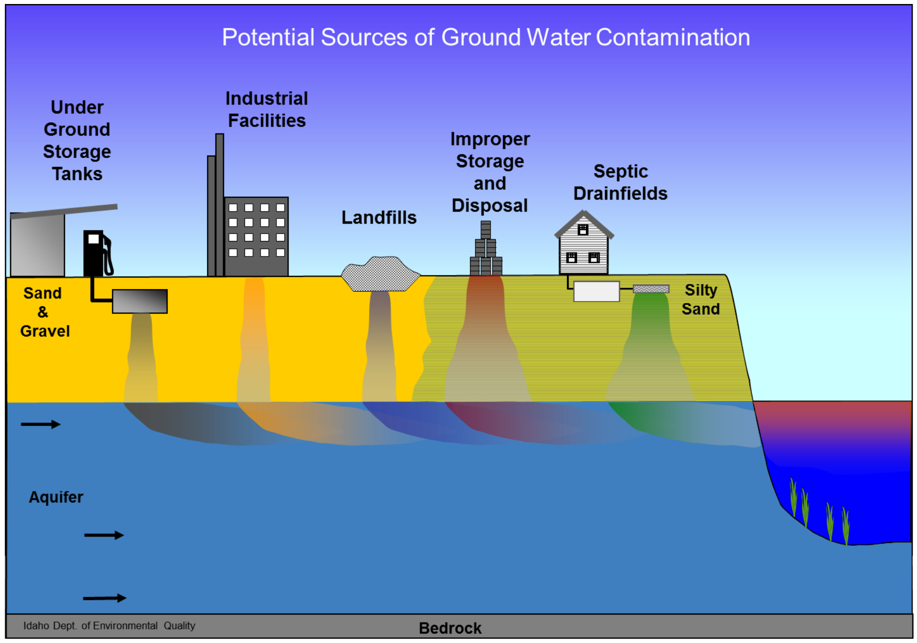
GROUP B

Ground Water Contamination

Lesson Plan #3: What is Ground Water Contamination?



Objectives: Learn what a contaminant is and how contaminants flow through an aquifer.

- What is a contaminant?
- What are common sources of contaminants?
- What affects contaminant flow through an aquifer?
- How to sample ground water.
- How to predict downgradeint contaminant concentrations.

Grades: 10– 12

Materials:

- Calculator/spreadsheet

Ground Water Contamination:
Ground water contamination is generally the result of chemicals used by humans entering an aquifer. If ground water has chemicals from human activity it is said to be contaminated. If the concentration of one or more chemicals is too elevated it may not be safe to drink.

Where do these chemicals come from? Humans use a number of different materials that contain chemicals. These liquid or solid materials are often stored in large tanks. There are a number of different sources of contamination such as:

1. Underground Storage Tanks
2. Industrial Facilities
3. Landfills
4. Improper Storage or Disposal
5. Septic Drainfields

If these liquids or solids that contain chemicals are not used or stored properly they can leak the chemicals into the soil and eventually into the ground water.

Underground Storage Tanks are commonly use to hold thousands of gallons of gasoline or diesel at gas stations. As the tanks age they may start to rust and corrode eventually forming holes. If the tank has holes then the gasoline or diesel will be released and infiltrate downward potentially contaminating the ground water.

Industrial Facilities often use large quantities of chemicals. Sometimes there are accidental spills of chemicals or improper storage that may result in releases to nearby rivers and streams, or may eventually seep into ground water.

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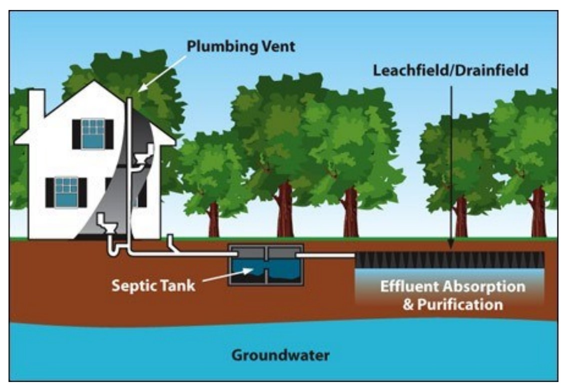
Landfills are places where household wastes go. Some household wastes contain chemicals that could be dangerous. If the household waste is allowed to sit outside, chemicals may seep out into the ground underneath. Most landfills have a low permeability layer underneath to keep chemicals from seeping into the ground water. Often after the waste is dumped a layer of low permeability soil will be placed on top to keep rain water from seeping into the waste and carrying chemicals into the soil. A number of cities have special hazardous waste drop off locations to put hazardous chemicals instead of throwing them into the garbage so that they stay out of the landfills.

