IMPACT OF CLIMATE CHANGE ON LEACHING SOIL CONTAMINATION

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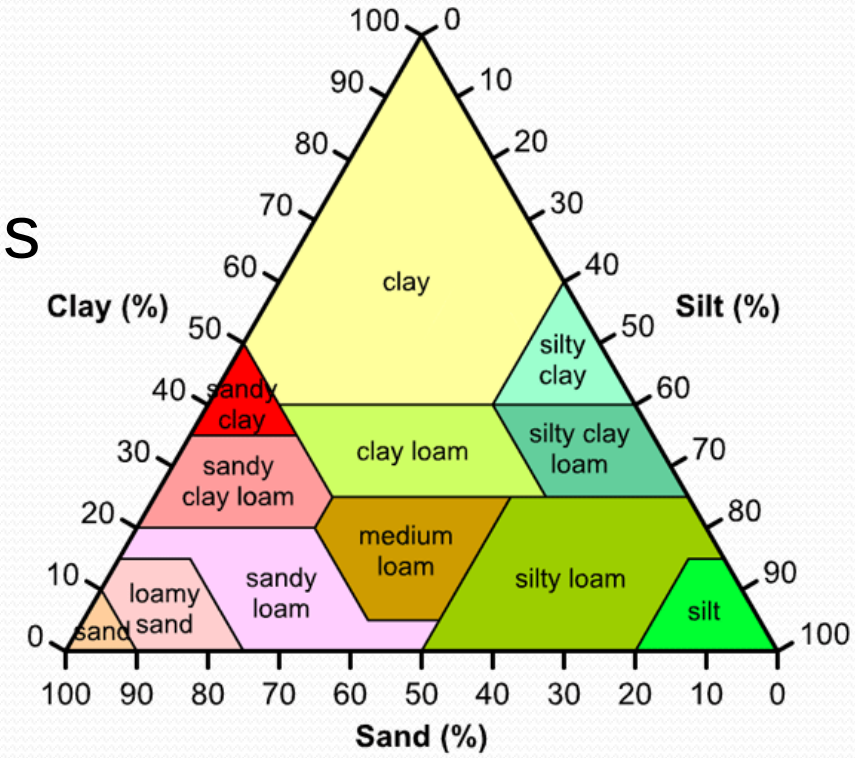
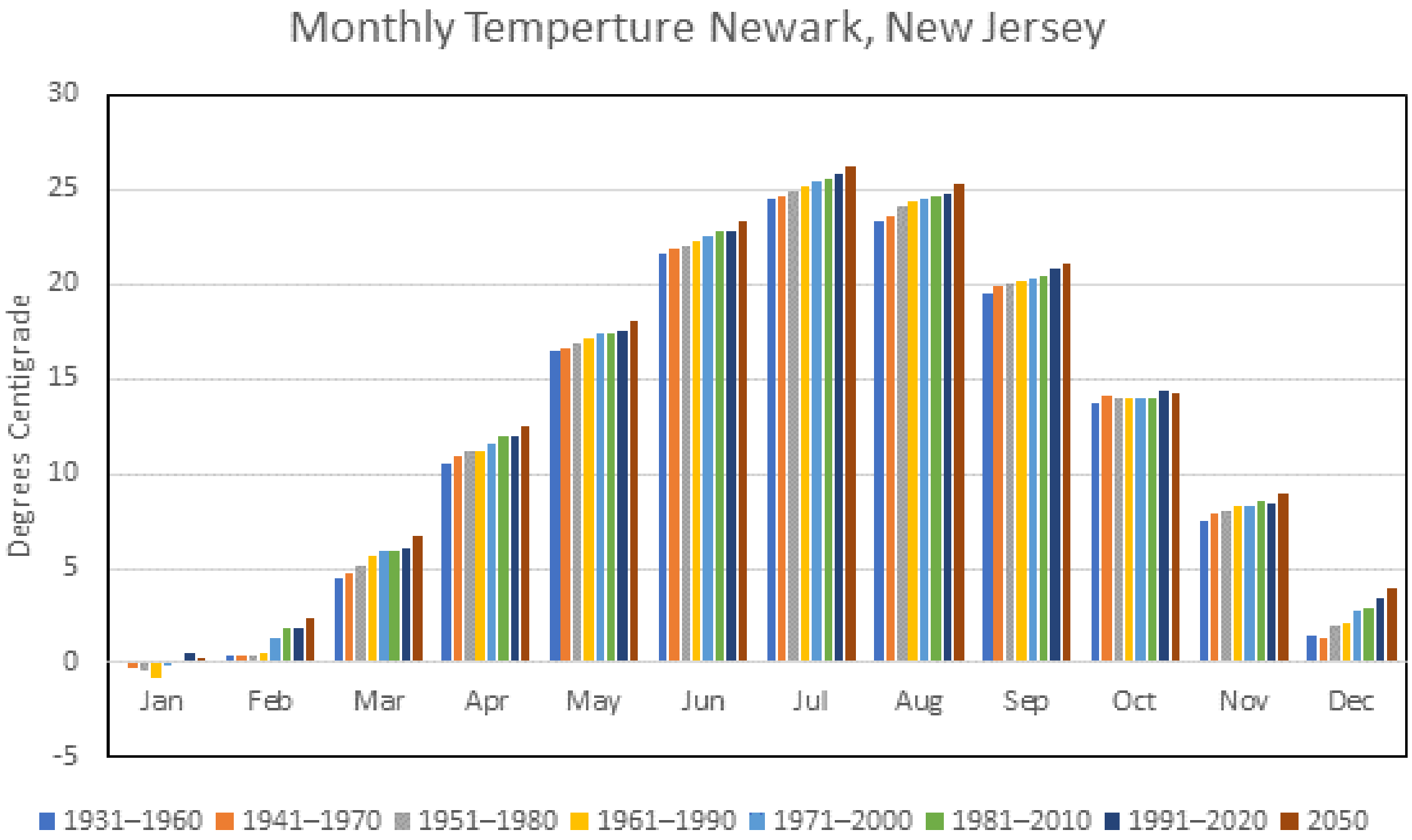
Model Parameters

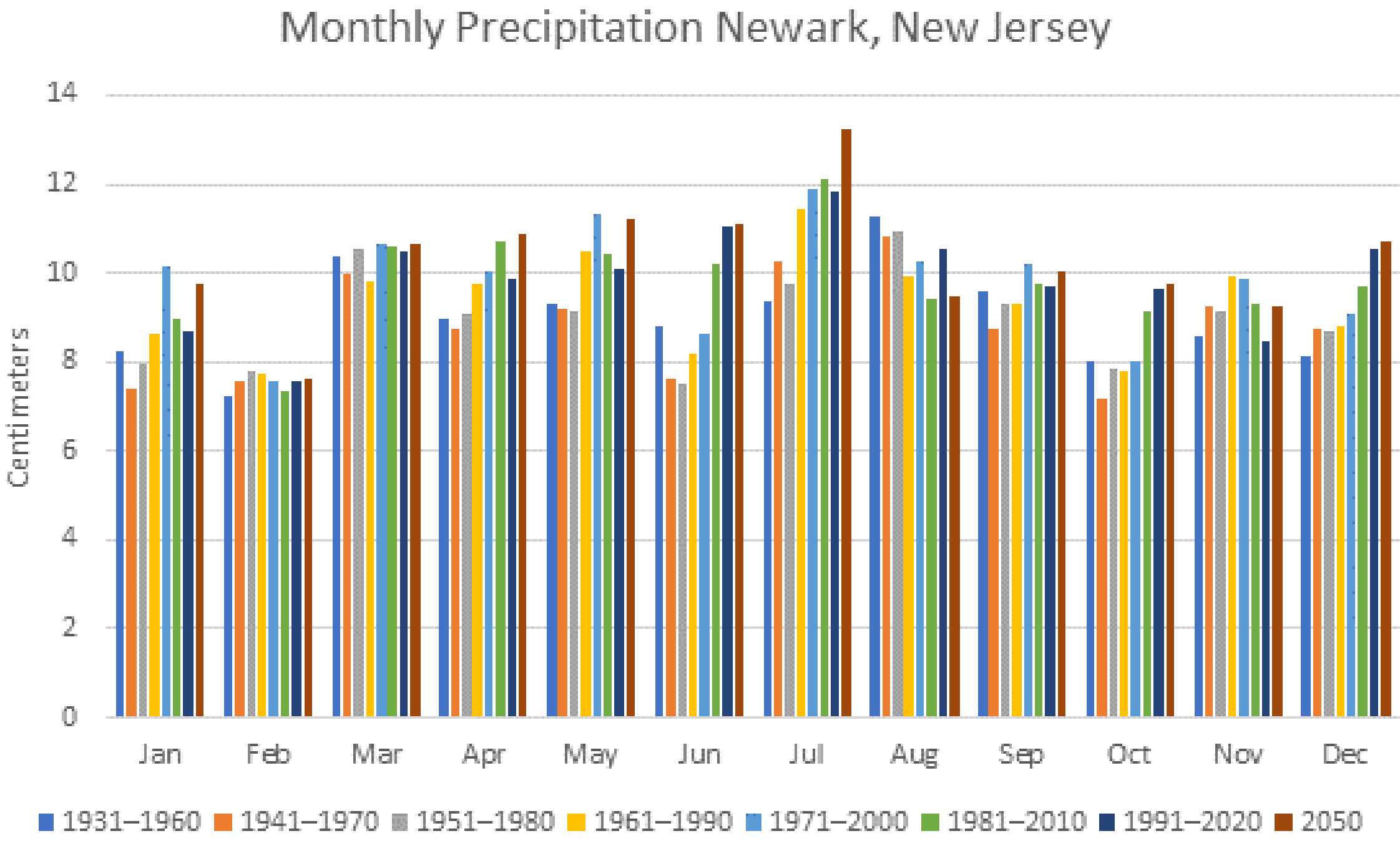
- Benzene
- 8 climate sets (1931–2050)
  - Monthly 30 years norms (1931–2020)
  - 2050 data based on 1931–2020 trends
- 14 USDA soil types
- 112 model runs

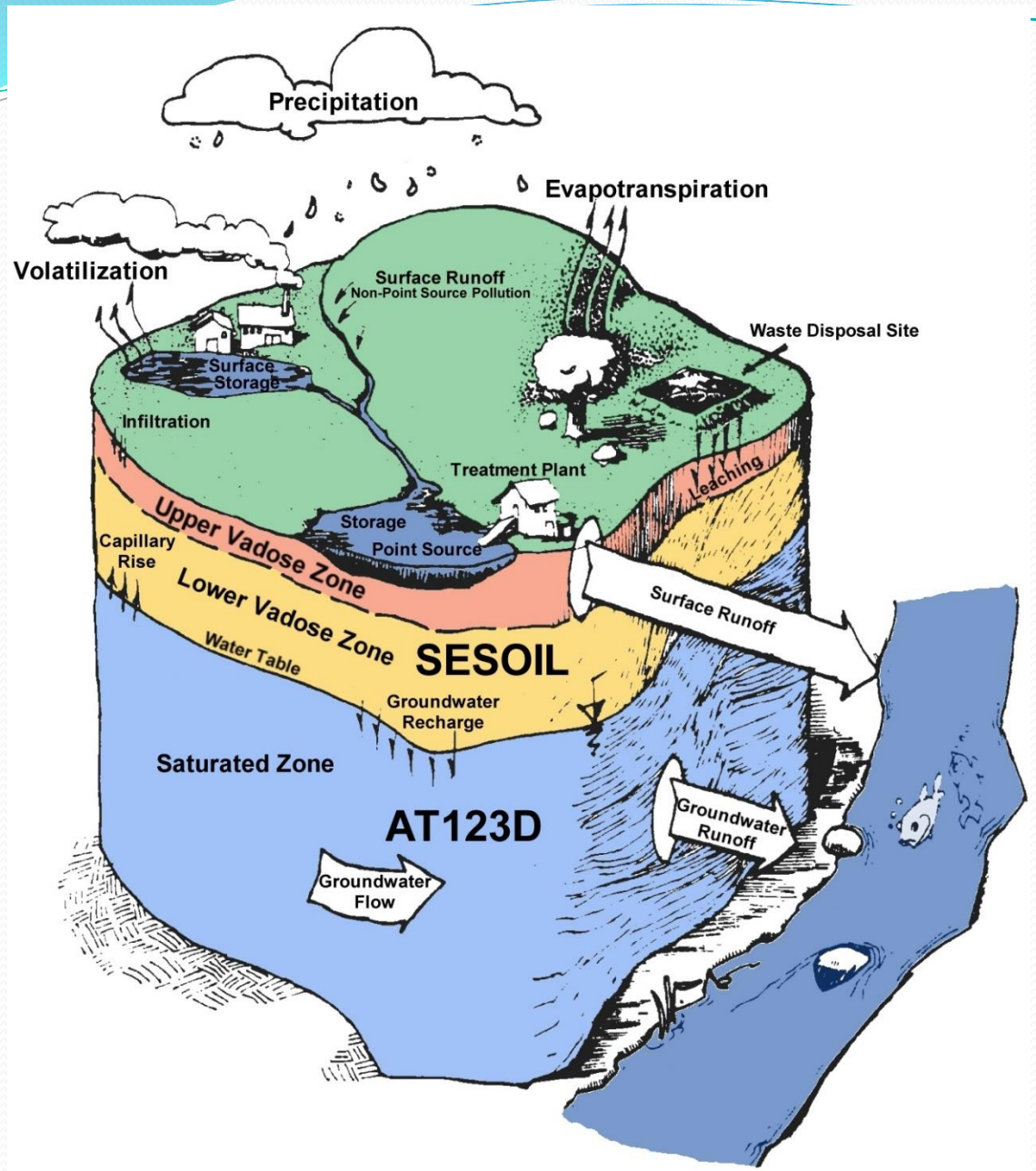


USDA

Soil Texture Triangle


Monthly Temperture Newark, New Jersey
Degrees Centigrade
30
25
20
15
10
5
0
-5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050


