Effects of Road Salting on Ground Water Quality at the Suffolk County Water Authority Ackerly Pond and Mill Lane Well Fields, Peconic, Town of Southold

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Abstract

of Long Island is contained within a series of hydraulically isolated lenses that decline in thickness eastward. In the recent past
d by elevated chloride concentrations. In an effort to determine the source of the high chlorides, the Suffolk County Water Autho
n Peconic- Mill Lane and Ackerly Pond Road- using samples obtained from vertical profile wells. Since the relative concentrati
lar ratio in groundwater affected by road salting is much lower than the Br/Cl molar ratio in groundwater impacted by lateral or
mples were analyzed to determine if the chloride increases observed in the public supply wells were due to upconing from overp
ng has impacted both well fields. This is especially true at the Ackerly Pond Road well field, since the site is located in close pr
major highway. Vertical profiles at Mill lane detected similarly abnormal Br/Cl molar ratios opposite the screen setting of the p
that future changes in the operation of both well fields, as well as closer monitoring of water quality trends, will allow the SCW

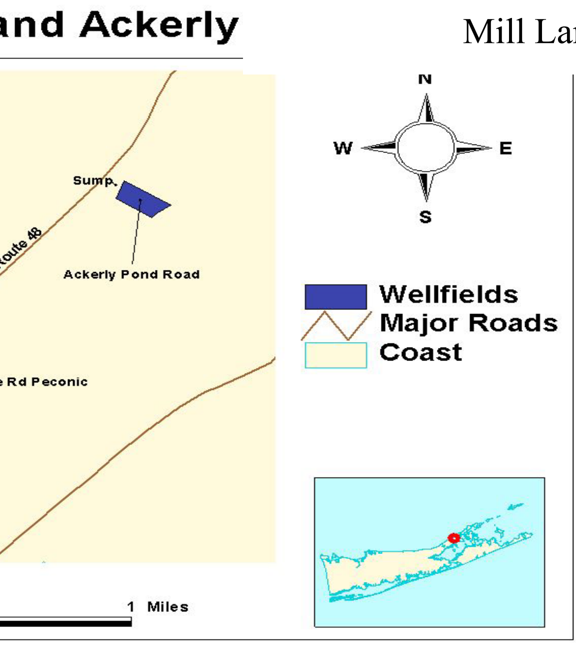
Introduction

nking water for residents of Suffolk County. Concerns as to the quality of drinking water are particularly acute on the North For
groundwater quality of the shallow aquifer system has been deteriorating as a result of residential expansion, agricultural practic
systems have been constructed at several well fields to address water quality concerns. A contaminant of particular interest is ro
thin the upper glacial aquifer. This process is of concern at present because high concentrations have been detected in stormwat
chloride to groundwater is the primary public concern since drinking water contaminated by sodium can pose a health risk to in
and local governments spend about $10 million each year to prevent and remediate problems of road salt contamination (S.R, 1
WA) public supply wells on the North Fork of Long Island became impacted by elevated chloride concentrations, potentially du
the thickness of the freshwater lens, lowering of water levels due to public supply and agricultural pumpage, and road salt cont
elevated chlorides. Hydrogeologic and geochemical knowledge of the watershed environment surrounding major roads is an im
ters (Bank, 1996). In 2000, the Suffolk County Water Authority studied the effects of stormwater runoff on the water quality at
rt will provide (1) a brief synopsis of the deteriorating water quality at Mill Lane and Ackerly Pond Road (2) the sampling and b
on between freshwater and water impacted by road runoff.

Background

nide concentrations are an effective means to determine the source of elevated chloride concentrations as either seawater or road
dy on the effects of stormwater runoff on the water quality at the Ackerly Pond Road, Southold, and Mill Lane, Peconic wellfie
se proximity to water bodies and a major road (County Route 48), SCWA was concerned with the vulnerability of these wells
ter supply system, which extends from Mattituck Creek to Dam Pond on the North Fork of Long Island. The Hamlets serviced
Marion. The locations of these sites are approximately mid-way between Peconic Bay and the Long Island Sound.

