From: "Dave Levy" <DLevy@telesto-inc.com>
To: "Michalak, Paul" <pxm2@nrc.gov>
Date: 1/24/06 6:32PM
Subject: Gas Hills Model

Hi Paul:

I updated the SWFR input files to include the most recent GW-8 data as we discussed. Attached is a pdf file of the relevant plots and the 4 input files for completeness. Two of the input files are for concentration vs distance (fast and slow flowe rate) and the other 2 input files are for concentration vs time at the POC (fast and slow flow rate). I also inlcuded the updated graph showing concentration vs distance between the POE/POC at various times (from 1 yr to 1,000 yrs). Once you have had time to review these data, please let me know how you would like to proceed from here. Thanks!

Dave

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Subject:	Gas Hills Model
Creation Date:	1/24/06 6:32PM
From:	"Dave Levy" <DLevy@telesto-inc.com>
Created By:	DLevy@telesto-inc.com

Recipients
nrc.gov
TWGWPO01.HQGWDO01
PXM2 (Paul Michalak)

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Files	**Size**	**Date & Time**
MESSAGE	851	01/24/06 06:32PM
TEXT.htm	1573	
SWFR_1_24_06.pdf	117359	
Mime.822	165052	

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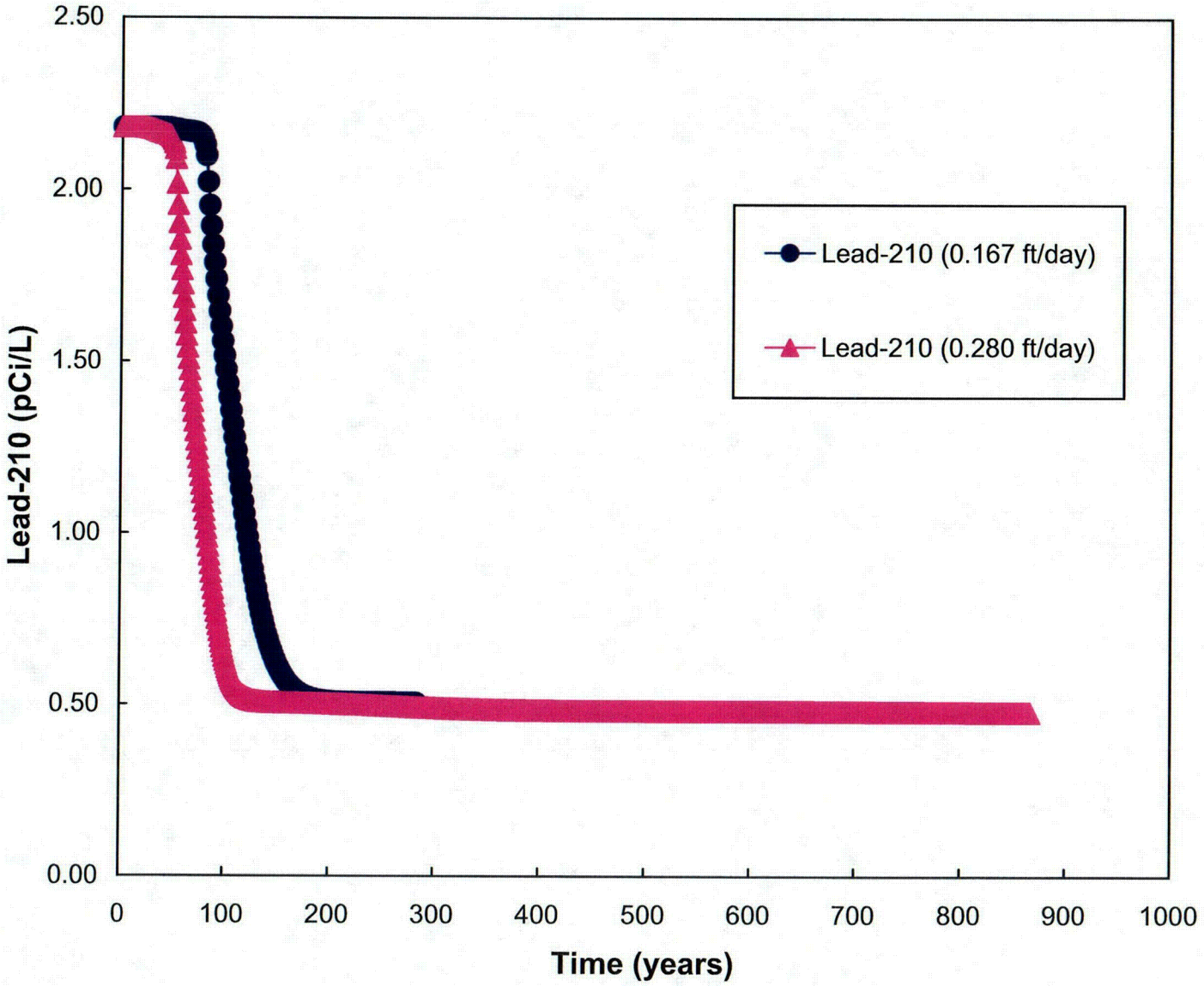
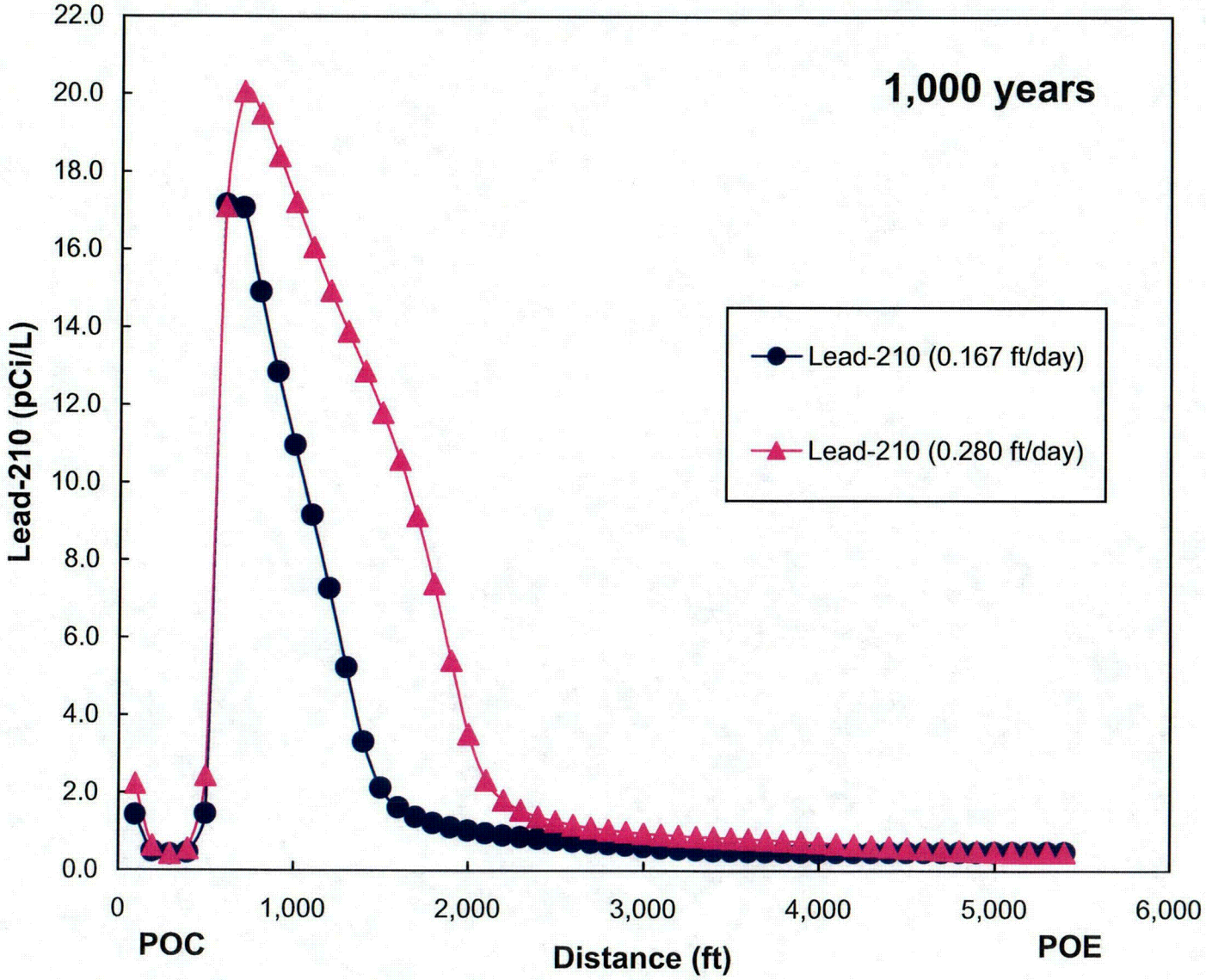
Security:	Standard

Figure 2: Predicted Lead-210 Concentrations at the POE for the Southwestern Flow Regime for a 1000-Year Time Frame Using the Proposed Revised ACL of 189 pCi/L.

