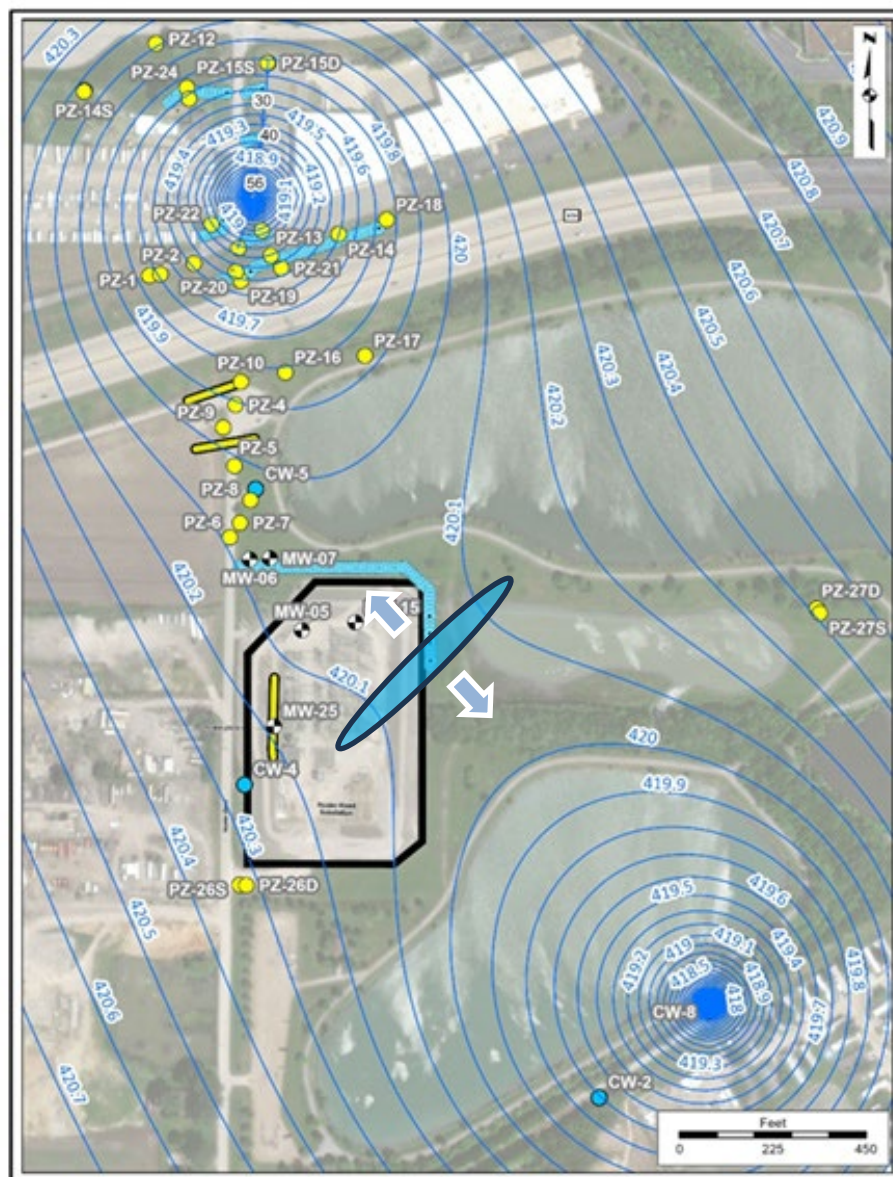
**SCENARIO 4 FIGURE: CW-7, CW-9, AND CW-10 PUMPING**



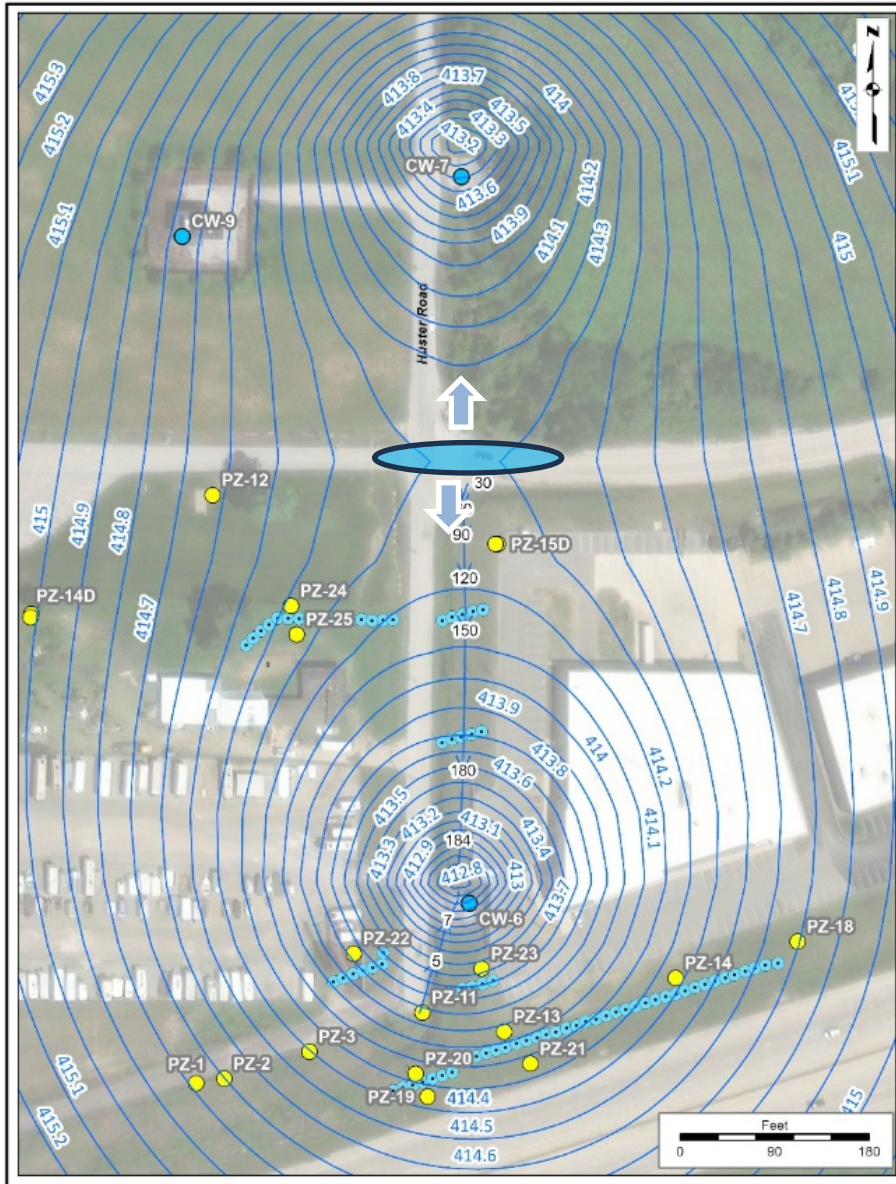
### 3.4. GROUNDWATER DIVIDES UNDER VARIOUS CITY WELL PUMPING SCENARIOS

When multiple City wells are pumping, groundwater divides are created dependent upon the pumping regime and pumping rates from the City wells, and within these groundwater divides, the water is relatively stagnant. As shown in the second figure for Scenario 2 above, these groundwater divides can significantly increase the travel times from impacted areas to the GETS recovery wells (MW-05 and MW-07) or to a City well. In some cases, groundwater is traveling slowly and travel times of greater than 1-2 years are observed. Slower travel times allow for greater natural attenuation and/or remediation treatment from the ISCO, ERD, and/or ISCR barriers resulting in a decrease in the concentrations of VC and cis-DCE before that groundwater can travel either off-site or to a City well. In addition, slower travel times allow the natural buffering capacity of the aquifer soils to aid in returning the groundwater pH and geochemistry to background levels, which in turn aids reprecipitation of dissolved metals onto the natural soils. Several examples of the modeled groundwater divides are presented below:

#### CW-6 AND CW-8 PUMPING – GROUNDWATER DIVIDE

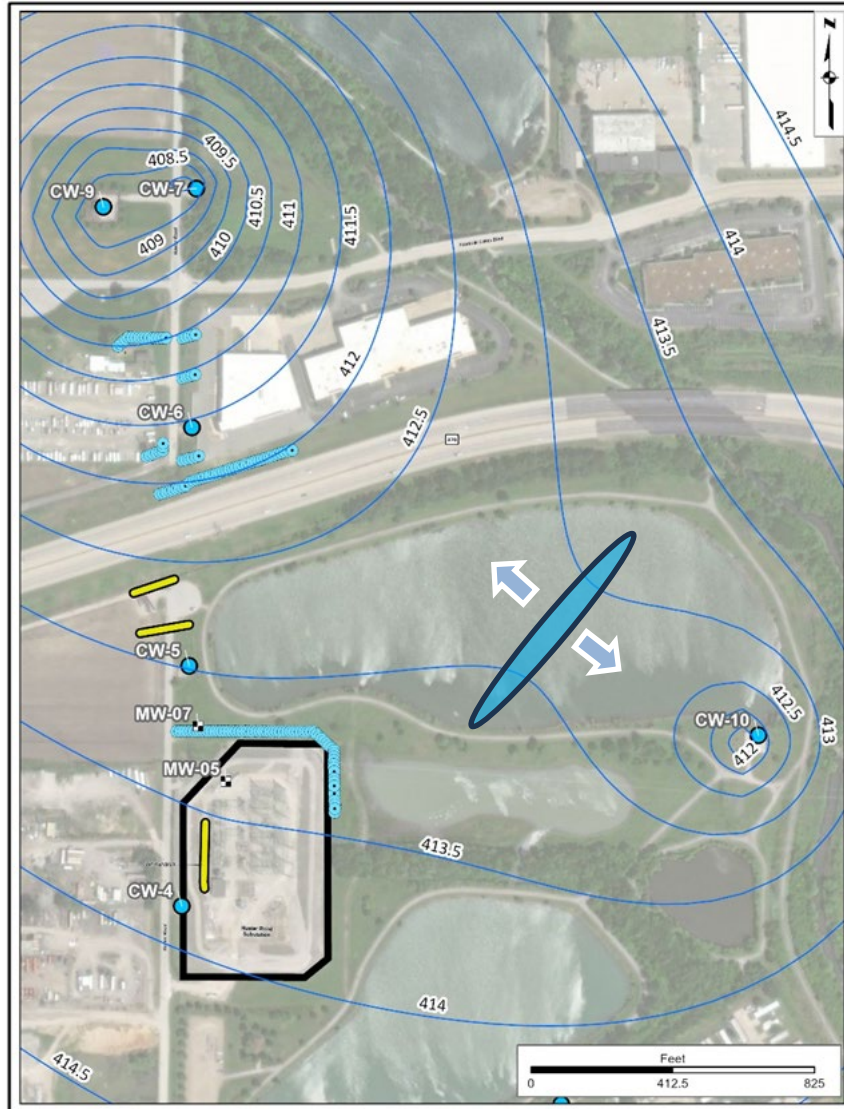


**CW-6 AND CW-7 PUMPING – GROUNDWATER DIVIDE**





## CW-7, CW-9, AND CW-10 PUMPING – GROUNDWATER DIVIDE



### **3.5. RESIDENCE TIME FOR THE ISCR BARRIERS**

The groundwater model was also used to predict the residence time (i.e., travel time) within the ISCR barriers installed in 2023, using the pumping scenarios above. Since the ISCR barriers are injected ZVI/nutrient substrate, the model assumed a radius of influence (ROI) for the injections of approximately 10-ft, which corresponds to the width of the ISCR barriers perpendicular to the groundwater flow. The ROI was field verified by LEA during installation of the ISCR barriers.

In general, the residence times within the barriers ranges from 3 to 5 days depending on the location of the barrier, and its proximity to and operation/pumping rate of the nearest City well. For example, the residence time within the 10-ft thick ISCR barrier along the eastern side of the Substation when CW-4 is pumping is 2-3 days. This is a result of the close proximity of that barrier to CW-4 and the high pumping rate (i.e., 1,129 gpm) at that well. Groundwater traveling through barriers located further from City wells travels slower, and thus the travel times through the ISCR barrier are slower (3-5 days).

### **3.6. MODELING ASSESSMENT OF REMEDIAL ACTIVITIES**

In general, evaluation of the modeling travel times indicates that there is enough travel time between the areas where the various remediation activities (i.e., ISCO, ERD, ISCR) were applied to allow the natural buffering capacity of the aquifer to return the groundwater to its background conditions. ISCO and ERD injections were conducted at locations far enough away from any City wells to preclude an impact on the water quality observed in those wells. Several of the ISCR barriers are located within proximity to City wells, as an additional measure to protect those wells from any impacts from VC and/or cis-DCE. Based on the modeling travel times using various pumping regime scenarios, the travel times between the closest ISCR barriers and the nearest City wells is **at least 7 days**. Again, this should provide sufficient time for any temporary impacts from the ISCR barrier to secondary groundwater quality, if any, to return to background conditions. If multiple City wells are pumping, then this could further increase travel times in certain areas to allow for additional buffering of groundwater from natural soils.

The only potential adverse effect modelled would be in the case of pumping CW-4 at its maximum rate (1,129 gpm), which significantly reduces the residence time within the ISCR barrier located on the western side of the Substation. Longer residence times within the ISCR barriers allows for longer contact time of cis-DCE and VC impacted groundwater to react with the ISCR amendments, and thus allowing increased treatment effectiveness. Shorter residence times (<2-3 days), decrease the contact time. Therefore, the proximity to and pumping rate of CW-4 that occurred during August 2023 could have an adverse impact on the effectiveness of the ISCR, but as noted above, would not be expected to have an adverse impact on the secondary water quality.

## **4. COMPARISON OF FIELD DATA WITH LITERATURE EXPECTATIONS ON IMPACTS TO WATER QUALITY**

To validate the literature expectations on the impacts to water quality in areas outside the immediate locations of remedial technologies application, available field data collected during the remedial activities' implementation were compared to baseline conditions measured in 2014 at the Substation and associated off-site locations. The vast majority of the remedial amendments, for the ISCO and ERD remedial technologies, were applied within the central and northern portions of the Substation from 2016 to 2023, as shown in Figure 1 and Table 2. Based on the groundwater flow modeling, as discussed above, the GETS captured 100 % of the shallow impacted groundwaters from those Substation areas, prior to the August 2023 operation of CW-4. If there were any significant impacts to groundwater outside of the immediate remedial technology's implementation areas, then any such significant water quality impacts would be captured by the GETS. Accordingly, a comparison of the water quality data collected at the Substation under initial operation of the GETS in 2014, prior to the implementation of any full-scale in-situ remedial technologies at the Substation, compared to the water quality data collected at the GETS during remedial activities provides an effective method to illustrate any significant water quality changes. A comparison of data from the initial GETS operations in 2014 and GETS data since initial operations to August 2023 is presented in Table 1.