Mill Lane and Ackerly Pond Road Wellfields



Hydrogeologic Setting

ed the North Fork aquifer system as part of the Freshwater Lens Setting. This is due in part to the freshwater lenses being bound ne rest of the Long Island fresh groundwater system and have no adjacent freshwater to provide recharge. The North Fork has a The unconfined part of the freshwater lenses is the upper glacial aquifer, and the horizontal hydraulic conductivity ranges from ld has shown the unconfined part of the aquifer to be underlain by fine to coarse-grained sand and gravel deposits. Geologic log t a depth of approximately 100 feet below grade (approximately 80 feet below msl). Research done by the USGS has indicated t ilar elevations. Depth to water within the wellfield is approximately 20 feet below grade, therefore, there are approximately 80 oad Well Field is located near a groundwater flow divide, therefore the direction of groundwater flow in the well field is not kno rea is approximately 45 inches(Simmons, 1986). During the primary recharge period (October 15 through May 15), the normal the Cornell University Station (located northwest of the study area) indicate that 75 – 90 percent of the rainfall during the prim ovement of the freshwater/saltwater interface through pumping results in a zone of diffusion and disproportionate withdrawals f in contamination of the freshwater supply(Cartwright, 1997). Other sources of groundwater contamination in this hydrogeologi on farms.

Br/Cl Molar Ratio Applications

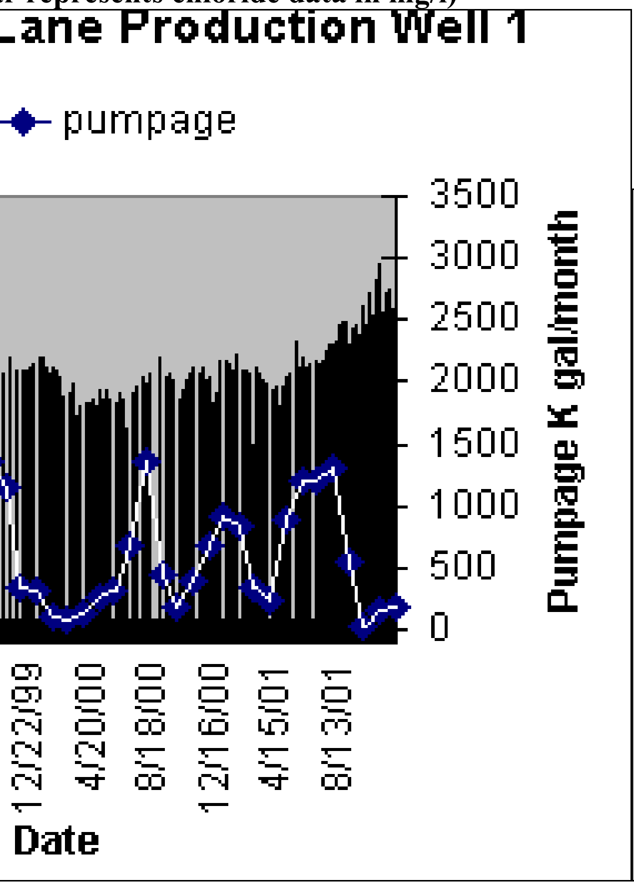
Long Island originates from seawater and has an average molar Br/Cl ratio of 1.54 nM/uM (nanomol/micromole), the Br/Cl rat As a result, molar Br/Cl ratio applications have been extremely useful in water quality analysis on Long Island. Analyzing the ation, because certain contaminants will result in a Br/Cl ratio above or below that of normal precipitation. Road salt, which in S affecting shallow aquifers and is often mistaken for seawater encroachment. Analyzing molar Br/Cl ratios allow for differentia e molar Br/Cl ratio that is relatively constant, a wellfield impacted by saltwater encroachment will still show the Br/Cl ratio equ ntrast halite will result in a molar Br/Cl ratio orders of magnitude lower than seawater, due to the exclusion of Br from the NaC lyzing the molar Br/Cl ratio in rural areas may be useful in determining pesticide contamination.