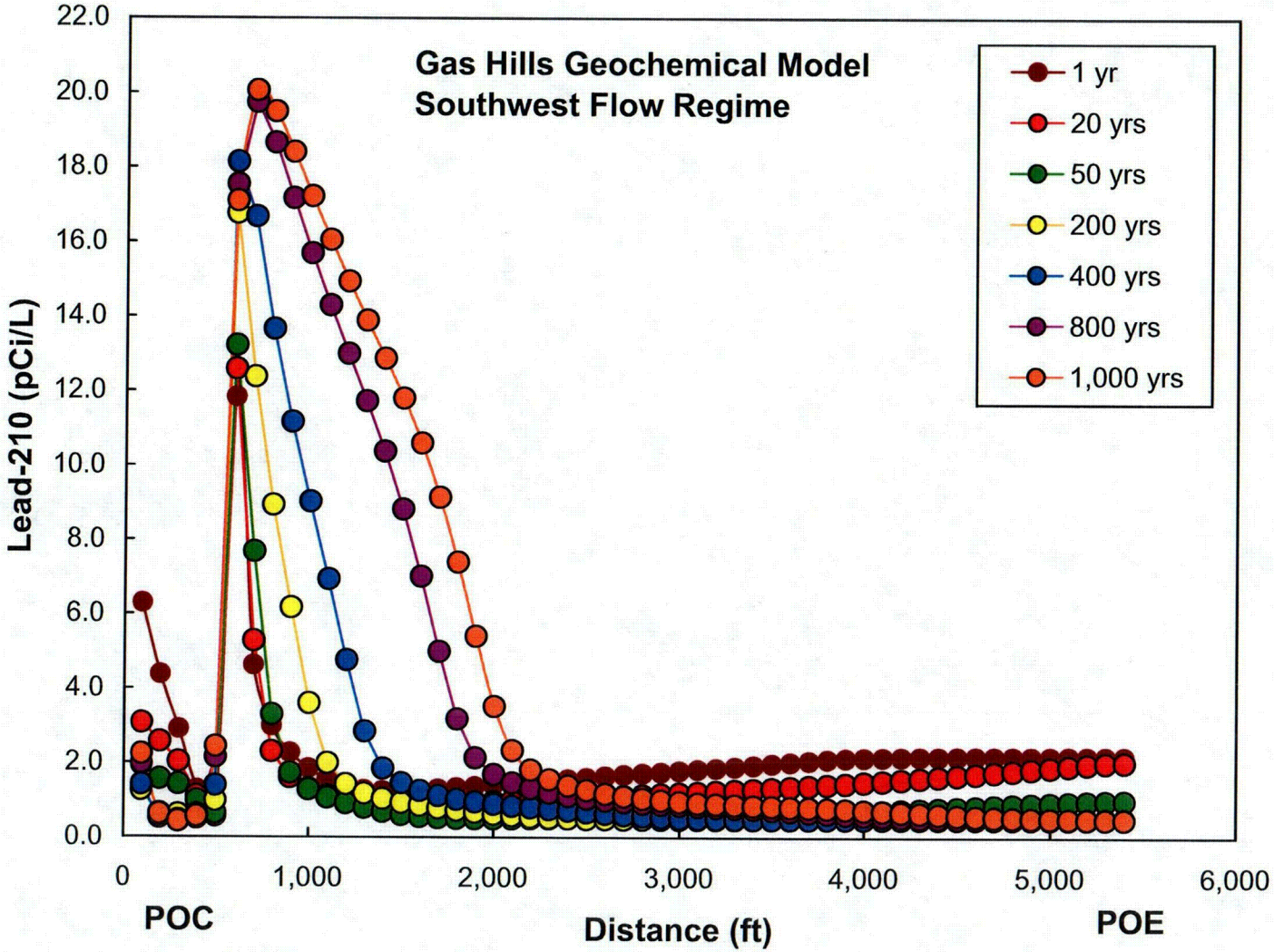


C01

Figure 1: Predicted 1000-Year Lead-210 Concentrations Between the Southwestern Flow Regime POC and POE Using the Proposed Revised ACL of 189 pCi/L.