#### **4.1. A REVIEW OF TABLE 1 SHOWS:**

- 4.1.1.** There has been a reduction of approximately 75% of the combined cis-DCE and VC in the GETS influent from 2014 through August 2023, reflecting the success of the remedial activities in treating the cis-DCE and VC in the shallow groundwater within the Substation.
- 4.1.2.** The available GETS data for comparison with baseline conditions is primarily cis-DCE, VC, pH and iron.
- 4.1.3.** The pH recorded at the GETS consistently reflects a 7 to 8.5 range. The pH in the ISCO treated areas was recorded up to 13.5. These localized elevated pH conditions were observed in the majority of the ISCO injection wells for several months but were never measured/observed at the GETS and therefore the pH returned to background over that distance.
- 4.1.4.** The iron recorded at the GETS influent has generally been in the 4 to 8 milligrams per liter (mg/L) range, while as pointed out by the City for MW-8 and MW-11 in the ERD remedial implementation area, the total iron has been recorded at 32.3 mg/L and 33.1 mg/L during the September 7, 2023, sampling event, respectively. The elevated iron in groundwater in the ERD area, as stated previously, is a localized and expected effect of the ERD implementation in those areas but did not travel beyond the ERD area, as such increase is not measured/observed at the GETS influent.

A similar analysis was performed at the ISCR PRB emplaced in 2014 in proximity to Route 370. PZ-5 is considered a representative background well, with respect to groundwater migration to the PRB. PZ-10 is located within 10 feet downgradient of the PRB. Figure 2 shows the locations of PZ-5 and P-10. Table 3 presents an example of the available geochemical data from PZ-5 and PZ-10 during the 2015 through 2017 timeframe.

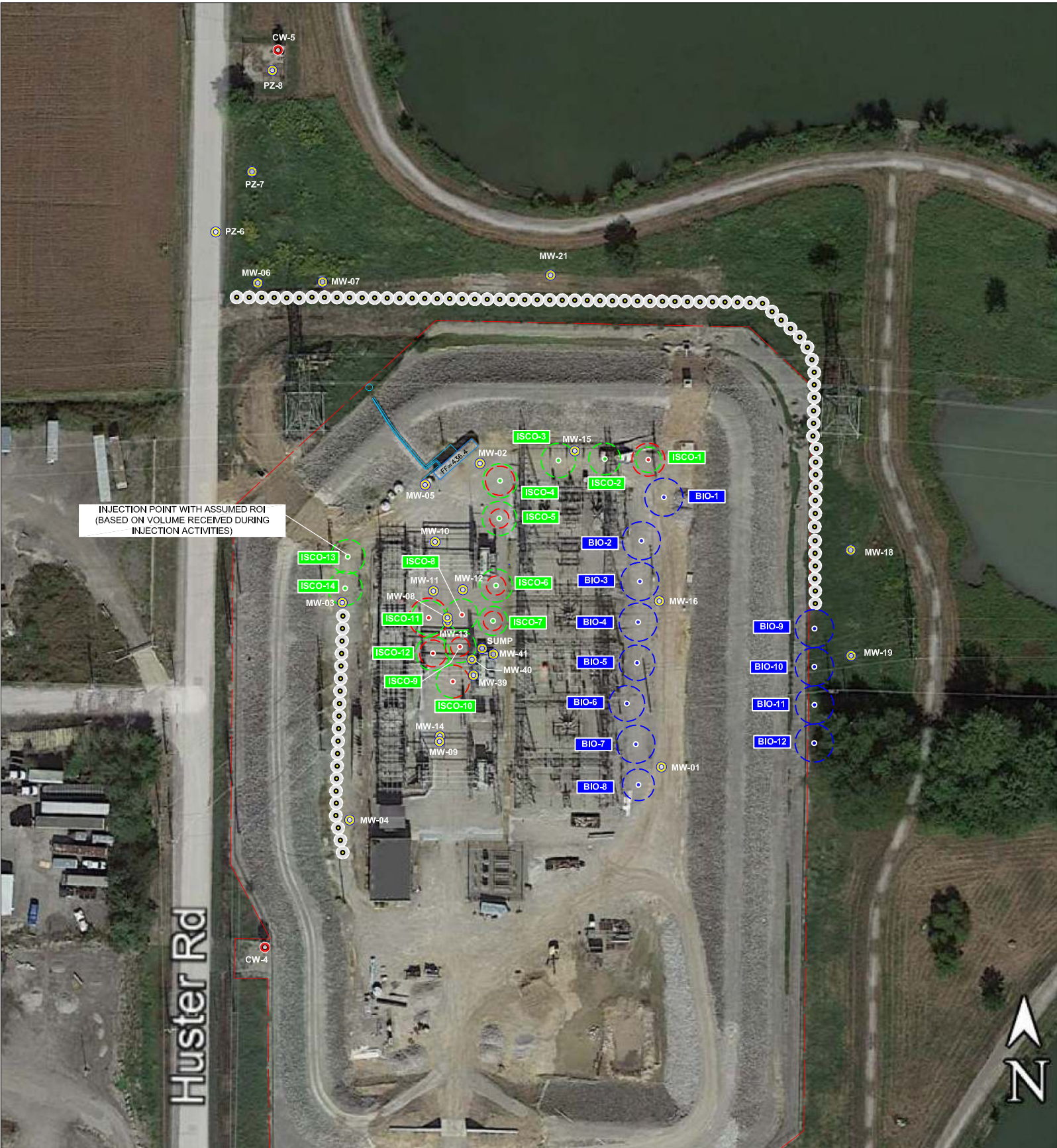
A review of geochemistry data from these PZ locations, collected after the 2014 installation of the EHC barrier, reflects water quality within normal ranges expected for the natural groundwater in the area. Accordingly, the data supports that groundwater equilibrium occurs within several feet of the PRBs.

#### **5. KEY CONCLUSIONS OF THIS EVALUATION**

- 5.1.** The in-situ remedial activities implemented on the Substation and in areas associated with the Substation consist of ISCO, ISCR, ERD, and GETS. Each of the ISCO, ISCR, and ERD technologies have a temporary impact on groundwater quality; however, the impacts are localized to the immediate area of technology application. The GETS only impacts water levels and has no negative impact on groundwater quality.
- 5.2.** Relevant literature referenced herein, and available site data validate the localized nature of the impacts of these types of remedial activities on the shallow groundwater quality on the Substation and in the surrounding City well field.
- 5.3.** Further, as reflected in a previous submission relative to naturally occurring ammonia, remedial activity applications at the substation showed no significant changes in groundwater quality relative to untreated areas including CW-10.
- 5.4.** The remedial activities implemented on the Substation resulted in a 75 % reduction in total cis-DCE and VC flux to the GETS system, from 2014, prior to remedial activities implementation on the Substation, through August 2023.

## References

- Ameren, 2023. Letter Re: Huster Substation, Findett Superfund Site, OU4 (MOD006333975), St. Charles, Missouri –Ammonia Memorandum. Letter to: Ms. Tonya Howell, EPA. Letter from: Ms. Lisa Meyer, Ameren, September 22, 2023.
- Borden, R.C., Tillotson, J.M., Ng, G.C., Bekins, B.A., Kent, D.B., and Curtis, G.P. Technical Report: Extent and Persistence of Secondary Water Quality Impacts after Enhanced Reductive Bioremediation. Strategic Environmental Research and Development Program (SERDP), SERDP Project No. ER-2131. September 2015.
- GSI, 2013. Groundwater containment system design package, Huster Road Substation, Ameren Missouri, St. Charles, Missouri.
- ITRC, 2005. Technical and Regulatory Guideline: Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater, Second Edition. The Interstate Technology and Regulatory Council (ITRC), Washington D.C., January 2005.
- ITRC, 2011. Technical and Regulatory Guideline: Permeable Reactive Barrier: Technology Update. The Interstate Technology and Regulatory Council (ITRC), Washington D.C., June 2011.
- Kemps, F.J, Siegrist, R/L/, Crimi, M.L., Furrer, R.F., and Petri, B.G., ISCO for Groundwater Remediation: Analysis of Field Applications and Performance; Groundwater Monitoring & Remediation, Vol. 30, #4, Fall 2010.
- SERDP, 2015. Guidance Document: Assessing the Potential for Metals Mobilization during the Application of In Situ Chemical Oxidation Technologies. SERDP Project No. ER-2132. Prepared by: Kevin Gardner and Emese Hadnagy, University of New Hampshire, Brant A. Smith and Karen O’Shaughnessy, XDD, LLC, Ryan Fimmen, Geosyntec Consultants, and Deepti Nair and Heather Rectanus, Battelle Memorial Institute. May 2015.



INJECTION POINT WITH ASSUMED ROI  
(BASED ON VOLUME RECEIVED DURING  
INJECTION ACTIVITIES)

Huster Rd



**LEGEND**

- ISCO APPLICATION APPLICATION # 1  
TEMPORARY INJECTION LOCATION
- ISCO APPLICATION APPLICATION # 2  
TEMPORARY INJECTION LOCATION  
(USED DURING ISCO APP #1)
- TEMPORARY BIOREMEDIATION  
INJECTION LOCATION
- MONITORING WELL
- CITY WELL

- EHC INJECTION LOCATION (ASSUMED 5 FT ROI)
- ASSUMED ROI - ISCO APP # 1
- ASSUMED ROI - ISCO APP # 2
- ASSUMED ROI - BIOREMEDIATION APP

**NOTES:**

1. Radius of influence (ROI) per injection location varies based on actual injection volumes and assumed soil porosity.
2. Temporary Bioremediation injection locations are approximate.



SCALE: AS SHOWN
DATE: SEPTEMBER 2023
PROJECT No.: 088UE3.09
CLIENT: AMEREN
DRAWN BY: PC
CHECKED BY: DI
APPROVED BY: DI



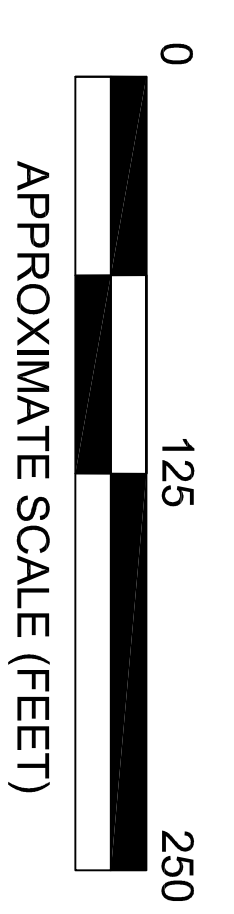
TITLE: REMEDICATION TREATMENT AREAS HUSTER RD. SUBSTATION ST. CHARLES, MO	
DRAWING NO. FIGURE 1	REV.

**LEGEND**

- PROPOSED 2023 EHC INJECTION LOCATION (ASSUMED 5 FT ROI)
- 2014 EHC INJECTION LOCATION (ASSUMED 5 FT ROI)
- MONITORING WELL
- CITY WELL
- PROPOSED MONITORING WELL LOCATION (PERMANENT)
- PROPOSED MONITORING WELL LOCATION (TEMPORARY)
- PROPOSED MONITORING WELL LOCATION (PERMANENT) [REQUIRES CITY ACCESS TO INSTALL]
- SUBSTATION FENCE
- ISCO-3 TEMPORARY IN SITU CHEMICAL OXIDATION (ISCO)
- ISB-5 TEMPORARY IN SITU BIOREMEDIATION (ISB)

**NOTES:**

1. WELLS WITH "MMW" NOMENCLATURE INDICATE WELLS LOCATED ON AMEREN PROPERTY.
2. WELLS WITH "PZ" NOMENCLATURE INDICATE WELLS LOCATED ON THE CITY OF ST. CHARLES, MO PROPERTY.



**TITLE:**

**MONITORING WELL & INJECTION LOCATIONS**  
 HUSTER RD. SUBSTATION  
 ST. CHARLES, MISSOURI

SCALE: AS SHOWN

DATE: SEPTEMBER 2023 DRAWN BY: PC

PROJECT NO.: 088UE2.14 CHECKED BY: DI

CLIENT: AMEREN PROJ. MGMT. APPROVAL: DI

DRAWING NO.



**FIGURE 2**

**TABLE 1**  
**Baseline vs. Post-Remediation Results**

Ameren - Huster Substation  
 St. Charles, Missouri

Sample Location	Date	cis-1,2-DCE Concentration (µg/L)	cis-1,2-DCE Concentration (µM/L)	Vinyl Chloride Concentration (µg/L)	Vinyl Chloride Concentration (µM/L)	Total (µM/L)	% Reduction	Influent Iron Concentration (mg/L)	Effluent pH Range (2018 to 2023)
MW-5	2014	180	1.857	18.3	0.293	2.15	81%	--	--
	2023	23.6	0.243	10.3	0.166	0.41			
GETS	2014 (Background)	132.8	1.37	23.5	0.38	1.75	75%	4.92 - 5.38	7.44 - 8.33
	2023	26.1	0.27	10.3	0.17	0.44		1.89 - 5.76	

Notes:

µg/L - micrograms per liter

µM/L - micromoles per liter

GETS - Groundwater Extraction Treatment System

pH range includes period of larger ISCO application in the central portion of the substation

**Table 2**  
**Amendment Application Summary**

Ameren - Huster Substation  
St. Charles, Missouri

Year	Month	Amendment Type	Amendment Quantity	Units
2014	March	Potassium Permanganate	1,158	lbs
	February	EHC	2,050	lbs
	April	DHC	20	liters
		EOS Pro	450	lbs
		Wilclear Sodium Lactate	1,212	lbs
2015	April	Sodium Permanganate	24,000	lbs
2016	October	DHC	100	liters
		EOS Pro	2,520	lbs
		Wilclear Sodium Lactate	7,272	lbs
2018	August	Sodium Permanganate	24,000	lbs
		DHC	60	liters
		EOS Pro	1,260	lbs
		Wilclear Sodium Lactate	4,848	lbs
2020	July	Wilclear Plus	2,400	lbs
		Lactoil SME 98	870	lbs
2021	June	Wilclear Plus	2,400	lbs
		Eos Pro	840	lbs
2022	July	Bio	40	liters
		EOS Pro With B12	840	lbs
		Sodium Bicarbonate	15	lbs
		Miracle Grow	10	lbs
2023	February/July	Sodium Persulfate	215,992	lbs
		Sodium Hydroxide	335,624	lbs
	February - May	EHC	142200*	lbs
	September	DHC	320	liters
		EOS QR	13,680	lbs
		EOS Pro	5,040	lbs
		Miracle Grow	15.88	lbs

**Notes:**

DHC - dehalococcoides

- Indicates remediation application targeting upper silty clay zone (not shallow groundwater).

\*An additional 68,200 lb of EHC was applied off site.