Improper storage and disposal may cause chemicals to seep or leak into the soil and contaminate the ground water. Chemicals should always be stored in proper containers and the containers should often be kept inside and on floors that will hold any spills or leaks if they occur

Septic Drainfields are used to dispose of wastewater from houses into the ground. If built and maintained properly the septic system will keep most contaminants out of the ground water. If a septic system fails or is not built properly then it may introduce contaminants like bacteria or viruses into the ground water If the homeowner is pouring chemicals down the drain rather then taking them to the hazardous waste drop off locations the chemicals will go to the drainfield and seep into the ground water. If there is a water well nearby the bacteria, viruses or chemicals coming from the drainfield may end up in someone's drinking water.



The rate that contaminants will be transported through an aquifer is affected by four processes; 1) advection, 2) dispersion 3) retardation, and 4) degradation. Advection is a process were contaminants will be carried along with the ground water. Dispersion is a process that results in contaminants spreading out away from the source. Retardation is a broad term that includes a variety of process that causes contaminates to migrate slower then the ground water. Degradation describes how the contaminant will breakdown with time.

Contaminants will advect at the same rate as the velocity of ground water. Dispersion will occur longitudinally (along the flow path), laterally and vertically (both perpendicular to the flow path). Dispersion will cause an increase in the plume size and a decrease in concentration. Dispersion is caused by 1) mechanical mixing of water, 2) convoluted pathways around aquifer material, and 3) changes in hydraulic conductivity of the aquifer material.

Dispersion coefficient is estimated with the following equation;

$$DL = \alpha Lv$$
$$DT = \alpha Tv$$
$$DV = \alpha Vv$$

Where;

DL, DT, Dv= Longitudinal, transverse and vertical dispersion in feet2 /day.
v = average pore water velocity in feet/day.
αL, αT, αV = Longitudinal, transverse and vertical dispersivity coefficient in feet.

IDAHO Department of Environmental Quality

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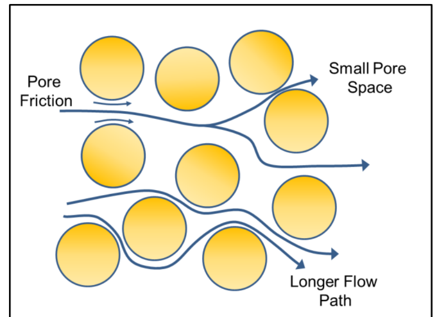
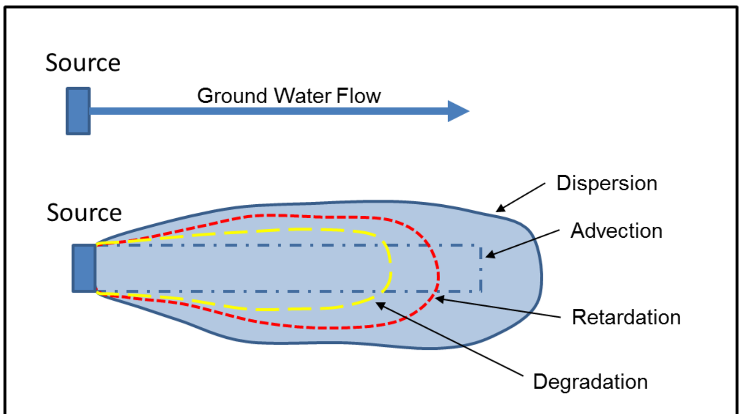


Factors Affecting Dispersion

Empirical evidence shows that the dispersion is scale dependent. The larger the plume the greater the dispersion. A general rule of thumb for estimating the longitudinal, transverse and vertical dispersvitiy is;

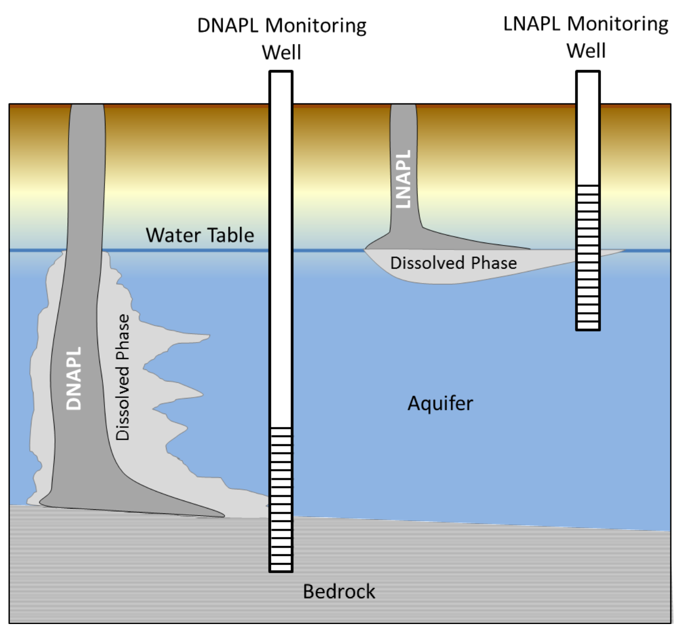
αL = 1/10th the plume length.
$\alpha T = \alpha L /10$
$\alpha V = \alpha T /10$