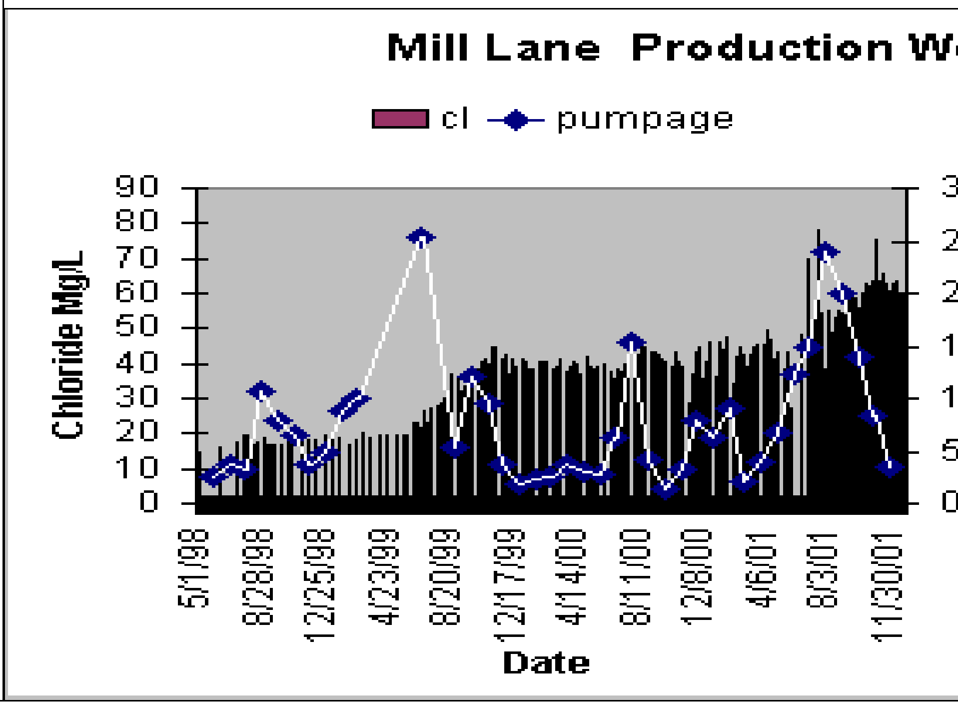
Research Strategy

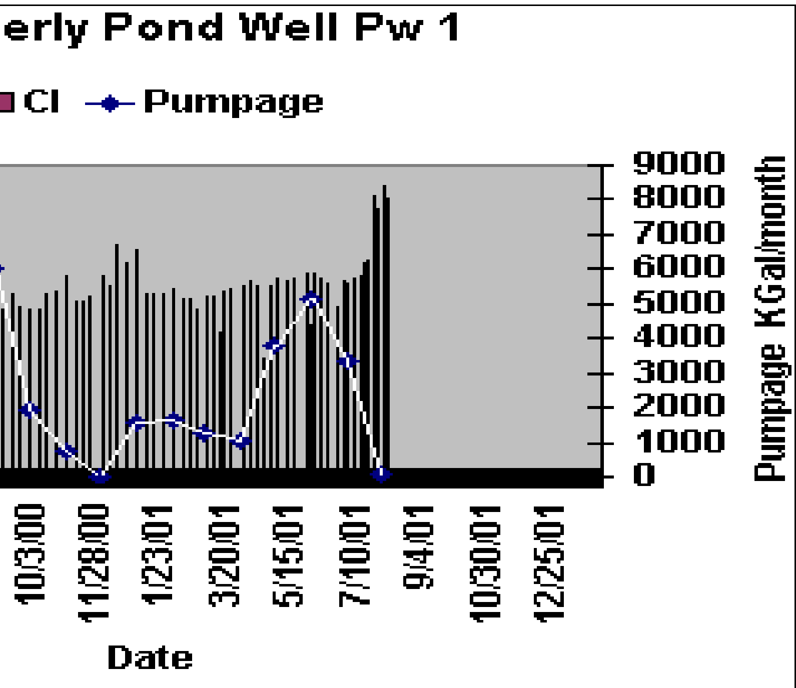
ughout the North Fork, the first objective was to accurately assess water quality at the Ackerly Pond Road and Mill Lane, well f