Monthly Precipitation Newark, New Jersey
Centimeters
0
2
4
6
8
10
12
14
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050



SESOIL & AT123D

- Used by state regulatory agencies
- To establish residual soil standards protective of groundwater

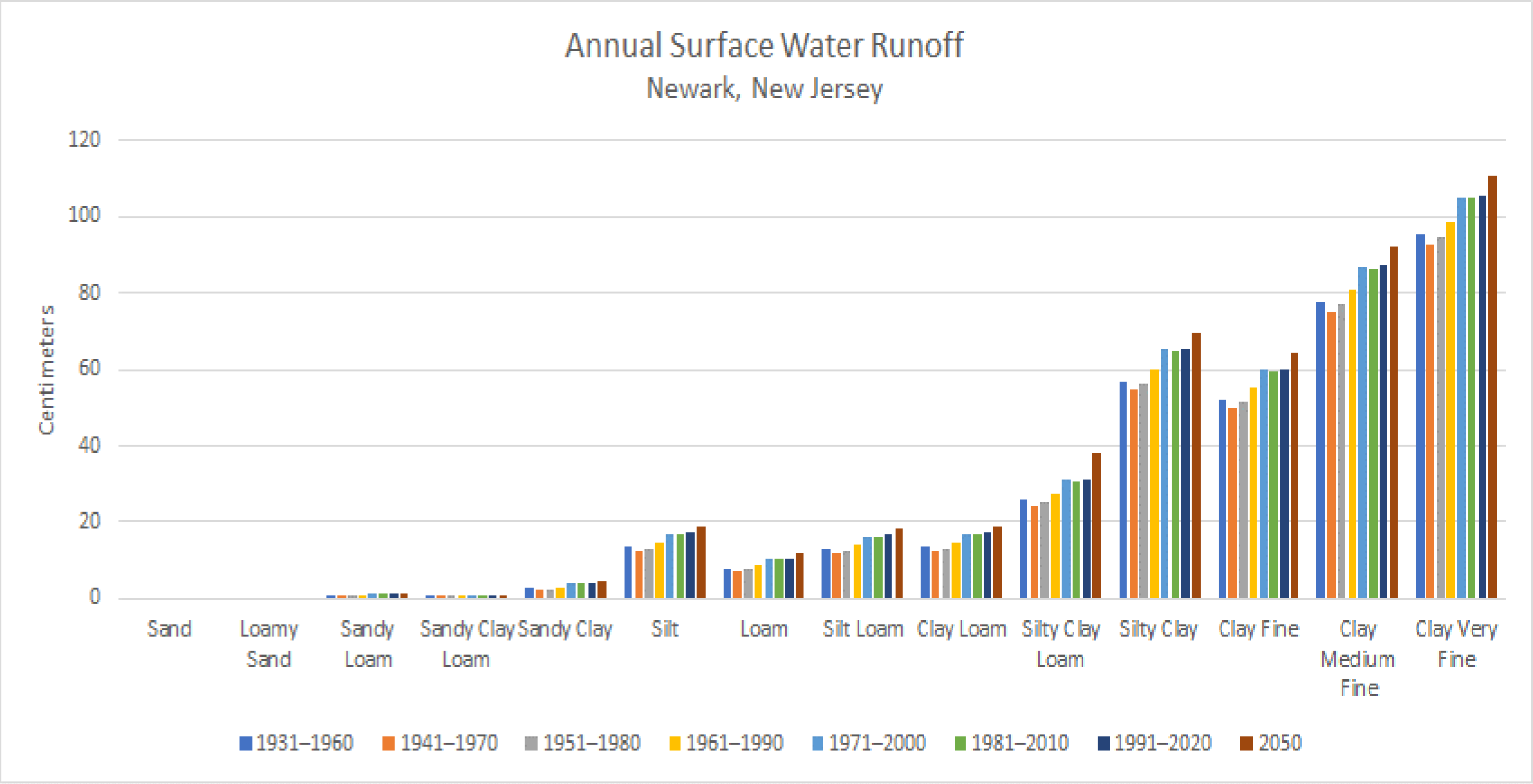
SESOIL Vadose Zone

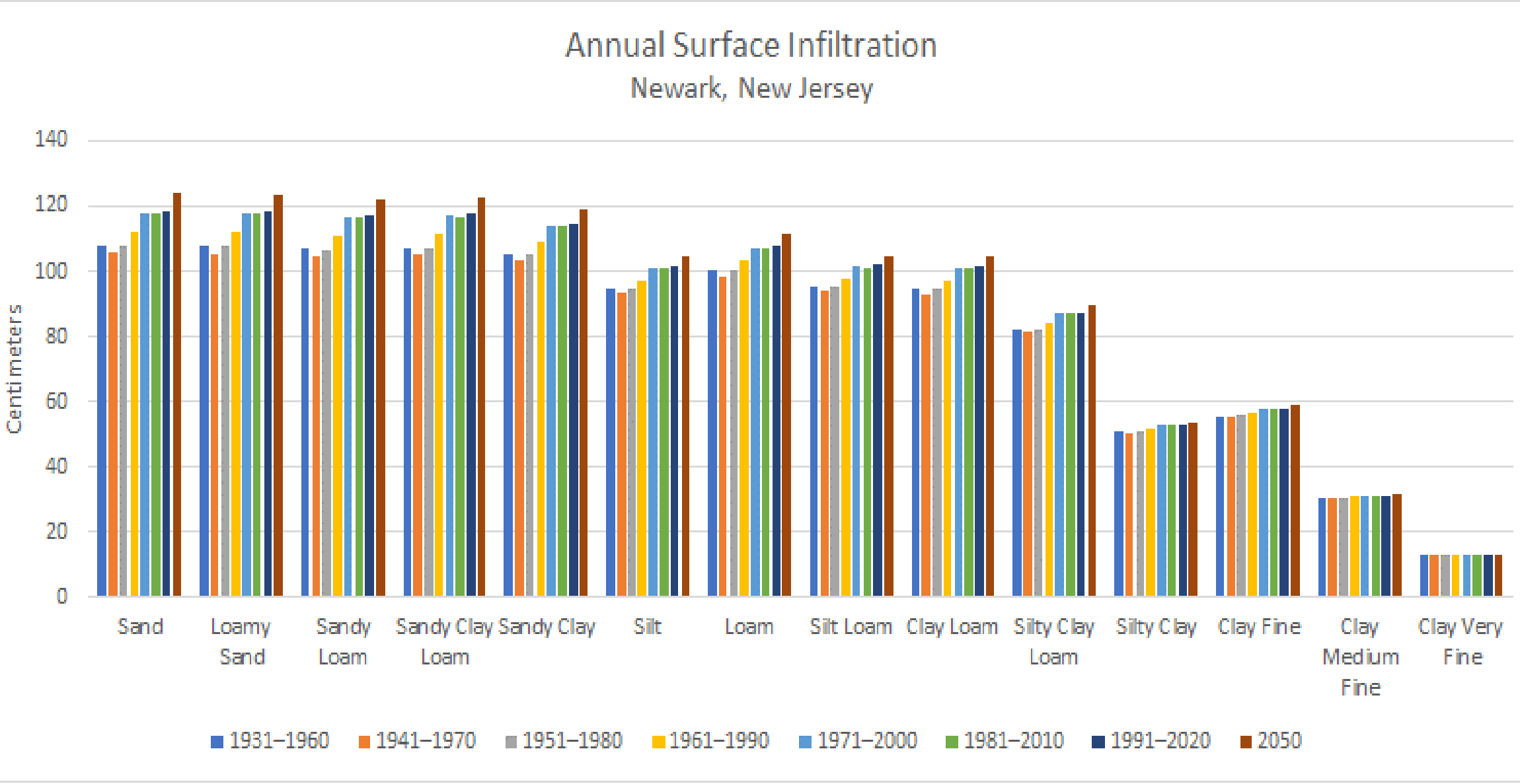
- Hydrologic cycle
- Pollutant cycle

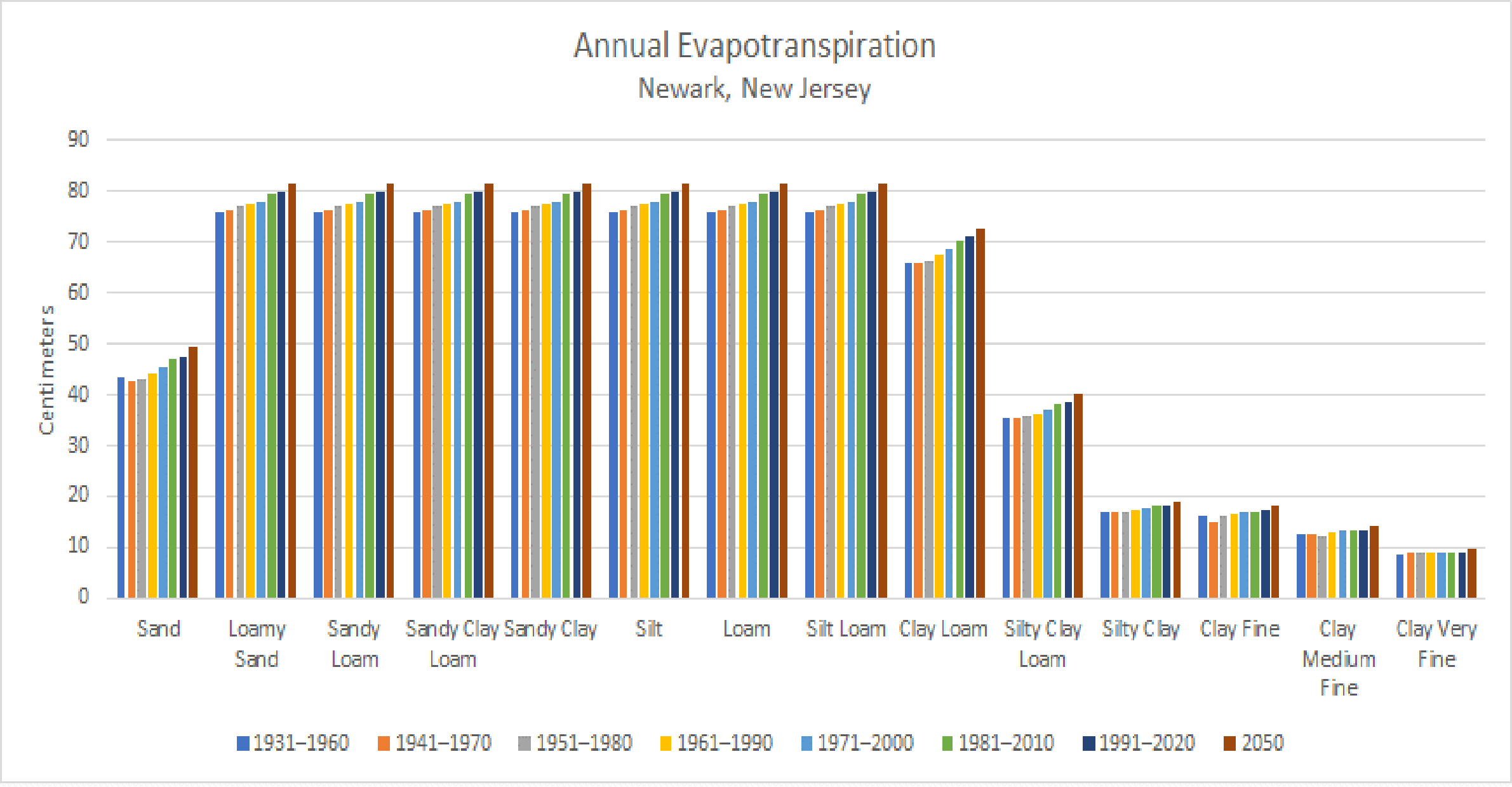
AT123D Groundwater

