



## North Carolina Cleanup Standards for Hydrocarbon Contaminated Groundwater

The North Carolina Department of Environment and Natural Resources has adopted Risk-Based Assessment and Corrective Action procedures to evaluate and remediate releases from petroleum underground storage tanks. Please visit our web site: <http://portal.ncdenr.org/web/wm/ust/ustmain> or call the Underground Storage Tank section at (919) 707-8171 for the most recent information.

North Carolina groundwater quality standards are established in 15A NCAC 2L .0202 and are based on the use of groundwater for human consumption. These standards are used as cleanup levels for High Risk Releases. Alternate site specific standards may be used for High, Intermediate and Low Risk releases.

Complete tables below.

**Contact:** Linda L. Smith, North Carolina Division of Waste Management, 919-707-8150

**E-mail:** [Linda.L.Smith@ncdenr.gov](mailto:Linda.L.Smith@ncdenr.gov)

**Web Site:** <http://portal.ncdenr.org/web/wm/ust/ustmain>

**Note:** Complete and Interim Groundwater Standards can be found at: <http://portal.ncdenr.org/web/wg/ps/csu/gwstandards>

## North Carolina Groundwater Quality Standards for USTs

Compound	CAS #	North Carolina Groundwater Quality Standards* (GWQS) (ug/l)
Acenaphthene	83-32-9	80
Acenaphthylene	208-96-8	200
Acetone	67-64-1	6000
tert-Amyl alcohol (TAA)	75-85-4	40
Tert-Amyl methyl ether (TAME)	994-05-8	128
Anthracene	120-12-7	2000
Barium	7440-39-3	700
Benzene	71-43-2	1
Benzo(a)anthracene (benz(a)anthracene)	56-55-3	0.05
Benzo(b)fluoranthene	205-99-2	0.05
Benzo(g,h,i)perylene	191-24-2	200
Benzo(k)fluoranthene	207-08-9	0.5
Benzoic acid	65-85-0	30000
Benzo(a)pyrene	50-32-8	0.005
Benzyl alcohol	100-51-6	700
Bis(2-chloroethyl)ether (BCEE)	111-44-4	0.03
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	3
Bromoform (tribromomethane)	75-25-2	4
Bromomethane (methylbromide)	74-83-9	100
Butanol	71-36-3	700
tert-Butyl alcohol (TBA) (tert-butanol)	75-65-0	10
n-Butylbenzene	104-51-8	70
sec-Butylbenzene	135-98-8	70
tert-Butylbenzene	98-06-6	70
tert-Butyl formate (TBF)	762-75-4	40
Carbon disulfide	75-15-0	700
Chlorobenzene	108-90-7	50
Chloroform (trichloromethane)	67-66-3	70
Chloromethane (methyl chloride)	74-87-3	3
4-Chlorotoluene (p-chlorotoluene)	106-43-4	24
Chromium	7440-50-8	10
Chrysene	218-01-9	5
Dibenz(a,h)anthracene	53-70-3	0.005
Dibenzofuran	132-64-9	28
Dibromochloromethane	124-48-1	0.4
1, 2-Dichlorobenzene (orthodichlorobenzene)	95-50-1	20
1, 3-Dichlorobenzene (metadichlorobenzene)	541-73-1	200