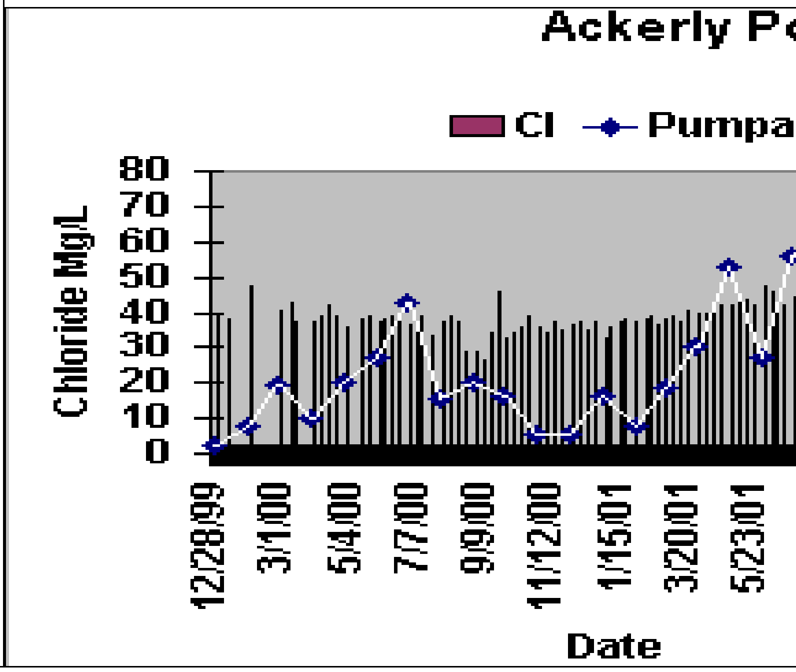
on (Fig. 1) were sampled in order to determine 1) the quality of ambient local water, and 2) the effects of nonpoint contaminant s
loride data of the Mill Lane and Ackerly Pond production wells were analyzed to allow for temporal analysis of pumpage induc
n both January and July, 2000 drilling programs allowed for both spatial and temporal analysis of Na+, Br, and Br/Cl ratios Du
f the boreholes at Mill Lane was analyzed using vertical profiles. The temporary boreholes were drilled with a Failing F-10 drill
ed with a plastic plug to prevent leakage into the augers. Subsequent auger sections were sealed at the joints by O-rings to preve
saturated zone into the water table. This methodology allows the auger string to act as a well casing and prevent a collapse of th
encountered at that depth. A 10-foot section of 2-inch diameter slotted PVC screen was lowered into the borehole and used to c
th the water table as the augers were raised. The profile samples were purged using a stainless steel pump and teflon lined tubin
e sampling. Decontamination of pumping equipment was conducted prior to sampling each borehole to prevent cross contamina
nd during the March 2002 drilling program. Due to the differences in the depths of the clay layer between Mill Lane and Ackerl
les were stored in HDPE (High-Density Polyethylene) containers and analyzed the same day. Br, Cl and $N0_3$ concentrations wer
ith AS4S-SC column and a standard sodium carbonate sodium bicarbonate eluant were used. Conductivity was used to determi
ntent of road salt was also determined.

r represents chloride data in mg/l)









Sample Results

d from the sites were summarized in table 1 and figure 4b. The tables and vertical profile layouts created on excel aided in the vi

le S-116843 in July 2000(table 3) indicated that at a depth of 90 feet, chloride concentrations reached a high of 116 mg/L. Th 5.4 mg/L), but subsided at a depth of 150 feet (50.2 mg/L). The sample data from profile S-116844 in July 2000 did not detec verage concentration of 27 mg/L. Samples collected approximately seven months earlier showed abnormal chloride concentratio e data collected from profile S-116845 had an average chloride concentration of 37 mg/L. Average chloride concentrations for and increased to 73 mg/L during the month of January 2001. Chloride concentrations for production well no. 2 averaged 40 m uary 2001.

