1R - 425-01

REPORTS

DATE:

9-23-10

Texerra

75 Wuthering Hts Drive Colorado Springs, CO 80921
Tel: 719-339-6791 E-mail: lpg@texerra.com

September 23rd, 2010

Mr. Edward Hansen
New Mexico Energy, Minerals, & Natural Resources
Oil Conservation Division, Environmental Bureau
1220 S. St. Francis Drive
Santa Fe, New Mexico 87504

RE: Remediation Termination Request
Rice Operating Company
Vacuum E-2 Junction Box, Unit E, Sec 2, T18S, R35E
OCD Case Number 1R0425-01

Sent via Email and U.S. Certified Mail Return Receipt No. 7008 1830 0004 2694 4330

Mr. Hansen,

The VAC E-2 Jct Box site has been extensively characterized since our initial site evaluation in June of 2006. The site is located about four miles east of Buckeye, New Mexico (Figure 1). Approximate locations of soil borings and monitor wells are given in Figure 2. Measured values of soil chlorides are given in Figure 3. Over the course of the past four years groundwater chlorides have oscillated and yet generally declined from levels above 600 ppm to below 200 ppm observed this past June (Figure 4). Rice has also done considerable soil restoration work and vegetation has since recovered well (Figure 5).

Texerra has calculated the residual, contributed soil chloride mass in the 20 ft interval above the water table (which is present at approximately 60 ft bgs) as 962 lbs (2,116 kg, Table 1). We have also employed a simple spreadsheet model (provided to you as an e-mail attachment, and explained in Table 2) to illustrate how these residual soil chlorides would be expected to decline over time (Figure 6) and to estimate how these would affect the chloride concentration in the groundwater immediately beneath the site (Figure 7). In brief, we anticipate that groundwater chloride concentrations will, on average, continue to decline over time below their present value (which averaged 224 mg/kg over the past four sampling quarters). Since we did not incorporate the effect of the clay barrier (Figures 8 & 9) which Rice installed across the excavation site our projections are likely to be conservative.

We believe that these multiple lines of evidence indicate that this site is no longer a threat to groundwater quality and thus respectfully request that NMOCD grant "termination" or similar closure status to this project.

ROC is the service provider (agent) for the Vacuum Salt Water Disposal System and has no ownership of any portion of pipeline, well or facility. The Vacuum SWD System is owned by a consortium of oil producers, System Parties, who provide all operating capital on a percentage ownership/usage basis.

Please do not hesitate to contact either myself or Rice Operating Company if you have any questions or need additional information.

Sincerely,

L. Peter Galusky, Jr. Ph.D.,P.G.

Attachments: Figures and Tables and (via e-mail) Excel model

Copy: Rice Operating Company

Figure 1 – VAC E-2 location.