Fate & Transport Processes Affecting Plume Size and Shape

There are many processes that affect retardation, generally the most significant process is sorption. Sorption is the process where contaminants will adhere to the aquifer sediments. Contaminants made up of cations (positively charged ions) can be sorbed onto clay minerals because clay minerals have a negative charge. Organic chemicals, such as benzene found in gasoline, can be sorbed onto organic carbon in soils. The process of sorption will slow the contaminant movement and reduce the dissolved concentration. Contaminants can undergo degradation. Degradation is the process of breaking down the contaminant into simpler compounds. The degradation process can occur chemically or can be facilitated by bacteria (biodegradation).

Contaminants may dissolve in ground water and are transported downgradeint. Other contaminants do not readily dissolve and are referred to as non-aqueous phase liquids. Some non-aqueous phase liquids are less dense then water and will float on top of the ground water, and are called light –non-aqueous phase liquids (LNAPL). Other s are more dense then water and will sink to the bottom of the aquifer and are called Dense Non-Aqueous Phase Liquids (DNAPL). Monitoring wells used to sample for each of these types of contaminants need to be constructed differently in order to be effective at Monitoring wells constructed for detecting LNAPLs have the screens placed on top of the water table, and monitoring wells constructed to detect DNAPLs have the screens placed at the bottom of the aquifer. detecting the presence of the contaminants.

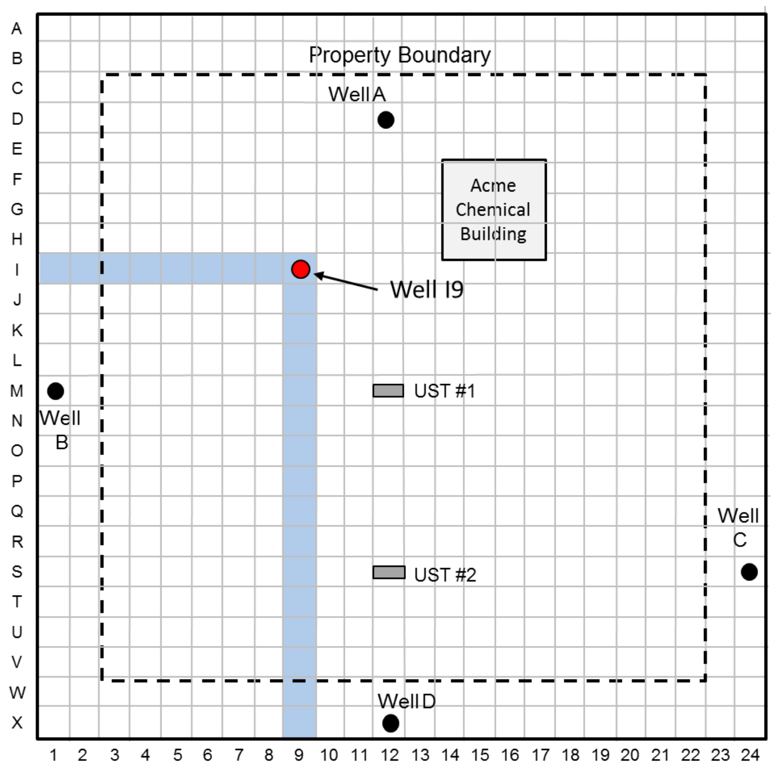


GROUP B

Ground Water Contamination

Lesson Plan #3: What is Ground Water Contamination?

Exercise:
The Acme Chemical Company has discovered that after an bi-annual chemical inventory they cannot account for 26,280 gallons of chemical X that is stored in their 20,000 gallon underground storage tanks, as shown on the attached map. The Acme Chemical Co. does not know which UST could be leaking. Chemical X readily dissolves in water and does not sorb onto soil or the aquifer material.



The aquifer has the following characteristics;

- Thickness = 50 feet
- Hydraulic Conductivity = 300 feet/day
- αL = 50 feet
- αT = 5 feet
- αV = 0.5 feet
- Porosity = 0.25

Release characteristics;

- Duration of the Release = 180 days
- Conc. of chemical X = 1,000 milligrams/liter

They have hired you as an expert hydrogeologist to determine;

1. Which direction tis he contaminant plume headed?
2. Has the contaminant plume reached the property boundary?
3. How long will it take to reach the property boundary?
4. Is there the potential that any of the drinking water wells (A,B,C,D) may be contaminated?
5. What maybe the concentration in the drinking water well if the water becomes contaminated.?
6. The maximum concentration allowed in drinking water for Chemical X is 0.1 mg/l. Is there the potential that the UST release will cause the concentrations of Chemical X in the drinking water well to exceed this?
7. How could you reduce or eliminate the release of chemical X?