C02


Gas Hills Geochemical Model
Southwest Flow Regime
1 yr
20 yrs
50 yrs
200 yrs
400 yrs
800 yrs
1,000 yrs
Lead-210 (pCi/L)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
1,000
2,000
3,000
4,000
5,000
6,000
POC
Distance (ft)
POE

C03

```
TITLE  A-9 area (SW flow regime). FILE: SWFR1td_nrc3.in
#Concentration vs Time (0 to 1000 years) at the POE
#Using flow rate of 0.167 ft/d - DECREASING SOURCE TERM TO 90% REDUCTION
#DISPERSIVITY = 50
#SOLID PHASES ALLOWED
#Revised in 2005/2006 for Pb-210/Solutions in Cells 1-54/Source sulfate

PRINT
     -reset     false

KNOBS
     -iterations 100
     -tolerance 1.00E-13
     -step_size 100
     -pe_step_size 10
     -diagonal_scale TRUE
     -debug_prep FALSE
     -debug_set FALSE
     -debug_model FALSE
     -debug_inverse FALSE
     -logfile FALSE

SELECTED_OUTPUT
     -file C:\SWFR1td_nrc3.dat

USER_PUNCH

     -headings As Be Cl Pb U Ni Se SO4 Th Ra sOPb+
     -headings wOPb+ PbX2 Anglesite sOHUO2+2
     -headings wOUO2+ USiO4(C) Uraninite sONi+ wONi+
     -headings NiSe sOHRa+2 wORa+ RaX2 RaSO4 wSeO4-
     -headings wOHSeO4-2 wSeO3- wOHSeO3-2 Se(A)
     -headings FeSe2 sSO4- wSO4- sOHSO4-2 wOHSO4-2
     -headings gypsum wOTh+3 wOTh(OH)+2 wOTh(OH)2+
     -headings wOTh(OH)3 wOTh(OH)4- sH2AsO3 wH2AsO3
     -headings sH2AsO4 wH2AsO4 sHAsO4- wHAsO4- sAsO4-2
     -headings wAsO4-2 sOHAsO4-3 wOHAsO4-3 sOBe+ wOBe+
     -headings Calcite Ca Mg Na K HCO3 SO4 Cl TDS
     -start
     10  REM Convert to ppm and show molalities
     20  PUNCH TOT("As")*74.9216*1000
     30  PUNCH TOT("Be")*9.0122*1000
     40  PUNCH TOT("Cl")*35.453*1000
     50  PUNCH TOT("Pb")*207.19*1000/1.29e-11
     60  PUNCH TOT("U")*238.029*1000
     70  PUNCH TOT("Ni")*58.71*1000
     80  PUNCH TOT("Se")*78.96*1000
     90 PUNCH TOT("S(6)")*96.0616*1000
     100 PUNCH TOT("Th")*232.038*1000/4.96e-8
     110 PUNCH TOT("Ra")*226*1000/1.01e-9
     120 PUNCH MOL("Hfo_sOPb+")
     130 PUNCH MOL("Hfo_wOPb+")
     140 PUNCH MOL("PbX2")
     150 PUNCH EQUI("Anglesite")
     160 PUNCH MOL("Hfo_sOHUO2+2")
     170 PUNCH MOL("Hfo_wOUO2+")
     180 PUNCH EQUI("USiO4(C)")
     190 PUNCH EQUI("Uraninite")
     200 PUNCH MOL("Hfo_sONi+")
     210 PUNCH MOL("Hfo_wONi+")
     220 PUNCH EQUI("NiSe")
     230 PUNCH MOL("Hfo_sOHRa+2")
     240 PUNCH MOL("Hfo_wORa+")
     250 PUNCH MOL("RaX2")
     260 PUNCH EQUI("RaSO4")
     270 PUNCH MOL("Hfo_wSeO4-")
     280 PUNCH MOL("Hfo_wOHSeO4-2")
```

```
      290 PUNCH MOL("Hfo_wSeO3-")
      300 PUNCH MOL("Hfo_wOHSeO3-2")
      310 PUNCH EQUI("Se(A)")
      320 PUNCH EQUI("Ferroselite")
      330 PUNCH MOL("Hfo_sSO4-")
      340 PUNCH MOL("Hfo_wSO4-")
      350 PUNCH MOL("Hfo_sOHSO4-2")
      360 PUNCH MOL("Hfo_wOHSO4-2")
      370 PUNCH EQUI("gypsum")
      380 PUNCH MOL("Hfo_wOTh+3")
      390 PUNCH MOL("Hfo_wOTh(OH)+2")
      400 PUNCH MOL("Hfo_wOTh(OH)2+")
      410 PUNCH MOL("Hfo_wOTh(OH)3")
      420 PUNCH MOL("Hfo_wOTh(OH)4-")
      430 PUNCH MOL("Hfo_sH2AsO3")
      440 PUNCH MOL("Hfo_wH2AsO3")
      450 PUNCH MOL("Hfo_sH2AsO4")
      460 PUNCH MOL("Hfo_wH2AsO4")
      470 PUNCH MOL("Hfo_sHAsO4-")
      480 PUNCH MOL("Hfo_wHAsO4-")
      490 PUNCH MOL("Hfo_sAsO4-2")
      500 PUNCH MOL("Hfo_wAsO4-2")
      510 PUNCH MOL("Hfo_sOHAsO4-3")
      520 PUNCH MOL("Hfo_wOHAsO4-3")
      530 PUNCH MOL("Hfo_sOBe+")
      540 PUNCH MOL("Hfo_wOBe+")
      550 PUNCH EQUI("Calcite")
      560 PUNCH TOT("Ca")*40.08*1000
      570 PUNCH TOT("Mg")*24.312*1000
      580 PUNCH TOT("Na")*22.9898*1000
      590 PUNCH TOT("K")*39.102*1000
      600 PUNCH MOL("HCO3-")*61.018*1000
      610 PUNCH TOT("S(6)")*96.0616*1000
      620 PUNCH TOT("Cl")*35.453*1000
      630 A = (TOT("Ca")*40.08*1000)+(TOT("Mg")*24.312*1000)
      640 B = (TOT("Na")*22.9898*1000)+(TOT("K")*39.102*1000)
      650 C = MOL("HCO3-")*61.018*1000
      660 D = TOT("S(6)")*96.0616*1000
      670 E = TOT("Cl")*35.453*1000
      680 PUNCH A+B+C+D+E
      -end

PRINT
      -selected_output false


SOLUTION 0 # Initial Source Term

      units       ppm
      pe          8
      pH          4.33
      Th          2.22e-6
      Pb          2.44e-9   #Revised ACL 2006 (189 pCi/L)
      Be          1.7
      Ca          710  #increased to obtain CB for SO4 <15%
      Mg          174  #increased to obtain CB for SO4 <15%
      Na          117  #increased to obtain CB for SO4 <15%
      K           15
      Fe(2)       160  #increased to obtain CB for SO4 <15%
      Cl          161
      As          1.36
      Ni          9.34
      Se          0.53
      Si          56.4
      U           34.1
      Alkalinity 2.44 as HCO3
      S(6)        3500 #previously 2650 (increased to reflect recent observed increases at GW-
```

```
8)
      Ra          3.57e-7

SOLUTION 1-5 GW8 #2005 data replaces January 2001 data

      units       ppm
      pe          7
      pH          4.41 #Aug-05
      S(6)        3020 #May-05
      Cl          420  #May-05
      #Alkalinity 2.0 as HCO3 (no carbonate alkalinity at pH 4.4)
      Ca          600 #Increased to achieve charge balance <15%
      Na          125 #Increased to achieve charge balance <15%
      Mg          175 #Increased to achieve charge balance <15%
      K           35 #Increased to achieve charge balance <15%
      Fe(2)       127
      As          0.0272 #May-05
      Be          0.22 #May-05
      Th          5.46e-8 #May-05
      Pb          2.32e-10 #May-05
      Ra          2.63e-7 #Aug-05
      Ni          3.2 #May-05
      Se          0.05 #May-05
      U           22.9 #May-05

SOLUTION 6-54 MW-72 # Data from MW-72 replaces MW-74 January 2001
      units       ppm
      pe          6
      pH          6.48        #Jun-04
      S(6)        1190        #Jun-04
      Cl          115         #Jun-04
      Alkalinity 400 as HCO3  #Jan-01
      Ca          580         #Jan-01
      Na          25          #Jan-01
      Mg          63          #Jan-01
      K           17          #Jan-01
      Fe(2)       4           #Jan-01
      As          0.0081      #Jun-05
      Be          0.0001      #Jun-05
      #Th         negative value reported
      Pb          2.97e-11  #Jan-01 (2.3 pCi/L)
      Ra          2.42e-8     #Jan-01
      Ni          0.0179      #Jun-05
      Se          0.017       #Jun-05
      U           0.609       #Jun-05
      #S(-2)      not measured

EQUILIBRIUM_PHASES 1-54
      Calcite          0.0        0.0
      Gypsum           0.0        0.0