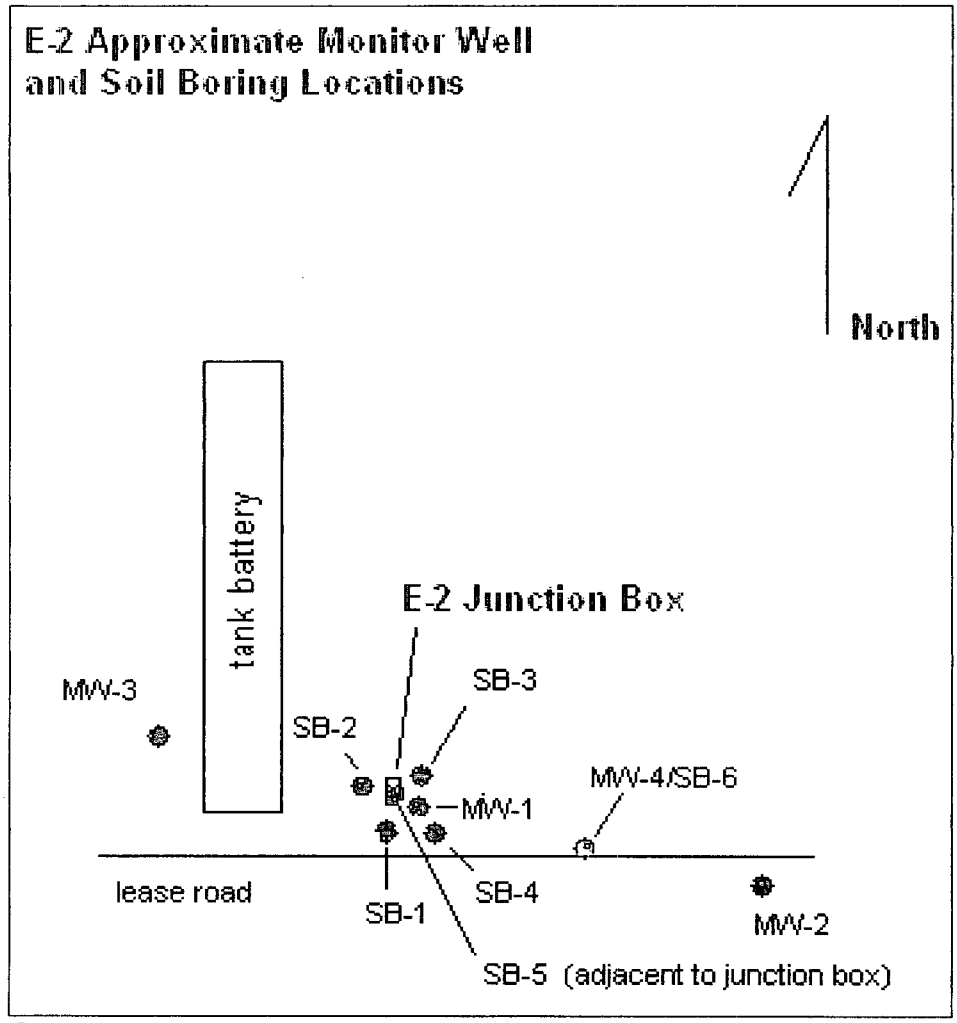


Figure 2 – VAC E-2 approximate locations of soil borings & monitor wells. MW-4 is approximately 100 ft SE of the E-2 Jct Box. However, the map is not to scale.