Compound	CAS #	North Carolina Groundwater Quality Standards* (GWQS) (ug/l)
1, 4-Dichlorobenzene (paradichlorobenzene)	106-46-7	6
Dichlorodifluoromethane (Freon-12; halon)	75-71-8	1000
1, 1-Dichloroethane	75-34-3	6
1, 2-Dichloroethane (ethylene dichloride)	107-06-2	0.4
1, 2-Dichloroethene (cis)	156-59-2	70
1, 2-Dichloroethene (trans)	156-60-5	100
1,2-Dichloroethene (cis and trans)	540-59-0	60
1, 1-Dichloroethylene (vinylidene chloride)	75-35-4	7
2,4-Dichlorophenol	120-83-2	0.98
1, 2-Dichloropropane	78-87-5	0.6
1, 3-Dichloropropene (cis and trans isomers)	542-75-6	0.4
2,4-Dimethylphenol	105-67-9	100
Ethanol	64-17-5	4000
Ethyl acetate	141-78-6	3000
Ethylbenzene	100-41-4	600
Ethylene dibromide (1, 2- Dibromoethane, EDB)	106-93-4	0.02
Ethylene glycol	107-21-1	10000
Ethyl tert-butyl ether	63-79-23	47
Fluoranthene	206-44-0	300
Fluorene	86-73-7	300
Hexachlorobutadiene	87-68-3	0.4
2-Hexanone (methyl n-butyl ketone)	591-78-6	40
Indeno(1,2,3-cd)pyrene	193-39-5	0.05
Isopropyl benzene (cumene)	98-82-8	70
Isopropyl ether (diisopropyl ether)	108-20-3	70
4-Isopropyltoluene (p-isopropyltoluene, p-cymene)	99-87-6	25
Lead	7439-92-1	15
Methanol	67-56-1	4000
Methyl ethyl ketone (2-butanone; MEK)	78-93-3	4000
Methyl isobutyl ketone (MIBK)	108-10-1	100
1-Methylnaphthalene	90-12-0	1
2-Methylnaphthalene	91-57-6	30
2-Methylphenol	95-48-7	400
Methyl tert-butyl ether (MTBE)	1634-04-4	20
Methylene chloride	75-09-2	5
Naphthalene	91-20-3	6
Pentachlorophenol	87-86-5	0.3
Phenanthrene	85-01-8	200
Phenol	108-95-2	30
n-Propylbenzene	103-65-1	70

Compound	CAS #	North Carolina Groundwater Quality Standards* (GWQS) (ug/l)
Pyrene	129-00-0	200
Silver	7440-22-4	20
Styrene (ethenylbenzene)	100-42-5	70
1,1,1,2-Tetrachloroethane	630-20-6	1
1,1,2,2-Tetrachloroethane	79-34-5	0.2
Tetrachloroethylene (perchloroethylene; PCE)	127-18-4	0.7
Toluene	108-88-3	600
1,2,4-Trichlorobenzene	120-82-1	70
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	200
1,1,2-Trichloroethane	79-00-5	0.6
Trichloroethylene (TCE)	79-01-6	3
Trichlorofluoromethane	75-69-4	2000
1,2,4-Trimethylbenzene	95-63-6	400
1,3,5-Trimethylbenzene	108-67-8	400
2,4,6-Trichlorophenol	88-06-2	4
Vinyl acetate	108-05-4	88
Vinyl chloride	75-01-4	0.03
Xylenes (o-, m-, and p-; mixed)	1330-20-7	500

\* includes interim Groundwater Quality Standards

## Approved Methods for Groundwater Analyses at Petroleum UST Release Investigations (All Phases)

Suspected Contaminant	Analytical Methods (See Notes)
1. Low Boiling Point Fuels: gasoline, aviation gasoline, ethanol-gasoline blends etc.	SM 6200B <sup>a, b</sup> MADEP VPH, <b>and</b> Lead (SM 3030C <sup>d</sup> Prep),
2. Medium/High Boiling Point Fuels: kerosene, diesel, Varsol, mineral spirits, naphtha, jet fuels, #2 fuel oil, etc. Varsol, mineral spirits, naphtha,	EPA 602 with Xylenes, EPA 625 Base/ Neutrals and Acids plus 10 largest non-target peaks, MADEP VPH, <b>and</b> MADEP EPH
3. Heavy Fuels: #4, #5, #6 fuel oil; motor oil; hydraulic fluid, etc. Mineral oil <sup>c</sup> .	EPA 625 Base/ Neutrals and Acids plus 10 largest non-target peaks, <b>and</b> MADEP EPH
4. Used / Waste Oil	SM 6200B, EPA 625 Base/ Neutrals and Acids plus 10 largest non-target peaks, MADEP VPH, MADEP EPH, <b>and</b> Metals (SM 3030C <sup>d</sup> prep.): Cr and Pb.

Rev. 0412

- a For EDB, also use EPA Method 504.1, initially and at closure.
- b Only analyze for full list of target analytes for SM 6200B (presented in the *Guidelines for Sampling* (current v App. B) at initial groundwater investigation (e.g., IAA/ IAR or LSA) unless DWM directs otherwise.
- c Carbon chains in mineral oils range from approximately C<sub>12</sub>-C<sub>45</sub>.
- d Total holding time from collection to laboratory filtering with a 0.45 micron filter is 72 hours.