      USiO4(c)         0.0        0.0
      Ferroselite      0.0        0.0
      Se(A)            0.0        0.0
      RaSO4            0.0        0.0
      NiSe             0.0        0.0
      Anglesite        0.0        0.0

SURFACE 1-5
      -equilibrate 1
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

SURFACE 6-54
      -equilibrate 6
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021
```

```
EXCHANGE 1-5
      -equilibrate 1
      X     1.2

EXCHANGE 6-54
         -equilibrate 6
      X       1.2

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          4
      -punch_cells     54

PRINT
      -selected_output true

END

PRINT
      -selected_output false

SOLUTION 0 #33% REDUCTION

      units       ppm
      pe          5.6
      pH          4.47
      Th          1.47e-6
      Pb          1.63e-9     #Revised ACL 2006
      Ra          2.41E-07
      U           22.62
      Be          1.13
      Ca          570
      Mg          137
      Na          94
      K           16.2
      Fe(2)       109
      Cl          114.6
      As          0.90
      Ni          6.20
      Se          0.35
      Si          37.4
      Alkalinity 4.0 as HCO3
      S(6)        2546 #previously 1980.5

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          2
      -punch_cells     54

PRINT
      -selected_output true

END

PRINT
      -selected_output false

SOLUTION 0 #50% Reduction

      units       ppm
      pe          5.5
      pH          4.57
      Th          1.12e-6
```

```
      Pb          1.22e-9    #Revised ACL 2006
      Ra          1.86E-07
      U           17.16
      Be          0.85
      Ca          503
      Mg          119
      Na          83
      K           16.8
      Fe(2)       85
      Cl          92.5
      As          0.68
      Ni          4.7
      Se          0.27
      Si          28.31
      Alkalinity 4.73 as HCO3
      S(6)        2089 #previously 1661

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           4
      -punch_cells      54

PRINT
      -selected_output true

END

PRINT
      selected_output  false

SOLUTION 0 #75% Reduction

      units       ppm
      pe          5.1
      pH          4.85
      Th          5.65E-07
      Pb          6.1e-10    #Revised ACL 2006
      Ra          1.0E-07
      U           8.62
      Be          0.43
      Ca          398
      Mg          91
      Na          66
      K           17.7
      Fe(2)       47
      Cl          58
      As          0.34
      Ni          2.36
      Se          0.13
      Si          14.2
      Alkalinity 5.88 as HCO3
      S(6)        1375 #previously 1161

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           12
      -punch_cells      54

PRINT
      selected_output  true

END
```

```
PRINT
     selected_output  false

SOLUTION 0 #90% Reduction

     units       ppm
     pe          4.4
     pH          5.27
     Th          2.33E-07
     Pb          2.45e-10   #Revised ACL 2006
     Ra          4.84e-8
     U           3.5
     Be          0.17
     Ca          334
     Mg          74
     Na          56
     K           18.2
     Fe(2)       24
     Cl          37.3
     As          0.14
     Ni          0.96
     Se          0.05
     Si          5.66
     Alkalinity 6.56 as HCO3
     S(6)        946 #previously 860.7

TRANSPORT
     -lengths         54*30.5
     -dispersivities  54*50
     -cells           54
     -shifts          588
     -punch_cells     54

PRINT
     -selected_output true
END

PRINT
     selected_output  false
```

```
TITLE  A-9 area (SW flow regime). FILE: SWFR2td_nrc3.in
#Concentration vs Time (0 to 1000 years) at the POE
#Using flow rate of 0.280 ft/d - DECREASING SOURCE TERM TO 90% REDUCTION
#SOLID PHASES ALLOWED
#Revised in 2006 for Pb-210/Solutions in cells 1-54/Source Sulfate

PRINT
     -reset     false

KNOBS
     -iterations 100
     -tolerance 1.00E-13
     -step_size 100
     -pe_step_size 10
     -diagonal_scale TRUE
     -debug_prep FALSE
     -debug_set FALSE
     -debug_model FALSE
     -debug_inverse FALSE
     -logfile FALSE

SELECTED_OUTPUT

     -file c:\SWFR2td_nrc3.dat

USER_PUNCH
     -headings As Be Cl Pb U Ni Se SO4 Th Ra sOPb+
     -headings wOPb+ PbX2 Anglesite sOHUO2+2
     -headings wOUO2+ USiO4(C) Uraninite sONi+ wONi+
     -headings NiSe sOHRa+2 wORa+ RaX2 RaSO4 wSeO4-
     -headings wOHSeO4-2 wSeO3- wOHSeO3-2 Se(A)
     -headings FeSe2 sSO4- wSO4- sOHSO4-2 wOHSO4-2
     -headings gypsum wOTh+3 wOTh(OH)+2 wOTh(OH)2+
     -headings wOTh(OH)3 wOTh(OH)4- sH2AsO3 wH2AsO3
     -headings sH2AsO4 wH2AsO4 sHAsO4- wHAsO4- sAsO4-2
     -headings wAsO4-2 sOHAsO4-3 wOHAsO4-3 sOBe+ wOBe+
     -headings Calcite Ca Mg Na K HCO3 SO4 Cl TDS
     -start
     10  REM Convert to ppm and show molalities
     20  PUNCH TOT("As")*74.9216*1000
     30  PUNCH TOT("Be")*9.0122*1000
     40  PUNCH TOT("Cl")*35.453*1000
     50  PUNCH TOT("Pb")*207.19*1000/1.29e-11
     60  PUNCH TOT("U")*238.029*1000
     70  PUNCH TOT("Ni")*58.71*1000
     80  PUNCH TOT("Se")*78.96*1000
     90  PUNCH TOT("S(6)")*96.0616*1000
     100 PUNCH TOT("Th")*232.038*1000/4.96e-8
     110 PUNCH TOT("Ra")*226*1000/1.01e-9
     120 PUNCH MOL("Hfo_sOPb+")
     130 PUNCH MOL("Hfo_wOPb+")
     140 PUNCH MOL("PbX2")
     150 PUNCH EQUI("Anglesite")
     160 PUNCH MOL("Hfo_sOHUO2+2")
     170 PUNCH MOL("Hfo_wOUO2+")
     180 PUNCH EQUI("USiO4(C)")
     190 PUNCH EQUI("Uraninite")
     200 PUNCH MOL("Hfo_sONi+")
     210 PUNCH MOL("Hfo_wONi+")
     220 PUNCH EQUI("NiSe")
     230 PUNCH MOL("Hfo_sOHRa+2")
     240 PUNCH MOL("Hfo_wORa+")
     250 PUNCH MOL("RaX2")
     260 PUNCH EQUI("RaSO4")
     270 PUNCH MOL("Hfo_wSeO4-")
     280 PUNCH MOL("Hfo_wOHSeO4-2")
     290 PUNCH MOL("Hfo_wSeO3-")
```

```
      300 PUNCH MOL("Hfo_wOHSeO3-2")
      310 PUNCH EQUI("Se(A)")
      320 PUNCH EQUI("Ferroselite")
      330 PUNCH MOL("Hfo_sSO4-")
      340 PUNCH MOL("Hfo_wSO4-")
      350 PUNCH MOL("Hfo_sOHSO4-2")
      360 PUNCH MOL("Hfo_wOHSO4-2")
      370 PUNCH EQUI("gypsum")
      380 PUNCH MOL("Hfo_wOTh+3")
      390 PUNCH MOL("Hfo_wOTh(OH)+2")
      400 PUNCH MOL("Hfo_wOTh(OH)2+")
      410 PUNCH MOL("Hfo_wOTh(OH)3")
      420 PUNCH MOL("Hfo_wOTh(OH)4-")
      430 PUNCH MOL("Hfo_sH2AsO3")
      440 PUNCH MOL("Hfo_wH2AsO3")
      450 PUNCH MOL("Hfo_sH2AsO4")
      460 PUNCH MOL("Hfo_wH2AsO4")
      470 PUNCH MOL("Hfo_sHAsO4-")