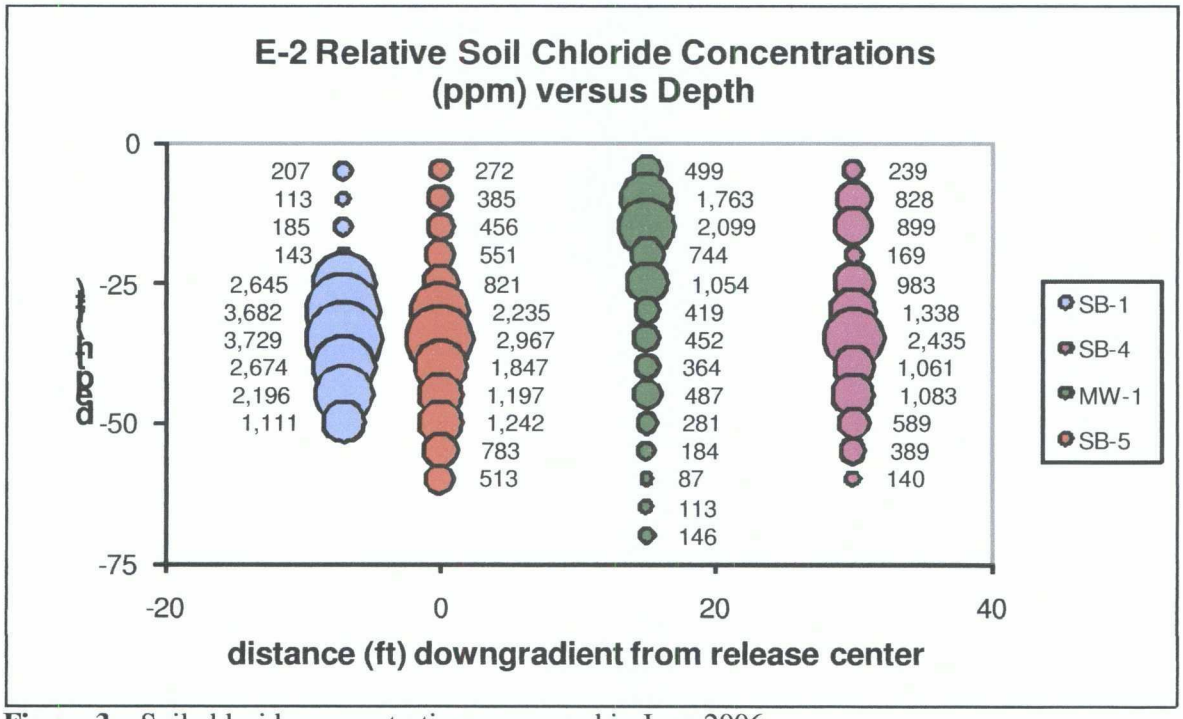


Figure 3 – Soil chloride concentrations measured in June 2006.

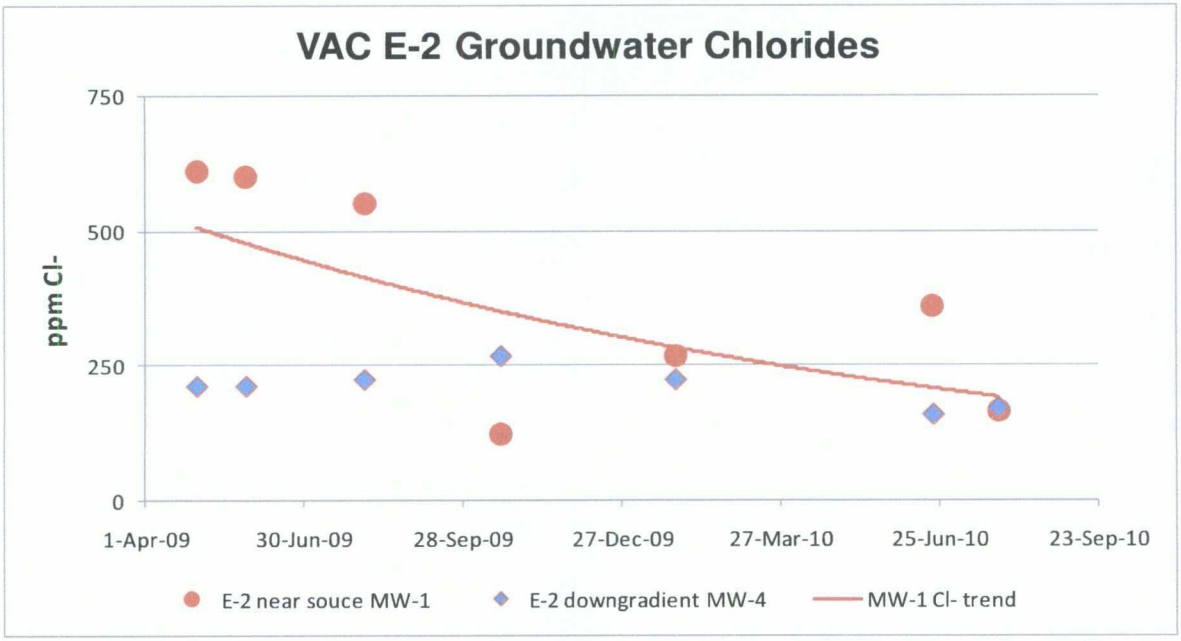


Figure 4 – Measured groundwater chloride concentrations in a near/at-source monitor well (MW-1) and approximately 100 ft down-gradient (MW-4). The red line is a "best-fit" exponential decline curve for the near/at-source monitor well (MW-1).