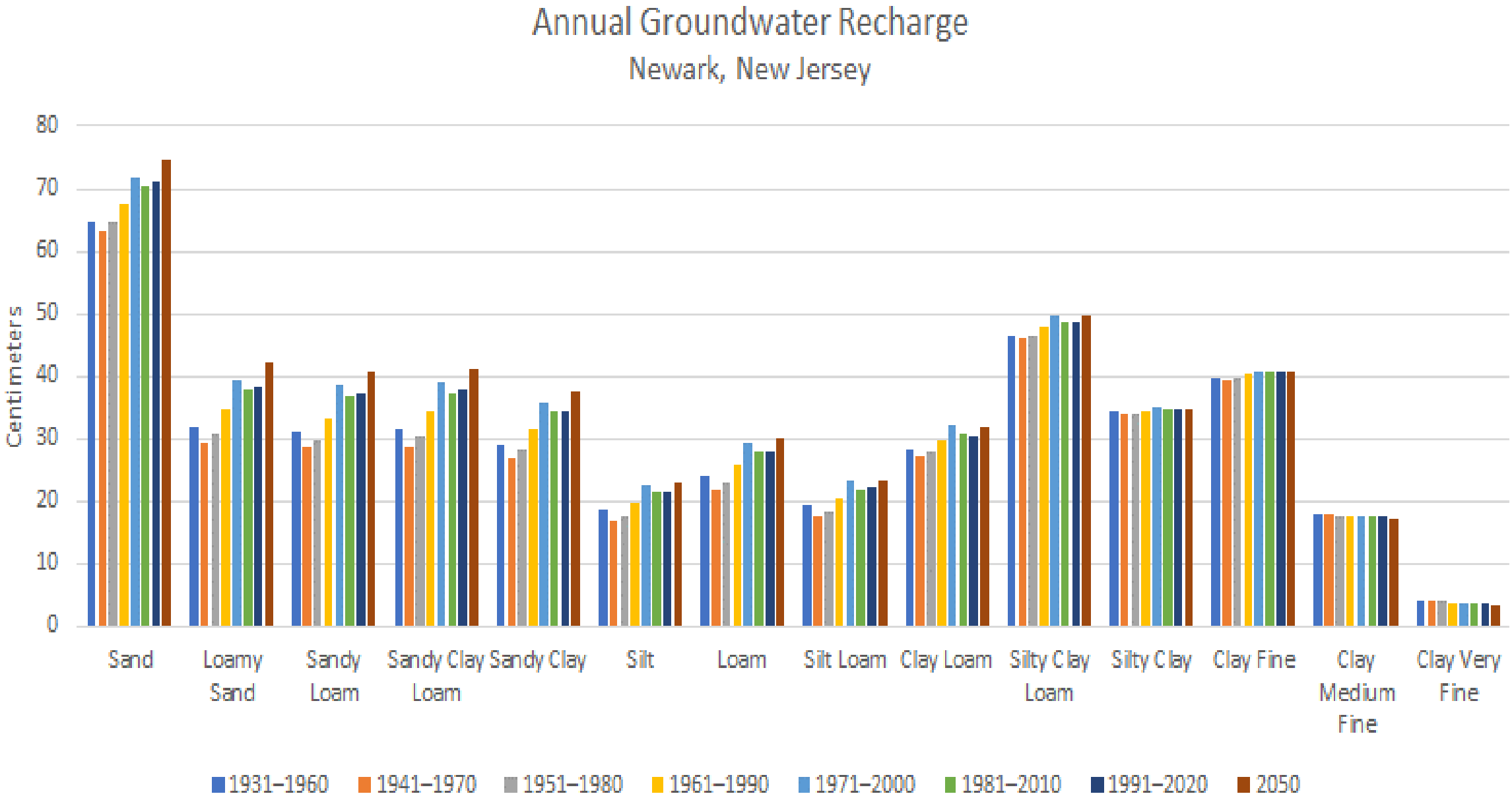
- Monthly mass load from SESOIL

SESOIL
Hydrologic Cycle
Results

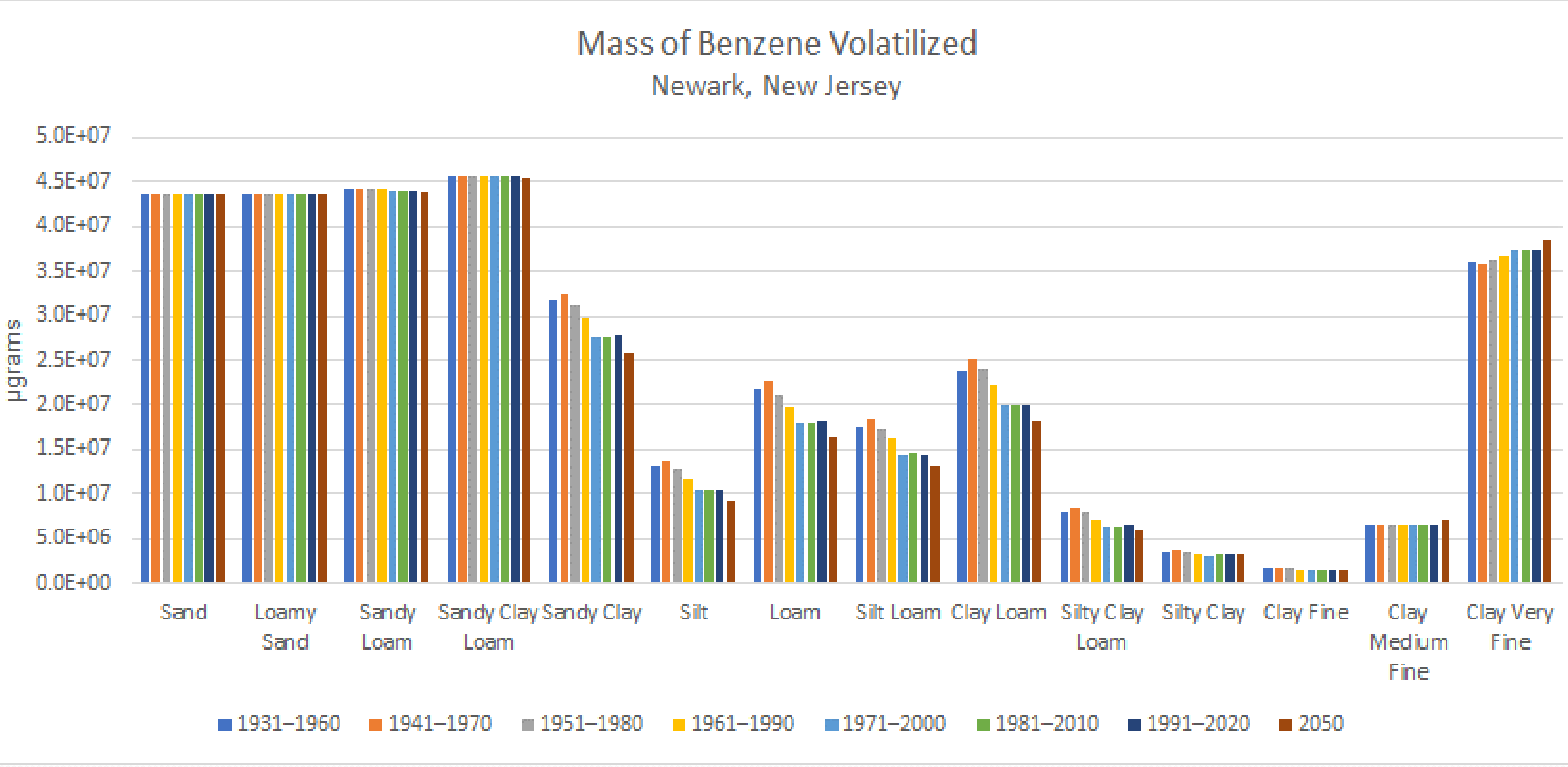

Annual Surface Water Runoff
Newark, New Jersey
Centimeters
120
100
80
60
40
20
0
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

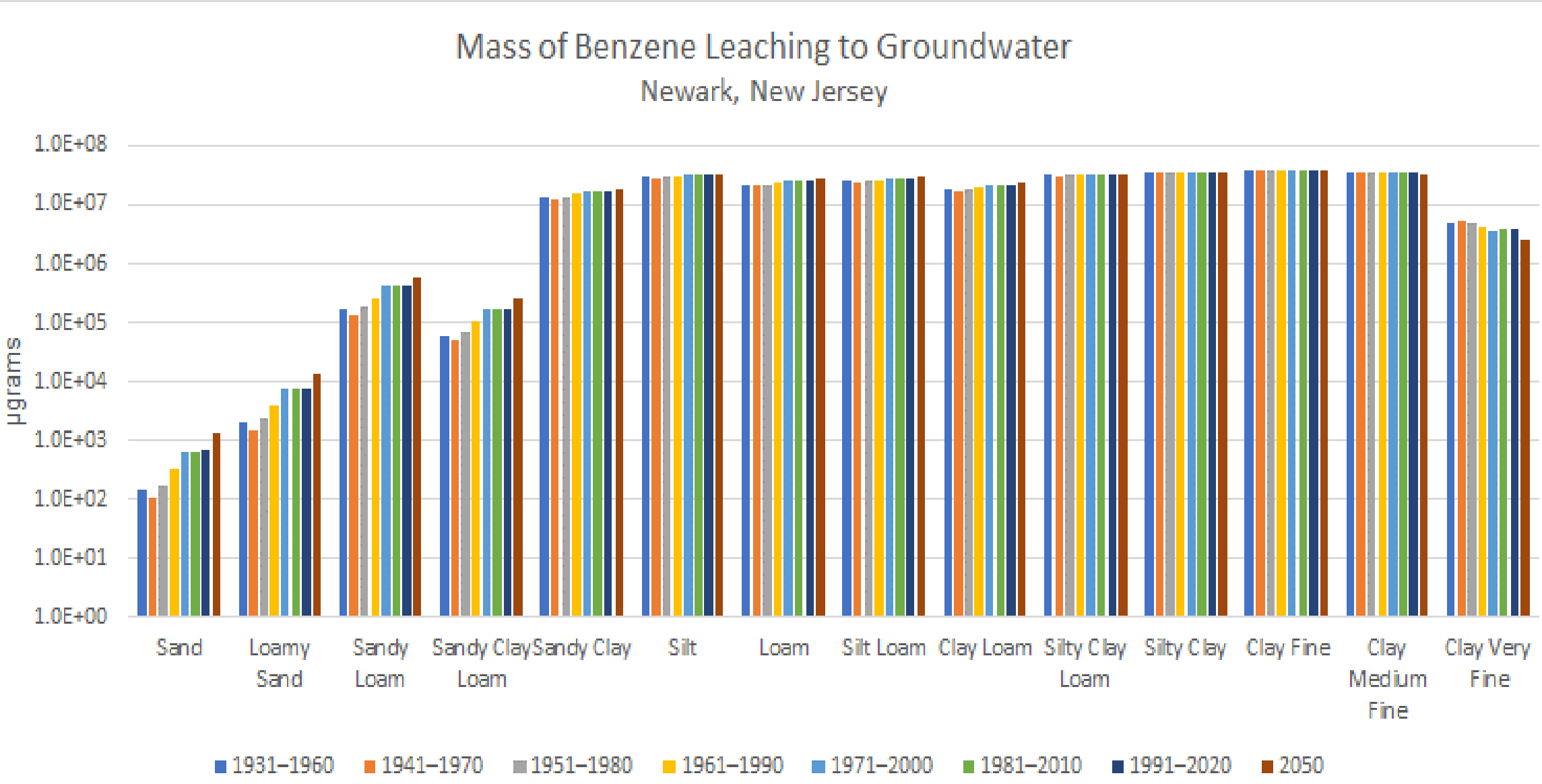

Annual Surface Infiltration
Newark, New Jersey
Centimeters
140
120
100
80
60
40
20
0
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