You have been given funding for a total of five monitoring wells to determine the ground water level and confirm contaminant concentration. You can only drill the wells on the Acme Chemical Co. property. Ground water flow direction can vary across a site and is unknown at the Acme Chemical Co. property.

Ground Water Contamination

Lesson Plan #3: What is Ground Water Contamination?

Exercise:

Your instructor will divide you into pairs or small groups each will be assign one of two different scenario's either A or B as seen at the top of the page.

As you drill each of your **five** wells well you can find out the water elevation and concentration of chemical X from someone in the other group. The location of each well will correspond to a grid defined by the letter on the vertical axis and a number on the horizontal axis. The groundwater elevations and contaminant concentrations for Group A are attached to the Group B lesson plans and vice versa. Once you determine the ground water flow direction and gradient, you should use the Contaminant Fate & Transport spreadsheet to help answer the questions and evaluate data if appropriate.

The spreadsheet has inputs for both source and aquifer characteristics. The resulting down gradient ground water concentrations are calculated using the Domenico Solution (see the calculations tab for the solution). Determine the gradient and flow direction from your five wells. Place the source and aquifer information into the spreadsheet and see what the resulting concentrations would be down gradient. See if the concentrations in your five wells match the concentrations calculated from the spreadsheet. Good luck!

2D - Fate and Transport of Chemical - No Retadation or Degradation

Project: Fate and Transport Training
Date: 8/20/2002
Prepared by: JNM
Contaminant: Chemical X

Input

- Input Cell

Source Characteristics

Concentration (mg/l)	Width (ft)	Thickness (ft)	Duration of Release (days)
100	10	10	365

Aquifer Characteristics

Hydraulic Conductivity (ft/day)	Gradient (ft/ft)	Porosity	Dispersivity Longitudinal (ft)	Tranverse (ft)	Vertical (ft)
100	0.013	0.25	20	2	0.2

Model Domain

Length (ft)	Width (ft)
500	250

Results

Lateral Feet From Source	Horizontal Feet From Source: 50	100	150	200	250	300	350	400	450	500
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.010	0.017
100	0.000	0.000	0.003	0.021	0.060	0.117	0.183	0.253	0.321	0.384
50	0.066	0.818	1.662	2.198	2.479	2.601	2.630	2.606	2.552	2.482
0	26.897	17.470	12.975	10.319	8.564	7.319	6.389	5.669	5.094	4.626
-50	0.066	0.818	1.662	2.198	2.479	2.601	2.630	2.606	2.552	2.482
-100	0.000	0.000	0.003	0.021	0.060	0.117	0.183	0.253	0.321	0.384
-150	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.010	0.017
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