      480 PUNCH MOL("Hfo_wHAsO4-")
      490 PUNCH MOL("Hfo_sAsO4-2")
      500 PUNCH MOL("Hfo_wAsO4-2")
      510 PUNCH MOL("Hfo_sOHAsO4-3")
      520 PUNCH MOL("Hfo_wOHAsO4-3")
      530 PUNCH MOL("Hfo_sOBe+")
      540 PUNCH MOL("Hfo_wOBe+")
      550 PUNCH EQUI("Calcite")
      560 PUNCH TOT("Ca")*40.08*1000
      570 PUNCH TOT("Mg")*24.312*1000
      580 PUNCH TOT("Na")*22.9898*1000
      590 PUNCH TOT("K")*39.102*1000
      600 PUNCH MOL("HCO3-")*61.018*1000
      610 PUNCH TOT("S(6)")*96.0616*1000
      620 PUNCH TOT("Cl")*35.453*1000
      630 A = (TOT("Ca")*40.08*1000)+(TOT("Mg")*24.312*1000)
      640 B = (TOT("Na")*22.9898*1000)+(TOT("K")*39.102*1000)
      650 C = MOL("HCO3-")*61.018*1000
      660 D = TOT("S(6)")*96.0616*1000
      670 E = TOT("Cl")*35.453*1000
      680 PUNCH A+B+C+D+E
      -end

PRINT
      -selected_output false

SOLUTION 0 # Initial Source Term

      units       ppm
      pe          8
      pH          4.33
      Th          2.22e-6
      Pb          2.44e-9    #Revised ACL 2006
      Be          1.7
      Ca          710  #increased to obtain CB for SO4 <15%
      Mg          174  #increased to obtain CB for SO4 <15%
      Na          117  #increased to obtain CB for SO4 <15%
      K           15
      Fe(2)       160  #increased to obtain CB for SO4 <15%
      Cl          161
      As          1.36
      Ni          9.34
      Se          0.53
      Si          56.4
      U           34.1
      Alkalinity 2.44 as HCO3
      S(6)        3500 #previously 2650 (increased to reflect recent observed increases in GW-
8)
      Ra          3.57e-7
```

```
SOLUTION 1-5 GW8 #2005 data replaces January 2001 data

      units       ppm
      pe          7
      pH          4.41 #Aug-05
      S(6)        3020 #May-05
      Cl          420 #May-05
      #Alkalinity 2.0 as HCO3 (no carbonate alkalinity at pH 4.4)
      Ca          600 #Increased to achieve charge balance <15%
      Na          125 #Increased to achieve charge balance <15%
      Mg          175 #Increased to achieve charge balance <15%
      K           35 #Increased to achieve charge balance <15%
      Fe(2)       127
      As          0.0272 #May-05
      Be          0.22 #May-05
      Th          5.46e-8 #May-05
      Pb          2.32e-10 #May-05
      Ra          2.63e-7 #Aug-05
      Ni          3.2 #May-05
      Se          0.05 #May-05
      U           22.9 #May-05

SOLUTION 6-54 MW-72 # Data from MW-72 replaces MW-74 January 2001
      units       ppm
      pe          6
      pH          6.48        #June-04
      S(6)        1190        #Jun-04
      Cl          115         #Jun-04
      Alkalinity 400 as HCO3      #Jan-01
      Ca          580         #Jan-01
      Na          25          #Jan-01
      Mg          63          #Jan-01
      K           17          #Jan-01
      Fe(2)       4           #Jan-01
      As          0.0081      #Jun-05
      Be          0.0001      #Jun-05
      #Th         Negative value reported
      Pb          2.97e-11    #Jan-01 (2.3 pCi/L)
      Ra          2.42e-8     #Jan-01
      Ni          0.0179      #Jun-05
      Se          0.017       #Jun-05
      U           0.609       #Jun-05
      #S(-2)      Not measured

EQUILIBRIUM_PHASES 1-54
      Calcite          0.0         0.0
      Gypsum           0.0         0.0
      Uraninite        0.0         0.0
      USiO4(c)         0.0         0.0
      Ferroselite           0.0         0.0
      Se(A)            0.0         0.0
      RaSO4            0.0         0.0
      NiSe             0.0         0.0
      Anglesite        0.0         0.0

SURFACE 1-5
      -equilibrate 1
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

SURFACE 6-54
      -equilibrate 6
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

EXCHANGE 1-5
```

```
      -equilibrate 1
      X     1.2

EXCHANGE 6-54
        -equilibrate 6
      X       1.2

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          6
      -punch_cells     54

PRINT
      -selected_output true

END

PRINT
      -selected_output false

SOLUTION 0 #33% REDUCTION

      units       ppm
      pe          5.6
      pH          4.47
      Th          1.47e-6
      Pb          1.63e-9          #Revised ACL 2006
      Ra          2.41E-07
      U           22.62
      Be          1.13
      Ca          570
      Mg          137
      Na          94
      K           16.2
      Fe(2)       109
      Cl          114.6
      As          0.90
      Ni          6.20
      Se          0.35
      Si          37.4
      Alkalinity 4.0 as HCO3
      S(6)        2546 #previously 1980.5

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          3
      -punch_cells     54

PRINT
      -selected_output true

END

PRINT
      -selected_output false


SOLUTION 0 #50% Reduction

      units       ppm
      pe          5.5
      pH          4.57
      Th          1.12e-6
```

```
      Pb          1.24e-9    #Revised ACL 2006
      Ra          1.86E-07
      U           17.16
      Be          0.85
      Ca          503
      Mg          119
      Na          83
      K           16.8
      Fe(2)       85
      Cl          92.5
      As          0.68
      Ni          4.7
      Se          0.27
      Si          28.31
      Alkalinity 4.73 as HCO3
      S(6)        2089 #previously 1661

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           7
      -punch_cells      54

PRINT
      -selected_output true

END

PRINT
      -selected_output false


SOLUTION 0 #75% Reduction

      units       ppm
      pe          5.1
      pH          4.85
      Th          5.65E-07
      Pb          6.42e-10   #Revised ACL 2006
      Ra          1.0E-07
      U           8.62
      Be          0.43
      Ca          398
      Mg          91
      Na          66
      K           17.7
      Fe(2)       47
      Cl          58
      As          0.34
      Ni          2.36
      Se          0.13
      Si          14.2
      Alkalinity 5.88 as HCO3
      S(6)        1375 #previously 1161

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           19
      -punch_cells      54

PRINT
      -selected_output true
END
```

```
PRINT
     -selected_output false

SOLUTION 0 #90% Reduction

     units       ppm
     pe          4.4
     pH          5.27
     Th          2.33E-07
     Pb          2.80e-10   #Revised ACL 2006
     Ra          4.84e-8
     U           3.5
     Be          0.17