Figure 5 – View across E-2 Jct looking north. Photo taken July 2010.

Soil Chloride Calculator			
Estimated Mass of Contributed, Residual Soil Chloride			
Rice Operating Company			
Site:	**VAC E-2**		
This estimate prepared by:	L. Peter Galusky, Jr.		
Date:	9/23/2010		
Inputs in Blue Font			Notes
length of affected area (ft)		**35**	measured/estimated
width of affected area (ft)		**35**	measured/estimated
depth to water table (ft)		**60**	measured
unsat zone affected depth (ft)		**20**	measured
sat zone affected thickness (ft)		**10**	prescribed by NMOCD
unsat zone avg Cl- conc of affected soil (ppm)		**700**	measured
unsat zone est. natural background Cl- conc (ppm)		**250**	prescribed by NMOCD
unsat zone mass density (lbs/cu yd)		**3,000**	estimated
sat zone avg Cl- conc of affected soil (ppm)		**130**	measured
sat zone est. natural background Cl- conc (ppm)		**250**	prescribed by NMOCD
sat zone mass density (lbs/cu yd)		**3,000**	estimated
affected area (sq ft)		**962**	calculated
unsat zone Cl- conc attributed to source (ppm)		**450**	calculated
unsat zone volume of affected soil (cu yds)		**712**	calculated
unsat zone total mass of affected soils (lbs)		**2,136,944**	calculated
unsat zone mass of contributed residual soil chloride (lbs)		**962**	calculated
sat zone Cl- conc attributed to source (ppm)		**0**	calculated
sat zone volume of affected soil (cu yds)		**356**	calculated
sat zone total mass of affected soils (lbs)		**1,068,472**	calculated
sat zone mass of contributed residual soil chloride (lbs)		**0**	calculated
Mass of contributed soil chlorides (lbs)	**unsat zone**	**962**	calculated
"	**sat zone**	**0**	calculated
"	**total**	**962**	calculated

Table 1 – Estimated residual soil chloride mass beneath former VAC E-2 junction box. This was calculated as the average measured soil chloride concentration across the affected area minus a prescribed 250 mg/kg as permissible "background" for 20 ft above the water table (unsaturated zone) and 10 ft below the water table (saturated zone).