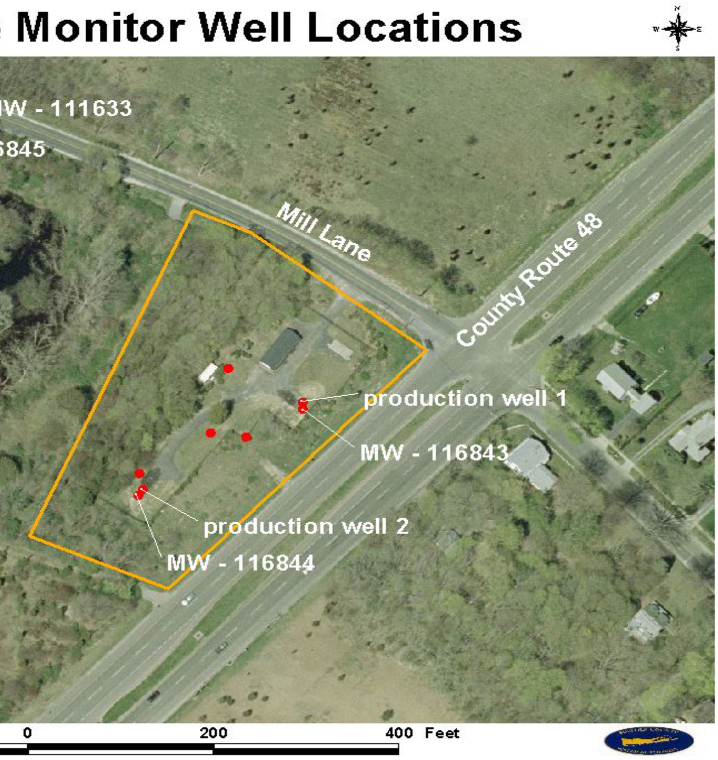
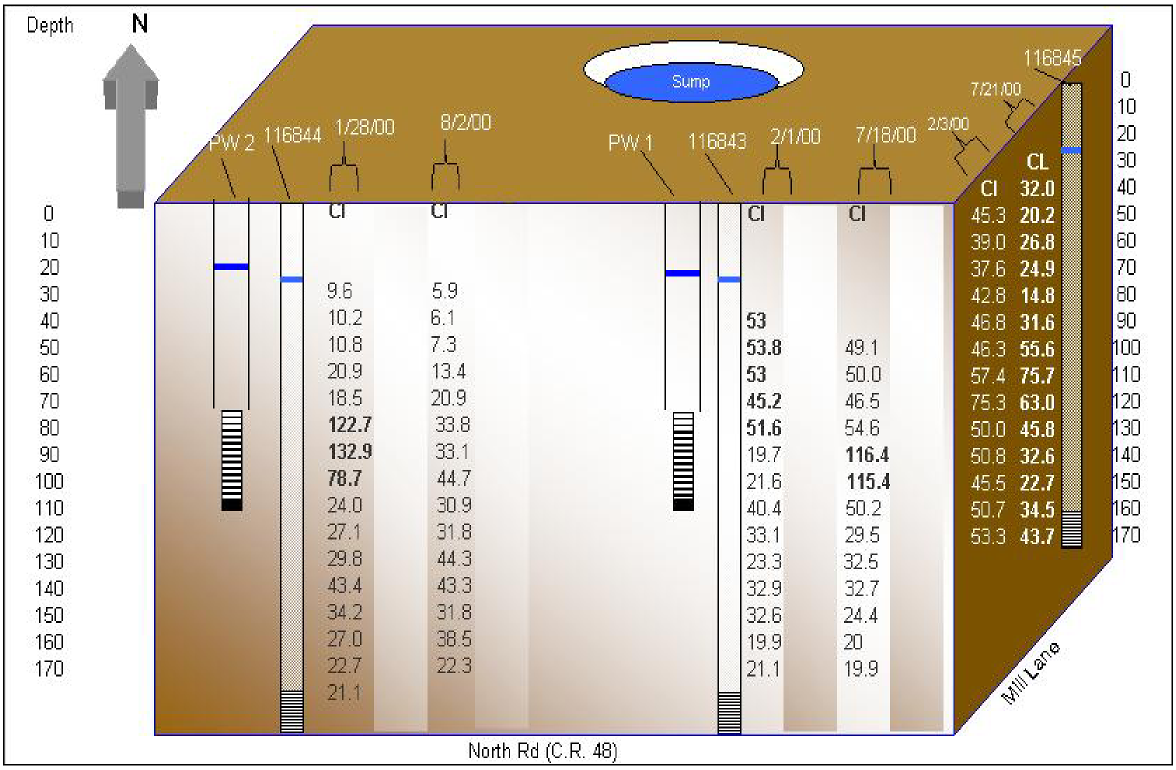