GROUP B

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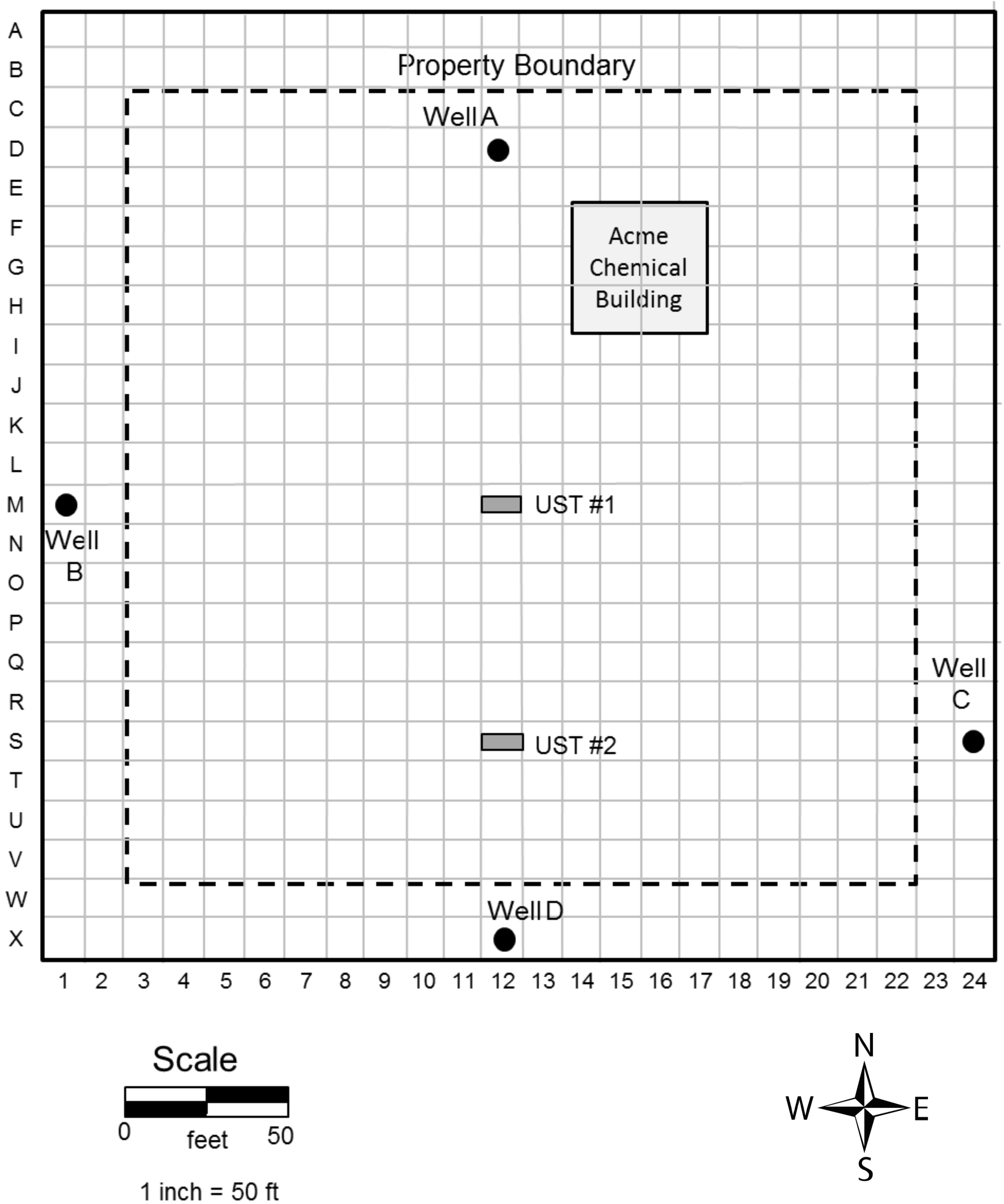