**Table 3**  
**EHC Permeable Reactive Barriers Effect on Water Quality**

Ameren - Huster Substation  
 St. Charles, Missouri

Sample Location	Date	Analyte (all results measured in mg/L)							
		Chloride	Iron, Dissolved	Iron, Total	Manganese, Dissolved	Manganese, Total	Nitrogen, Nitrate (as N)	Sulfate, Total	Total Organic Carbon (TOC)
PZ-5 (Upgradient*)	10/27/2014 (Baseline)	26	5.21	6.64	1.1	1.22	0.13	55	1.4
	1/15/2015	25	5.51	5.91	1.3	1.36	0.01 J	68	2.1
	2/11/2015	38	5.98	6.88	1.37	1.45	0.038 J	71	1.5
	3/9/2015	31	5.75	6.09	1.3	1.36	0.034 J	74	1.6
	5/13/2015	16	5.19	6.21	1.12	1.22	<0.05	46	1.4
PZ-10 (Downgradient*)	10/27/2014 (Baseline)	18	4.53	5.15	1.21	1.33	0.221	65	1.7
	1/15/2015	16	4.23	4.7	1.1	1.17	0.012 J	55	1.8
	2/11/2015	31	1.25	23 S	0.026 J	5.1	4.26	4.47	1.19
	3/9/2015	24	4.83	5.4	1.21	1.27	0.013 J	7 J	28.9
	5/13/2015	52	6.31	6.72	1.41	1.49	<0.05	25	6.2

Notes:

\* indicates sample location is either upgradient or downgradient of EHC barriers installed in 2014 relative to groundwater flow

J - analyte detected below quantitation limits

S - Spike Recovery outside recovery limits

# Attachment A



## SAFETY DATA SHEET



### 1. IDENTIFICATION OF MATERIAL AND SUPPLIER

<b>Product Identifier:</b>	LactOil <sup>®</sup> Soy Microemulsion
<b>Other Name(s):</b>	none known
<b>Recommended Use:</b>	In-situ Bioremediation
<b>Recommended Restrictions:</b>	none known
<b>Supplier Name:</b>	JRW Bioremediation, LLC
<b>Address:</b>	14321 W. 96 <sup>th</sup> Terrace Lenexa, KS 66215
<b>Telephone:</b>	913-438-5544
<b>EMERGENCY Telephone:</b>	800-779-5545 x 116 (Mon-Fri 9am-5pm CST) 913-961-6644 (afterhours)

### 2. HAZARD IDENTIFICATION

#### Health & Physical Hazards:

This product is not expected to cause adverse health effects while used as intended. Prolonged exposure may cause slight irritation to skin, eyes, respiratory system, headache, nausea, drowsiness. May cause abdominal discomfort, nausea, and diarrhea.

#### Flammability Hazards:

This is a Non-Flammable liquid with a closed cup flash point >75C via Pensky-Martens Closed Cup Test (ASTM std D93)

#### Reactivity Hazards:

This product is considered stable. Hydrolysis may occur in the presence of strong acids and may react with strong oxidizing agents. There are no known hazardous decomposition or byproducts.

#### OSHA Hazards: L

This material is not considered hazardous by OSHA. No labels or signage are known to be required.

### 3. COMPOSITION / INFORMATION ON INGREDIENTS

Components	CAS #	% by Weight	Hazard Classification
LactOil®	Proprietary blend	100%	none

### 4. FIRST-AID MEASURES

**Inhalation:**

Inhalation of vapors or mist may cause mild irritation of respiratory system. If symptoms are experienced, remove source of contamination or move to fresh air. If affected person is not breathing, apply artificial respiration. If breathing is difficult, give oxygen.

**Skin Contact:**

In case of contact with skin, immediately wash with plenty of soap and water while removing contaminated clothing. Seek medical attention if skin Irritation develops or persists.

**Eye Contact:**

In case of contact with eyes, immediately flush eyes with water for at least 15 minutes, lifting eyelids to facilitate irrigation. Get medical attention if necessary.

**Ingestion:**

If swallowed, get medical attention. Do NOT induce vomiting.

**Signs and symptoms of exposure:**

May cause slight irritation to skin, eyes, respiratory system, headache, nausea, drowsiness. May cause abdominal discomfort, nausea, and diarrhea. Treat symptomatically.

**Medical Conditions aggravated by exposure:**

Soybean derived product. Avoid if sensitive to soy products.

**Indication of immediate medical attention or special treatment needed:**

If medical advice is needed, have product SDS and/or label available to medical personnel.

## 5. FIRE-FIGHTING MEASURES

<b>Suitable Extinguishing Media:</b>	Dry chemical, foam, carbon dioxide, or water fog.
<b>Unsuitable Extinguishing Media:</b>	Do not use heavy water stream as it may spread burning oil
<b>Specific hazards from substance/mixture:</b>	May react with strong oxidizing agents. Hydrolysis may occur in the presence of strong acids or bases.
<b>General fire hazards:</b>	No unusual fire or explosion hazards noted

### **Special protective equipment / precautions for fire-fighters:**

Wear full protective clothing and positive pressure breathing apparatus. If possible, prevent/minimize material from entering waterways.

## 6. ACCIDENTAL RELEASE MEASURES

### **Methods and Materials for containment and clean up:**

Contain spill with absorbent materials such as clay or soil; shovel and place material in drum for disposal. Surfaces may become slippery after spillage. Dispose of according to all local, state, and federal regulations at an approved waste treatment facility.

### **Personal precautions / Protective equipment:**

Use personal protective equipment. Prevent spills, contamination, and leakage.

### **Environmental precautions:**

Prevent material from entering waterways. If contamination of local sewer or waterway has occurred advise local emergency services.

## 7. HANDLING AND STORAGE

### **Precautions for safe handling:**

Observe good work and industrial hygiene practices. Use personal protective equipment. Prevent spills, contamination, and leakage.

### **Conditions for safe storage, including any incompatibilities:**

Keep container tightly closed. Keep in properly labeled containers. Store in a well ventilated, cool, dry area. Avoid freezing or excessive heat or sources of ignition.

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

<b>Control parameters:</b>	No exposure or biological limits noted for ingredients(s).
<b>Appropriate engineering controls:</b>	General ventilation and local exhaust are recommended.
<b>Individual protection measures, such as Personal Protective Equipment (PPE):</b>	
Eye/Face protection:	Chemical goggles recommended.
Skin / hand / body protection:	Chemical resistant gloves recommended. Suitable protective clothing as defined by employer.
Respiratory protection:	May be required if used in poorly ventilated area or if material is sprayed or heated. OSHA respiratory regulations found in 29 CFR 1910.134. Use NIOSH approved respirator when necessary.
General considerations:	Avoid contact with skin. When using material, do not eat, drink, or smoke. Remove and wash any contaminated clothing before storage or re-use.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance:</b>	Thick, brown to yellowish liquid
<b>Odor:</b>	Sweet, mild alcohol-like scent
<b>Odor threshold:</b>	not applicable
<b>pH:</b>	7.5
<b>Melting point/freezing point:</b>	not applicable
<b>Initial boiling point and boiling range:</b>	not determined
<b>Closed cup Flash point:</b>	>75C vis Pensky-Martens Closed Cup Test (ASTM std D93)
<b>Evaporation rate:</b>	not determined
<b>Flammability (solid, gas):</b>	not determined
<b>Upper/lower flammability or explosive limits:</b>	not determined
<b>Vapor pressure (Mg Hg):</b>	not determined
<b>Vapor density (air = 1):</b>	not determined
<b>Density:</b>	1.05
<b>Solubility in water:</b>	soluable
<b>Auto-ignition temperature:</b>	not determined
<b>Decomposition temperature:</b>	not determined
<b>Specific Gravity (H<sub>2</sub>O = 1):</b>	not determined

## 10. STABILITY AND REACTIVITY

<b>Reactivity:</b>	Non-reactive under conditions of normal use, storage & transport.
<b>Chemical stability:</b>	Stable under conditions of normal use, storage and transport.
<b>Possibility of hazardous reactions:</b>	
<b>Conditions to avoid:</b>	Hydrolysis may occur in the presence of strong acids or bases.
<b>Incompatible materials:</b>	May react with strong oxidizing agents.
<b>Hazardous decomposition products:</b>	None known

## 11. TOXICOLOGICAL INFORMATION

No adverse health effects are expected if the product is used as intended and in accordance with this Safety Data Sheet.

<b>Inhalation:</b>	Inhalation of vapors or mist may cause mild irritation of respiratory system. If symptoms are experienced, remove source of contamination or move to fresh air. If affected person is not breathing, apply artificial respiration. If breathing is difficult, give oxygen.
<b>Ingestion:</b>	If swallowed, get medical attention. Soybean derived product. Avoid if sensitive to soy products.
<b>Skin:</b>	In case of contact with skin, immediately wash with plenty of soap and water while removing contaminated clothing. Seek medical attention if skin irritation develops or persists.
<b>Eye contact:</b>	In case of contact with eyes, immediately flush eyes with water for at least 15 minutes, lifting eyelids to facilitate irrigation. Get medical attention if necessary.
<b>Signs &amp; symptoms of exposure:</b>	Slight irritation to skin, eyes, respiratory system, headache, nausea, drowsiness. May cause abdominal discomfort, nausea, and diarrhea. No chronic effects from short and long term exposure expected.
<b>Carcinogenicity:</b>	Not determined.
<b>Mutagenicity:</b>	Not determined.
<b>Reproductive Toxicity:</b>	Not determined.

## 12. ECOLOGICAL INFORMATION

<b>Ecotoxicity:</b>	Product is not considered environmentally hazardous and is not expected to cause significant harm to aquatic, animal, or plant life however it is generally recommended to prevent material from entering waterways.
<b>Persistence/degradability:</b>	Readily biodegradable.
<b>Bioaccumulative potential:</b>	Not expected to bioconcentrate or bioaccumulate.
<b>Mobility in soil:</b>	No specific information available.

## 13. DISPOSAL CONSIDERATIONS

### Disposal Methods:

Contain spill with absorbent materials such as clay or soil and shovel and place material in drum for disposal. Surfaces may become slippery after spillage. Dispose of according to all local, state, and federal regulations at an approved waste treatment facility.

## 14. TRANSPORTATION INFORMATION

<b>DOT hazard class:</b>	Not Applicable, non-regulated
<b>Labeling:</b>	Not Applicable
<b>Proper Shipping Name:</b>	LactOil® Soy Microemulsion
<b>NMFC#:</b>	144920
<b>Class</b>	65

## 15. REGULATORY INFORMATION

**Restrictions on use:** None.

**Other regulations:** No information available.

## 16. OTHER INFORMATION

The information in this SDS summarizes to the best of our knowledge at the date of issue, the chemical health and safety hazards of this material and general guidance for safe handling, use, processing, storage, transportation, disposal, and release. This information is not intended to be considered a warranty or quality specifications. The information contained relates only to the specific material designated and may not be valid if used in conjunction with other materials or in any other processes other than intended use. If further clarification or information is required, please contact JRW Bioremediation.



## MATERIAL SAFETY DATA SHEET

# BAC-9

[Microbial Consortium]

### 1. MANUFACTURER AND EMERGENCY CONTACT

**Manufacturer:**

**EOS Remediation, LLC**  
1101 Nowell Road  
Raleigh, NC 27607  
[www.EOSRemediation.com](http://www.EOSRemediation.com)  
**Phone:** 919-873-2204  
**Fax:** 919-873-1074

**24-Hour Emergency Contact:**

**ChemTel Inc.**  
Phone: 1-800-255-3924  
**International**  
Phone: 813-248-0585

**Date of Preparation:**  
January 9, 2013

### 2. HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

COMPONENT(S)	% by WEIGHT	CAS NO.	EXPOSURE LIMITS		
			OSHA PEL-TWA	ACGIH TLV-TWA	NIOSH REL-TWA
Microbes and enzymes in a water-based medium Trade Secret <sup>1,2</sup>	100	Proprietary	NE	NE	NE

NE - Not established

- 1 - The precise composition of this product is proprietary information. A more complete disclosure will be provided to a physician in the event of a medical emergency.
- 2 - The components of BAC-9<sup>TM</sup> include non-pathogenic, naturally occurring non-altered anaerobic microbes and enzymes in a water-based medium.

### 3. PHYSICAL / CHEMICAL CHARACTERISTICS

**Boiling Point:** 100°C (water)  
**Specific Gravity:** 0.9 to 1.1  
**Vapor Pressure:** 24 mm Hg (water)  
**Melting Point:** 0°C (water)  
**pH:** 6.0 to 8.0  
**Vapor Density:** Not established  
**Evaporation Rate:** 0.9 to 1.1  
**Solubility in Water:** Soluble  
**Appearance and Odor:** Murky, yellow to grey water with musty odor



## 4. FIRE AND EXPLOSION HAZARD DATA

<b>Flash Point:</b>	Not established
<b>Flammable Limits:</b>	Not established
<b>Extinguishing Media:</b>	CO <sub>2</sub> , foam, dry chemical or water appropriate for surrounding materials
<b>Special Fire Fighting Procedures:</b>	None
<b>Unusual Fire Hazards:</b>	None
<b>Unusual Explosion Hazards:</b>	None

## 5. REACTIVITY DATA

<b>Stability:</b>	Stable
<b>Incompatibility:</b>	Water reactive materials
<b>Hazardous Decomposition Products:</b>	None
<b>Conditions to Avoid:</b>	None known

## 6. HEALTH HAZARD DATA

<b>Routes of Entry/Exposure:</b>	Ingestion, dermal
<b>Health Hazards:</b>	
<b>Acute:</b>	Potential eye and skin irritant, ingestion of large quantities may result in abdominal discomfort including nausea, vomiting, cramps, diarrhea and fever.
<b>Chronic:</b>	None known
<b>Carcinogenicity:</b>	
<b>N.T.P:</b>	No
<b>IARC:</b>	No
<b>OSHA:</b>	No
<b>Signs and Symptoms of Exposure:</b>	None known
<b>Medical Conditions Aggravated by Exposure:</b>	None known
<b>Emergency First Aid Procedures:</b>	
<b>Inhalation:</b>	Remove to fresh air; if allergic symptoms develop see a physician.
<b>Eyes:</b>	Flush with water for 15 minutes; if irritation persists see a physician.
<b>Skin:</b>	Wash with mild soap and water; if allergic symptoms develop see a physician.
<b>Ingestion:</b>	Product is non-toxic; if allergic symptoms develop see a physician

## 7. PRECAUTIONS FOR SAFE HANDLING AND USE

<b>Handling and Storage:</b>	No special requirements
<b>Other Precautions:</b>	Eyewash station recommended
<b>Spill Response:</b>	Soak up with dry absorbent or vacuum into container.
<b>Waste Disposal Methods:</b>	Dispose of according to Federal and local regulations.

**8. CONTROL MEASURES**

<b>Respiratory Protection:</b>	Not normally required
<b>Ventilation:</b>	Provide proper ventilation to remove odors.
<b>Protective Gloves:</b>	Recommended
<b>Eye Protection:</b>	Recommended
<b>Other Protective Clothing or Equipment:</b>	Adequate to prevent skin contact

The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose.

# Material Safety Data Sheet

## EHC® ISCR Amendment

MSDS #: EHC-C  
Revision Date: 2013-04-16  
Version 1.03



## ENVIRONMENTAL SOLUTIONS

This MSDS has been prepared to meet U.S. OSHA Hazard Communication Standard 29 CFR 1910.1200 and Canada's Workplace Hazardous Materials Information System (WHMIS) requirements.