     Ca          334
     Mg          74
     Na          56
     K           18.2
     Fe(2)       24
     Cl          37.3
     As          0.14
     Ni          0.96
     Se          0.05
     Si          5.66
     Alkalinity 6.56 as HCO3
     S(6)        946 #previously 860.7

TRANSPORT
     -lengths         54*30.5
     -dispersivities  54*50
     -cells           54
     -shifts          987
     -punch_cells     54

PRINT
     -selected_output true

END

PRINT
     -selected_output false
```

```
TITLE  A-9 area (SW flow regime). FILE: SWFR1d_nrc3.in
#Concentration vs Distance between POC and POE
#Using flow rate of 0.167 ft/d - DECREASING SOURCE TERM TO 90% REDUCTION
#DISPERSIVITY = 50
#SOLID PHASES ALLOWED
#Revised in 2006 for Pb-210/Solutions in Cells 1-54/Source sulfate

PRINT
      -reset     false

KNOBS
      -iterations 100
      -tolerance 1.00E-13
      -step_size 100
      -pe_step_size 10
      -diagonal_scale TRUE
      -debug_prep FALSE
      -debug_set FALSE
      -debug_model FALSE
      -debug_inverse FALSE
      -logfile FALSE

SELECTED_OUTPUT
      -file C:\SWFR1d_nrc3.dat

USER_PUNCH

      -headings As Be Cl Pb U Ni Se SO4 Th Ra sOPb+
      -headings wOPb+ PbX2 Anglesite sOHUO2+2
      -headings wOUO2+ USiO4(C) Uraninite sONi+ wONi+
      -headings NiSe sOHRa+2 wORa+ RaX2 RaSO4 wSeO4-
      -headings wOHSeO4-2 wSeO3- wOHSeO3-2 Se(A)
      -headings FeSe2 sSO4- wSO4- sOHSO4-2 wOHSO4-2
      -headings gypsum wOTh+3 wOTh(OH)+2 wOTh(OH)2+
      -headings wOTh(OH)3 wOTh(OH)4- sH2AsO3 wH2AsO3
      -headings sH2AsO4 wH2AsO4 sHAsO4- wHAsO4- sAsO4-2
      -headings wAsO4-2 sOHAsO4-3 wOHAsO4-3 sOBe+ wOBe+
      -headings Calcite Ca Mg Na K HCO3 SO4 Cl TDS
      -start
      10  REM Convert to ppm and show molalities
      20  PUNCH TOT("As")*74.9216*1000
      30  PUNCH TOT("Be")*9.0122*1000
      40  PUNCH TOT("Cl")*35.453*1000
      50  PUNCH TOT("Pb")*207.19*1000/1.29e-11
      60  PUNCH TOT("U")*238.029*1000
      70  PUNCH TOT("Ni")*58.71*1000
      80  PUNCH TOT("Se")*78.96*1000
      90 PUNCH TOT("S(6)")*96.0616*1000
      100 PUNCH TOT("Th")*232.038*1000/4.96e-8
      110 PUNCH TOT("Ra")*226*1000/1.01e-9
      120 PUNCH MOL("Hfo_sOPb+")
      130 PUNCH MOL("Hfo_wOPb+")
      140 PUNCH MOL("PbX2")
      150 PUNCH EQUI("Anglesite")
      160 PUNCH MOL("Hfo_sOHUO2+2")
      170 PUNCH MOL("Hfo_wOUO2+")
      180 PUNCH EQUI("USiO4(C)")
      190 PUNCH EQUI("Uraninite")
      200 PUNCH MOL("Hfo_sONi+")
      210 PUNCH MOL("Hfo_wONi+")
      220 PUNCH EQUI("NiSe")
      230 PUNCH MOL("Hfo_sOHRa+2")
      240 PUNCH MOL("Hfo_wORa+")
      250 PUNCH MOL("RaX2")
      260 PUNCH EQUI("RaSO4")
      270 PUNCH MOL("Hfo_wSeO4-")
      280 PUNCH MOL("Hfo_wOHSeO4-2")
```

```
     290 PUNCH MOL("Hfo_wSeO3-")
     300 PUNCH MOL("Hfo_wOHSeO3-2")
     310 PUNCH EQUI("Se(A)")
     320 PUNCH EQUI("Ferroselite")
     330 PUNCH MOL("Hfo_sSO4-")
     340 PUNCH MOL("Hfo_wSO4-")
     350 PUNCH MOL("Hfo_sOHSO4-2")
     360 PUNCH MOL("Hfo_wOHSO4-2")
     370 PUNCH EQUI("gypsum")
     380 PUNCH MOL("Hfo_wOTh+3")
     390 PUNCH MOL("Hfo_wOTh(OH)+2")
     400 PUNCH MOL("Hfo_wOTh(OH)2+")
     410 PUNCH MOL("Hfo_wOTh(OH)3")
     420 PUNCH MOL("Hfo_wOTh(OH)4-")
     430 PUNCH MOL("Hfo_sH2AsO3")
     440 PUNCH MOL("Hfo_wH2AsO3")
     450 PUNCH MOL("Hfo_sH2AsO4")
     460 PUNCH MOL("Hfo_wH2AsO4")
     470 PUNCH MOL("Hfo_sHAsO4-")
     480 PUNCH MOL("Hfo_wHAsO4-")
     490 PUNCH MOL("Hfo_sAsO4-2")
     500 PUNCH MOL("Hfo_wAsO4-2")
     510 PUNCH MOL("Hfo_sOHAsO4-3")
     520 PUNCH MOL("Hfo_wOHAsO4-3")
     530 PUNCH MOL("Hfo_sOBe+")
     540 PUNCH MOL("Hfo_wOBe+")
     550 PUNCH EQUI("Calcite")
     560 PUNCH TOT("Ca")*40.08*1000
     570 PUNCH TOT("Mg")*24.312*1000
     580 PUNCH TOT("Na")*22.9898*1000
     590 PUNCH TOT("K")*39.102*1000
     600 PUNCH MOL("HCO3-")*61.018*1000
     610 PUNCH TOT("S(6)")*96.0616*1000
     620 PUNCH TOT("Cl")*35.453*1000
     630 A = (TOT("Ca")*40.08*1000)+(TOT("Mg")*24.312*1000)
     640 B = (TOT("Na")*22.9898*1000)+(TOT("K")*39.102*1000)
     650 C = MOL("HCO3-")*61.018*1000
     660 D = TOT("S(6)")*96.0616*1000
     670 E = TOT("Cl")*35.453*1000
     680 PUNCH A+B+C+D+E
     -end

PRINT
     -selected_output false


SOLUTION 0 # Initial Source Term

     units      ppm
     pe         8
     pH         4.33
     Th         2.22e-6
     Pb         2.44e-9   #Revised ACL 2006 (189 pCi/L)
     Be         1.7
     Ca         710  #increased to obtain CB for SO4 <15%
     Mg         174  #increased to obtain CB for SO4 <15%
     Na         117  #increased to obtain CB for SO4 <15%
     K          15
     Fe(2)      160  #increased to obtain CB for SO4 <15%
     Cl         161
     As         1.36
     Ni         9.34
     Se         0.53
     Si         56.4
     U          34.1
     Alkalinity 2.44 as HCO3
     S(6)       3500 #previously 2650 (increased to reflect recent observed increases at GW-
```

```
8)
      Ra          3.57e-7

SOLUTION 1-5 GW8 #2005 data replaces January 2001 data

      units       ppm
      pe          7
      pH          4.41 #Aug-05
      S(6)        3020 #May-05
      Cl          420 #May-05
      #Alkalinity 2.0 as HCO3 (no carbonate alkalinity at pH 4.4)
      Ca          600 #Increased to achieve charge balance <15%
      Na          125 #Increased to achieve charge balance <15%
      Mg          175 #Increased to achieve charge balance <15%
      K           35  #Increased to achieve charge balance <15%
      Fe(2)       127
      As          0.0272 #May-05
      Be          0.22 #May-05
      Th          5.46e-8 #May-05
      Pb          2.32e-10 #May-05
      Ra          2.63e-7 #Aug-05
      Ni          3.2 #May-05
      Se          0.05 #May-05
      U           22.9 #May-05

SOLUTION 6-54 MW-72 # Data from MW-72 replaces MW-74 January 2001
      units       ppm
      pe          6
      pH          6.48        #Jun-04
      S(6)        1190        #Jun-04
      Cl          115         #Jun-04
      Alkalinity 400 as HCO3  #Jan-01
      Ca          580         #Jan-01
      Na          25          #Jan-01
      Mg          63          #Jan-01
      K           17          #Jan-01
      Fe(2)       4           #Jan-01
      As          0.0081      #Jun-05
      Be          0.0001      #Jun-05
      #Th         negative value reported
      Pb          2.97e-11  #Jan-01 (2.3 pCi/L)
      Ra          2.42e-8     #Jan-01
      Ni          0.0179      #Jun-05