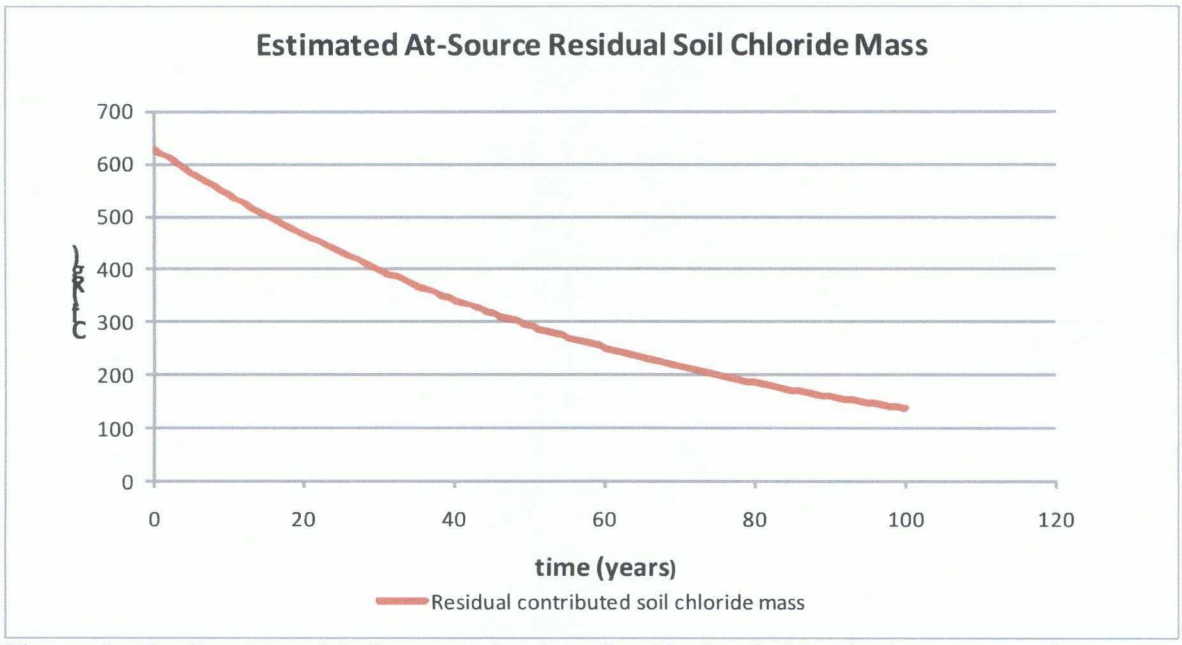


Figure 6 – Predicted (modeled) mass reduction of residual soil chlorides in unsaturated zone beneath affected area due to percolation.

Figure 7 – Predicted (modeled) groundwater chloride concentration immediately beneath the affected area.

Table 2 – Model Rationale

Unsaturated Zone

- The residual, contributed unsaturated zone soil chloride mass was calculated for the 20 ft above the measured water table depth based upon measured soil chloride levels, subtracting a value of 250 ppm as an NMOCD permissible baseline.
- The center of mass of these residual, contributed chlorides were assumed to move into the water table at an estimated average rate of 0.5 meters/year. The unsaturated zone residual chloride mass is thus predicted to decline steadily over time (Figure 6).

Saturated Zone

- The chloride concentration in the groundwater beneath the affected area is calculated as a function of the initial value, the increase due to percolation from the unsaturated zone and a decrease due to natural dilution (Figure 7).
- The initial value for groundwater chloride concentration was set as the average measured value for the last 4 quarters (224 mg/kg).
- The effective rate of dilution was estimated based on the measured decline over the past 8 quarters (55%/yr).