### 1. PRODUCT AND COMPANY IDENTIFICATION

<b>Product name</b>	<b>EHC® ISCR Amendment</b>
<b>Recommended use</b> <b>Uses advised against</b>	Bioremediation product for the remediation of contaminated soil and groundwater Not for use in potable drinking water.
<b>Manufacturer</b>	<b>Emergency telephone number</b>
FMC CORPORATION Environmental Solutions 1735 Market Street Philadelphia, PA 19103 Phone: +1 215/ 299-6000 (General Information) E-Mail: msdsinfo@fmc.com	For leak, fire, spill or accident emergencies, call: +1 703-527-3887 (CHEMTREC) 1 303 / 595 9048 (Medical - U.S. - Call Collect)

### 2. Hazards identification

#### Emergency Overview

**CONTAINMENT HAZARD:**

Any vessel that contains wet wet EHC must be vented due to potential pressure build up from fermentation gases

#### **Potential health effects**

#### Acute Toxicity

**Eyes**

**Skin**

**Inhalation**

**Ingestion**

No significant health effects anticipated

Product dust may cause mechanical eye irritation.

None known .

Inhalation of dust in high concentration may cause irritation of respiratory system.

Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

#### Chronic Toxicity

No known chronic effects of components present at greater than 1%.

**3. Composition/information on ingredients****Ingredients**

Chemical Name	CAS-No	Weight %
Organic amendment	Proprietary	52-82
Iron	7439-89-6	18-48

**4. First aid measures**

<b>Eye contact</b>	In case of contact, immediately flush skin with plenty of water. Get medical attention if irritation develops and persists.
<b>Skin contact</b>	Wash off with soap and water.
<b>Inhalation</b>	Remove person to fresh air. If signs/symptoms continue, get medical attention.
<b>Ingestion</b>	Rinse mouth with water and afterwards drink plenty of water or milk. Call a poison control center or doctor immediately for treatment advice.

**5. Fire-fighting measures**

<b>Flammable properties</b>	Combustible material.
<b>Suitable extinguishing media</b>	Dry chemical, CO <sub>2</sub> , sand, earth, water spray or regular foam.
<b>Explosion Data</b>	
Sensitivity to Mechanical Impact	not applicable
Sensitivity to Static Discharge	not applicable
<b>Specific hazards arising from the chemical</b>	Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.

NFPA	Health Hazard 1	Flammability 1	Stability 0	Special Hazards -
------	-----------------	----------------	-------------	-------------------

**6. Accidental release measures**

<b>Personal precautions</b>	Avoid dust formation. For personal protection see section 8.
<b>Methods for containment</b>	Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry.
<b>Methods for cleaning up</b>	Sweep or vacuum up spillage and return to container. The waste may be recovered and recycled.

**7. Handling and storage**

<b>Handling</b>	Minimize dust generation and accumulation. Keep away from open flames, hot surfaces and sources of ignition. Refer to Section 8.
<b>Storage</b>	Keep tightly closed in a dry and cool place. Keep away from open flames, hot surfaces and sources of ignition. Any vessel that contains wet EHC must be vented due to potential pressure build up from fermentation gases.

**8. Exposure controls/personal protection**

Exposure guidelines Local nuisance dust standards apply.

Occupational exposure controls

<b>Engineering measures</b>	None under normal use conditions. Provide appropriate exhaust ventilation at places where dust is formed.
<b>General Information</b>	If the product is used in mixtures, it is recommended that you contact the appropriate protective equipment suppliers. These recommendations apply to the product as supplied.
<b>Respiratory protection</b>	Whenever dust in the worker's breathing zone cannot be controlled with ventilation or other engineering means, workers should wear respirators or dust masks approved by NIOSH/MSHA, EU CEN or comparable organization to protect against airborne dust.
<b>Eye/face protection</b>	Safety glasses with side-shields
<b>Skin and body protection</b>	No special precautions required.
<b>Hand protection</b>	Use gloves if extended exposure is anticipated.

**Hygiene measures** Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and immediately after handling the product.

**9. Physical and chemical properties**9.1 Information on basic physical and chemical properties

<b>Appearance</b>	Tan brown flakes,
<b>Physical state</b>	solid
<b>Odor</b>	odorless
<b>Odor Threshold</b>	not applicable
<b>pH</b>	5.6 (as aqueous solution)
<b>Melting Point/Range</b>	No information available.
<b>Freezing point</b>	No information available.
<b>Boiling Point/Range</b>	not applicable
<b>Flash Point</b>	not applicable
<b>Evaporation rate</b>	not applicable
<b>Flammable properties</b>	Combustible material
<b>Vapor pressure</b>	No information available.
<b>Vapor density</b>	No information available.
<b>Density</b>	0.80 g/mL
<b>Bulk density</b>	No data available
<b>Water solubility</b>	practically insoluble
<b>Percent volatile</b>	No information available.
<b>Partition coefficient:</b>	not applicable
<b>Viscosity</b>	No information available.

9.2 Other information

**Autoignition Temperature** No information available.

## 10. Stability and reactivity

<b>Stability</b>	Stable.
<b>Conditions to avoid</b>	Heat, flames and sparks
<b>Materials to avoid</b>	Oxidizing agents Strong acids
<b>Hazardous decomposition products</b>	Burning produces obnoxious and toxic fumes.
<b>Hazardous polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous reactions</b>	May react with water to release flammable hydrogen gas.

## 11. Toxicological information

### Acute effects

<b>Remarks</b>	The product has not been tested. Data is based on component.
<b>Eye irritation</b>	No data available for the formulation. Non-irritating (rabbit) (based on components)
<b>Skin irritation</b>	No data available for the formulation. Non-irritating (rabbit) (based on components)
<b>LD50 Oral</b>	Iron: 98.6 g/kg (rat)
<b>LD50 Dermal</b>	No information available.
<b>LC50 Inhalation:</b>	Iron: > 100 mg/m <sup>3</sup> 6 hr (rat)

### Chronic Toxicity

<b>Chronic Toxicity</b>	No known chronic effects of components present at greater than 1%.
<b>Carcinogenicity</b>	Contains no ingredient listed as a carcinogen

## 12. Ecological information

### Ecotoxicity

Contains no substances known to be hazardous to the environment or that are not degradable in waste water treatment plants

<b>Persistence and degradability</b>	Biodegradability does not pertain to inorganic substances.
<b>Bioaccumulation</b>	Does not bioaccumulate.
<b>Mobility</b>	Is not likely mobile in the environment due its low water solubility.
<b>Other adverse effects</b>	None known

**13. Disposal considerations**

<b>Waste disposal methods</b>	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.
<b>Contaminated packaging</b>	Dispose of in accordance with local regulations.

**14. Transport information**

<u>DOT</u>	not regulated
<u>TDG</u>	not regulated
<u>ICAO/IATA</u>	not regulated
<u>IMDG/IMO</u>	not regulated

**15. Regulatory information****International Inventories**

<b>TSCA Inventory (United States of America)</b>	Complies
<b>DSL (Canada)</b>	Complies
<b>NDSL (Canada)</b>	Complies
<b>EINECS/ELINCS (Europe)</b>	Complies
<b>ENCS (Japan)</b>	-
<b>IECSC (China)</b>	Complies
<b>KECL (Korea)</b>	Complies
<b>PICCS (Philippines)</b>	Complies
<b>AICS (Australia)</b>	Complies
<b>NZIoC (New Zealand)</b>	Complies

**U.S. Federal Regulations****SARA 313**

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

**SARA 311/312 Hazard Categories**

<b>Acute Health Hazard</b>	no
<b>Chronic Health Hazard</b>	no
<b>Fire Hazard</b>	no
<b>Sudden Release of Pressure Hazard</b>	no
<b>Reactive Hazard</b>	no

**CERCLA**

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

**International Regulations**

**Mexico - Grade** No information available.

**Canada**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

**WHMIS Hazard Class**  
 not determined

**16. Other information**

<b>HMIS</b>	<b>Health Hazard 1</b>	<b>Flammability 1</b>	<b>Stability 0</b>	<b>Special precautions -</b>
-------------	------------------------	-----------------------	--------------------	------------------------------

**NFPA/HMIS Ratings Legend**

Severe = 4; Serious = 3; Moderate = 2; Slight = 1; Minimal = 0

**Revision Date:** 2013-04-16  
**Reason for revision:** No information available.

**Disclaimer**

FMC Corporation believes that the information and recommendations contained herein (including data and statements) are accurate as of the date hereof. **NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION PROVIDED HEREIN.** The information provided herein relates only to the specified product designated and may not be applicable where such product is used in combination with any other materials or in any process. Further, since the conditions and methods of use are beyond the control of FMC Corporation, FMC corporation expressly disclaims any and all liability as to any results obtained or arising from any use of the products or reliance on such information.

**Prepared By**

FMC Corporation  
 FMC Logo and EHC - Trademarks of FMC Corporation

© 2013 FMC Corporation. All Rights Reserved.  
**End of Material Safety Data Sheet**





## MATERIAL SAFETY DATA SHEET

# EOS PRO, EOS LS, EOS 450, EOS XR

### 1. MANUFACTUER AND EMERGENCY CONTACT

**Manufacturer:**

**EOS Remediation, LLC**  
 1101 Nowell Road  
 Raleigh, NC 27607  
[www.EOSRemediation.com](http://www.EOSRemediation.com)  
**Phone:** 919-873-2204  
**Fax:** 919-873-1074

**24-Hour Emergency Contact:**

**ChemTel Inc.**  
 Phone: 1-800-255-3924  
**International**  
 Phone: 813-248-0585

**Date of Preparation:**  
 January 9, 2013

### 2. HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

COMPONENT(S)	% by WEIGHT	CAS NO.	EXPOSURE LIMITS		
			OSHA PEL-TWA	ACGIH TLV-TWA	NIOSH REL-TWA
Soybean Oil	45 - 60*	8001-22-7	Mist: 15 mg/m <sup>3</sup> (total) 5 mg/m <sup>3</sup> (respirable)	NE	Mist: 10 mg/m <sup>3</sup> (total) 5 mg/m <sup>3</sup> (respirable)
Emulsifiers Trade Secret <sup>1,2</sup>	1 - 10	Proprietary	NE	NE	NE
Soluble Substrates Trade Secret <sup>1,2</sup>	4 - 8	Proprietary	Mist: 15 mg/m <sup>3</sup> (total) 5 mg/m <sup>3</sup> (respirable)	Mist: 10 mg/m <sup>3</sup>	NE
Organic Substrate Trade Secret <sup>1</sup>	0 - 10	Proprietary	NE	Mist: 10 mg/m <sup>3</sup>	NE
Food Additives / Preservatives Trade Secret <sup>1</sup>	0.1 - 1	Proprietary	NE	NE	NE
Nutrients / Extracts Trade Secret <sup>1,2</sup>	0 - 1	Proprietary	NE	NE	NE
Water	Balance	7732-18-5	NE	NE	NE

NE - Not established

1 - The precise composition of this product is proprietary information. A more complete disclosure will be provided to a physician in the event of a medical emergency.

2 - The soluble substrates and emulsifiers are generally recognized as safe for food contact.

\* - Percentage of soybean oil varies by product.

### 3. PHYSICAL / CHEMICAL CHARACTERISTICS

<b>pH:</b>	Neutral
<b>Boiling Point:</b>	212°F
<b>Specific Gravity:</b>	0.96-0.98; 0.92 (pure oil phase)
<b>Vapor Pressure:</b>	Not established
<b>Melting Point:</b>	Liquid at room temperature
<b>Percent Volatile by Volume (%):</b>	25 - 48 (as water)
<b>Vapor Density:</b>	Heavier than air
<b>Evaporation Rate:</b>	Not established
<b>Solubility in Water:</b>	Dispersible
<b>Appearance and Odor:</b>	White liquid with vegetable oil odor

### 4. FIRE AND EXPLOSION HAZARD DATA

<b>Flash Point:</b>	>300°F
<b>Flammable Limits:</b>	Not established
<b>Extinguishing Media:</b>	CO <sub>2</sub> , foam, dry chemical Note: Water, fog and foam may cause frothing and spattering.
<b>Special Fire Fighting Procedures:</b>	Wear self-contained breathing apparatus and chemical resistant clothing. Use water spray to cool fire exposed containers.
<b>Unusual Fire Hazards:</b>	Burning will cause oxides of carbon.
<b>Unusual Explosion Hazards:</b>	None

### 5. REACTIVITY DATA

<b>Stability:</b>	Stable
<b>Incompatibility:</b>	Strong acids and oxidizers
<b>Hazardous Decomposition Products:</b>	Thermal decomposition may produce oxides of carbon.
<b>Hazardous Polymerization:</b>	Will not occur
<b>Conditions to Avoid:</b>	None known

### 6. HEALTH HAZARD DATA

<b>Routes of Entry:</b>	Ingestion, dermal
<b>Health Hazards:</b>	
<b>Acute:</b>	Potential eye and skin irritant
<b>Chronic:</b>	None known
<b>Carcinogenicity:</b>	
<b>N.T.P:</b>	No
<b>IARC:</b>	No
<b>OSHA:</b>	No
<b>Signs and Symptoms of Exposure:</b>	None known
<b>Medical Conditions Aggravated by Exposure:</b>	None known

# MATERIAL SAFETY DATA SHEET

EOS<sup>PRO</sup>, EOS<sup>LS</sup>, EOS<sup>450</sup>, EOS<sup>XR</sup>

## Emergency First Aid Procedures:

<b>Inhalation:</b>	Remove to fresh air.
<b>Eyes:</b>	Flush with water for 15 minutes; if irritation persists see a physician.
<b>Skin:</b>	Wash with mild soap and water.
<b>Ingestion:</b>	Product is non-toxic. If nausea occurs, induce vomiting and seek medical attention.

## 7. PRECAUTIONS FOR SAFE HANDLING AND USE

<b>Handling and Storage:</b>	Do not store near excessive heat or oxidizers.
<b>Other Precautions:</b>	None
<b>Spill Response:</b>	Soak up with dry absorbent and flush area with large amounts of water.
<b>Waste Disposal Methods:</b>	Dispose of according to Federal and local regulations for non-hazardous waste.

## 8. CONTROL MEASURES

<b>Respiratory Protection:</b>	Not normally required.
<b>Ventilation:</b>	Local exhaust
<b>Protective Gloves:</b>	Recommended
<b>Eye Protection:</b>	Recommended
<b>Other Protective Clothing or Equipment:</b>	None

The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose.