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GROUP B

Group A

Water Elevetaions

Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)	Cell	Water Elevetaion (ft-msl)
A1	100.85	B1	100.85	C1	100.85	D1	100.85	E1	100.85	F1	100.85	G1	100.85	H1	100.85	I1	100.85	J1	100.85	K1	100.85	L1	100.85
A2	100.90	B2	100.90	C2	100.90	D2	100.90	E2	100.90	F2	100.90	G2	100.90	H2	100.90	I2	100.90	J2	100.90	K2	100.90	L2	100.90
A3	100.95	B3	100.95	C3	100.95	D3	100.95	E3	100.95	F3	100.95	G3	100.95	H3	100.95	I3	100.95	J3	100.95	K3	100.95	L3	100.95
A4	101.00	B4	101.00	C4	101.00	D4	101.00	E4	101.00	F4	101.00	G4	101.00	H4	101.00	I4	101.00	J4	101.00	K4	101.00	L4	101.00
A5	101.05	B5	101.05	C5	101.05	D5	101.05	E5	101.05	F5	101.05	G5	101.05	H5	101.05	I5	101.05	J5	101.05	K5	101.05	L5	101.05
A6	101.10	B6	101.10	C6	101.10	D6	101.10	E6	101.10	F6	101.10	G6	101.10	H6	101.10	I6	101.10	J6	101.10	K6	101.10	L6	101.10
A7	101.15	B7	101.15	C7	101.15	D7	101.15	E7	101.15	F7	101.15	G7	101.15	H7	101.15	I7	101.15	J7	101.15	K7	101.15	L7	101.15
A8	101.20	B8	101.20	C8	101.20	D8	101.20	E8	101.20	F8	101.20	G8	101.20	H8	101.20	I8	101.20	J8	101.20	K8	101.20	L8	101.20
A9	101.25	B9	101.25	C9	101.25	D9	101.25	E9	101.25	F9	101.25	G9	101.25	H9	101.25	I9	101.25	J9	101.25	K9	101.25	L9	101.25
A10	101.30	B10	101.30	C10	101.30	D10	101.30	E10	101.30	F10	101.30	G10	101.30	H10	101.30	I10	101.30	J10	101.30	K10	101.30	L10	101.30
A11	101.35	B11	101.35	C11	101.35	D11	101.35	E11	101.35	F11	101.35	G11	101.35	H11	101.35	I11	101.35	J11	101.35	K11	101.35	L11	101.35
A12	101.40	B12	101.40	C12	101.40	D12	101.40	E12	101.40	F12	101.40	G12	101.40	H12	101.40	I12	101.40	J12	101.40	K12	101.40	L12	101.40
A13	101.45	B13	101.45	C13	101.45	D13	101.45	E13	101.45	F13	101.45	G13	101.45	H13	101.45	IA13	101.45	J13	101.45	K13	101.45	L13	101.45
A14	101.50	B14	101.50	C14	101.50	D14	101.50	E14	101.50	F14	101.50	G14	101.50	H14	101.50	I14	101.50	J14	101.50	K14	101.50	L14	101.50
A15	101.55	B15	101.55	C15	101.55	D15	101.55	E15	101.55	F15	101.55	G15	101.55	H15	101.55	I15	101.55	J15	101.55	K15	101.55	L15	101.55
A16	101.60	B16	101.60	C16	101.60	D16	101.60	E16	101.60	F16	101.60	G16	101.60	H16	101.60	I16	101.60	J16	101.60	K16	101.60	L16	101.60
A17	101.65	B17	101.65	C17	101.65	D17	101.65	E17	101.65	F17	101.65	G17	101.65	H17	101.65	I17	101.65	J17	101.65	K17	101.65	L17	101.65
A18	101.70	B18	101.70	C18	101.70	D18	101.70	E18	101.70	F18	101.70	G18	101.70	H18	101.70	I18	101.70	J18	101.70	K18	101.70	L18	101.70
A19	101.75	B19	101.75	C19	101.75	D19	101.75	E19	101.75	F19	101.75	G19	101.75	H19	101.75	I19	101.75	J19	101.75	K19	101.75	L19	101.75