Table 3 Mill Lane Vertical Profile Results (chlorides in mg/l)

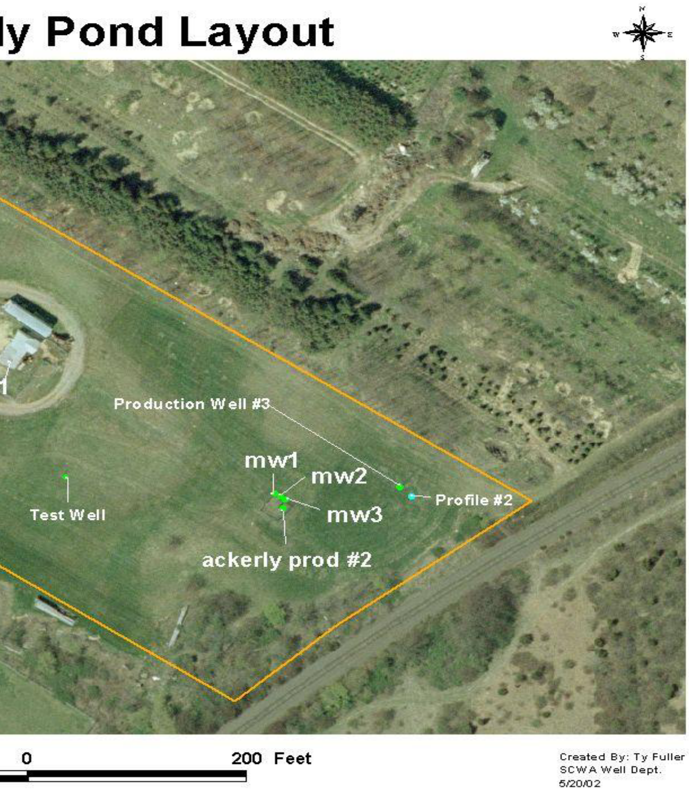


Depth	116844 1/28/00 Cl	116844 8/2/00 Cl	116843 2/1/00 Cl	116843 7/18/00 Cl	116845 2/3/00 Cl	116845 7/21/00 CL
0						
10						
20						
30	9.6	5.9				
40	10.2	6.1	**53**			**32.0**
50	10.8	7.3	**53.8**	49.1	45.3	**20.2**
60	20.9	13.4	**53**	50.0	39.0	**26.8**
70	18.5	20.9	**45.2**	46.5	37.6	**24.9**
80	**122.7**	33.8	**51.6**	54.6	42.8	**14.8**
90	**132.9**	33.1	19.7	**116.4**	46.8	**31.6**
100	**78.7**	44.7	21.6	**115.4**	46.3	**55.6**
110	24.0	30.9	40.4	50.2	57.4	**75.7**
120	27.1	31.8	33.1	29.5	75.3	**63.0**
130	29.8	44.3	23.3	32.5	50.0	**45.8**
140	43.4	43.3	32.9	32.7	50.8	**32.6**
150	34.2	31.8	32.6	24.4	45.5	**22.7**
160	27.0	38.5	19.9	20	50.7	**34.5**
170	22.7	22.3	21.1	19.9	53.3	**43.7**
	21.1					