## North Carolina Cleanup Standards for Hydrocarbon Contaminated Soil

The North Carolina Department of Environment and Natural Resources has adopted Risk-Based Assessment and Corrective Action procedures to evaluate and remediate releases from petroleum underground storage tanks. Please visit our web site: <http://portal.ncdenr.org/web/wm/ust/ustmain> or call the Underground Storage Tank section at (919) 707-8171 for the most recent information.

In accordance with 15A NCAC 2L .0408, three categories of soil cleanup levels have been established: residential, industrial/commercial, and soil-to-groundwater maximum soil contaminant concentrations. The soil-to-groundwater maximum soil contaminant concentrations were established to protect groundwater from the leaching of contaminants from soil.

### Cleanup Requirements

Pursuant to 15A NCAC 2L .0408, soil must be remediated to the maximum soil contaminant concentrations or as closely thereto as economically or technologically feasible.

**High and Intermediate Risk Releases:** For high and intermediate risk releases, soil contamination must be remediated to the *lowest* of:

- a) Residential or industrial/commercial maximum soil contaminant concentrations, whichever are applicable; or
- b) Soil-to-groundwater maximum soil contaminant concentrations.

**Low Risk Releases:** For low risk releases, soil contamination must be remediated to the residential or industrial/commercial maximum soil contaminant concentrations, whichever are applicable.

**Contact:** Linda L. Smith, North Carolina Division of Waste Management, 919-707-8150

**E-mail:** [Linda.L.Smith@ncdenr.gov](mailto:Linda.L.Smith@ncdenr.gov)

**Web Site:** <http://portal.ncdenr.org/web/wm/ust/ustmain>

## Maximum Soil Contaminant Concentrations (MSCCs)

(See <http://portal.ncdenr.org/web/wm/ust/guidance#OTHCAB> for current version)

Constituent	CAS#	Soil-to-Water Maximum Contaminant Concentration (Soil mg/kg)	Residential Soil Cleanup Levels (mg/kg)	Industrial/ Commercial Soil Cleanup Levels (mg/kg)
Acenaphthene	83-32-9	8.2	940	24000
Acenaphthylene	208-96-8	11	469	12264
Acetone	67-64-1	24	14000	360000
Aliphatics, C5-C8	N/A	68	939	24528
Aliphatics, C9-C18	N/A	540	1500	40000
Aliphatics, C19-C36	N/A	#	31000	810000
tert-Amyl alcohol (TAA)	75-85-4	0.1		
tert-Amyl methyl ether (TAME)	994-05-8	0.52	1960	51100
Anthracene	120-12-7	940	4600	122000
Aromatics, C9-C22	N/A	31	469	12264
Barium	7440-39-3	290	3100	81000
Benzene	71-43-2	0.0056	18	164
Benzo(a)anthracene (benz(a)anthracene)	56-55-3	0.35	0.88	8
Benzo(b)fluoranthene	205-99-2	1.2	0.88	8
Benzo(g,h,i)perylene	191-24-2	6400	469	12264
Benzo(k)fluoranthene	207-08-9	12	9	78
Benzoic acid	65-85-0	120	62571	1635200
Benzo(a)pyrene	50-32-8	0.096	0.088	0.78
Benzyl alcohol	100-51-6	2	1000	40000
Bis(chloroethyl)ether (BCEE)	111-44-4	0.00016	0.58	5.2
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	6.6	46	410
Bromoform (tribromomethane)	75-25-2	0.026	81	724
Bromomethane (methylbromide)	74-83-9	0.4	22	570
Butanol	71-36-3	2	1000	40000
tert-Butyl alcohol (TBA) (tert-butanol)	75-65-0	0.04	213	1910
n-Butylbenzene	104-51-8	4.3	626	16350
sec-Butylbenzene	135-98-8	3.3	626	16350
tert-Butylbenzene	98-06-6	3.4	626	16350
tert-Butyl formate (TBF)	762-75-4	0.1		
Carbon disulfide	75-15-0	4.3	1564	40880
Chlorobenzene	108-90-7	0.44	312	8176
Chloroform (trichloromethane)	67-66-3	0.37	20	180
Chloromethane (methyl chloride)	74-87-3	0.02	49	440
4-Chlorotoluene (p-chlorotoluene)	106-43-4	0.1	1000	20000
Chromium (Total)	7440-50-8	5.4	47	1226
Chromium III	16065-83-1	4200	23460	613200
Chromium VI	18540-29-9	5.4	47	1226
Chrysene	218-01-9	39	88	780