H.J. HEINZ CO. -- DISTILLED WHITE VINEGAR

=====  
MSDS Safety Information  
=====

FSC: 8950  
MSDS Date: 11/13/1992  
MSDS Num: BVCGS  
LIIN: 00N048492  
Product ID: DISTILLED WHITE VINEGAR  
MFN: 01  
Responsible Party  
Cage: 73137  
Name: H.J. HEINZ CO.  
Address: 1062 PROGRESS ST.  
City: PITTSBURGH PA 15212-5990  
Info Phone Number: 412-237-5119  
Emergency Phone Number: 412-237-5118  
Published: Y

=====  
Contractor Summary  
=====

Cage: 73137  
Name: H.J. HEINZ CO.  
Address: 1062 PROGRESS ST.  
City: PITTSBURGH PA 15212-5990  
Phone: 412-237-5119

=====  
Ingredients  
=====

Cas: 8028-52-2  
Name: DILUTE ACETIC ACID (CH\*3 COOH)  
OSHA PEL: N/K (FP N)  
ACGIH TLV: N/K (FP N)

=====  
Health Hazards Data  
=====

LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.  
Route Of Entry Inds - Inhalation: YES  
Skin: YES  
Ingestion: YES  
Carcinogenicity Inds - NTP: NO  
IARC: NO  
OSHA: NO  
Effects of Exposure: PROLONGED INHALATION OF VAPORS CAN CAUSE IRRITATION TO  
RESPIRATORY TRACT. EYES:WILL CAUSE EYE IRRITATION - SMARTING AND REDDENING OF  
THE EYE.

Explanation Of Carcinogenicity: NOT RELEVANT.  
Signs And Symptions Of Overexposure: SEE HEALTH HAZARDS.  
Medical Cond Aggravated By Exposure: NONE SPECIFIED BY MANUFACTURER.  
First Aid: INHAL:REMOVE TO FRESH AIR. SUPPORT BREATHING (GIVE O\*2/ARTF RESP)  
(FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL MD (FP N). EYE:FLUSH  
IMMEDIATELY AND THOROUGHLY WITH WATER FOR AT LEAST 15-20 MINU TES (TIMED BY A  
CLOCK). CALL A PHYSICIAN. INGEST:LARGE AMOUNTS, WATER SHOULD BE CONSUMED TO  
DILUTE. DO NOT INDUCE VOMITING. DO NOT GIVE EMETICS OR BAKING SODA. CALL A  
PHYSICIAN.

=====  
Handling and Disposal  
=====

Spill Release Procedures: IF VINEGAR IS SPILLED, WATER MAY BE USED TO DILUTE.  
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Methods: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N).

Handling And Storage Precautions: NONE SPECIFIED BY MANUFACTURER.

Other Precautions: NONE SPECIFIED BY MANUFACTURER.

=====

Fire and Explosion Hazard Information

=====

Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).

Fire Fighting Procedures: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N).

Unusual Fire/Explosion Hazard: NONE SPECIFIED BY MANUFACTURER.

=====

Control Measures

=====

Respiratory Protection: NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).

Ventilation: NONE SPECIFIED BY MANUFACTURER.

Protective Gloves: NONE SPECIFIED BY MANUFACTURER.

Eye Protection: NONE SPECIFIED BY MANUFACTURER.

Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Supplemental Safety and Health: PH:2.2 @ 100 GRAIN.

=====

Physical/Chemical Properties

=====

B.P. Text: 244F,118C

Vapor Pres: 11 MM

Vapor Density: 2.1

Spec Gravity: 1.01

PH: SUPDAT

Evaporation Rate & Reference: NOT KNOWN

Solubility in Water: COMPLETE

Appearance and Odor: CLEAR LIQUID, ODOR OF VINEGAR

=====

Reactivity Data

=====

Stability Indicator: YES

Stability Condition To Avoid: NONE SPECIFIED BY MANUFACTURER.

Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomposition Products: NONE SPECIFIED BY MANUFACTURER.

Hazardous Polymerization Indicator: NO

Conditions To Avoid Polymerization: NOT RELEVANT.

=====

Toxicological Information

=====

=====

Ecological Information

=====

=====

MSDS Transport Information

=====

=====

Regulatory Information

=====

=====

Other Information

=====

=====

HAZCOM Label

=====

Product ID: DISTILLED WHITE VINEGAR  
Cage: 73137  
Company Name: H.J. HEINZ CO.  
Street: 1062 PROGRESS ST.  
City: PITTSBURGH PA  
Zipcode: 15212-5990  
Health Emergency Phone: 412-237-5118  
Label Required IND: Y  
Date Of Label Review: 02/11/1994  
Status Code: C  
Label Date: 02/11/1994  
Origination Code: G  
Eye Protection IND: YES  
Skin Protection IND: YES  
Signal Word: CAUTION  
Respiratory Protection IND: YES  
Health Hazard: Slight  
Contact Hazard: Slight  
Fire Hazard: None  
Reactivity Hazard: None  
Hazard And Precautions: ACUTE:INHAL/EYES:IRRITATION. CHRONIC:NONE SPECIFIED BY  
MANUFACTURER.

=====  
Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever expressly or implied warrants, states, or intends said information to have any application, use or viability by or to any person or persons outside the Department of Defense nor any person or persons contracting with any instrumentality of the United States of America and disclaims all liability for such use. Any person utilizing this instruction who is not a military or civilian employee of the United States of America should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation regardless of similarity to a corresponding Department of Defense or other government situation.

**MATERIAL SAFETY DATA SHEET****SECTION I PRODUCT IDENTIFICATION**

**PRODUCT NAME:** Wilclear Plus<sup>®</sup> Lactate with Accelerite<sup>®</sup>  
**PRODUCT USE:** Bioremediation  
**SUPPLIER:** JRW Bioremediation, LLC  
 14321 W. 96<sup>th</sup> Terrace  
 Lenexa, KS 66215  
 913-438-5544  
**EMERGENCY TELEPHONE:** 800-779-5545 x 116 (Mon-Fri 9am-5pm CST)  
 913-961-6644 (afterhours)  
**DATE REVISED:** 05-06-2011

**SECTION II COMPOSITION/INFORMATION ON INGREDIENTS**

Name	CAS #	% by Weight
Sodium lactate	72-17-3	33-40%
Sodium propionate	137-40-6	0-8%
Sodium acetate	127-09-3	0-8%
Sodium butyrate	156-54-7	0-8%
Total sodium carboxylates		45-50%
Carbohydrates & fermentation metabolites	68476-78-8	15-20%
Water	7732-18-5	30-38%

**SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS**

**Boiling point:** > 100°C  
**Vapor pressure (Mg Hg):** Not determined  
**Vapor density (air = 1):** Not determined  
**Solubility in water:** Completely soluble  
**Appearance and odor:** Light brown liquid  
**Specific gravity (H<sub>2</sub>O = 1):** > 1  
**Melting point:** Not determined  
**Evaporation rate:** Not determined  
**pH:** Not determined

**SECTION IV FIRE AND EXPLOSION HAZARD DATA**

**Flash point:** Not determined  
**Flammable limits:** Not determined  
**LEL:** Not determined  
**UEL:** Not determined  
**Extinguishing media:** Water, carbon dioxide, or dry chemical.  
**Special Fire Fighting procedures:** Standard procedure for chemical fires.  
**Unusual Fire Fighting hazards:** Thermal decomposition may lead to release of irritating gases and vapors.

**SECTION V REACTIVITY DATA**

Stability:	Unstable	Stable	X
Conditions to avoid:	Avoid temperatures above 150°C		
Incompatibility (materials to avoid):	Fermentation can occur when diluted with water.		
Hazardous decomposition or byproducts:	Thermal decomposition may lead to release of irritating gases and vapors.		
Hazardous polymerization:	May Occur	Will Not Occur	X

**SECTION VI HEALTH HAZARD DATA** Based on concentration as sold

## Route/s of Entry:

Inhalation:	Inhalation of mist may cause mild irritation of respiratory system. Move to fresh air.
Skin contact:	Dermal contact with liquid may cause mild irritation. Remove all contaminated clothes, and wash skin with soap and water.
Eye contact:	Mild irritation upon contact. Rinse immediately with plenty of water for at least 15 minutes, lifting eyelids to facilitate irrigation. Get medical attention if necessary.
Ingestion:	If swallowed, get medical attention.
Health hazards (acute and chronic):	No specific data. Low order of toxicity. The chemical, physical, and toxicological properties have not been thoroughly examined.
Carcinogenicity:	Not determined.
Signs and symptoms of exposure:	Mild irritation to skin and eyes upon contact; mild irritation to respiratory system upon inhalation.
Medical conditions aggravated by exposure:	Not determined.

**SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE**

Steps to be taken in case material is released or spilled:	Contain spill and place material in drum for disposal. Dispose of according to all local, state, and federal regulations at an approved waste treatment facility.
Precautions to be taken in handling and storage:	Use personal protective equipment. Prevent spills and leakage. Keep container tightly closed. Keep in properly labeled containers. Store in a cool, dry area.
Other precautions:	No special environmental precautions required.

**SECTION VIII CONTROL MEASURES**

Respiratory protection (specify type):	No personal respiratory protective equipment normally required in well ventilated areas.
Ventilation:	Use adequate mechanical ventilation, especially in confined spaces.
Protective gloves:	Rubber gloves.
Eye protection:	Safety glasses.
Other protective clothing or equipment:	Unnecessary if other control measures are used.
Hygiene practices:	Avoid contact with skin. When using, do not eat, drink, or smoke. Remove and wash contaminated clothing before re-use.



**SECTION IX****DOT INFORMATION**

DOT hazard class:

Not Applicable

Labeling:

Not Applicable

Proper Shipping Name:

Wilclear Plus<sup>®</sup> Lactate with Accelerite<sup>®</sup>

NMFC#:

46400.02

Class:

70




---

## MATERIAL SAFETY DATA SHEET

---

### 1,1-Dichloroethane,99+%, stabilized with nitromethane 83933

#### \*\*\*\* SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION \*\*\*\*

MSDS Name: 1,1-Dichloroethane,99+%, stabilized with nitromethane

Ethylidene chloride

Company Identification: Acros Organics N.V.  
One Reagent Lane  
Fairlawn, NJ 07410

For information in North America, call: 800-ACROS-01  
For emergencies in the US, call CHEMTREC: 800-424-9300

#### \*\*\*\* SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS \*\*\*\*

CAS#	Chemical Name	%	EINECS#
75-34-3	1,1-Dichloroethane, 99+%, stabilized with nitromethane		200-863-5

Hazard Symbols: XN F  
Risk Phrases: 11 22 36/37 52/53

#### \*\*\*\* SECTION 3 - HAZARDS IDENTIFICATION \*\*\*\*

##### EMERGENCY OVERVIEW

Appearance: clear colourless to very light yellow liquid.

Target Organs: None.

##### Potential Health Effects

The toxicological properties of this material have not been investigated. Use appropriate procedures to prevent opportunities for direct contact with the skin or eyes and to prevent inhalation.

#### \*\*\*\* SECTION 4 - FIRST AID MEASURES \*\*\*\*

##### Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately.

Skin:

Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Remove contaminated clothing and shoes.

Ingestion:

If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately. Do NOT induce vomiting. Allow the victim to rinse his mouth and then to drink 2-4 cupfuls of water, and seek medical advice.

Inhalation:

Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician:

Treat symptomatically and supportively.

\*\*\*\* SECTION 5 - FIRE FIGHTING MEASURES \*\*\*\*

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Flammable Liquid.

Extinguishing Media:

In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam. Use agent most appropriate to extinguish fire.

Autoignition Temperature: 660 deg C ( 1,220.00 deg F)

Flash Point: -10 deg C ( 14.00 deg F)

NFPA Rating: health-2; flammability-3; reactivity-0

Explosion Limits, Lower: .16 vol %

Upper: .06 vol %

\*\*\*\* SECTION 6 - ACCIDENTAL RELEASE MEASURES \*\*\*\*

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Clean up spills immediately, observing precautions in the Protective Equipment section.

\*\*\*\* SECTION 7 - HANDLING and STORAGE \*\*\*\*

Handling:

Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Avoid contact with heat, sparks and flame. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage:

Keep away from heat, sparks, and flame. Flammables-area.

\*\*\*\* SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION \*\*\*\*

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs

1,1-Dichloroethane, 99+%, stabilized with nitromethane	100 ppm ; 405 mg/m3	100 ppm TWA; 400 mg/m3 TWA; see Appendix C (Chloroethanes) for supplementary exposure limits 3000 ppm IDLH	100 ppm TWA; 400 mg/m3 TWA
--	---------------------	--	----------------------------

OSHA Vacated PELs:  
 1,1-Dichloroethane, 99+%, stabilized with nitromethane:  
 100 ppm TWA; 400 mg/m3 TWA

Personal Protective Equipment

Eyes:

Wear chemical goggles. Wear safety glasses and chemical goggles if splashing is possible.

Skin:

Wear appropriate protective gloves and clothing to prevent skin exposure. Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to minimize contact with skin.

Respirators:

A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use. Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

\*\*\*\* SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES \*\*\*\*

Physical State: Not available.  
 Appearance: clear colorless to very faint yellow  
 Odor: None reported.  
 pH: Not available.  
 Vapor Pressure: 244 mbar @ 20 C  
 Vapor Density: Not available.  
 Evaporation Rate: Not available.  
 Viscosity: Not available.  
 Boiling Point: 57 deg C @ 760.00mm Hg  
 Freezing/Melting Point: -97 deg C  
 Decomposition Temperature: Not available.  
 Solubility: 0.5g/100ml  
 Specific Gravity/Density: 1.1770g/cm3  
 Molecular Formula: C2H4Cl2  
 Molecular Weight: 98.96

\*\*\*\* SECTION 10 - STABILITY AND REACTIVITY \*\*\*\*

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, strong oxidants.

Incompatibilities with Other Materials:

Oxidizing agents.

Hazardous Decomposition Products:

Hydrogen chloride, phosgene, carbon monoxide, irritating and toxic

fumes and gases, carbon dioxide.  
Hazardous Polymerization: Has not been reported.

## \*\*\*\* SECTION 11 - TOXICOLOGICAL INFORMATION \*\*\*\*

## RTECS#:

CAS# 75-34-3: KI0175000

## LD50/LC50:

CAS# 75-34-3: Inhalation, rat: LC50 =13000 ppm/4H; Oral, rat: LD50 =  
725 mg/kg.

## Carcinogenicity:

1,1-Dichloroethane, 99+%, stabilized with nitromethane -  
ACGIH: A4 - Not Classifiable as a Human Carcinogen  
California: carcinogen - initial date 1/1/90

## \*\*\*\* SECTION 12 - ECOLOGICAL INFORMATION \*\*\*\*

## Ecotoxicity:

Not available.

## \*\*\*\* SECTION 13 - DISPOSAL CONSIDERATIONS \*\*\*\*

Dispose of in a manner consistent with federal, state, and local regulations.

RCRA D-Series Maximum Concentration of Contaminants:

None listed.

RCRA D-Series Chronic Toxicity Reference Levels: None  
listed.

RCRA F-Series: None listed.

RCRA P-Series: None listed.

RCRA U-Series: CAS# 75-34-3: waste number U076.

CAS# 75-34-3 is banned from land disposal according  
to RCRA.