A20	101.80	B20	101.80	C20	101.80	D20	101.80	E20	101.80	F20	101.80	G20	101.80	H20	101.80	I20	101.80	J20	101.80	K20	101.80	L20	101.80
A21	101.85	B21	101.85	C21	101.85	D21	101.85	E21	101.85	F21	101.85	G21	101.85	H21	101.85	I21	101.85	J21	101.85	K21	101.85	L21	101.85
A22	101.90	B22	101.90	C22	101.90	D22	101.90	E22	101.90	F22	101.90	G22	101.90	H22	101.90	I22	101.90	J22	101.90	K22	101.90	L22	101.90
A23	101.95	B23	101.95	C23	101.95	D23	101.95	E23	101.95	F23	101.95	G23	101.95	H23	101.95	I23	101.95	J23	101.95	K23	101.95	L23	101.95
A24	102.00	B24	102.00	C24	102.00	D24	102.00	E24	102.00	F24	102.00	G24	102.00	H24	102.00	I24	102.00	J24	102.00	K24	102.00	L24	102.00
M1	100.85	N1	100.85	O1	100.85	P1	100.85	Q1	100.85	R1	100.85	S1	100.85	T1	100.85	U1	100.85	V1	100.85	W1	100.85	X1	100.85
M2	100.90	N2	100.90	O2	100.90	P2	100.90	Q2	100.90	R2	100.90	S2	100.90	T2	100.90	U2	100.90	V2	100.90	W2	100.90	X2	100.90
M3	100.95	N3	100.95	O3	100.95	P3	100.95	Q3	100.95	R3	100.95	S3	100.95	T3	100.95	U3	100.95	V3	100.95	W3	100.95	X3	100.95
M4	101.00	N4	101.00	O4	101.00	P4	101.00	Q4	101.00	R4	101.00	S4	101.00	T4	101.00	U4	101.00	V4	101.00	W4	101.00	X4	101.00
M5	101.05	N5	101.05	O5	101.05	P5	101.05	Q5	101.05	R5	101.05	S5	101.05	T5	101.05	U5	101.05	V5	101.05	W5	101.05	X5	101.05
M6	101.10	N6	101.10	O6	101.10	P6	101.10	Q6	101.10	R6	101.10	S6	101.10	T6	101.10	U6	101.10	V6	101.10	W6	101.10	X6	101.10
M7	101.15	N7	101.15	O7	101.15	P7	101.15	Q7	101.15	R7	101.15	S7	101.15	T7	101.15	U7	101.15	V7	101.15	W7	101.15	X7	101.15
M8	101.20	N8	101.20	O8	101.20	P8	101.20	Q8	101.20	R8	101.20	S8	101.20	T8	101.20	U8	101.20	V8	101.20	W8	101.20	X8	101.20
M9	101.25	N9	101.25	O9	101.25	P9	101.25	Q9	101.25	R9	101.25	S9	101.25	T9	101.25	U9	101.25	V9	101.25	W9	101.25	X9	101.25
M10	101.30	N10	101.30	O10	101.30	P10	101.30	Q10	101.30	R10	101.30	S10	101.30	T10	101.30	U10	101.30	V10	101.30	W10	101.30	X10	101.30
M11	101.35	N11	101.35	O11	101.35	P11	101.35	Q11	101.35	R11	101.35	S11	101.35	T11	101.35	U11	101.35	V11	101.35	W11	101.35	X11	101.35
M12	101.40	N12	101.40	O12	101.40	P12	101.40	Q12	101.40	R12	101.40	S12	101.40	T12	101.40	U12	101.40	V12	101.40	W12	101.40	X12	101.40
M13	101.45	N13	101.45	O13	101.45	P13	101.45	Q13	101.45	R13	101.45	S13	101.45	T13	101.45	U13	101.45	V13	101.45	W13	101.45	X13	101.45
M14	101.50	N14	101.50	O14	101.50	P14	101.50	Q14	101.50	R14	101.50	S14	101.50	T14	101.50	U14	101.50	V14	101.50	W14	101.50	X14	101.50
M15	101.55	N15	101.55	O15	101.55	P15	101.55	Q15	101.55	R15	101.55	S15	101.55	T15	101.55	U15	101.55	V15	101.55	W15	101.55	X15	101.55
M16	101.60	N16	101.60	O16	101.60	P16	101.60	Q16	101.60	R16	101.60	S16	101.60	T16	101.60	U16	101.60	V16	101.60	W16	101.60	X16	101.60