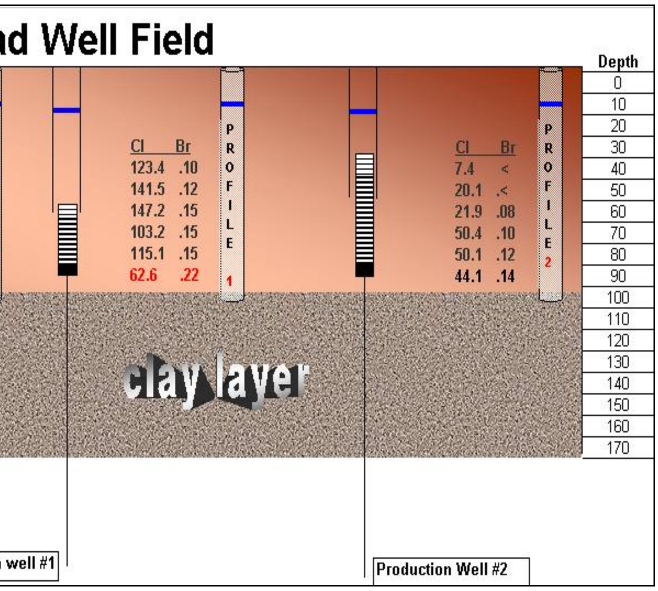
Mill Lane profiles are summarized in Table 4.

istinct difference in Br/Cl ratios at depths where the unusual chloride concentrations were detected. The sample results from pr
table 1). This unusually low ratio was also present at a depth of 100 feet (.35 nM/uM), but improved at a depth of 120 feet (1.
any unusual chloride concentrations, the Br/Cl ratio was low at a depth of 80 feet (.79 nM/uM) to 90 feet (.69 nM/uM). Sa
Cl ratios at a depth of 80 feet (.40 nM/uM) and 90 feet (.30 nM/uM). The sample data collected from profile S-116845 indicated
).

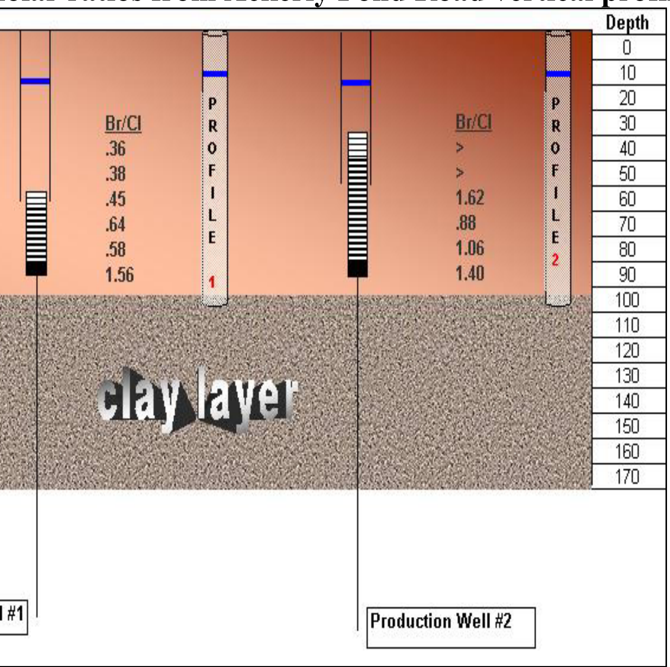
. 4a & 4b) indicated that at a depth of 60 feet, chloride concentrations reached a high of 147.2 mg/l. The corresponding molar B
h chloride concentration was present at most depths, but subsided at a depth of 150 feet (62.2 mg/l). The sample data collected f
ponding Br/Cl ratio had an average concentration of 1.24 nM/uM. The sample data collected from profile 3 detected chloride co
depth was .14 nM/uM.