## \*\*\*\* SECTION 14 - TRANSPORT INFORMATION \*\*\*\*

## US DOT

Shipping Name: 1,1-DICHLOROETHANE

Hazard Class: 3

UN Number: UN2362

Packing Group: II

## IMO

Shipping Name: 1,1-DICHLOROETHANE

Hazard Class: 3.2

UN Number: 2362

Packing Group: II

## IATA

Shipping Name: 1,1-DICHLOROETHANE

Hazard Class: 3

UN Number: 2362

Packing Group: II

## RID/ADR

Shipping Name: 1,1-DICHLOROETHANE

Dangerous Goods Code: 3(3B)

UN Number: 2362

## Canadian TDG

Shipping Name: 1,1-DICHLOROETHANE

Hazard Class: 3

UN Number: UN2362

Other Information: FLASHPOINT -10 C

## \*\*\*\* SECTION 15 - REGULATORY INFORMATION \*\*\*\*

## US FEDERAL

## TSCA

CAS# 75-34-3 is listed on the TSCA inventory.  
Health & Safety Reporting List  
CAS# 75-34-3: Effective Date: June 1, 1987; Sunset Date: June 1, 1997  
Chemical Test Rules  
None of the chemicals in this product are under a Chemical Test Rule.  
Section 12b  
CAS# 75-34-3: export notification required - Section 4  
TSCA Significant New Use Rule  
None of the chemicals in this material have a SNUR under TSCA.

## SARA

Section 302 (RQ)  
CAS# 75-34-3: final RQ = 1000 pounds (454 kg)  
Section 302 (TPQ)  
None of the chemicals in this product have a TPQ.  
Section 313  
This chemical is not at a high enough concentration to be reportable under Section 313.  
No chemicals are reportable under Section 313.

## Clean Air Act:

CAS# 75-34-3 is listed as a hazardous air pollutant (HAP).  
This material does not contain any Class 1 Ozone depletors.  
This material does not contain any Class 2 Ozone depletors.

## Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.  
CAS# 75-34-3 is listed as a Priority Pollutant under the Clean Water Act.  
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

## OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

## STATE

1,1-Dichloroethane, 99+%, stab can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains 1,1-Dichloroethane, 99+%, stab, a chemical known to the state of California to cause cancer.

California No Significant Risk Level:

CAS# 75-34-3: no significant risk level = 100 ug/day

## European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F

Risk Phrases:

R 11 Highly flammable.  
R 22 Harmful if swallowed.  
R 36/37 Irritating to eyes and respiratory system.  
R 52/53 Harmful to aquatic organisms; may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.  
S 23 Do not inhale gas/fumes/vapour/spray.  
S 61 Avoid release to the environment. Refer to special instructions/Safety data sheets.

## WGK (Water Danger/Protection)

CAS# 75-34-3: 3

## Canada

CAS# 75-34-3 is listed on Canada's DSL/NDSL List.  
This product has a WHMIS classification of B2, D2B.

CAS# 75-34-3 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 75-34-3: OEL-ARAB Republic of Egypt. OEL-AUSTRALIA:TWA 200 ppm (810 mg/m3);STEL 250 pp (1010 mg/m3). OEL-AUSTRIA:TWA 100 ppm (400 mg/m3). OEL-BELGIUM:TWA 200 ppm (810 mg/m3);STEL 250 ppm (1010 mg/m3). OEL-DENMARK:TWA 100 ppm (400 mg/m3). OEL-FINLAND:TWA 100 ppm (400 mg/m3);STEL 250 ppm (1000 mg/m3). OEL-FRANCE:TWA 200 ppm (810 mg/m3). OEL-GERMANY:TWA 100 ppm (400 mg/m3). OEL-JAPAN:TWA 100 ppm (400 mg/m3). OEL-THE NETHERLANDS:TWA 200 ppm (820 mg/m3). OEL-THE PHILIPPINES:TWA 100 ppm (400 mg/m3). OEL-RUSSIA:TWA 100 ppm. OEL-SWITZERLAND:TWA 100 ppm (400 mg/m3);STEL 200 ppm (800 mg/m3). OEL-THAILAND:TWA 50 ppm;STEL 100 ppm. OEL-TURKEY:TWA 100 ppm (400 mg/m3). OEL-UNITED KINGDOM:TWA 200 ppm (810 mg/m3);STEL 400 ppm. OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV. OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

\*\*\*\* SECTION 16 - ADDITIONAL INFORMATION \*\*\*\*

MSDS Creation Date: 8/11/1990 Revision #2 Date: 9/02/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

-----

[Back](#) to product information.

---

DOW CHEMICAL -- PERCHLOROETHYLENE INDUSTRIAL - TETRACHLOROETHYLENE, TECHNICAL  
DOW CHEMICAL -- PERCHLOROETHYLENE INDUSTRIAL - TETRACHLOROETHYLENE, TECHNICAL  
MATERIAL SAFETY DATA SHEET

NSN: 6810008191128

Manufacturer's CAGE: 0BHP4

Part No. Indicator: A

Part Number/Trade Name: PERCHLOROETHYLENE INDUSTRIAL

=====  
General Information  
=====

Item Name: TETRACHLOROETHYLENE, TECHNICAL  
Company's Name: DOW CHEMICAL COMPANY  
Company's Street: 1776 DOW BUILDING  
Company's City: MIDLAND  
Company's State: MI  
Company's Country: US  
Company's Zip Code: 48674-1776  
Company's Emerg Ph #: 517-636-4400  
Company's Info Ph #: 517-636-4400  
Distributor/Vendor # 1: CSD INC. (409-756-1065)  
Distributor/Vendor # 1 Cage: 4N760  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 008  
Status: SE  
Date MSDS Prepared: 01MAY91  
Safety Data Review Date: 20MAY93  
Supply Item Manager: CX  
MSDS Serial Number: BQQMW  
Specification Number: O-T-236  
Spec Type, Grade, Class: B GRADE  
Hazard Characteristic Code: T4  
Unit Of Issue: CN  
Unit Of Issue Container Qty: 5 GALLONS  
Type Of Container: CAN  
Net Unit Weight: 67.5 LBS

=====  
Ingredients/Identity Information  
=====

Proprietary: NO  
Ingredient: PERCHLOROETHYLENE (TETRACHLOROETHYLENE) (SARA III)  
Ingredient Sequence Number: 01  
Percent: 100  
NIOSH (RTECS) Number: KX3850000  
CAS Number: 127-18-4  
OSHA PEL: 100 PPM  
ACGIH TLV: 25PPM/100, A3 STEL;94  
Other Recommended Limit: NONE RECOMMENDED

=====  
Physical/Chemical Characteristics  
=====

Appearance And Odor: COLORLESS LIQUID. ETHER-LIKE ODOR.  
Boiling Point: 250F, 121C  
Melting Point: UNKNOWN  
Vapor Pressure (MM Hg/70 F): 13 @ 68F  
Vapor Density (Air=1): 5.76  
Specific Gravity: 1.619 @ 77F  
Decomposition Temperature: UNKNOWN



Evaporation Rate And Ref: 2.1 (N-BUTYL ACETATE = 1)  
Solubility In Water: NEGLIGIBLE  
Viscosity: UNKNOWN  
Corrosion Rate (IPY): UNKNOWN  
Autoignition Temperature: NONE

=====  
Fire and Explosion Hazard Data  
=====

Flash Point: NONE  
Flash Point Method: TCC  
Lower Explosive Limit: NONE  
Upper Explosive Limit: NONE  
Extinguishing Media: NON-FLAMMABLE. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.  
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT AND A FULL FACED SELF CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER SPRAY.  
Unusual Fire And Expl Hazrds: COMBUSTION OR HEAT OF FIRE MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS AND VAPORS.

=====  
Reactivity Data  
=====

Stability: YES  
Cond To Avoid (Stability): HIGH HEAT, OPEN FLAMES AND OTHER SOURCES OF IGNITION  
Materials To Avoid: STRONG OXIDIZING AGENTS AND STRONG ACIDS.  
Hazardous Decomp Products: HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE AND CHLORINE.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT APPLICABLE

=====  
Health Hazard Data  
=====

LD50-LC50 Mixture: LD 50 ORAL RABBIT IS > 5000 MG/KG  
Route Of Entry - Inhalation: YES  
Route Of Entry - Skin: NO  
Route Of Entry - Ingestion: NO  
Health Haz Acute And Chronic: HEALTH HAZARDS: ACUTE: IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSANT, ANESTHETIC AND NARCOTIC EFFECTS, ASPIRATION MAY LEAD TO PULMONARY EDEMA. A SINGLE BRIEF INHALATION AT HIGH CONCENTRATION MAY BE LETHAL. CHRONIC: DERMATITIS, LIVER AND KIDNEY DAMAGE.  
Carcinogenicity - NTP: YES  
Carcinogenicity - IARC: YES  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: NTP, ANTICIPATED CARCINOGEN. IARC, 2B, SUPECTED CARCINOGEN.  
Signs/Symptoms Of Overexp: EYES: SLIGHT IRRITATION, PAIN. SKIN: PROLONGED RESPIRATORY TRACT IRRITATION, DIZZINESS, NAUSEA, HEADACHE, LOSS OF IRRITATION OF MOUTH AND GASTROINTESTINAL TRACT, VOMITING.  
Med Cond Aggravated By Exp: INDIVIDUALS WITH A HISTORY OF SKIN AND RESPIRATORY DISORDERS MAY BE AT INCREASED RISK FROM EXPOSURE.  
Emergency/First Aid Proc: EYES/SKIN: FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. INHALATION: REMOVE VICTIM TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. SEE DOCTOR. INGESTION: DO NOT INDUCE VOMITING. SEE DOCTOR IMMEDIATELY. NOTE TO PHYSICIAN: BECAUSE RAPID ABSORPTION MAY OCCUR THROUGH LUNGS IF ASPIRATED AND CAUSE SYSTEMIC EFFECTS, THE DECISION TO INDUCE VOMITING OR NOT SHOULD BE MADE BY A PHYSICIAN.

=====

Precautions for Safe Handling and Use

=====

Steps If Matl Released/Spill: REMOVE PERSONNEL. VENTILATE AREA. WEAR RESPIRATOR AND GLOVES. MOP UP, WIPE UP OR SOAK UP IMMEDIATELY AND REMOVE TO OUT DOORS. PLACE IN APPROPRIATE DISPOSAL CONTAINER. WASH AREA WITH PLENTY OF WATER.

Neutralizing Agent: NOT APPLICABLE

Waste Disposal Method: CONTACT YOUR LOCAL ENVIRONMENTAL OFFICER. DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS. EPA HAZARDOUS WASTE NUMBER U210. MANUFACTURER RECOMMENDS TO SEND TO LICENSED RECLAIMER OR TO PERMITTED INCINERATOR.

Precautions-Handling/Storing: STORE IN COOL, DRY, WELL VENTILATED AREA. PROTECT FROM HEAT AND INCOMPATIBLE MATERIALS. KEEP CONTAINERS CLOSED.

Other Precautions: DO NOT USE IN POORLY VENTILATED AREAS WITHOUT PROPER PROTECTION. PERCHLOROETHYLENE VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS. AVOID EYE AND SKIN CONTACT. DO NOT BREATHE VAPORS. DO NOT INGEST.

=====

Control Measures

=====

Respiratory Protection: NONE NORMALLY REQUIRED WITH ADEQUATE VENTILATION. NIOSH/MSHA-APPROVED FULL FACE ORGANIC VAPOR CARTRIDGE OR CANSISTER RESPIRATOR OR SCBA AS APPROPRIATE FOR EXPOSURE OF CONCERN. LETHAL CONCENTRATIONS MAY EXISTS WITH POOR VENTILATION.

Ventilation: MECHANICAL (GENERAL) VENTILATION OR LOCAL EXHAUST VENTILATION TO KEEP EXPOSURE LEVELS BELOW PEL.

Protective Gloves: VITON, PVA. (NITRILE FOR LIMITED USE)

Eye Protection: SPLASHPROOF GOGGLES.

Other Protective Equipment: FOR BRIEF CONTACT CLEAN BODY-COVERING CLOTHING. FOR FREQUENT CONTACT, BOOTS, APRONS, OR FULL BODY SUITS.

Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING AND BEFORE EATING. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

Suppl. Safety & Health Data: NONE.

=====

Transportation Data

=====

Trans Data Review Date: 93140

DOT PSN Code: NYB

DOT Proper Shipping Name: TETRACHLOROETHYLENE

DOT Class: 6.1

DOT ID Number: UN1897

DOT Pack Group: III

DOT Label: KEEP AWAY FROM FOOD

IMO PSN Code: OJV

IMO Proper Shipping Name: TETRACHLOROETHYLENE

IMO Regulations Page Number: 6264

IMO UN Number: 1897

IMO UN Class: 6.1

IMO Subsidiary Risk Label: -

IATA PSN Code: XOW

IATA UN ID Number: 1897

IATA Proper Shipping Name: TETRACHLOROETHYLENE

IATA UN Class: 6.1

IATA Label: TOXIC

AFI PSN Code: XOW

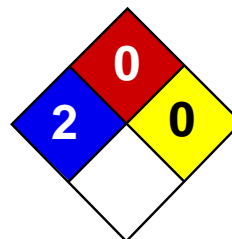
AFI Prop. Shipping Name: TETRACHLOROETHYLENE

AFI Class: 6.1  
AFI ID Number: UN1897  
AFI Pack Group: III  
AFI Special Prov: N36  
AFI Basic Pac Ref: 10-10  
N.O.S. Shipping Name: PERCHLOROETHYLENE (TETRACHLOROETHYLENE)

=====  
Disposal Data  
=====

=====  
Label Data  
=====

Label Required: YES  
Technical Review Date: 20MAY93  
Label Status: F  
Common Name: PERCHLOROETHYLENE INDUSTRIAL  
Signal Word: WARNING!  
Acute Health Hazard-Moderate: X  
Contact Hazard-Slight: X  
Fire Hazard-None: X  
Reactivity Hazard-None: X  
Special Hazard Precautions: HEALTH HAZARDS: ACUTE: IRRITATION, CENTRAL  
NERVOUS SYSTEM DEPRESSANT, ANESTHETIC AND NARCOTIC EFFECTS, ASPIRATION MAY  
LEAD TO PULMONARY EDEMA. A SINGLE BRIEF INHALATION AT HIGH CONCENTRATION  
REMOVE VICTIM TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. SEE DOCTOR.  
INGESTION: DO NOT INDUCE VOMITING. SEE DOCTOR IMMEDIATELY. NOTE TO  
PHYSICIAN: BECAUSE RAPID ABSORPTION MAY OCCUR THROUGH LUNGS IF ASPIRATED  
AND CAUSE SYSTEMIC EFFECTS, THE DECISION TO INDUCE VOMITING OR NOT SHOULD  
BE MADE BY A PHYSICIAN.  
Protect Eye: Y  
Protect Skin: Y  
Label Name: DOW CHEMICAL COMPANY  
Label Street: 1776 DOW BUILDING  
Label City: MIDLAND  
Label State: MI  
Label Zip Code: 48674-1776  
Label Country: US  
Label Emergency Number: 517-636-4400



Health	2
Fire	0
Reactivity	0
Personal Protection	G

## Material Safety Data Sheet Tetrachloroethylene MSDS

### Section 1: Chemical Product and Company Identification

**Product Name:** Tetrachloroethylene

**Catalog Codes:** SLT3220

**CAS#:** 127-18-4

**RTECS:** KX3850000

**TSCA:** TSCA 8(b) inventory: Tetrachloroethylene

**CI#:** Not available.

**Synonym:** Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolve; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

**Chemical Name:** Ethylene, tetrachloro-

**Chemical Formula:** C<sub>2</sub>-Cl<sub>4</sub>

**Contact Information:**

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**  
1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

### Section 2: Composition and Information on Ingredients

**Composition:**

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

**Toxicological Data on Ingredients:** Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50 ): Acute: 5200 ppm 4 hours [Mouse].