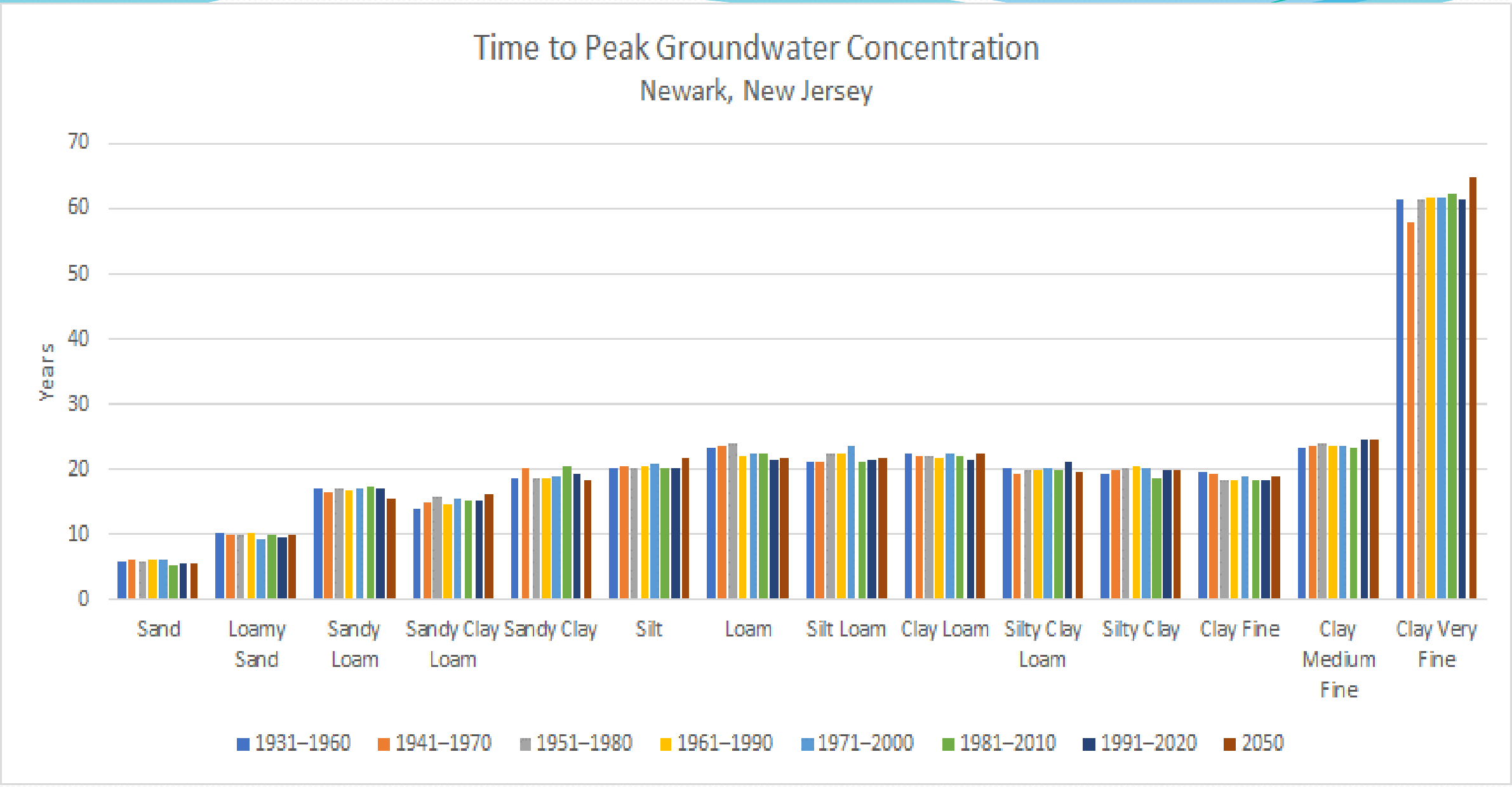

Annual Evapotranspiration
Newark, New Jersey
Centimeters
90
80
70
60
50
40
30
20
10
0
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050


Annual Groundwater Recharge
Newark, New Jersey
Centimeters
80
70
60
50
40
30
20
10
0
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

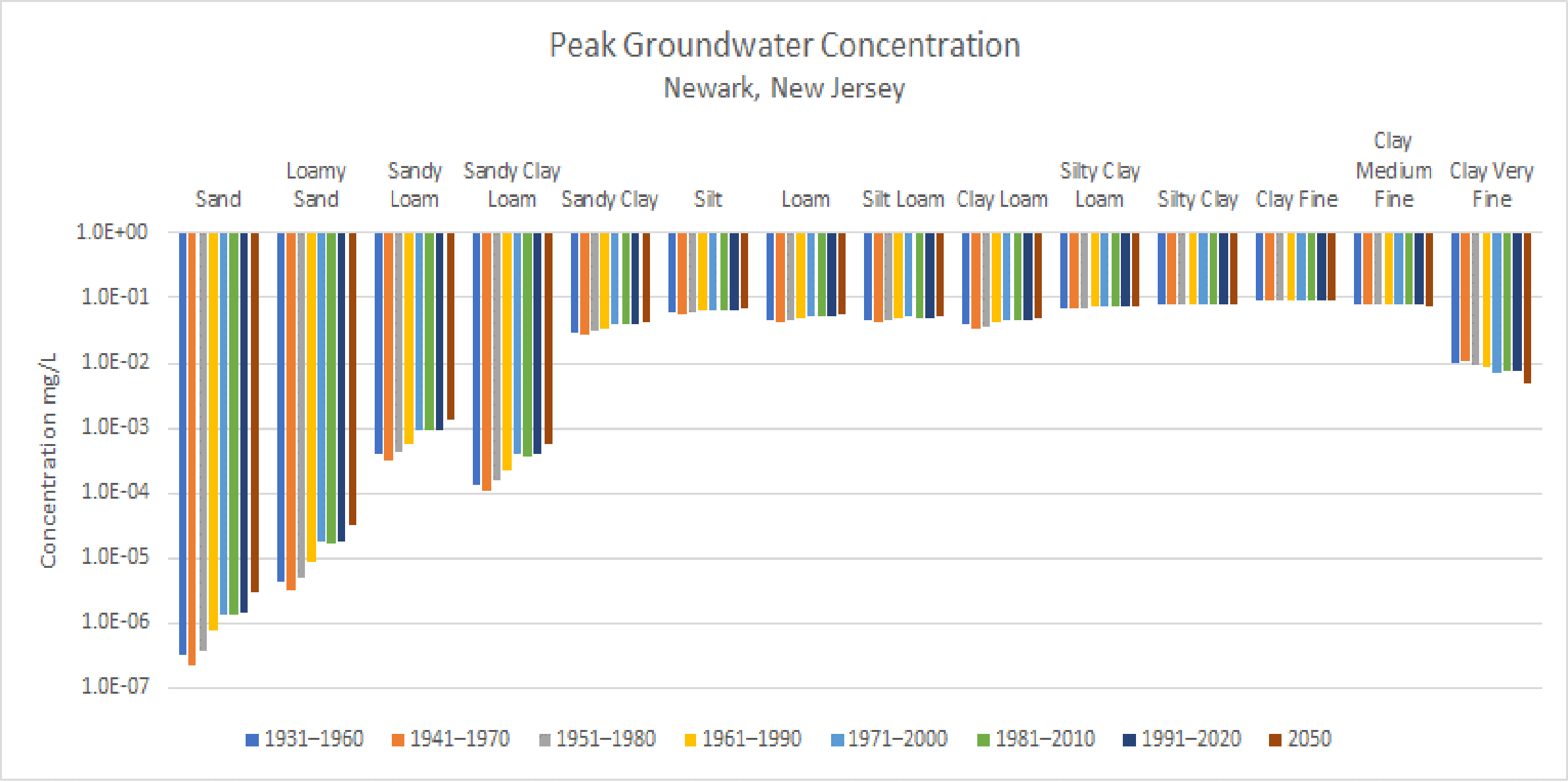
SESOIL
Pollutant Cycle
Results


Mass of Benzene Volatilized
Newark, New Jersey
µgrams
5.0E+07
4.5E+07
4.0E+07
3.5E+07
3.0E+07
2.5E+07
2.0E+07
1.5E+07
1.0E+07
5.0E+06
0.0E+00
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

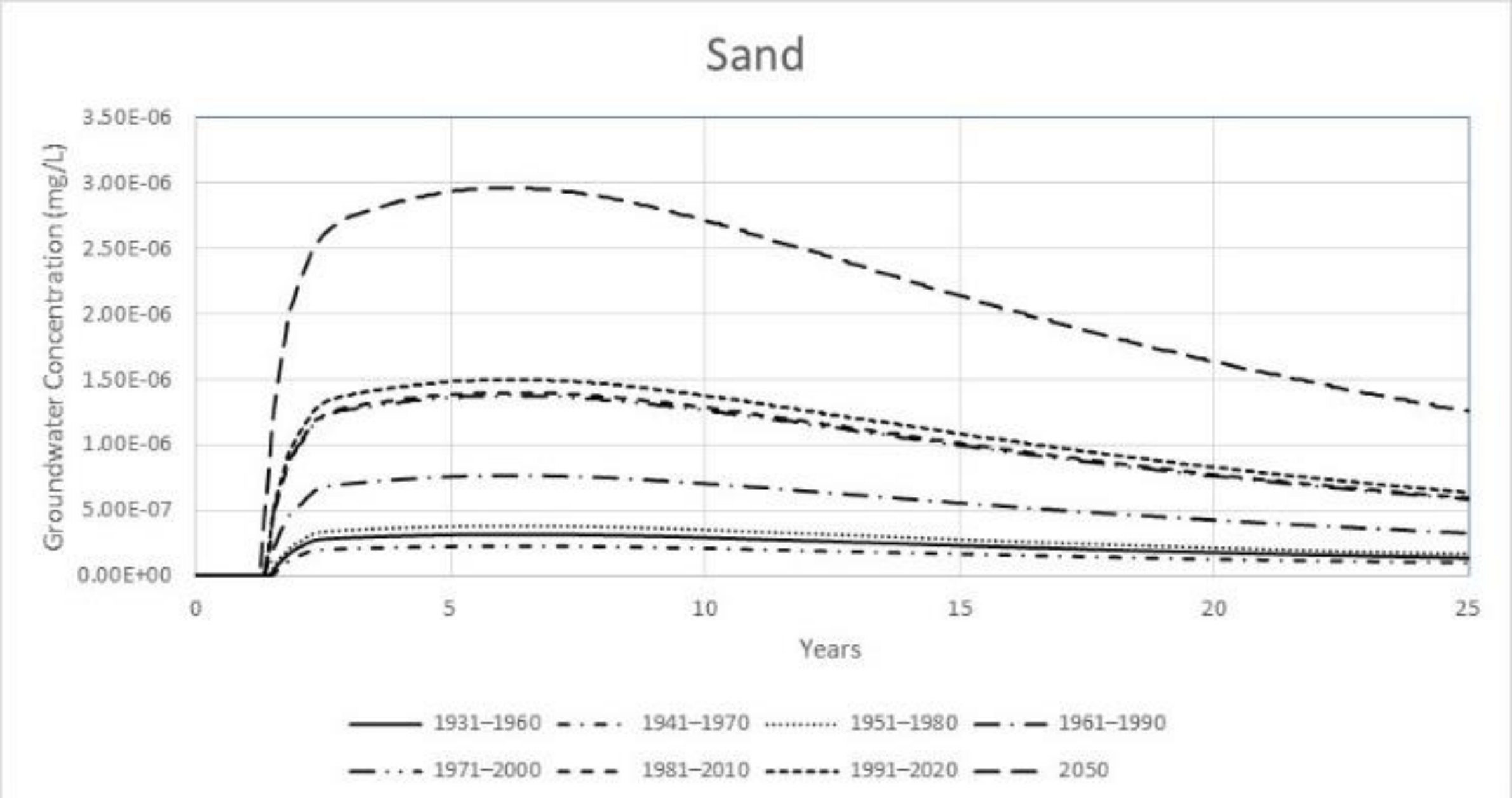

Mass of Benzene Leaching to Groundwater
Newark, New Jersey
µgrams
1.0E+08
1.0E+07
1.0E+06
1.0E+05
1.0E+04
1.0E+03
1.0E+02
1.0E+01
1.0E+00
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050