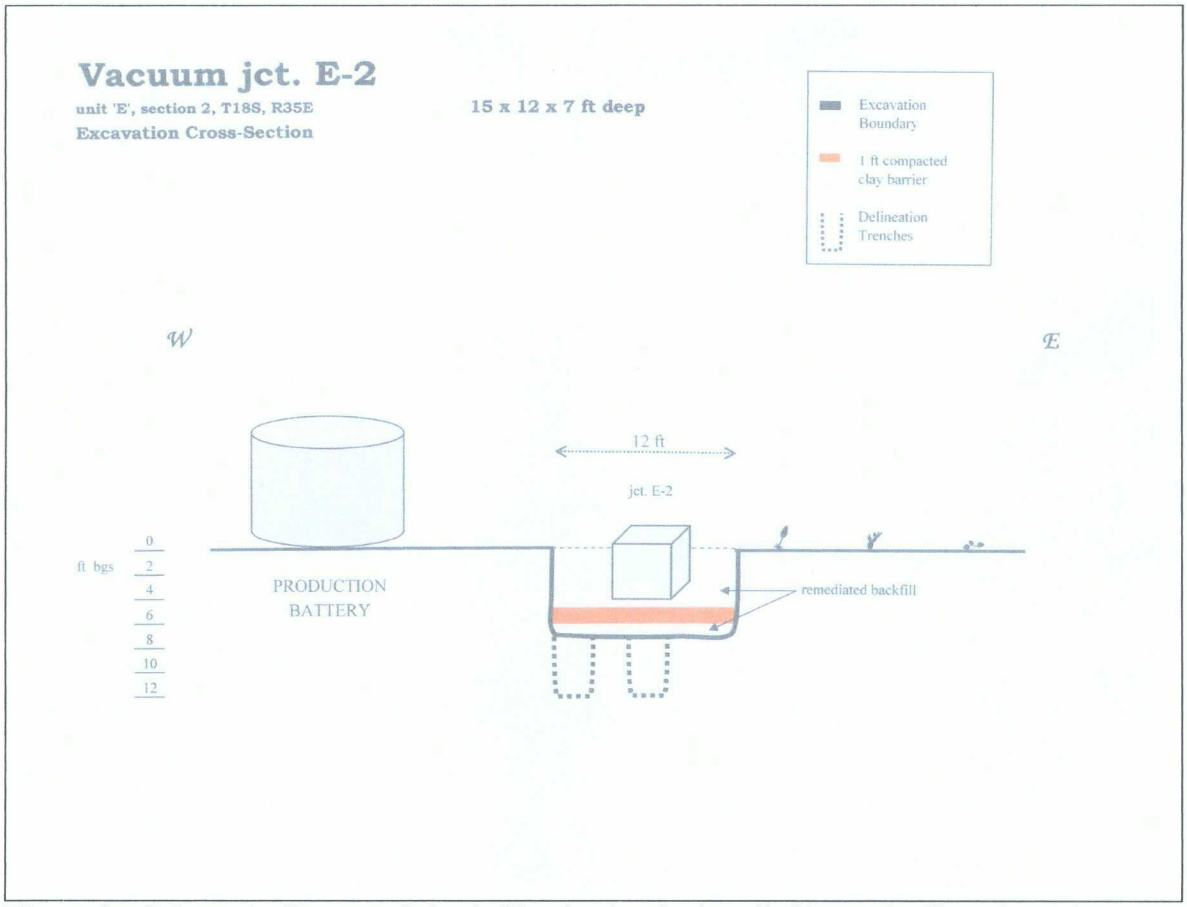


Figure 8 – Schematic diagram of clay infiltration barrier installed beneath affected area in September 2004.

Figure 9 – Installation of clay infiltration barrier installed beneath affected area in September 2004.

Hansen, Edward J., EMNRD

From: lpg@texerra.com
Sent: Wednesday, October 06, 2010 3:53 PM
To: Hansen, Edward J., EMNRD
Cc: Hack Conder; Katie Jones
Subject: Rice Operating Company. VAC E-2 groundwater model.
Attachments: VAC E-2 1D discrete groundwater chloride transport model 10.06.10 lpg.xls

Edward,

Please find attached the groundwater model that we reviewed today, where I adjusted the natural background unsaturated zone chloride concentration to 100 mg/kg (from 250 mg/kg) per your request. The effect on tje predicted groundwater chloride concentrations is negligible.

Thank you for your consideration.

Sincerely,

Pete G.

L. Peter Galusky, Jr. Ph.D.
Texerra
Voicemail (no live pick-up) & Fax: 877-534-9001
Cell: 719-339-6791
Web: www.texerra.com

Chloride Transport Model (CTM)