Constituent	CAS#	Soil-to-Water Maximum Contaminant Concentration (Soil mg/kg)	Residential Soil Cleanup Levels (mg/kg)	Industrial/ Commercial Soil Cleanup Levels (mg/kg)
Dibenz(a,h)anthracene	53-70-3	0.17	0.088	0.78
Dibenzofuran	132-64-9	4.7	62	1635
Dibromochloromethane	124-48-1	0.0021	7	68
1,2-Dichlorobenzene (orthodichlorobenzene)	95-50-1	0.23	1400	36000
1,3-Dichlorobenzene (metadichlorobenzene)	541-73-1	7.6	460	12000
1,4-Dichlorobenzene (paradichlorobenzene)	106-46-7	0.099	110	1000
Dichlorodifluoromethane (Freon-12; halon)	75-71-8	210	3129	81760
1,1-Dichloroethane	75-34-3	0.032	110	1000
1,2-Dichloroethane (ethylene dichloride)	107-06-2	0.0019	7	63
1,2-Dichloroethene (cis)	156-59-2	0.35	156	4000
1,2-Dichloroethene (trans)	156-60-5	0.54	310	8200
1,2-Dichloroethene (cis and trans)	540-59-0	0.35	100	3000
1,1-Dichloroethylene (vinylidene chloride)	75-35-4	0.045	780	20000
2,4-Dichlorophenol	120-83-2	0.0034	40	1000
1,2-Dichloropropane	78-87-5	0.003	10	92
1,3-Dichloropropene (cis and trans isomers)	542-75-6	0.001	5	57
2,4-Dimethylphenol (2,4-xylenol)	105-67-9	0.64	312	8176
Ethanol	64-17-5	16	7000	200000
Ethyl acetate	141-78-6	12	14078	367920
Ethylbenzene	100-41-4	4.9	1560	40000
Ethylene dibromide (1,2-dibromoethane)	106-93-4	0.000098	0.31	2.8
Ethylene glycol	107-21-1	40	31290	817600
Ethyl tert-butyl ether	63-79-23	0.2		
Fluoranthene	206-44-0	290	620	16400
Fluorene	86-73-7	47	620	16400
Hexachlorobutadiene	87-68-3	0.23	4.6	73
2-Hexanone (methyl n-butyl ketone, MBK)	591-78-6	0.1	70	2000
Indeno(1,2,3-cd)pyrene	193-39-5	3.4	0.88	8
Isopropyl benzene (cumene)	98-82-8	1.7	1564	40880
Isopropyl ether (diisopropyl ether)	108-20-3	0.37	156	4088
4-Isopropyltoluene (p-isopropyltoluene, p-cymene)	99-87-6	0.12	100	4000
Lead	7439-92-1	270	400	400
Methanol	67561	16	7821	204400
Methyl ethyl ketone (2-butanone; MEK)	78-93-3	16	9385	245280
Methyl tert-butyl ether (MTBE)	1634-04-4	0.091	350	3100
Methylene chloride	75-09-2	0.02	85	763
Methyl isobutyl ketone (MIBK)	108-10-1	0.4	1200	32000
1-Methylnaphthalene	90-12-0	0.004	20	100
2-Methylnaphthalene	91-57-6	3.6	63	1635
2-Methylphenol	95-48-7	1	700	20000
Naphthalene	91-20-3	0.16	313	8176