Time to Peak Groundwater Concentration
Newark, New Jersey
Years
70
60
50
40
30
20
10
0
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

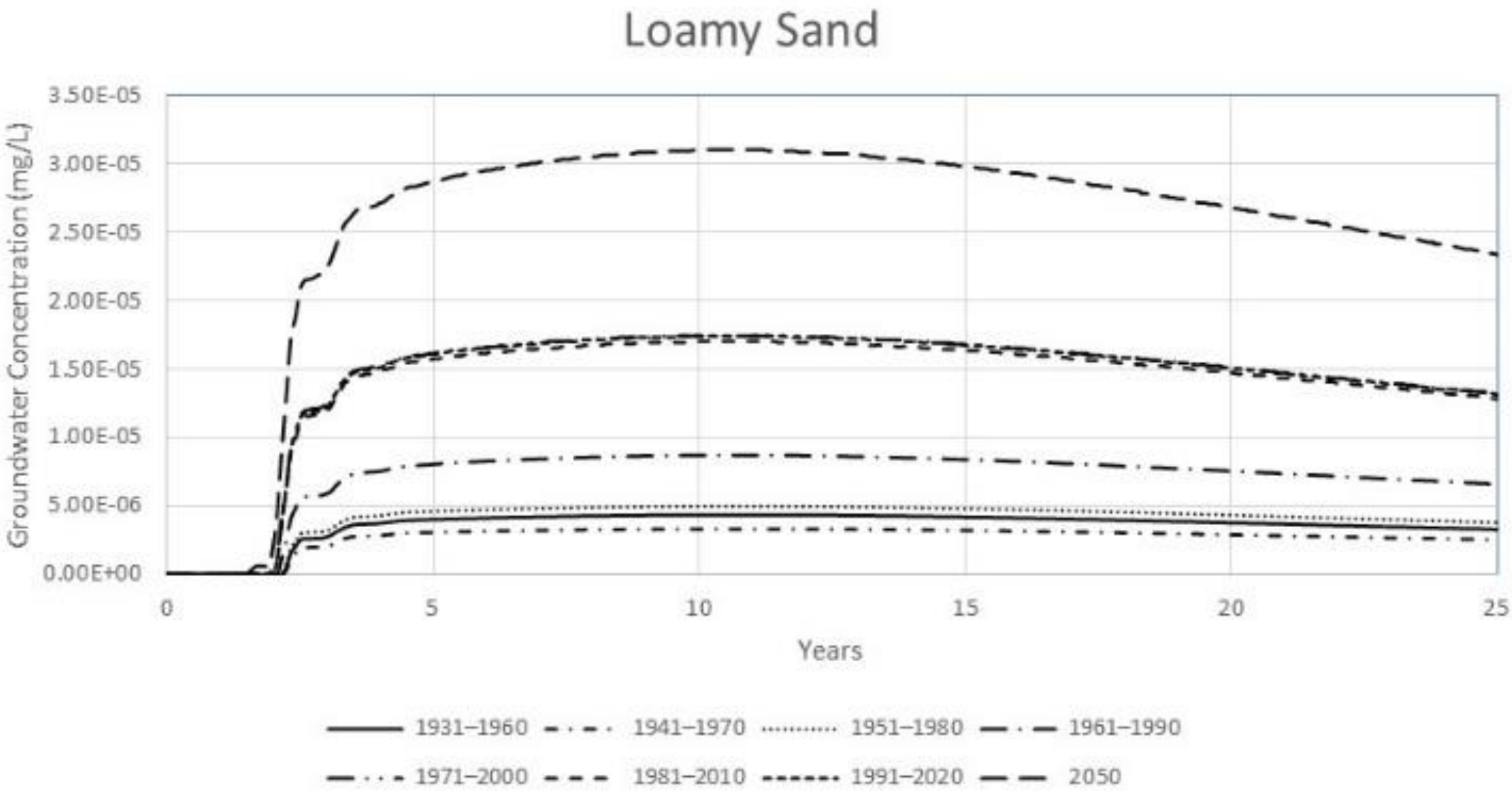
AT123D
Groundwater Results


Peak Groundwater Concentration
Newark, New Jersey
Sand
Loamy Sand
Sandy Loam
Sandy Clay Loam
Sandy Clay
Silt
Loam
Silt Loam
Clay Loam
Silty Clay Loam
Silty Clay
Clay Fine
Clay Medium Fine
Clay Very Fine
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
Concentration mg/L
1931–1960
1941–1970
1951–1980
1961–1990
1971–2000
1981–2010
1991–2020
2050