### Section 3: Hazards Identification

**Potential Acute Health Effects:**

Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

**Potential Chronic Health Effects:**

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

## Section 4: First Aid Measures

### Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

### Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

### Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

### Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

### Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

### Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** Non-flammable.

**Auto-Ignition Temperature:** Not applicable.

**Flash Points:** Not applicable.

**Flammable Limits:** Not applicable.

**Products of Combustion:** Not available.

**Fire Hazards in Presence of Various Substances:** Not applicable.

**Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

**Fire Fighting Media and Instructions:** Not applicable.

**Special Remarks on Fire Hazards:** Not available.

**Special Remarks on Explosion Hazards:** Not available.

## Section 6: Accidental Release Measures

**Small Spill:** Absorb with an inert material and put the spilled material in an appropriate waste disposal.

### Large Spill:

Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

## Section 7: Handling and Storage

**Precautions:**

Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

**Storage:** Keep container tightly closed. Keep container in a cool, well-ventilated area.

## Section 8: Exposure Controls/Personal Protection

**Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

**Personal Protection:**

Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

**Personal Protection in Case of a Large Spill:**

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**

TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

## Section 9: Physical and Chemical Properties

**Physical state and appearance:** Liquid.

**Odor:** Ethereal.

**Taste:** Not available.

**Molecular Weight:** 165.83 g/mole

**Color:** Clear Colorless.

**pH (1% soln/water):** Not available.

**Boiling Point:** 121.3°C (250.3°F)

**Melting Point:** -22.3°C (-8.1°F)

**Critical Temperature:** 347.1°C (656.8°F)

**Specific Gravity:** 1.6227 (Water = 1)

**Vapor Pressure:** 1.7 kPa (@ 20°C)

**Vapor Density:** 5.7 (Air = 1)

**Volatility:** Not available.

**Odor Threshold:** 5 - 50 ppm

**Water/Oil Dist. Coeff.:** The product is more soluble in oil; log(oil/water) = 3.4

**Ionicity (in Water):** Not available.

**Dispersion Properties:** Not available.

**Solubility:**

Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Incompatible materials

**Incompatibility with various substances:** Reactive with oxidizing agents, metals, acids, alkalis.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:**

Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium, barium. Protect from light.

**Special Remarks on Corrosivity:** Slowly corrodes aluminum, iron, and zinc.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Eye contact. Inhalation. Ingestion.

**Toxicity to Animals:**

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

**Chronic Effects on Humans:**

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

**Other Toxic Effects on Humans:**

Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

**Special Remarks on Toxicity to Animals:**

Lowest Published Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

**Special Remarks on Chronic Effects on Humans:**

May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic). May cause cancer.

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symptoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorientation, seizures, emotional instability, stupor, coma). It may cause pulmonary edema. Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver (hepatitis, fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/central nervous system/peripheral nervous system (impaired memory, numbness of extremities, peripheral neuropathy and other

## Section 12: Ecological Information

### Ecotoxicity:

Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fathead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

**BOD5 and COD:** Not available.

### Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.

**Special Remarks on the Products of Biodegradation:** Not available.

## Section 13: Disposal Considerations

### Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

## Section 14: Transport Information

**DOT Classification:** CLASS 6.1: Poisonous material.

**Identification:** : Tetrachloroethylene UNNA: 1897 PG: III

**Special Provisions for Transport:** Marine Pollutant

## Section 15: Other Regulatory Information

### Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

### Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

### Other Classifications:

#### WHMIS (Canada):

CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

#### DSCL (EEC):

R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.



**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 0

**Reactivity:** 0

**Personal Protection:** g

**National Fire Protection Association (U.S.A.):**

**Health:** 2

**Flammability:** 0

**Reactivity:** 0

**Specific hazard:**

**Protective Equipment:**

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

**Section 16: Other Information**

**References:** Not available.

**Other Special Considerations:** Not available.

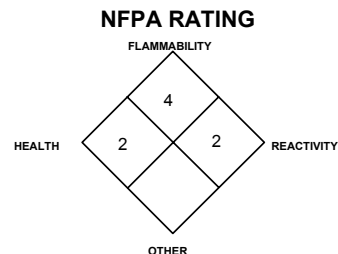
**Created:** 10/10/2005 08:29 PM

**Last Updated:** 11/01/2010 12:00 PM

*The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.*

## MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards



### **PART I** *What is the material and what do I need to know in an emergency?*

#### 1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **VINYL CHLORIDE - CH<sub>2</sub>CHCl**  
 Document Number: 001067

PRODUCT USE: For general analytic/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.  
ADDRESS: 259 N. Radnor-Chester Road  
 Suite 100  
 Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253  
EMERGENCY PHONE: 1-800-949-7937  
 International: 423-479-0293

DATE OF PREPARATION: November 20, 1997  
REVISION DATE: January 3, 2001

#### 2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Vinyl Chloride	75-01-4	> 99.9%	5, A1 (Confirmed Human Carcinogen)	NE	1	5, C (15 minutes)	NE	NIOSH: Carcinogen; Reduce exposure to lowest feasible level.  Carcinogen: IARC-1; MAK-A1; NTP-1; OSHA-X; NIOSH-X
Maximum Impurities		< 0.1%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

### 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** Vinyl Chloride is a colorless, liquefied, toxic, flammable gas with a sweet, ethereal odor. Vinyl Chloride is a known human carcinogen and is toxic by all routes of exposure. Contact with the skin and eyes will result in irritation. Inhalation of Vinyl Chloride may produce symptoms of drowsiness, blurred vision, staggering gait and tingling and numbness in the extremities. Contact with the liquid may result in frostbite. Both the liquid and gas pose a serious fire hazard when accidentally released. Vinyl Chloride polymerizes readily when exposed to air, sunlight, heat or oxygen and so can form dangerous explosive air/gas mixtures. Flame or high temperature impinging on a localized area of the cylinder of Vinyl Chloride can cause the cylinder to rupture without activating the cylinder's relief devices. Provide adequate fire protection during emergency response situations.

**SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:**

The most significant routes of overexposure for Vinyl Chloride are by inhalation or skin and eye contact. The following paragraphs describe symptoms of exposure by route of exposure.

**INHALATION:** Vinyl Chloride acts as a general anesthetic in concentrations over 500 ppm. Overexposure to low levels of Vinyl Chloride will result in dizziness, light-headedness, euphoria, nervousness, drowsiness, headache, blurred vision, impaired hearing and confusion. Acute exposures to 1000 ppm will slowly produce symptoms such as staggering gait and tingling in the hands and feet. Overexposure to extremely high concentrations (greater than 70,000 ppm) of Vinyl Chloride may cause unconsciousness and death, with possible liver, spleen, and kidney damage.

**SKIN CONTACT:** The gas is mildly irritating to exposed skin. Accidental spraying of the liquid gas may cause burns from freezing, due to rapid evaporation.

**EYE CONTACT:** Vinyl Chloride gas is mildly irritating to the eyes. Accidental spraying of the liquid into the eye(s) may cause burns from freezing, due to rapid evaporation.



**OTHER POTENTIAL HEALTH EFFECTS:** Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE:** An Explanation in Lay Terms. Overexposure to Vinyl Chloride may cause the following health effects:

**ACUTE:** The most significant hazard associated with Vinyl Chloride is inhalation of vapors, which can produce symptoms of central nervous system depression, such as dizziness, light-headedness, headache, nervousness confusion and impairment of vision and hearing. Overexposure to extremely high concentrations may cause unconsciousness and death, with possible liver, spleen, and kidney damage. Contact with liquid or rapidly expanding gases may cause frostbite.

**CHRONIC:** Long-term exposure to low levels of Vinyl Chloride causes angiosarcoma of the liver, which is a rare form of liver cancer. Chronic exposure to Vinyl Chloride has been associated with cancers of the brain, lungs and blood-forming and lymphatic systems. In the past, chronic exposure to high levels of Vinyl Chloride has resulted in acro-osteolysis (a type of degenerative bone disease) and reports of increased frequency of chromosomal changes. These symptoms have been reduced significantly due to current stringent handling procedures. Refer to Section 11 (Toxicology Information) of this MSDS for additional information.

**TARGET ORGANS:** Central nervous system, liver, spleen, kidneys, respiratory system and, potentially, the reproductive system.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	2
FLAMMABILITY		(RED)	4
REACTIVITY		(YELLOW)	2
PROTECTIVE EQUIPMENT			X
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For routine industrial applications			

**See Section 16 for Definition of Ratings**

## **PART II** *What should I do if a hazardous situation occurs?*

### **4. FIRST-AID MEASURES**

**RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO VINYL CHLORIDE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant Personal Protective equipment should be worn. Adequate fire protection must be provided during rescue situations.**

Remove victim(s) to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary.

**SKIN EXPOSURE:** Immediately flush affected area with water for at least 15 minutes. Contact with the liquid or rapidly expanding gases can cause frostbite. In the event of frostbite, medical attention must be sought. Frozen tissue is painless and appears waxy, with a possible yellow color. Frozen tissue will become swollen, painful and prone to infection when thawed. If the frozen part of the body has been thawed by the time medical attention has been obtained, cover the area with a dry sterile dressing and a large bulky protective covering.

**EYE EXPOSURE:** In the event of contact with the eyes, flush the affected eye(s) with running water for at least 15 minutes. Victims of eye exposure should be taken to medical attention immediately.

### **5. FIRE-FIGHTING MEASURES**

**FLASH POINT (Open Cup):** -77.8°C (-108°F)

**AUTOIGNITION TEMPERATURE:** 472.0°C (881.6°F)

**FLAMMABLE LIMITS (in air by volume, %):**

**Lower (LEL):** 4.0%

**Upper (UEL):** 22.0%

**FIRE EXTINGUISHING MATERIALS:** Extinguish Vinyl Chloride fires by shutting off the source of the gas. Water spray should be used to cool fire-exposed containers, structures and equipment. Use carbon dioxide, foam or dry chemicals as extinguishing media, if possible.

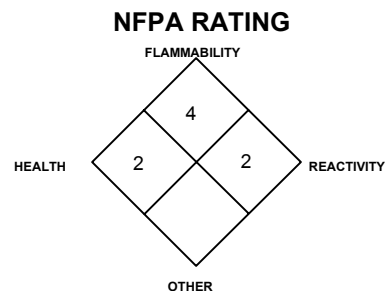
**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Extremely flammable gas. Very dangerous fire hazard when exposed to heat, flame or powerful oxidizers. If stored for prolonged periods of time in the absence of sufficient polymerization inhibitor, dangerous peroxide compounds may form by oxidization with atmospheric oxygen in the presence of various contaminants. Contact with metals such as copper, aluminum and certain catalytic impurities can cause violent polymerization. Explosion hazard in confined spaces. During a fire, toxic gases (i.e. hydrogen chloride, carbon dioxide, carbon monoxide, and traces of phosgene) may be produced.

**DANGER!** Fires impinging (direct flame) on the outside surface of unprotected cylinders of Vinyl Chloride can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

**Explosion Sensitivity to Mechanical Impact:** Not sensitive.

**Explosion Sensitivity to Static Discharge:** Static discharge may cause Vinyl Chloride to ignite explosively.

**SPECIAL FIRE-FIGHTING PROCEDURES:** Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Because of the potential for a BLEVE, evacuation of non-emergency personnel is essential. If the flow of gas cannot be stopped, it is better to allow the gas to burn rather than form potentially explosive air/gas hazard. If the fire is extinguished before the flow of gas can be stopped, the gas can explosively re-ignite. If water is not available for cooling or protection of cylinder exposures, evacuate the area. Refer to the North American Emergency Response Guidebook (Guide #116P) for additional information.



**See Section 16 for Definition of Ratings**

---

## 6. ACCIDENTAL RELEASE MEASURES

**SPILL AND LEAK RESPONSE:** Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a gas release, clear the affected area, protect people, and respond with trained personnel.

Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. If the gas is leaking from cylinder or valve, contact the supplier. Adequate fire protection must be provided. Use only non-sparking tools and equipment during the response.

Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus**. Use only non-sparking tools and equipment.

Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas to dissipate. Combustible gas concentration must be below 10% of the LEL (4%) prior to entry. Monitor the surrounding area for combustible gas levels and oxygen level. The atmosphere must have levels of Vinyl Chloride below those listed in Section 2 (Information and Composition on Ingredients) and at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

**THIS IS AN EXTREMELY FLAMMABLE GAS, WHICH IS ALSO TOXIC AND A KNOWN HUMAN CARCINOGEN.** Protection of all personnel and the area must be maintained.

---

## **PART III** *How can I prevent hazardous situations from occurring?*

---

### 7. HANDLING and STORAGE

**WORK PRACTICES AND HYGIENE PRACTICES:** As with all chemicals, avoid getting Vinyl Chloride IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of exposure as indicated in Section 2 (Composition and Information on Ingredients); exposures to fatal concentrations of Vinyl Chloride could occur rapidly.

**NOTE:** Refer to the OSHA Vinyl Chloride Standard (29 CFR 1910.1017) for specific requirements associated with the use of this gas. The Action Level for Vinyl Chloride is 0.5 ppm. In workplaces where employees are exposed above the Action Level, the OSHA requirements for monitoring, establishment of regulated areas, methods of compliance, respiratory protection, emergency response protocol, medical surveillance, training, and record-keeping must be followed.

**STORAGE AND HANDLING PRACTICES:** Entrances to regulated areas (as defined by the OSHA Vinyl Chloride Standard) must be posted with legible signs which reads as follows:

**CANCER-SUSPECT AGENT AREA  
AUTHORIZED PERSONNEL ONLY**

Vinyl Chloride should be used in a well-ventilated area, preferably in a hood with forced ventilation. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals (refer to Section 10, Stability and Reactivity).

Storage areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs in storage or use areas. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers). This gas is heavier than air and will accumulate in low areas. Do not store below ground level.

Steel is recommended for all piping, storage tanks and equipment used with Vinyl Chloride. Copper and its alloys and aluminum should never be used in equipment used with Vinyl Chloride due to the potential for violent polymerization with these materials.

Keep the smallest amount on-site as is necessary. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time.

## 7. HANDLING and STORAGE (Continued)

**STORAGE AND HANDLING PRACTICES (continued):** Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof. Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders.

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS:** Protect cylinders against physical damage. Use a check valve or trap in the discharge line to prevent hazardous backflow. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to work situations in which cylinders are being used:

**Before Use:** Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap, if provided, in-place until cylinder is ready for use.

**During Use:** Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

**After Use:** Close main cylinder valve. Replace valve protection cap, if provided. Mark empty cylinders "EMPTY".

**NOTE:** Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Vinyl Chloride. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres".

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (i.e. nitrogen) before attempting repairs.