      Se          0.017       #Jun-05
      U           0.609       #Jun-05
      #S(-2)      not measured

EQUILIBRIUM_PHASES 1-54
      Calcite          0.0        0.0
      Gypsum           0.0        0.0
      USiO4(c)         0.0        0.0
      Ferroselite      0.0        0.0
      Se(A)            0.0        0.0
      RaSO4            0.0        0.0
      NiSe             0.0        0.0
      Anglesite        0.0        0.0

SURFACE 1-5
      -equilibrate 1
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

SURFACE 6-54
      -equilibrate 6
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021
```

```
EXCHANGE 1-5
      -equilibrate 1
      X     1.2

EXCHANGE 6-54
         -equilibrate 6
      X       1.2

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          4

END


SOLUTION 0 #33% REDUCTION

      units       ppm
      pe          5.6
      pH          4.47
      Th          1.47e-6
      Pb          1.63e-9     #Revised ACL 2006
      Ra          2.41E-07
      U           22.62
      Be          1.13
      Ca          570
      Mg          137
      Na          94
      K           16.2
      Fe(2)       109
      Cl          114.6
      As          0.90
      Ni          6.20
      Se          0.35
      Si          37.4
      Alkalinity 4.0 as HCO3
      S(6)        2546 #previously 1980.5

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          2

END


SOLUTION 0 #50% Reduction

      units       ppm
      pe          5.5
      pH          4.57
      Th          1.12e-6
      Pb          1.22e-9     #Revised ACL 2006
      Ra          1.86E-07
      U           17.16
      Be          0.85
      Ca          503
      Mg          119
      Na          83
      K           16.8
      Fe(2)       85
      Cl          92.5
      As          0.68
      Ni          4.7
```

```
      Se          0.27
      Si          28.31
      Alkalinity 4.73 as HCO3
      S(6)        2089 #previously 1661

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           4

END


SOLUTION 0 #75% Reduction

      units       ppm
      pe          5.1
      pH          4.85
      Th          5.65E-07
      Pb          6.1e-10     #Revised ACL 2006
      Ra          1.0E-07
      U           8.62
      Be          0.43
      Ca          398
      Mg          91
      Na          66
      K           17.7
      Fe(2)       47
      Cl          58
      As          0.34
      Ni          2.36
      Se          0.13
      Si          14.2
      Alkalinity 5.88 as HCO3
      S(6)        1375 #previously 1161

TRANSPORT
      -lengths          54*30.5
      -dispersivities   54*50
      -cells            54
      -shifts           12

END


SOLUTION 0 #90% Reduction

      units       ppm
      pe          4.4
      pH          5.27
      Th          2.33E-07
      Pb          2.45e-10    #Revised ACL 2006
      Ra          4.84e-8
      U           3.5
      Be          0.17
      Ca          334
      Mg          74
      Na          56
      K           18.2
      Fe(2)       24
      Cl          37.3
      As          0.14
      Ni          0.96
      Se          0.05
      Si          5.66
      Alkalinity 6.56 as HCO3
```

```
      S(6)       946 #previously 860.7

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          588
      -punch_frequency 588

PRINT
      -selected_output true
END

PRINT
      selected_output  false
```

```
TITLE  A-9 area (SW flow regime). FILE: SWFR2d_nrc3_20.in
#Concentration vs Distance at the POE
#Using flow rate of 0.280 ft/d - DECREASING SOURCE TERM TO 90% REDUCTION
#SOLID PHASES ALLOWED
#Revised in 2006 for Pb-210 ACL/Solutions 1-54/Source Sulfate

PRINT
     -reset     false

KNOBS
     -iterations 100
     -tolerance 1.00E-13
     -step_size 100
     -pe_step_size 10
     -diagonal_scale TRUE
     -debug_prep FALSE
     -debug_set FALSE
     -debug_model FALSE
     -debug_inverse FALSE
     -logfile FALSE

SELECTED_OUTPUT

     -file c:\SWFR2d_nrc3_20.dat

USER_PUNCH
     -headings As Be Cl Pb U Ni Se SO4 Th Ra sOPb+
     -headings wOPb+ PbX2 Anglesite sOHUO2+2
     -headings wOUO2+ USiO4(C) Uraninite sONi+ wONi+
     -headings NiSe sOHRa+2 wORa+ RaX2 RaSO4 wSeO4-
     -headings wOHSeO4-2 wSeO3- wOHSeO3-2 Se(A)
     -headings FeSe2 sSO4- wSO4- sOHSO4-2 wOHSO4-2
     -headings gypsum wOTh+3 wOTh(OH)+2 wOTh(OH)2+
     -headings wOTh(OH)3 wOTh(OH)4- sH2AsO3 wH2AsO3
     -headings sH2AsO4 wH2AsO4 sHAsO4- wHAsO4- sAsO4-2
     -headings wAsO4-2 sOHAsO4-3 wOHAsO4-3 sOBe+ wOBe+
     -headings Calcite Ca Mg Na K HCO3 SO4 Cl TDS
     -start
     10  REM Convert to ppm and show molalities
     20  PUNCH TOT("As")*74.9216*1000
     30  PUNCH TOT("Be")*9.0122*1000
     40  PUNCH TOT("Cl")*35.453*1000
     50  PUNCH TOT("Pb")*207.19*1000/1.29e-11
     60  PUNCH TOT("U")*238.029*1000
     70  PUNCH TOT("Ni")*58.71*1000
     80  PUNCH TOT("Se")*78.96*1000
     90  PUNCH TOT("S(6)")*96.0616*1000
     100 PUNCH TOT("Th")*232.038*1000/4.96e-8
     110 PUNCH TOT("Ra")*226*1000/1.01e-9
     120 PUNCH MOL("Hfo_sOPb+")
     130 PUNCH MOL("Hfo_wOPb+")
     140 PUNCH MOL("PbX2")
     150 PUNCH EQUI("Anglesite")
     160 PUNCH MOL("Hfo_sOHUO2+2")
     170 PUNCH MOL("Hfo_wOUO2+")
     180 PUNCH EQUI("USiO4(C)")
     190 PUNCH EQUI("Uraninite")
     200 PUNCH MOL("Hfo_sONi+")
     210 PUNCH MOL("Hfo_wONi+")
     220 PUNCH EQUI("NiSe")
     230 PUNCH MOL("Hfo_sOHRa+2")
     240 PUNCH MOL("Hfo_wORa+")
     250 PUNCH MOL("RaX2")
     260 PUNCH EQUI("RaSO4")
     270 PUNCH MOL("Hfo_wSeO4-")
     280 PUNCH MOL("Hfo_wOHSeO4-2")
     290 PUNCH MOL("Hfo_wSeO3-")
```

```
      300 PUNCH MOL("Hfo_wOHSeO3-2")
      310 PUNCH EQUI("Se(A)")
      320 PUNCH EQUI("Ferroselite")
      330 PUNCH MOL("Hfo_sSO4-")
      340 PUNCH MOL("Hfo_wSO4-")
      350 PUNCH MOL("Hfo_sOHSO4-2")
      360 PUNCH MOL("Hfo_wOHSO4-2")
      370 PUNCH EQUI("gypsum")
      380 PUNCH MOL("Hfo_wOTh+3")
      390 PUNCH MOL("Hfo_wOTh(OH)+2")
      400 PUNCH MOL("Hfo_wOTh(OH)2+")
      410 PUNCH MOL("Hfo_wOTh(OH)3")
      420 PUNCH MOL("Hfo_wOTh(OH)4-")
      430 PUNCH MOL("Hfo_sH2AsO3")
      440 PUNCH MOL("Hfo_wH2AsO3")
      450 PUNCH MOL("Hfo_sH2AsO4")
      460 PUNCH MOL("Hfo_wH2AsO4")
      470 PUNCH MOL("Hfo_sHAsO4-")
      480 PUNCH MOL("Hfo_wHAsO4-")
      490 PUNCH MOL("Hfo_sAsO4-2")
      500 PUNCH MOL("Hfo_wAsO4-2")
      510 PUNCH MOL("Hfo_sOHAsO4-3")
      520 PUNCH MOL("Hfo_wOHAsO4-3")