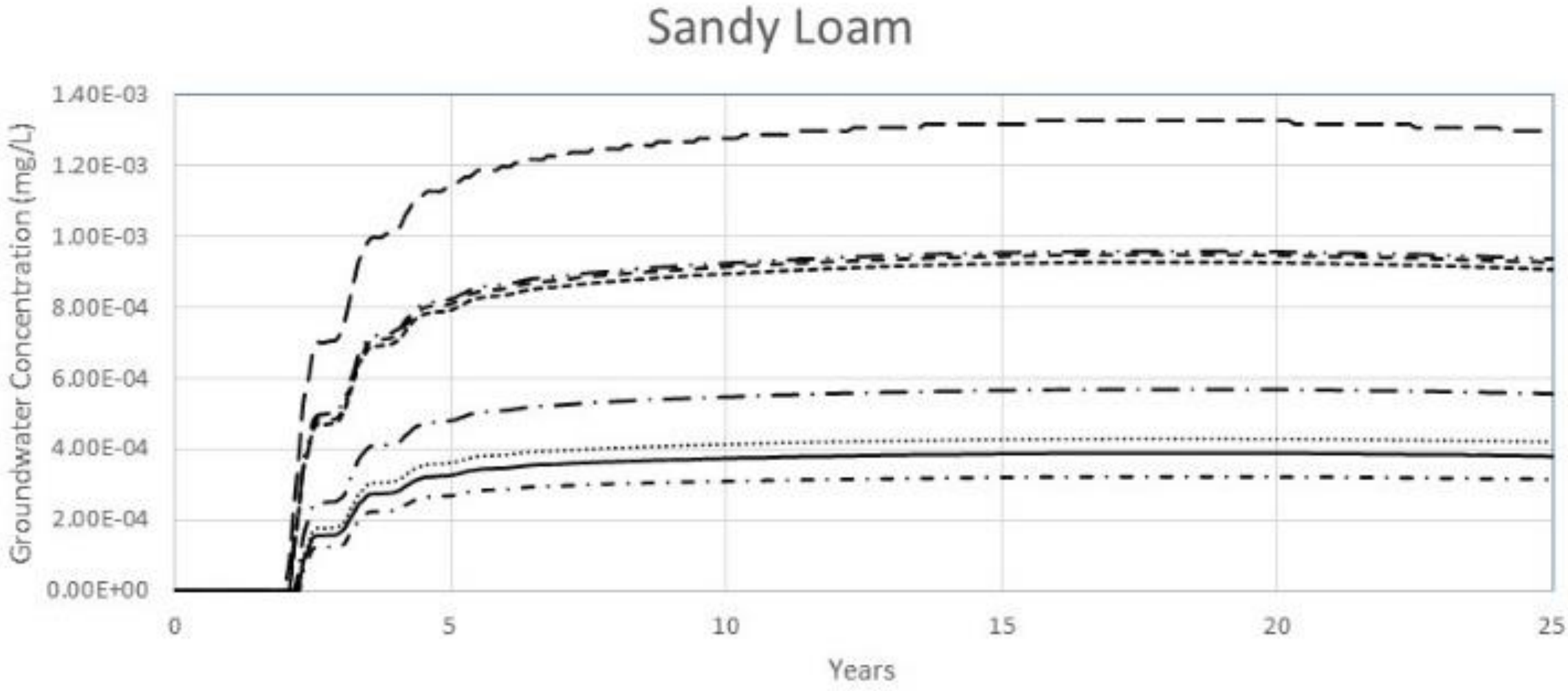
Groundwater Concentration



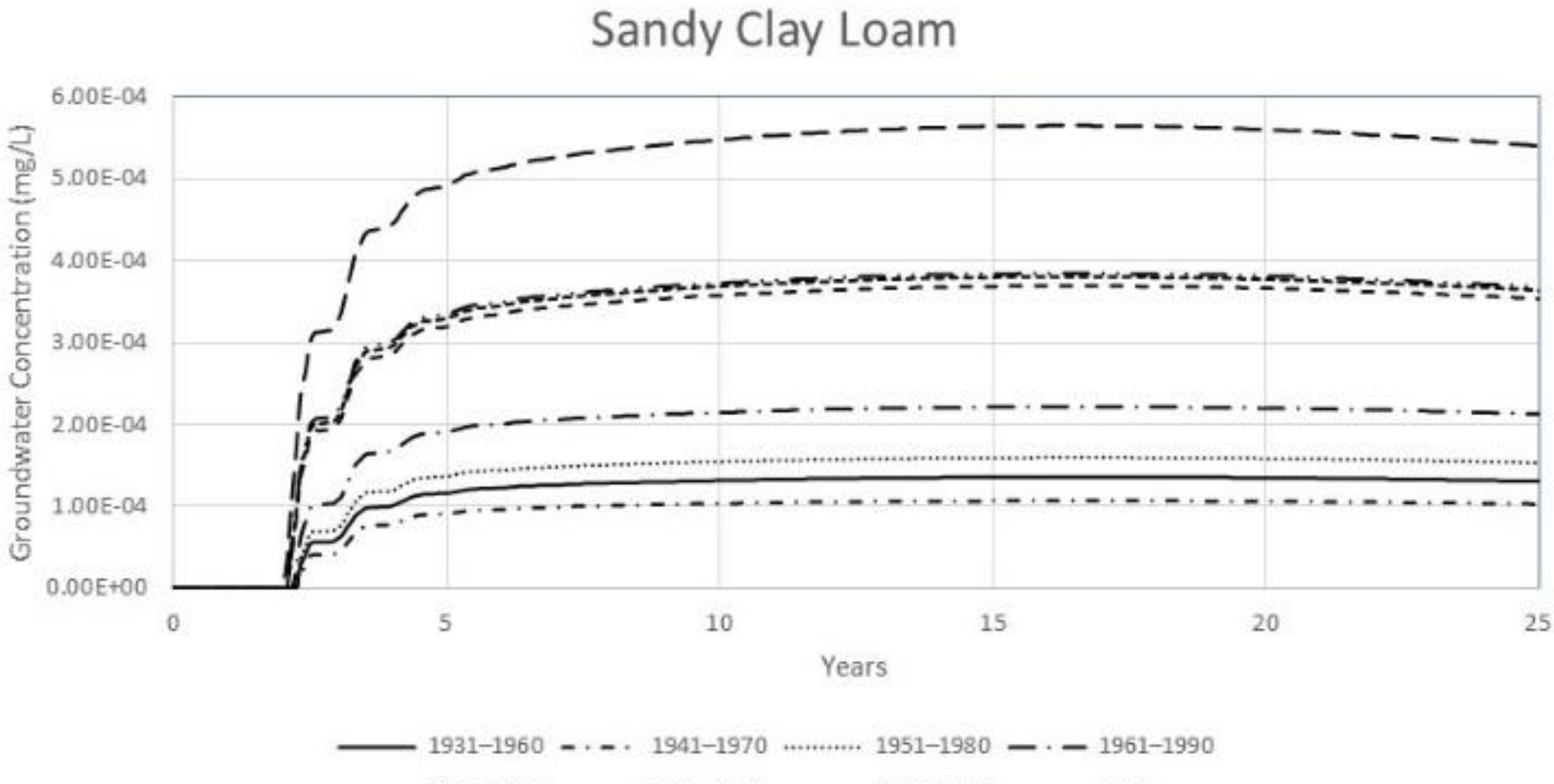
Groundwater Concentration



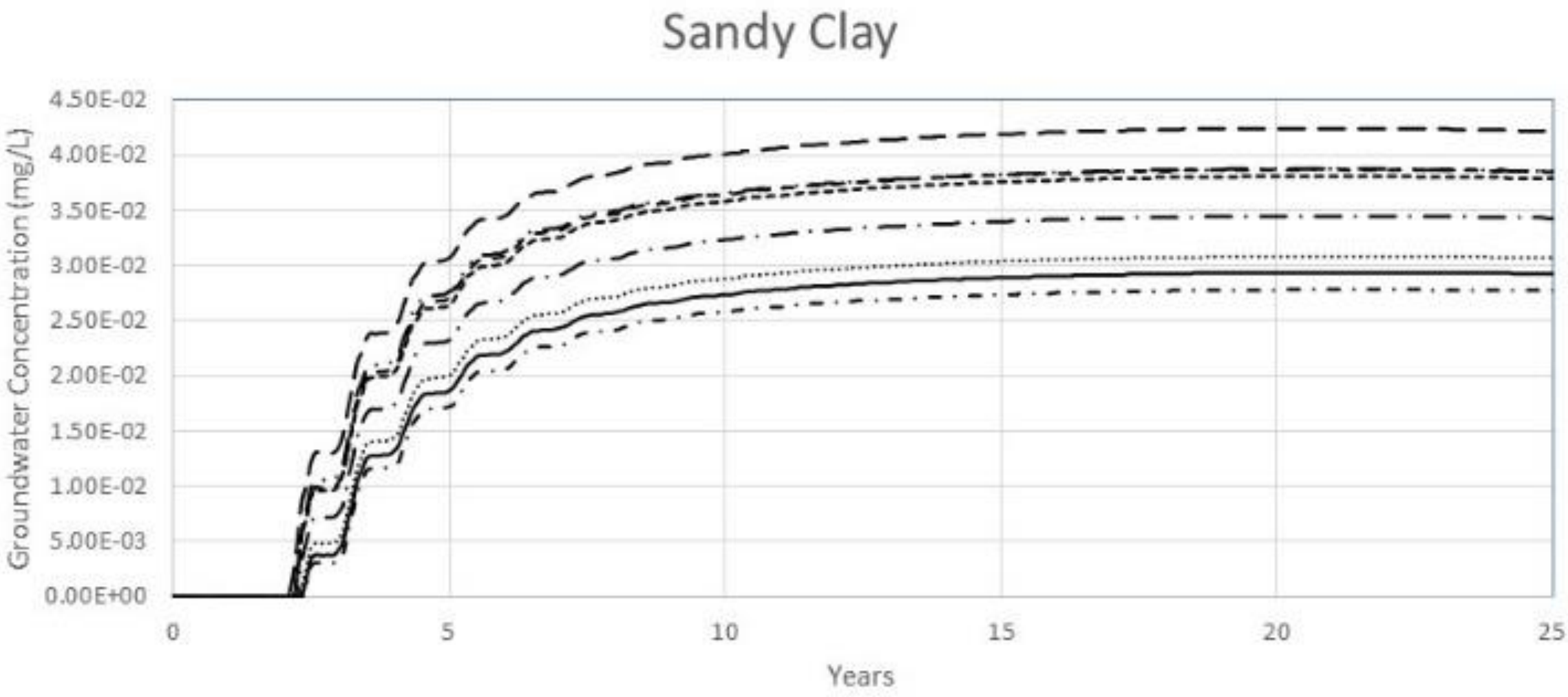
Groundwater Concentration



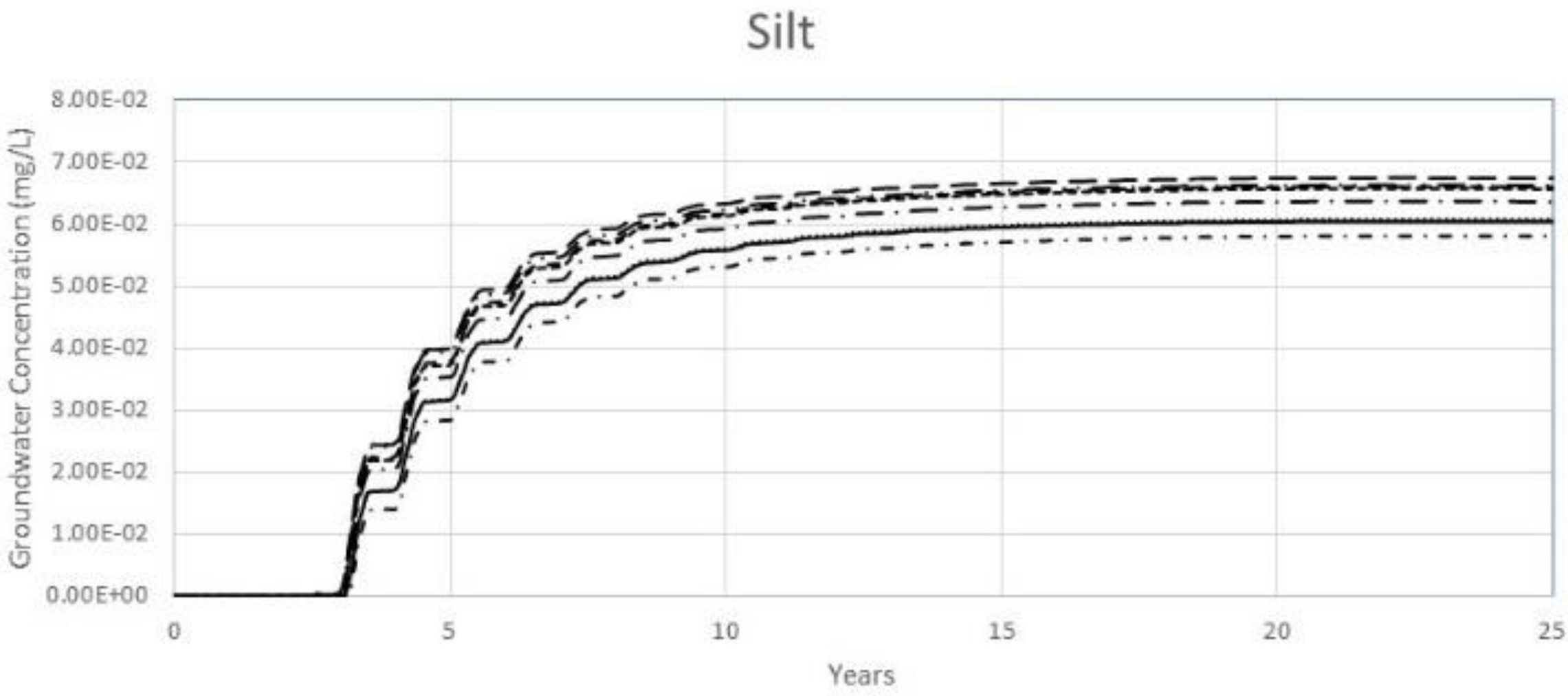
Groundwater Concentration



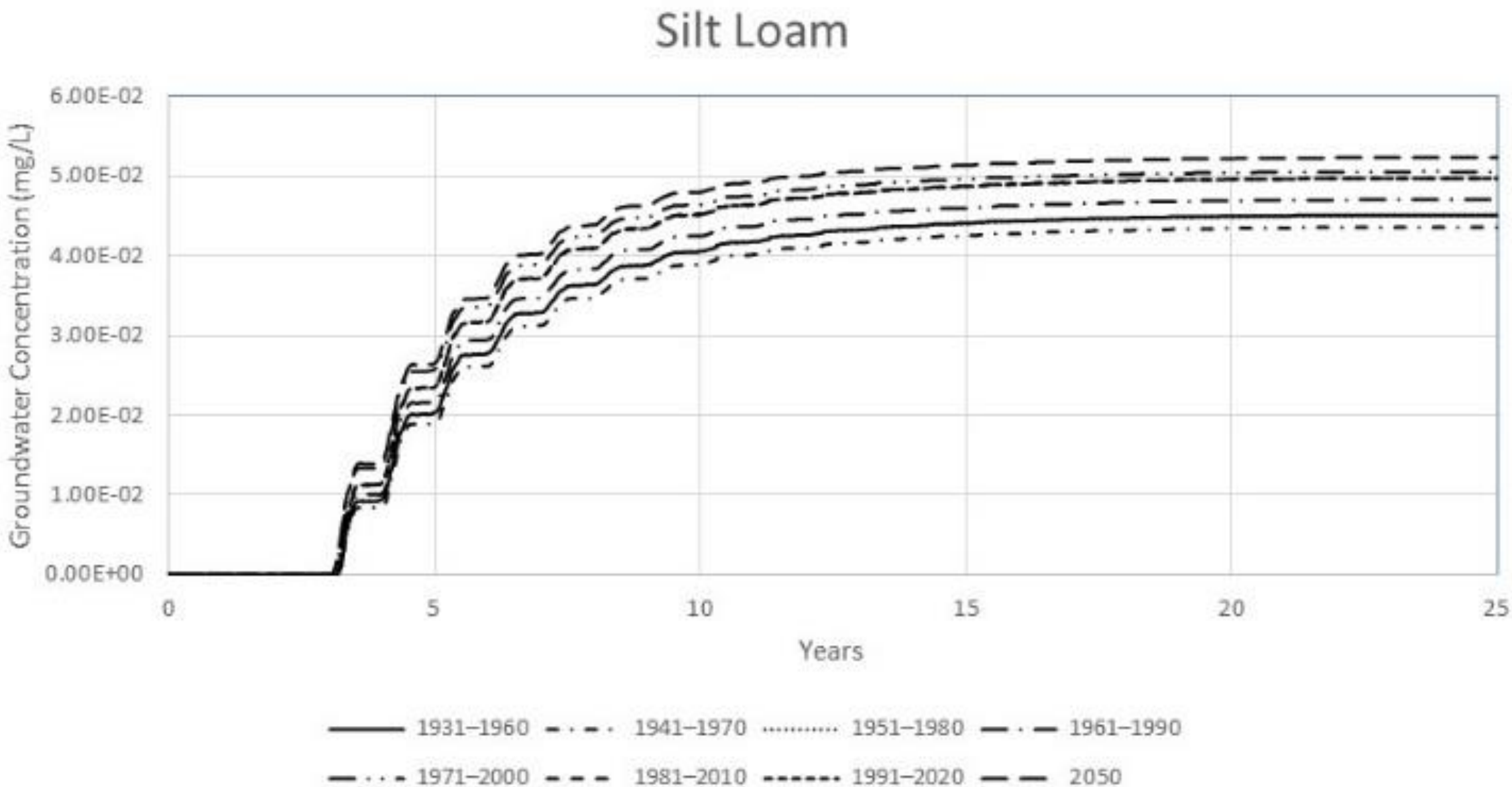
Groundwater Concentration



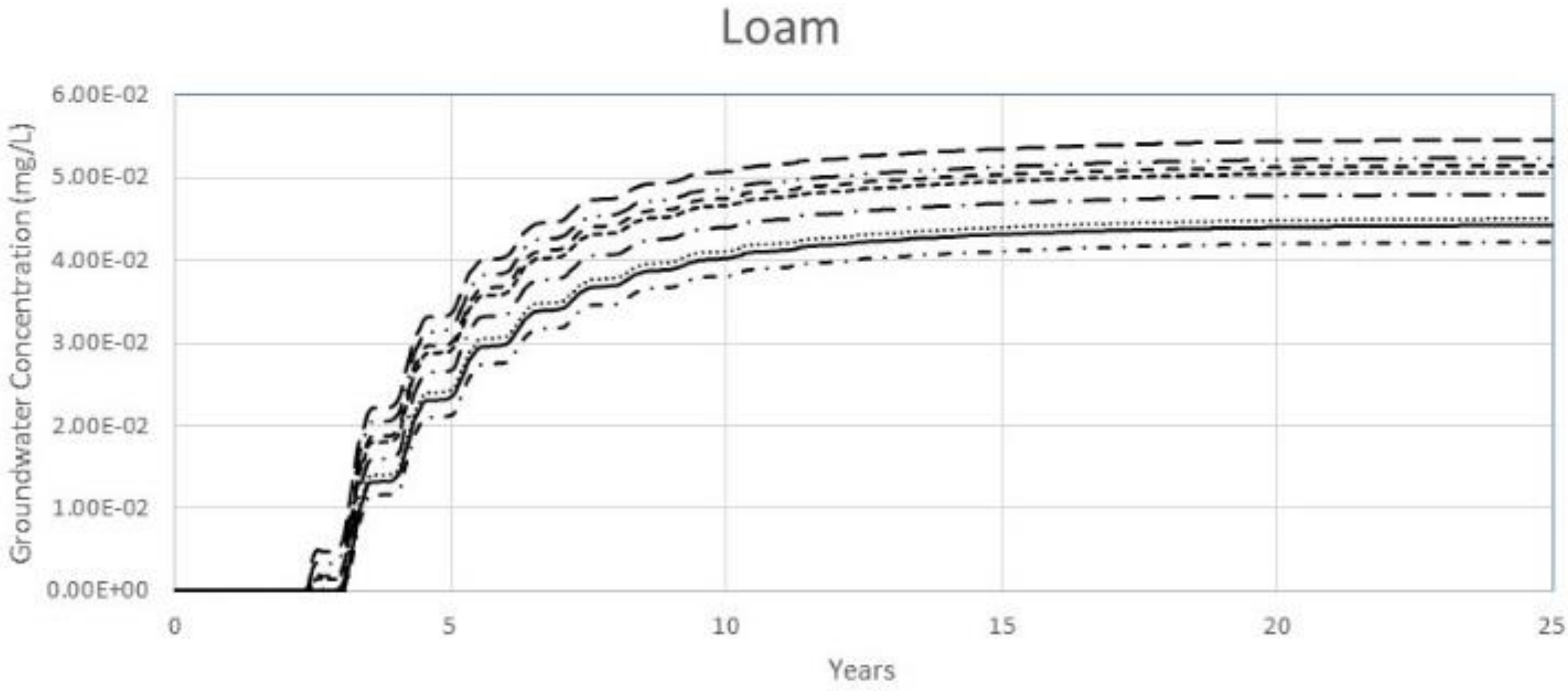
Groundwater Concentration



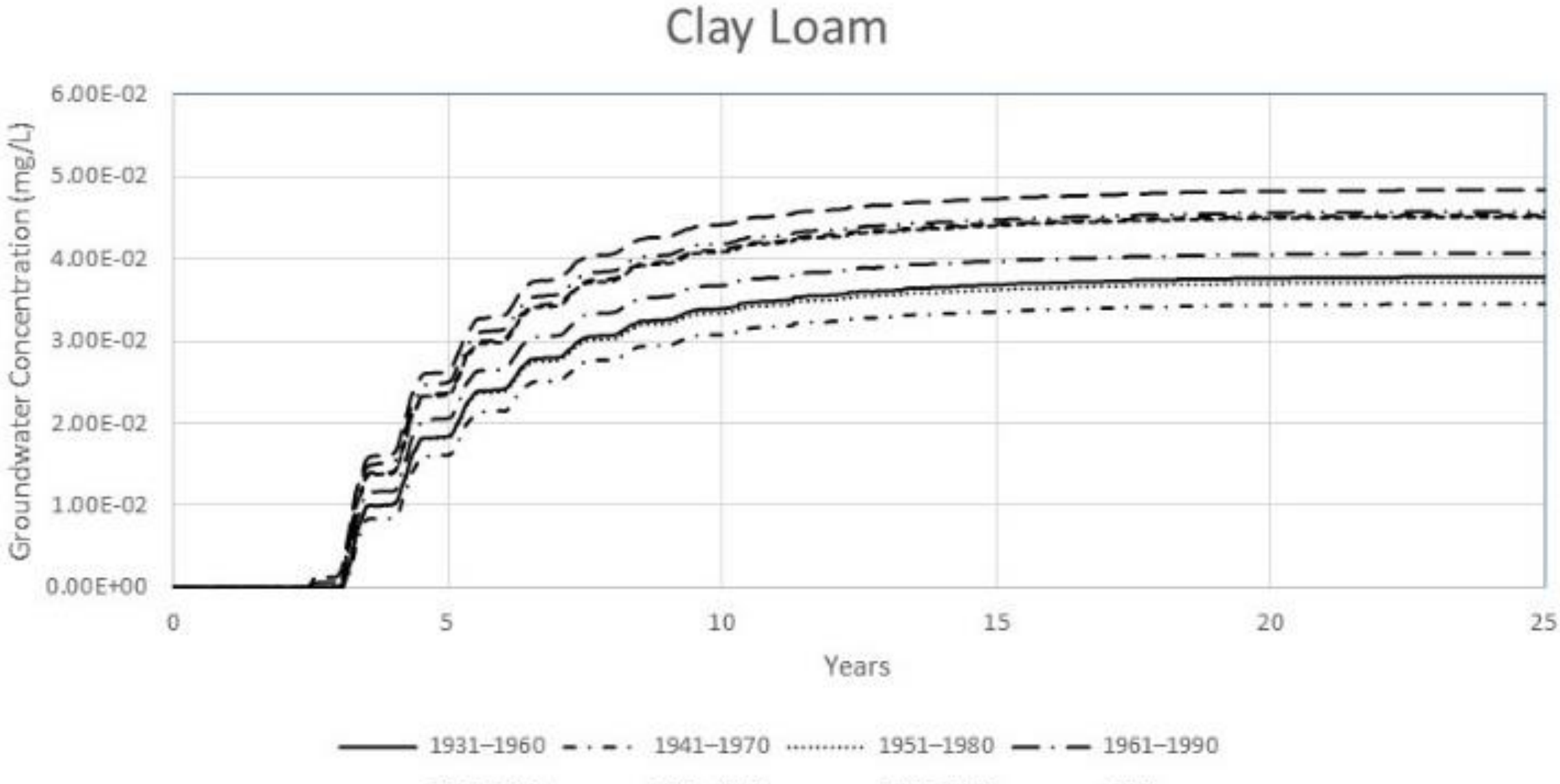