Date: 23-Sep-10

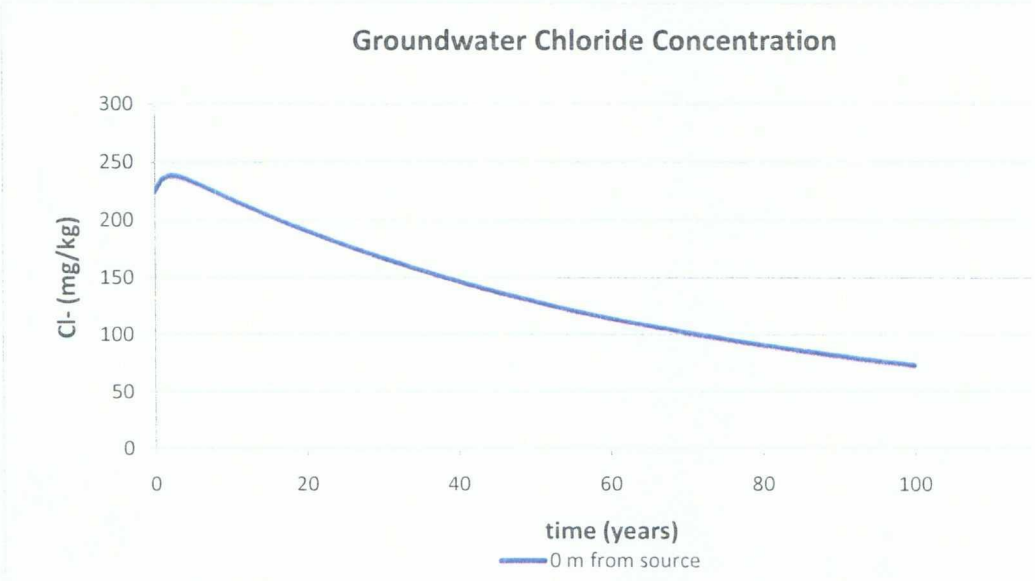
Unsaturated Zone Inputs

Parameter	Unit	Value	Notes
equivalent length (in direction of gw flow) of affected area	m	10	
equivalent width (perpendicular to gw flow) of affected area	m	10	measured/estimated
affected depth	m	7	measured/estimated
depth to water table	m	33	measured/estimated
avg Cl- conc of affected soil	mg/kg	700	measured/estimated
est. natural background Cl- conc	mg/kg	100	measured/estimated
unsat zone mass density	kg/m3	2,000	estimated/assumed
rate of Cl- percolation	m/yr	0.5	estimated/assumed

Saturated Zone Inputs

Parameter	Unit	Value	Notes
upgradient (baseline) Cl- conc	mg/kg	24	measured/estimated
initial Cl- conc (Co)	mg/kg	224	avg of last 4 qtrs
thickness of affected aquifer	m	3.0	prescribed by NMOCD (10 ft)
aquifer porosity	per cent	25%	estimated/assumed
rate of groundwater movement	m/yr	5.00	estimated/assumed