GROUP B

Group A

Contaminant Concentrations

Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)	Cell	Cont. Conc. (mg/l)
A1	0.000	B1	0.000	C1	0.000	D1	0.000	E1	0.000	F1	0.000	G1	0.000	H1	0.000	I1	0.001	J1	0.003	K1	0.009	L1	0.018
A2	0.000	B2	0.000	C2	0.000	D2	0.000	E2	0.000	F2	0.000	G2	0.000	H2	0.000	I2	0.001	J2	0.007	K2	0.023	L2	0.046
A3	0.000	B3	0.000	C3	0.000	D3	0.000	E3	0.000	F3	0.000	G3	0.000	H3	0.000	I3	0.002	J3	0.013	K3	0.049	L3	0.108
A4	0.000	B4	0.000	C4	0.000	D4	0.000	E4	0.000	F4	0.000	G4	0.000	H4	0.000	I4	0.003	J4	0.021	K4	0.092	L4	0.225
A5	0.000	B5	0.000	C5	0.000	D5	0.000	E5	0.000	F5	0.000	G5	0.000	H5	0.000	I5	0.003	J5	0.028	K5	0.154	L5	0.423
A6	0.000	B6	0.000	C6	0.000	D6	0.000	E6	0.000	F6	0.000	G6	0.000	H6	0.000	I6	0.002	J6	0.032	K6	0.223	L6	0.718
A7	0.000	B7	0.000	C7	0.000	D7	0.000	E7	0.000	F7	0.000	G7	0.000	H7	0.000	I7	0.001	J7	0.027	K7	0.277	L7	1.104
A8	0.000	B8	0.000	C8	0.000	D8	0.000	E8	0.000	F8	0.000	G8	0.000	H8	0.000	I8	0.000	J8	0.016	K8	0.280	L8	1.531
A9	0.000	B9	0.000	C9	0.000	D9	0.000	E9	0.000	F9	0.000	G9	0.000	H9	0.000	I9	0.000	J9	0.005	K9	0.210	L9	1.898
A10	0.000	B10	0.000	C10	0.000	D10	0.000	E10	0.000	F10	0.000	G10	0.000	H10	0.000	I10	0.000	J10	0.000	K10	0.086	L10	2.012
A11	0.000	B11	0.000	C11	0.000	D11	0.000	E11	0.000	F11	0.000	G11	0.000	H11	0.000	I11	0.000	J11	0.000	K11	0.004	L11	1.456
A12	0.000	B12	0.000	C12	0.000	D12	0.000	E12	0.000	F12	0.000	G12	0.000	H12	0.000	I12	0.000	J12	0.000	K12	0.000	L12	0.000
A13	0.000	B13	0.000	C13	0.000	D13	0.000	E13	0.000	F13	0.000	G13	0.000	H13	0.000	IA13	0.000	J13	0.000	K13	0.000	L13	0.000
A14	0.000	B14	0.000	C14	0.000	D14	0.000	E14	0.000	F14	0.000	G14	0.000	H14	0.000	I14	0.000	J14	0.000	K14	0.000	L14	0.000
A15	0.000	B15	0.000	C15	0.000	D15	0.000	E15	0.000	F15	0.000	G15	0.000	H15	0.000	I15	0.000	J15	0.000	K15	0.000	L15	0.000
A16	0.000	B16	0.000	C16	0.000	D16	0.000	E16	0.000	F16	0.000	G16	0.000	H16	0.000	I16	0.000	J16	0.000	K16	0.000	L16	0.000
A17	0.000	B17	0.000	C17	0.000	D17	0.000	E17	0.000	F17	0.000	G17	0.000	H17	0.000	I17	0.000	J17	0.000	K17	0.000	L17	0.000
A18	0.000	B18	0.000	C18	0.000	D18	0.000	E18	0.000	F18	0.000	G18	0.000	H18	0.000	I18	0.000	J18	0.000	K18	0.000	L18	0.000
A19	0.000	B19	0.000	C19	0.000	D19	0.000	E19	0.000	F19	0.000	G19	0.000	H19	0.000	I19	0.000	J19	0.000	K19	0.000	L19	0.000
A20	0.000	B20	0.000	C20	0.000	D20	0.000	E20	0.000	F20	0.000	G20	0.000	H20	0.000	I20	0.000	J20	0.000	K20	0.000	L20	0.000
A21	0.000	B21	0.000	C21	0.000	D21	0.000	E21	0.000	F21	0.000	G21	0.000	H21	0.000	I21	0.000	J21	0.000	K21	0.000	L21	0.000
A22	0.000	B22	0.000	C22	0.000	D22	0.000	E22	0.000	F22	0.000	G22	0.000	H22	0.000	I22	0.000	J22	0.000	K22	0.000	L22	0.000
A23	0.000	B23	0.000	C23	0.000	D23	0.000	E23	0.000	F23	0.000	G23	0.000	H23	0.000	I23	0.000	J23	0.000	K23	0.000	L23	0.000
A24	0.000	B24	0.000	C24	0.000	D24	0.000	E24	0.000	F24	0.000	G24	0.000	H24	0.000	I24	0.000	J24	0.000	K24	0.000	L24	0.000
M1	0.022	N1	0.018	O1	0.009	P1	0.003	Q1	0.001	R1	0.000	S1	0.000	T1	0.000	U1	0.000	V1	0.000	W1	0.000	X1	0.000
M2	0.059	N2	0.046	O2	0.023	P2	0.007	Q2	0.001	R2	0.000	S2	0.000	T2	0.000	U2	0.000	V2	0.000	W2	0.000	X2	0.000
M3	0.140	N3	0.108	O3	0.049	P3	0.013	Q3	0.002	R3	0.000	S3	0.000	T3	0.000	U3	0.000	V3	0.000	W3	0.000	X3	0.000
M4	0.302	N4	0.225	O4	0.092	P4	0.021	Q4	0.003	R4	0.000	S4	0.000	T4	0.000	U4	0.000	V4	0.000	W4	0.000	X4	0.000
M5	0.592	N5	0.423	O5	0.154	P5	0.028	Q5	0.003	R5	0.000	S5	0.000	T5	0.000	U5	0.000	V5	0.000	W5	0.000	X5	0.000
M6	1.060	N6	0.718	O6	0.223	P6	0.032	Q6	0.002	R6	0.000	S6	0.000	T6	0.000	U6	0.000	V6	0.000	W6	0.000	X6	0.000
M7	1.748	N7	1.104	O7	0.277	P7	0.027	Q7	0.001	R7	0.000	S7	0.000	T7	0.000	U7	0.000	V7	0.000	W7	0.000	X7	0.000
M8	2.689	N8	1.531	O8	0.280	P8	0.016	Q8	0.000	R8	0.000	S8	0.000	T8	0.000	U8	0.000	V8	0.000	W8	0.000	X8	0.000
M9	3.924	N9	1.898	O9	0.210	P9	0.005	Q9	0.000	R9	0.000	S9	0.000	T9	0.000	U9	0.000	V9	0.000	W9	0.000	X9	0.000
M10	5.581	N10	2.012	O10	0.086	P10	0.000	Q10	0.000	R10	0.000	S10	0.000	T10	0.000	U10	0.000	V10	0.000	W10	0.000	X10	0.000
M11	8.160	N11	1.456	O11	0.004	P11	0.000	Q11	0.000	R11	0.000	S11	0.000	T11	0.000	U11	0.000	V11	0.000	W11	0.000	X11	0.000
M12	0.000	N12	0.000	O12	0.000	P12	0.000	Q12	0.000	R12	0.000	S12	0.000	T12	0.000	U12	0.000	V12	0.000	W12	0.000	X12	0.000
M13	0.000	N13	0.000	O13	0.000	P13	0.000	Q13	0.000	R13	0.000	S13	0.000	T13	0.000	U13	0.000	V13	0.000	W13	0.000	X13	0.000
M14	0.000	N14	0.000	O14	0.000	P14	0.000	Q14	0.000	R14	0.000	S14	0.000	T14	0.000	U14	0.000	V14	0.000	W14	0.000	X14	0.000
M15	0.000	N15	0.000	O15	0.000	P15	0.000	Q15	0.000	R15	0.000	S15	0.000	T15	0.000	U15	0.000	V15	0.000	W15	0.000	X15	0.000
M16	0.000	N16	0.000	O16	0.000	P16	0.000	Q16	0.000	R16	0.000	S16	0.000	T16	0.000	U16	0.000	V16	0.000	W16	0.000	X16	0.000