---

## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

**VENTILATION AND ENGINEERING CONTROLS:** Use with adequate ventilation. A hood with forced ventilation is preferred, due to the significant toxicity and flammability hazards of Vinyl Chloride. Installation of automatic monitoring equipment to detect the level of Vinyl Chloride and potentially explosive air-gas mixtures is highly recommended.

**RESPIRATORY PROTECTION:** Maintain exposure levels of Vinyl Chloride below the levels listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. During an emergency situation, before entering the area, check for flammable gas level as well as oxygen-deficient atmospheres. Use supplied air respiratory protection if Vinyl Chloride levels exceed exposure limits and if oxygen level is below 19.5% or during emergency response to a release of Vinyl Chloride. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards. The following are NIOSH recommendations for respiratory protection for concentration of Vinyl Chloride in air.

### **CONCENTRATION**

AT ANY DETECTABLE CONCENTRATION:

ESCAPE:

### **RESPIRATORY EQUIPMENT**

Positive pressure, full-facepiece Self-Contained Breathing Apparatus (SCBA) or positive pressure, full-facepiece Supplied Air Respirator (SAR) with an auxiliary positive pressure SCBA.

Gas mask with canister to protect against Vinyl Chloride, or escape-type SCBA.

**NOTE:** Follow the specific respiratory selection guidelines of the OSHA Vinyl Chloride Standard in regulated areas (as defined by 29 CFR 1910.1017).

**EYE PROTECTION:** Splash goggles or safety glasses and face shield when handling the liquid or gas.

**HAND PROTECTION:** Wear leather gloves when handling cylinders of Vinyl Chloride. Chemical resistant gloves should be worn when using Vinyl Chloride.

**BODY PROTECTION:** Use body protection appropriate for task. Chemical resistant material is recommended for protection against contamination with Vinyl Chloride. Safety shoes are recommended when handling cylinders. Response to leaks requires the use of fire retardant clothing. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from gas spraying, as well as fire-retardant items.

---

## 9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY @ 21.1°C (70°F) and 1 atm: 0.160 lb/ft<sup>3</sup> (2.56 kg/m<sup>3</sup>)

LIQUID DENSITY @ 21.1°C (70°F) and 1 atm: 56.71 lb/ft<sup>3</sup> (908.41 kg/m<sup>3</sup>)

SPECIFIC GRAVITY @ 15°C (59°F) air = 1: 2.15

EVAPORATION RATE (nBuAc = 1): Not applicable.

FREEZING/MELTING POINT @ 1 atm: -153.9°C (-245°F)

EXPANSION RATIO: Not applicable.

SOLUBILITY IN WATER wt/wt @ 1 atm/25°C (77°F): 0.00114

COEFFICIENT WATER/OIL DISTRIBUTION: Log K<sub>ow</sub> = 0.6 (calculated).

BOILING POINT @ 1 atm: -13.4°C (7.93°F)

pH: Not applicable.

VAPOR PRESSURE @ 21.1°C (70°F) psig: 35.3

ODOR THRESHOLD: 2000 ppm

SPECIFIC VOLUME (ft<sup>3</sup>/lb): 6.25

APPEARANCE AND COLOR: Colorless gas with a sweet, ethereal odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor is not a reliable warning property. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

---

## 10. STABILITY and REACTIVITY

STABILITY: Stable with polymerization inhibitor. Without an inhibitor, storage for prolonged periods of time can form potentially hazardous peroxides by oxidization with atmospheric oxygen in the presence of a variety of contaminants.

DECOMPOSITION PRODUCTS: Decomposition products of Vinyl Chloride include the following toxic gases: carbon monoxide, carbon dioxide and hydrogen chloride gas and trace amounts of phosgene.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Vinyl Chloride is incompatible with strong oxidizers, copper and its alloys, aluminum, certain catalytic impurities, oxides of nitrogen. Vinyl Chloride can react violently with all these materials.

HAZARDOUS POLYMERIZATION: Hazardous polymerization can occur in the presence of air, sunlight or heat. Vinyl Chloride can cause violent polymerization in the presence of strong oxidizers. Vinyl Chloride also polymerizes violently upon contact with copper and its alloys, aluminum and certain catalytic impurities.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

---

## PART IV *Is there any other useful information about this material?*

---

## 11. TOXICOLOGICAL INFORMATION

**TOXICITY DATA:** The following information is for Vinyl Chloride (gas).

Microsomal Mutagenicity Assay-Salmonella typhimurium 1 ppH

Cytogenetic Analysis-Human: HeLa cell 10 mmol/L

Inhalation-Man TCLo: 30 mg/m<sup>3</sup> (5 years male): Reproductive effects

Inhalation-Man TCLo: 200 ppm/14 years: Carcinogenic effects,

Oral-Rat TDLo: 1 ppm/4 hours and 3463 mg/kg/52 weeks, intermittent:

Carcinogenic effects

Inhalation-Rat TCLo: 10,000 ppm/4 hours (12-18 days preg):

Carcinogenic effects, Teratogenic effects

Intraperitoneal-Rat TDLo: 21 mg/kg/65 weeks, intermittent: Equivocal tumorigenic agent

Subcutaneous-Rat TDLo: 21 mg/kg/6765 weeks, intermittent: Equivocal tumorigenic agent

Oral-Rat LD<sub>50</sub>: 500 mg/kg

Inhalation-Mouse TCLo: 50 ppm/30 weeks: Carcinogenic effects

Inhalation-Hamster TCLo: 50 ppm/4H/30 weeks: Carcinogenic effects

Inhalation-Rat TC: 50 ppm/7H/26 weeks: Carcinogenic effects

Inhalation-Rat TC: 100 ppm/7H/26 weeks: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/47 weeks I: Carcinogenic effects

Oral-Rat TD: 34 g/kg/3 years, Intermittent: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/6H/4 weeks: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/4H/30 weeks: Carcinogenic effects

Inhalation-Rat TC: 250 ppm/2 Years, Intermittent: Carcinogenic effects

Inhalation-Human TC: 300 mg/m<sup>3</sup>/ weeks: Carcinogenic effects, Blood effects

Inhalation-Rat TC: 5 ppm/4H/52 weeks: Carcinogenic effects

Inhalation Rat TC: 50 ppm/6H-43 weeks: Carcinogenic effects

**SUSPECTED CANCER AGENT:** Vinyl Chloride is a known human carcinogen, which is listed by the following agencies: IARC-1 (Carcinogenic to Humans); MAK-A1 (Capable of Inducing Malignant Tumors/Human Evidence); NTP-1 (Known to be a Carcinogen); OSHA-X (Carcinogen); ACGIH-A1 (Confirmed Human Carcinogen); NIOSH-X (Carcinogen); Cal-OSHA (Carcinogen).

**IRRITANCY OF PRODUCT:** Vinyl Chloride can be mildly irritating to eyes and skin. Contact with the liquid or rapidly expanding gases can cause frostbite to exposed tissue.

**SENSITIZATION TO THE PRODUCT:** Vinyl Chloride is not known to be a sensitizer to humans upon prolonged or repeated contact.

## 11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Vinyl Chloride on the human reproductive system.

Mutagenicity: Human mutation data are reported for Vinyl Chloride.

Embryotoxicity: There is insufficient evidence currently available to categorize Vinyl Chloride as embryotoxic to humans.

Teratogenicity: There is insufficient evidence currently available to categorize Vinyl Chloride as teratogenic to humans.

Reproductive Toxicity: Vinyl chloride is reported to produce adverse effects on the human reproductive system (i.e. changes in spermatogenesis).

*A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.*

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Conditions relating to the target organs may be aggravated by overexposures to Vinyl Chloride. See Section 3 (Hazard Identification) for information on these conditions.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treat symptoms and eliminate exposure. Refer to the OSHA Vinyl Chloride Standard (29 CFR 1910.1017; paragraph K and Appendix A) for specific information on Medical Surveillance requirements (i.e. for the general physical exam, medical history, serum specimens, specific tests, and re-examination protocol).

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Vinyl Chloride.

---

## 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas. There are limited data indicating the Vinyl Chloride is resistant to biodegradation in aerobic systems. Evaporation half-life from water is 0.45-2.5 hours.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: This gas can be harmful to animal life. Suspected toxic effects on a variety of test animals during clinical studies indicate adverse effects on the central nervous system and liver. Plants may be damaged by frost produced in the presence of rapidly expanding gases. Additional data on the effects of Vinyl Chloride on plants are available as follows:

Increased production of hydrogen peroxide in germinating seeds exposed to Vinyl Chloride gas decreased their sulfhydryl content and thereby produced adverse effects and abnormalities in growth. Threshold levels of Vinyl Chloride were greater than 200 ppm and saturation level was 1000 ppm.

EFFECT OF CHEMICAL ON AQUATIC LIFE: The effect of Vinyl Chloride effects on aquatic life is not fully known. The following data are available for Vinyl Chloride.

Estimated Bioconcentration Factor of 7. Reported water solubility of 2,700 mg/L. Based on the BCF, Vinyl Chloride is not expected to significantly bioconcentrate in aquatic organisms.

---

## 13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, and local regulations. Return cylinders with residual product to Airgas. Do not dispose locally.

---

## 14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

<u>PROPER SHIPPING NAME:</u>	Vinyl chloride, inhibited
<u>HAZARD CLASS NUMBER and DESCRIPTION:</u>	2.1 (Flammable Gas)
<u>UN IDENTIFICATION NUMBER:</u>	UN 1086
<u>PACKING GROUP:</u>	Not Applicable
<u>DOT LABEL(S) REQUIRED:</u>	Flammable Gas (Note: Per the requirements of the OSHA Vinyl Chloride Standard, 29 CFR 1910.1017, the additional legend "Cancer-Suspect Agent" must be applied near the label or placard).



## 11. TOXICOLOGICAL INFORMATION (Continued)

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 116P

MARINE POLLUTANT: Vinyl Chloride is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

## 15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: Vinyl Chloride is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Vinyl Chloride	NO	YES	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Vinyl Chloride = 1 lb.

CANADIAN DSL INVENTORY: Vinyl Chloride is listed on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Vinyl Chloride is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Vinyl Chloride is regulated under 28 CFR 1910.1017 (OSHA Vinyl Chloride Standard). Vinyl Chloride is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 pounds. Depending on specific operations involving the use of Vinyl Chloride, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Vinyl Chloride is listed in Appendix A of this Standard and the threshold quantity for Vinyl Chloride is 15,000 pounds.

U.S. STATE REGULATORY INFORMATION: Vinyl Chloride is covered under specific State regulations, as denoted below:

**Alaska - Designated Toxic and Hazardous Substances**: Vinyl Chloride.

**California - Permissible Exposure Limits for Chemical Contaminants**: Vinyl Chloride.

**Florida - Substance List**: Vinyl Chloride.

**Illinois - Toxic Substance List**: Vinyl Chloride.

**Kansas - Section 302/313 List**: Methyl Chloride.

**Massachusetts - Substance List**: Vinyl Chloride.

**Michigan - Critical Materials Register**: Vinyl Chloride.

**Minnesota - List of Hazardous Substances**: Vinyl Chloride.

**Missouri - Employer Information/Toxic Substance List**: Vinyl Chloride.

**New Jersey - Right to Know Hazardous Substance List**: Vinyl Chloride.

**North Dakota - List of Hazardous Chemicals, Reportable Quantities**: Vinyl Chloride.

**Pennsylvania - Hazardous Substance List**: Vinyl Chloride.

**Rhode Island - Hazardous Substance List**: Vinyl Chloride.

**Texas - Hazardous Substance List**: Vinyl Chloride.

**West Virginia - Hazardous Substance List**: Vinyl Chloride.

**Wisconsin - Toxic and Hazardous Substances**: Vinyl Chloride.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Vinyl Chloride is on the Proposition 65 lists. **WARNING**: Contains a chemical known to the State of California to cause cancer.

LABELING:

**DANGER**:

CANCER SUSPECT AGENT.

FLAMMABLE LIQUID AND GAS UNDER PRESSURE.

CAN FORM EXPLOSIVE MIXTURES WITH AIR.

MAY CAUSE LIVER, KIDNEY, SPLEEN AND OTHER ORGAN DAMAGE.

MAY CAUSE IRRITATION TO EYES, SKIN, AND MUCOUS MEMBRANES.

MAY CAUSE FROSTBITE.

Do not breathe gas.

Do not get liquid in skin, in eyes, or on clothing.

Keep away from heat, flames, and sparks.

Store and use with adequate ventilation in closed systems.

Cylinder temperature should not exceed 52°C (125°F).

Close valve after each use and when empty.

Use in accordance with the Material Safety Data Sheet.

## 15. REGULATORY INFORMATION (Continued)

LABELING (continued):

**NOTE:**

Suck-back into cylinder may cause rupture.  
Always use a back flow preventative device in piping.

**FIRST-AID:**

**IF INHALED:** Remove to fresh air. If not breathing, give artificial respiration, If breathing is difficult, give oxygen, Call a physician.

**IN CASE OF CONTACT,** immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. (Discard contaminated shoes)

**IN CASE OF FROSTBITE,** obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

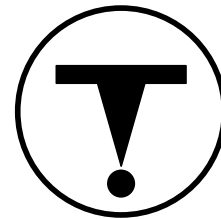
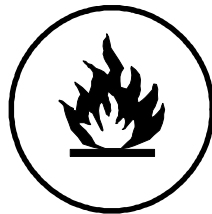
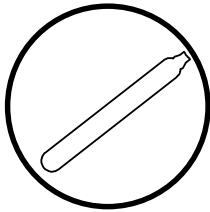
CANADIAN WHMIS SYMBOLS:

**Class A:** Compressed Gas.

**Class B1:** Flammable Gas

**Class D1B** Materials Causing Immediate and Serious Toxic Effects

**Class D2A:** Other Toxic Material



---

## 16. OTHER INFORMATION

**PREPARED BY:**

**Airgas - SAFECOR**

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

## DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

**CAS #:** This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

### EXPOSURE LIMITS IN AIR:

**ACGIH** - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

**TLV - Threshold Limit Value** - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour **Time Weighted Average (TWA)**, the 15-minute **Short Term Exposure Limit**, and the instantaneous **Ceiling Level**. Skin absorption effects must also be considered.

**OSHA** - U.S. Occupational Safety and Health Administration.

**PEL - Permissible Exposure Limit** - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

**IDLH - Immediately Dangerous to Life and Health** - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

**The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called **Recommended Exposure Levels (RELs)**. When no exposure guidelines are established, an entry of **NE** is made for reference.

### HAZARD RATINGS:

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM:** Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

**NATIONAL FIRE PROTECTION ASSOCIATION:** Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

### FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the **National Fire Protection Association (NFPA)**. Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

### TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD<sub>50</sub>** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC<sub>50</sub>** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m<sup>3</sup>** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDL<sub>0</sub>**, the lowest dose to cause a symptom and **TCL<sub>0</sub>** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause death. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

### REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. **Superfund Amendments and Reauthorization Act (SARA)**; the **Canadian Domestic Substances List (DSL)**; the U.S. **Toxic Substance Control Act (TSCA)**; Marine Pollutant status according to the **DOT**; California's Safe Drinking Water Act (**Proposition 65**); the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label.