      530 PUNCH MOL("Hfo_sOBe+")
      540 PUNCH MOL("Hfo_wOBe+")
      550 PUNCH EQUI("Calcite")
      560 PUNCH TOT("Ca")*40.08*1000
      570 PUNCH TOT("Mg")*24.312*1000
      580 PUNCH TOT("Na")*22.9898*1000
      590 PUNCH TOT("K")*39.102*1000
      600 PUNCH MOL("HCO3-")*61.018*1000
      610 PUNCH TOT("S(6)")*96.0616*1000
      620 PUNCH TOT("Cl")*35.453*1000
      630 A = (TOT("Ca")*40.08*1000)+(TOT("Mg")*24.312*1000)
      640 B = (TOT("Na")*22.9898*1000)+(TOT("K")*39.102*1000)
      650 C = MOL("HCO3-")*61.018*1000
      660 D = TOT("S(6)")*96.0616*1000
      670 E = TOT("Cl")*35.453*1000
      680 PUNCH A+B+C+D+E
      -end

PRINT
      -selected_output false

SOLUTION 0 # Initial Source Term

      units       ppm
      pe          8
      pH          4.33
      Th          2.22e-6
      Pb          2.44e-9    #Revised ACL 2006
      Be          1.7
      Ca          710  #increased to obtain CB for SO4 <15%
      Mg          174  #increased to obtain CB for SO4 <15%
      Na          117  #increased to obtain CB for SO4 <15%
      K           15
      Fe(2)       160  #increased to obtain CB for SO4 <15%
      Cl          161
      As          1.36
      Ni          9.34
      Se          0.53
      Si          56.4
      U           34.1
      Alkalinity 2.44 as HCO3
      S(6)        3500 #previously 2650 (increased to reflect recent observed increases in GW-
8)
      Ra          3.57e-7
```

```
SOLUTION 1-5 GW8 #2005 data replaces January 2001 data

      units       ppm
      pe          7
      pH          4.41 #Aug-05
      S(6)        3020 #May-05
      Cl          420 #May-05
      #Alkalinity 2.0 as HCO3 (no carbonate alkalinity at pH 4.4)
      Ca          600 #Increased to achieve charge balance <15%
      Na          125 #Increased to achieve charge balance <15%
      Mg          175 #Increased to achieve charge balance <15%
      K           35 #Increased to achieve charge balance <15%
      Fe(2)       127
      As          0.0272 #May-05
      Be          0.22 #May-05
      Th          5.46e-8 #May-05
      Pb          2.32e-10 #May-05
      Ra          2.63e-7 #Aug-05
      Ni          3.2 #May-05
      Se          0.05 #May-05
      U           22.9 #May-05

SOLUTION 6-54 MW-72 # Data from MW-72 replaces MW-74 January 2001
      units       ppm
      pe          6
      pH          6.48        #June-04
      S(6)        1190        #Jun-04
      Cl          115         #Jun-04
      Alkalinity 400 as HCO3      #Jan-01
      Ca          580         #Jan-01
      Na          25          #Jan-01
      Mg          63          #Jan-01
      K           17          #Jan-01
      Fe(2)       4           #Jan-01
      As          0.0081      #Jun-05
      Be          0.0001      #Jun-05
      #Th         Negative value reported
      Pb          2.97e-11    #Jan-01 (2.3 pCi/L)
      Ra          2.42e-8     #Jan-01
      Ni          0.0179      #Jun-05
      Se          0.017       #Jun-05
      U           0.609       #Jun-05
      #S(-2)      Not measured

EQUILIBRIUM_PHASES 1-54
      Calcite          0.0        0.0
      Gypsum           0.0        0.0
      Uraninite        0.0        0.0
      USiO4(c)         0.0        0.0
      Ferroselite           0.0        0.0
      Se(A)            0.0        0.0
      RaSO4            0.0        0.0
      NiSe             0.0        0.0
      Anglesite        0.0        0.0

SURFACE 1-5
      -equilibrate 1
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

SURFACE 6-54
      -equilibrate 6
      Hfo_wOH    0.086      600      45.9
      Hfo_sOH    0.0021

EXCHANGE 1-5
```

```
      -equilibrate 1
      X    1.2

EXCHANGE 6-54
        -equilibrate 6
      X       1.2

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          6

END


SOLUTION 0 #33% REDUCTION

      units       ppm
      pe          5.6
      pH          4.47
      Th          1.47e-6
      Pb          1.63e-9          #Revised ACL 2006
      Ra          2.41E-07
      U           22.62
      Be          1.13
      Ca          570
      Mg          137
      Na          94
      K           16.2
      Fe(2)       109
      Cl          114.6
      As          0.90
      Ni          6.20
      Se          0.35
      Si          37.4
      Alkalinity 4.0 as HCO3
      S(6)        2546 #previously 1980.5

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          3

END


SOLUTION 0 #50% Reduction

      units       ppm
      pe          5.5
      pH          4.57
      Th          1.12e-6
      Pb          1.24e-9    #Revised ACL 2006
      Ra          1.86E-07
      U           17.16
      Be          0.85
      Ca          503
      Mg          119
      Na          83
      K           16.8
      Fe(2)       85
      Cl          92.5
      As          0.68
      Ni          4.7
      Se          0.27
```

```
      Si          28.31
      Alkalinity 4.73 as HCO3
      S(6)        2089 #previously 1661

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          7

END

SOLUTION 0 #75% Reduction

      units       ppm
      pe          5.1
      pH          4.85
      Th          5.65E-07
      Pb          6.42e-10   #Revised ACL 2006
      Ra          1.0E-07
      U           8.62
      Be          0.43
      Ca          398
      Mg          91
      Na          66
      K           17.7
      Fe(2)       47
      Cl          58
      As          0.34
      Ni          2.36
      Se          0.13
      Si          14.2
      Alkalinity 5.88 as HCO3
      S(6)        1375 #previously 1161

TRANSPORT
      -lengths         54*30.5
      -dispersivities  54*50
      -cells           54
      -shifts          19
END

SOLUTION 0 #90% Reduction

      units       ppm
      pe          4.4
      pH          5.27
      Th          2.33E-07
      Pb          2.80e-10   #Revised ACL 2006
      Ra          4.84e-8
      U           3.5
      Be          0.17
      Ca          334
      Mg          74
      Na          56
      K           18.2
      Fe(2)       24
      Cl          37.3
      As          0.14
      Ni          0.96
      Se          0.05
      Si          5.66
      Alkalinity 6.56 as HCO3
      S(6)        946 #previously 860.7

TRANSPORT
      -lengths         54*30.5
```

```
      -dispersivities  54*50
      -cells           54
      -shifts          987
      -punch_frequency 20

PRINT
      -selected_output true

END
```