Constituent	CAS#	Soil-to-Water Maximum Contaminant Concentration (Soil mg/kg)	Residential Soil Cleanup Levels (mg/kg)	Industrial/ Commercial Soil Cleanup Levels (mg/kg)
Pentachlorophenol	87-86-5	0.0065	5	48
Phenanthrene	85-01-8	56	469	12264
Phenol	108-95-2	0.17	4693	122600
n-Propylbenzene	103-65-1	1.7	626	16350
Pyrene	129-00-0	270	469	12264
Silver	7440-22-4	0.25	78.2	2044
Styrene (ethenylbenzene)	100-42-5	1.5	3128	81760
1,1,1,2-Tetrachloroethane	360-20-6	0.004	20	200
1,1,2,2-Tetrachloroethane	79-34-5	0.001	0.78	20
Tetrachloroethylene (perchloroethylene; PCE)	127-18-4	0.0074	1.1	10
Toluene	108-88-3	4.3	1200	32000
1,2,4-Trichlorobenzene	120-82-1	2.6	156	4088
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	1.6	31000	810000
1,1,2-Trichloroethane	79-00-5	0.002	10	100
Trichloroethylene (TCE)	79-01-6	0.019	4.6	120
Trichlorofluoromethane	75-69-4	29	4692	122640
1,2,4-Trimethylbenzene	95-63-6	8.5	782	20440
1,3,5-Trimethylbenzene	108-67-8	8.3	782	20440
2,4,6-Trichlorophenol	88-06-2	0.01	10	400
Vinyl acetate	108-05-4	0.36	10000	400000
Vinyl chloride	75-01-4	0.00018	0.46	4.1
Xylenes (o-, m-, and p-; mixed)	1330-20-7	4.6	3129	81760

# Health based level > 100%

Rev. 4/16/2012

## considered immobile

## Approved Methods for Petroleum Contaminated Soil Analyses

(Laboratories must be certified by the North Carolina DWQ to perform the following methods)

### Approved Methods for Soil Analyses at Petroleum UST Closures and Over-Excavation and at Site Checks and for Non-UST Releases of Petroleum

Suspected Contaminant	Analytical Methods for Closure, Site Check, or Other Preliminary Investigation Samples	Analytical Methods for Samples from Over-Excavation Following a Release
1a. Low Boiling Point Fuels: gasoline, aviation gasoline' etc. <sup>a</sup>	EPA 8015C for TPH-GRO (or UVF for TPH) <sup>b</sup>	EPA 8260B and MADEP VPH
1b. Ethanol-Gasoline Blends	EPA 8015C for TPH-GRO (or UVF for TPH) <sup>b</sup> <b>and</b> EPA 8260B	
2. Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, fuel oil #2, biodiesel (containing diesel), etc. Varsol, mineral spirits, naphtha.	EPA 8015C for TPH-GRO <b>and</b> EPA 8015C for TPH-DRO (or UVF for TPH) <sup>b</sup>	EPA 8260B, EPA 8270D, MADEP VPH, <b>and</b> MADEP EPH
3. Heavy Fuels: #4, #5, #6 fuel oils, motor oil, hydraulic fluid, etc. Mineral oil <sup>c</sup>	EPA 8015C for TPH-DRO (or UVF for TPH) <sup>b</sup>	EPA 8270D <b>and</b> MADEP EPH
4. Used / Waste Oil	EPA 8260B, EPA 8270D, MADEP VPH, MADEP EPH, (or UVF for TPH and PAH) <sup>b</sup> <b>and</b> EPA 3050B or 3051A Prep: Total Metals (Cr and Pb), EPA 8081B (pesticides), <b>and</b> EPA 8082A (PCBs) <sup>d</sup>	EPA 8260B, EPA 8270D, MADEP VPH, MADEP EPH, EPA 3050B or 3051A Prep: Total Metals (Cr and Pb), EPA 8081B (pesticides) , <b>and</b> EPA 8082A (PCBs) <sup>e</sup>

a Analyze for Pb, EPA 3050B or 3051A Prep: Total Metals (Pb).

Rev. 0412

b Only UVF technology with product (fuel) identification and calibration approved by DWM is allowed. (Other methods for TPH analysis may be approved by DWM for the initial investigation if determined to meet all requirements.)

c Carbon chains in mineral oils range from approximately C<sub>12</sub>-C<sub>45</sub>.

d Analyses for PCBs and pesticides are not required for service station/garage waste oil investigations.