oncentrations from Ackerly Pond Road vertical profiles



molar ratios from Ackerly Pond Road vertical profiles



Discussion

ation vs. pumpage for Ackerly Pond Road Production Wells 1 and 2 over time. As shown, chloride concentrations at PW-1 have
ntrations were observed at PW-1, one in December 2000 and the other at the end of July 2001 through August 2001. The chloric
e to conclude that these increases in chloride concentrations are representative of a source other than seawater upconing. Low B
in, which is the likely source of the chloride concentrations. The likely cause for the moderate increase in chloride concentratio
f 2000, allowing for a stronger gradient created by the operation of PW-2 to induce additional chlorides to the southern portion
afflicting the wellfield at Mill lane Peconic. The vertical profiles indicate that, at depths ranging from 80 –120 feet the molar B
o the screen setting of the production well. Pumping of the production well would be expected to draw in contaminants (such as
ea of surface contaminants affecting the wellfield. The results of this study shows that Br/Cl ratios are an effective means of ide
etween road salt and natural seawater.

Depth	S-116843 January 2000 Br/Cl (nM/uM)	S-116843 July 2000 Br/Cl (nM/uM)	S-116844 January 2000 Br/Cl (nM/uM)	S-116844 July 2000 Br/Cl (nM/uM)	S-116845 January 2000 Br/Cl (nM/uM)	S-116845 July 2000 Br/Cl (nM/uM)
30			0.00	0.00		
40	0.67		0.00	0.00		0.69
50	0.66	0.54	0.00	0.00	1.18	1.32
60	0.59	0.62	1.49	0.00	1.14	1.49
70	0.79	0.57	1.44	0.00	1.42	1.07
80	0.52	0.41	0.40	0.79	1.24	0.00
90	1.58	0.30	0.30	0.80	1.33	0.00
100	1.44	0.35	0.39	0.69	0.95	0.40
110	1.10	0.80	1.48	1.44	0.85	0.35
120	2.14	1.80	2.29	1.81	0.53	0.35
130	2.29	1.77	2.23	1.50	1.06	0.68
140	2.16	1.90	1.64	1.33	1.48	0.82
150	2.04	1.82	1.36	1.40	1.46	1.76
160	2.01	1.55	1.97	0.92	1.31	1.29
170	2.10	1.56	1.95	1.59	1.42	1.24
180	1.91		1.95		1.38	

REFERENCES

ne watershed connection", Proceedings of Watershed '96, a National Conference on Watershed Management and Protection: Baltimore, M eration.

in press) "Effects Of Road Salting On Stormwater and Groundwater Quality at the East Meadow Brook Headwaters Area, Nassau County, , Programs with Abstracts, April 22, 1995, Long Island Geologists, Stony Brook, New York.

ologic-Setting classification for Suffolk County, Long Island, New York (with results of selected aquifer-test analyses)", United States Geol

Ianagement Handbook", Long Island Regional Planning Board 1984

9 Letter Report to Suffolk County Water Authority "Middle Road (North Road C.R. 48) Well Field Town of Southold, New York"

mmary, New York, 1997", Volume 109, Number 13.

d Brown, Craig J. (in press) "Bromide in Long Island Groundwaters and Surface Waters", Geology of Long Island and Metropolitan New Y ok, New York.

l-Water Flow Paths and Traveltime to Three Small Embayments within the Peconic Estuary, Eastern Suffolk County, New York", United S

d Ground-Water Quality on Shelter Island, Suffolk County, New York", 1983-84, United States Geological Survey, Water Resources Repo

(in press) "Hydrogeologic Framework and Extent of Saltwater Intrusion On The Manhasset Neck Peninsula, Long Island, New York, by us Ietropolitan New York, Programs with Abstracts, April 20, 1996, Long Island Geologists, Stony Brook, New York.

Comparing Salt and Calcium Magnesium Acetate." TRB, National Research Council, Washington D.C., 1991

rvices, 1997, "Water Table Contours and Locations of Observation Wells in Suffolk County, New York, March 1997".

Table 1 Br/Cl Molar Ratio of Vertical Profiles