Groundwater Concentration



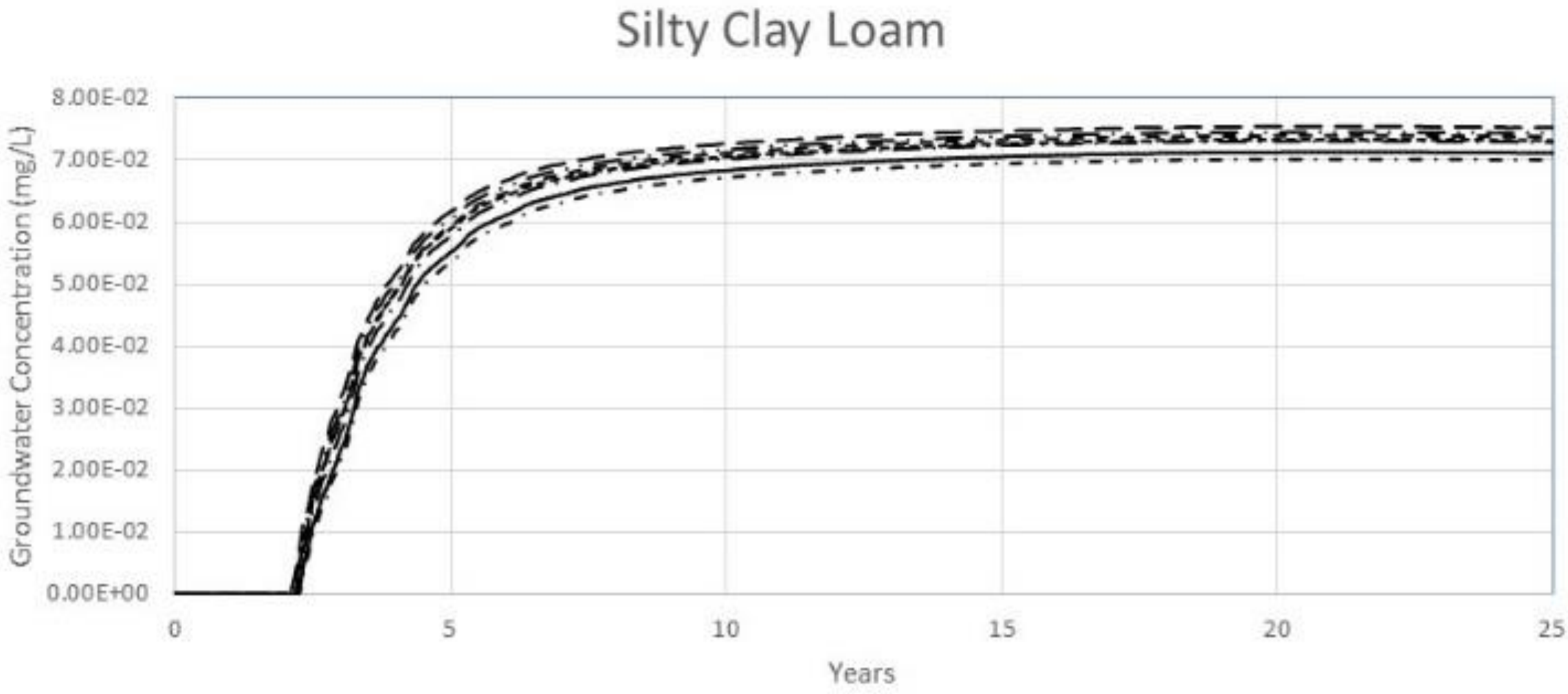
Groundwater Concentration



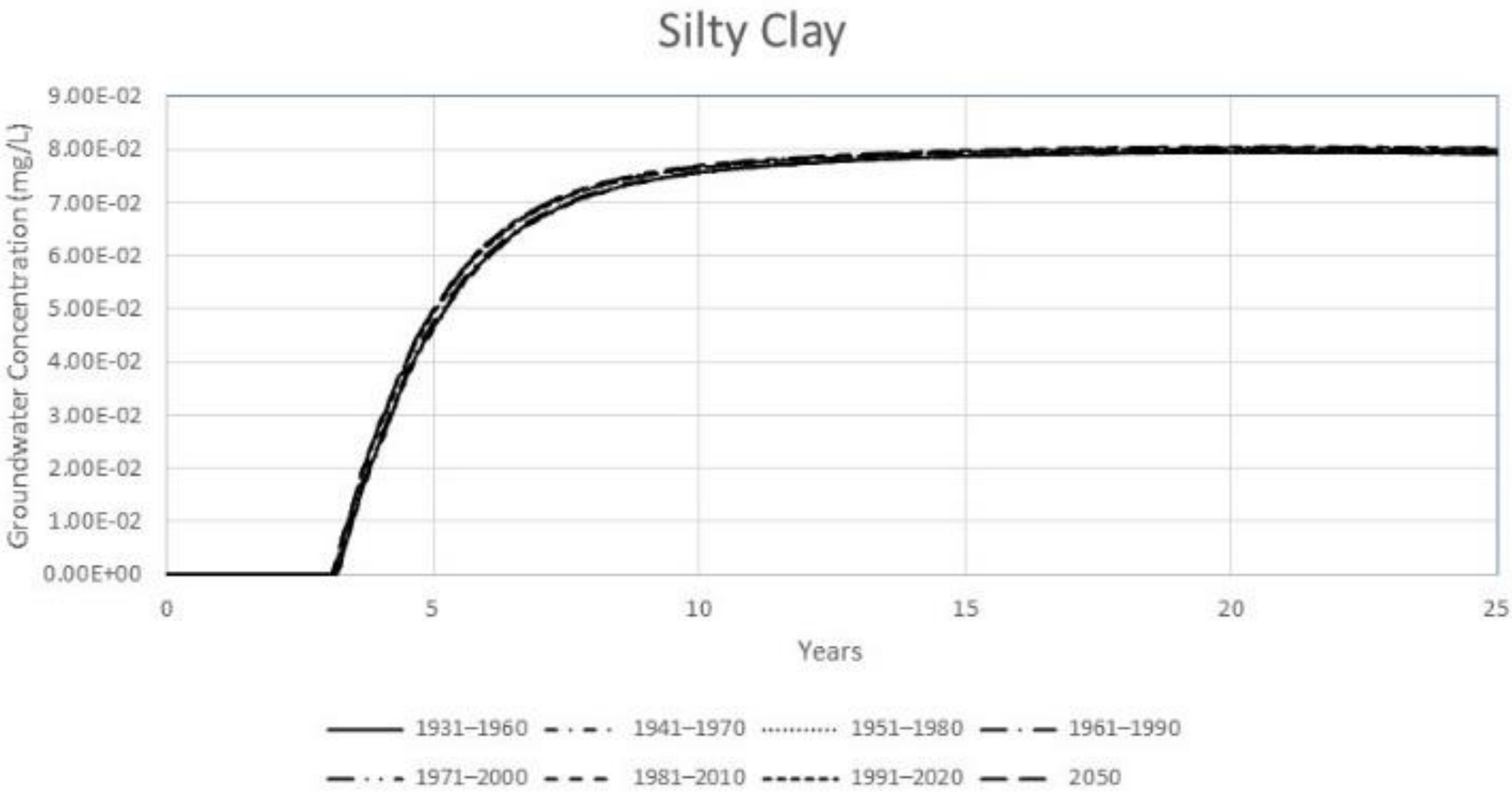
Groundwater Concentration



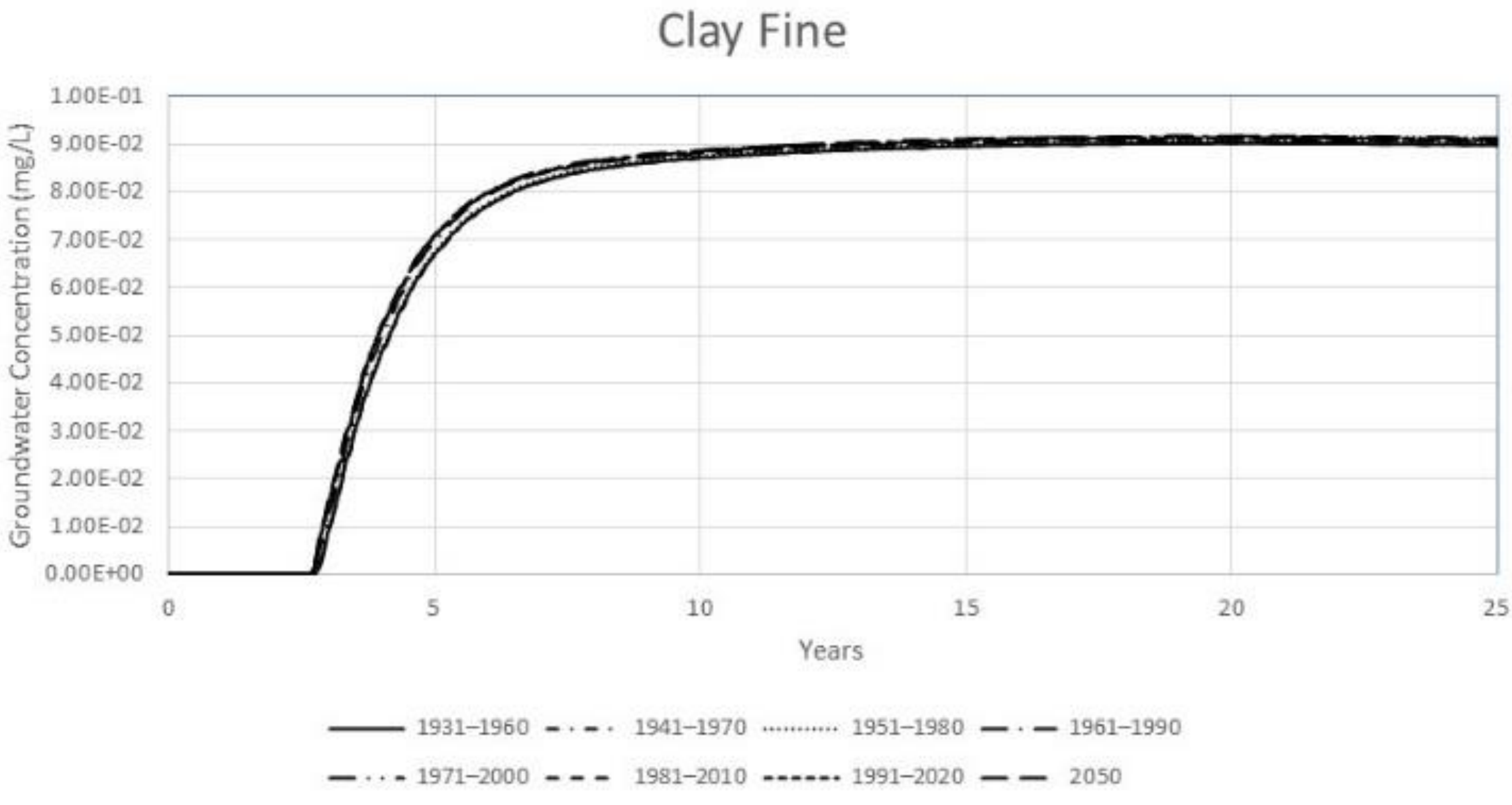
Groundwater Concentration



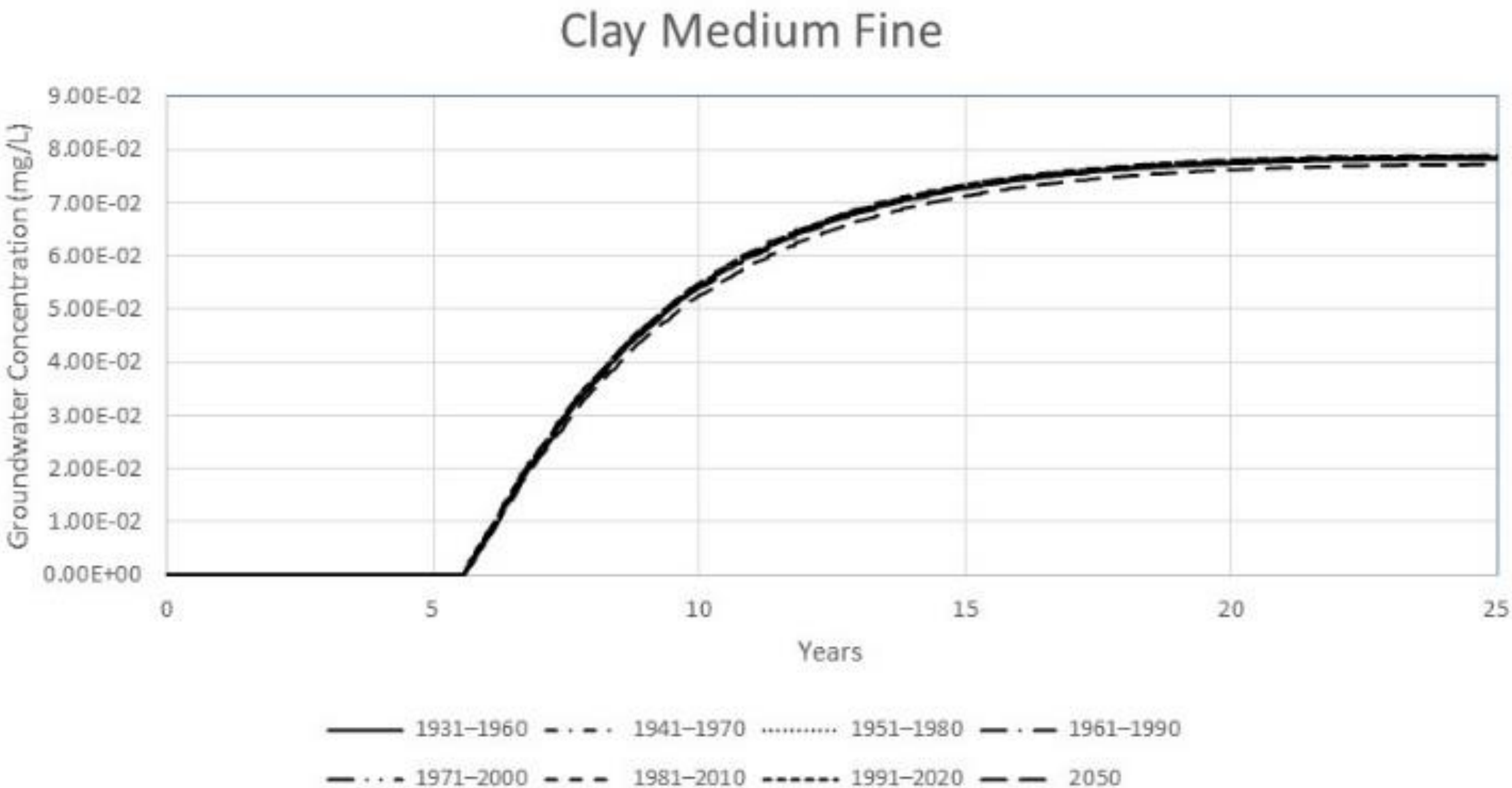
Groundwater Concentration



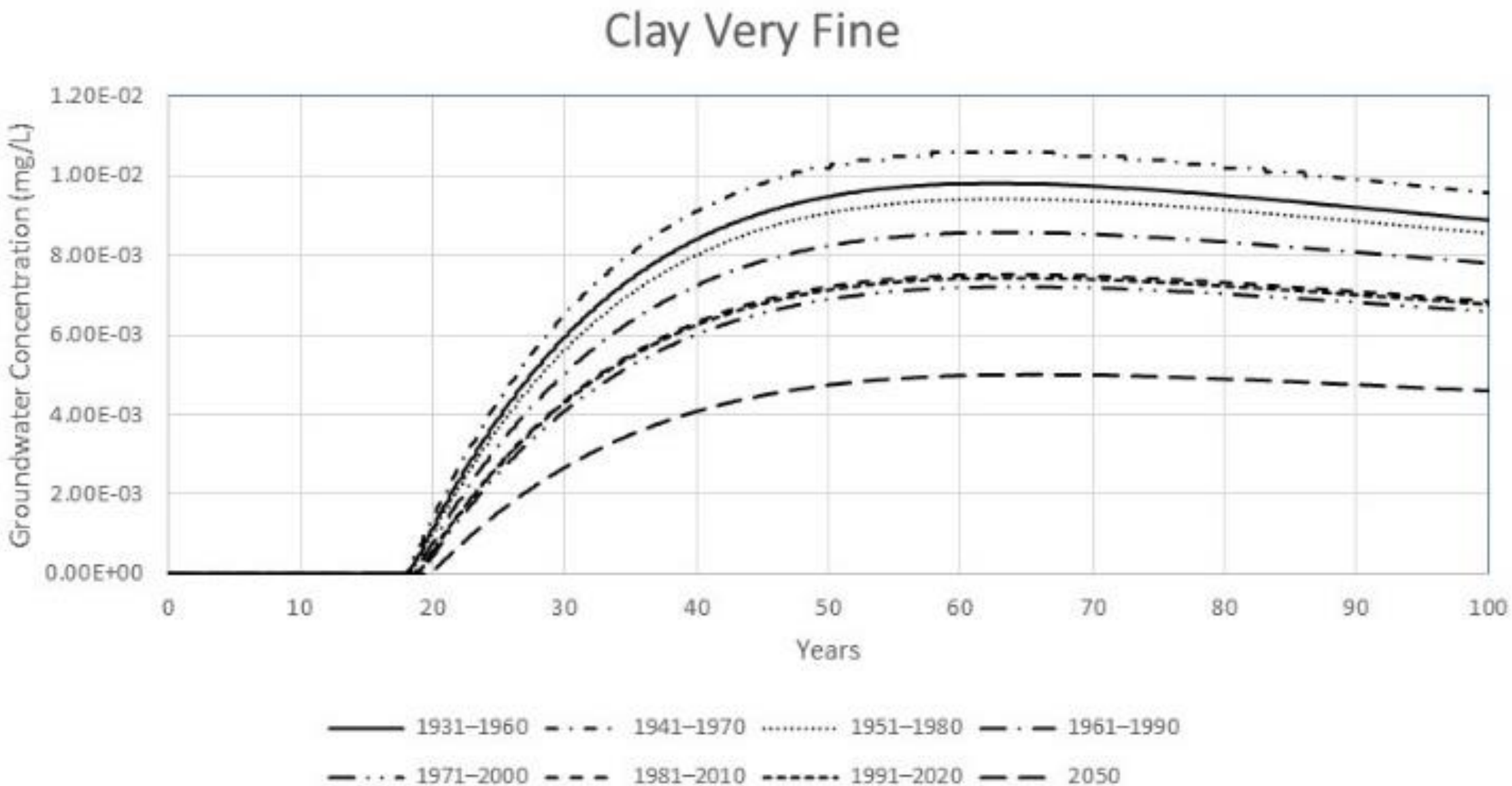
Groundwater Concentration



Groundwater Concentration



Groundwater Concentration



Conclusions

Conclusions

- By 2050 leaching soil contaminants in sandy soil could be as much as an order of magnitude higher due to climate change
- Threating our most productive aquifers

Conflict of Interest

One of the authors (Schneiker) has developed the SEVIEW contaminant transport and fate modeling software used in this research. The author receives compensation for the sale, support, and training of the software.

Questions?