### Approved Methods for Soil Analyses during Advanced Phases of Petroleum UST Release Investigations

Suspected Contaminant	LSA 1 Soil Sampling <sup>a</sup>	Comprehensive Site Assessment and Monitoring Soil Sampling <sup>b f</sup>	Final Site Closure Soil Sampling
1. Low Boiling Point Fuels: gasoline, aviation gasoline, ethanol-gasoline blends, etc.	For the first sample collected below land/excavation surface and the last sample prior to saturated zone use: EPA 8260B with IPE & MTBE <b>and</b> MADEP VPH For all other samples, analyze only by: MADEP VPH	Analyze all samples from each vertical boring by EPA 8260B with IPE & MTBE <b>and</b> EPA 8015C (TPH GRO) Then analyze the sample from each boring with the highest TPH-GRO value by MADEP VPH <sup>d</sup>	EPA 8260B with IPE & MTBE <b>and</b> MADEP VPH
2. Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, naphtha, fuel oil #2, etc. Varsol, mineral spirits, naphtha,	For the first sample collected below land/excavation surface and the last sample prior to saturated zone use: EPA 8260B, EPA 8270D, MADEP VPH, <b>and</b> MADEP EPH For all other samples, analyze only by: MADEP VPH, <b>and</b> MADEP EPH	Analyze all samples from each vertical boring by EPA 8260B, EPA 8270D, EPA 8015C (TPH GRO) <b>and</b> EPA 8015C (TPH DRO) Then analyze the sample from each boring with the highest TPH-GRO value by MADEP VPH <sup>d</sup> <b>and</b> Then analyze the sample from each boring with the highest TPH-DRO value by MADEP VPH <b>and</b> MADEP EPH <sup>d</sup>	EPA 8260B, EPA 8270D, MADEP VPH, <b>and</b> MADEP EPH
3. Heavy Fuels: #4, #5, #6 fuel oils; motor oil; hydraulic fluid; etc. Mineral oil <sup>e</sup>	For the first sample collected below land/excavation surface and the last sample prior to saturated zone use: EPA 8270D <b>and</b> MADEP EPH For all other samples, analyze only by: MADEP EPH	Analyze all samples from each vertical boring by EPA 8270D <b>and</b> EPA 8015C (TPH DRO) Then analyze the sample from each boring with the highest TPH-DRO value by MADEP EPH <sup>d</sup>	EPA 8270D <b>and</b> MADEP EPH
4. Used / Waste Oil	For the first sample collected below land/excavation surface and the last sample prior to saturated zone use: EPA 8260B, EPA 8270D, MADEP VPH, MADEP EPH, EPA 3050B or 3051A Prep: Total Metals (Cr and Pb), EPA 8081B (pesticides), <b>and</b> EPA 8082A (PCBs) <sup>f</sup> For all other samples, analyze only by: MADEP VPH, <b>and</b> MADEP EPH	Analyze all samples from each vertical boring by EPA 8260B, EPA 8270D, EPA 3050B or 3051A Prep: Total Metals (Cr and Pb), EPA 8081B (pesticides), <b>and</b> EPA 8082A (PCBs), Then analyze the sample from each boring with the highest TPH-GRO value by MADEP VPH <b>and</b> Then analyze the sample from each boring with the highest TPH-DRO value by MADEP VPH <b>and</b> MADEP EPH <sup>d</sup>	EPA 8260B, EPA 8270D, MADEP VPH, MADEP EPH, EPA 3050B or 3051A Prep: Total Metals (Cr and Pb), EPA 8081B (pesticides), <b>and</b> EPA 8082A (PCBs) <sup>c</sup>

- a 2 full analysis samples are required per well boring.
- b Sample analysis for monitoring will be limited to constituents previously detected
- c Analyses for PCBs and pesticides are not required for service station/garage waste oil investigations.
- d Avoid sampling the smear zone. If the samples with the highest EPA 8015C values appear to represent the smear zone, do not analyze them using MADEP. If all samples from a boring are non-detect for the 8000 series and 8015C, the additional analyses by MADEP should not be performed on the sample.
- e Carbon chains in mineral oils range from approximately C<sub>12</sub>-C<sub>45</sub>.
- f Use of UVF technology with product (fuel) identification and calibration approved by DWM is allowed for initial field assessment to facilitate intensive semi-quantitative assessment of contamination prior to collection at optimal locations of a minimum number of samples for laboratory analysis by the approved methods.