Year multiplier for graphical output 2

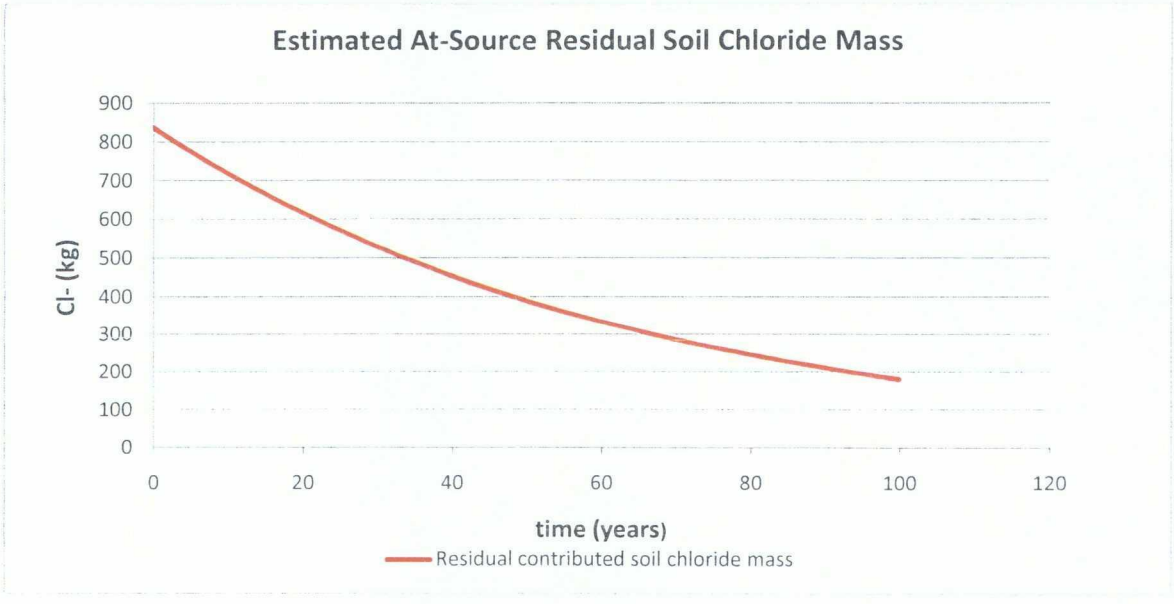


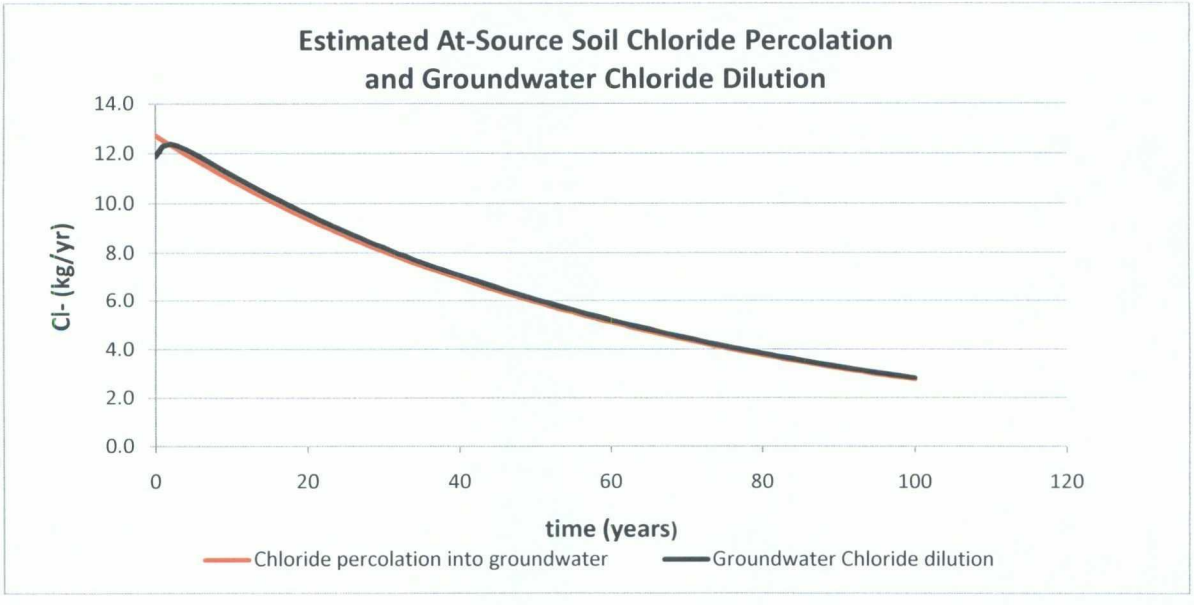
Unsaturated Zone Calculated Parameters

Parameter	Unit	Value	Notes
affected area	m2	100	
volume of affected soil	m3	700	
total mass of affected soils	kg	1,400,000	
Cl- conc attributed to source	mg/kg	600	
mass of contributed residual soil chloride	kg	840	
annual decline in residual chloride	per cent	1.5%	

Saturated Zone Calculated Parameters

Parameter	Unit	Value	Notes
total volume of affected aquifer	m3	305	
sat volume of initial affected aquifer volume	m3	76	
mass of affected aquifer volume	kg	76,200	
initial Cl- mass in affected aquifer volume	kg	17	
annual dilution attenuation factor (DAF) in affected aquifer volume	per cent	55.0%	
time for plume center to travel 100 meters	yrs	20.0	
time for gw cross section to traverse affected area	yrs	2.0	




Estimated At-Source Soil Chloride Percolation and Groundwater Chloride Dilution
Cl- (kg/yr)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
20
40
60
80
100
120
time (years)
Chloride percolation into groundwater
Groundwater Chloride dilution