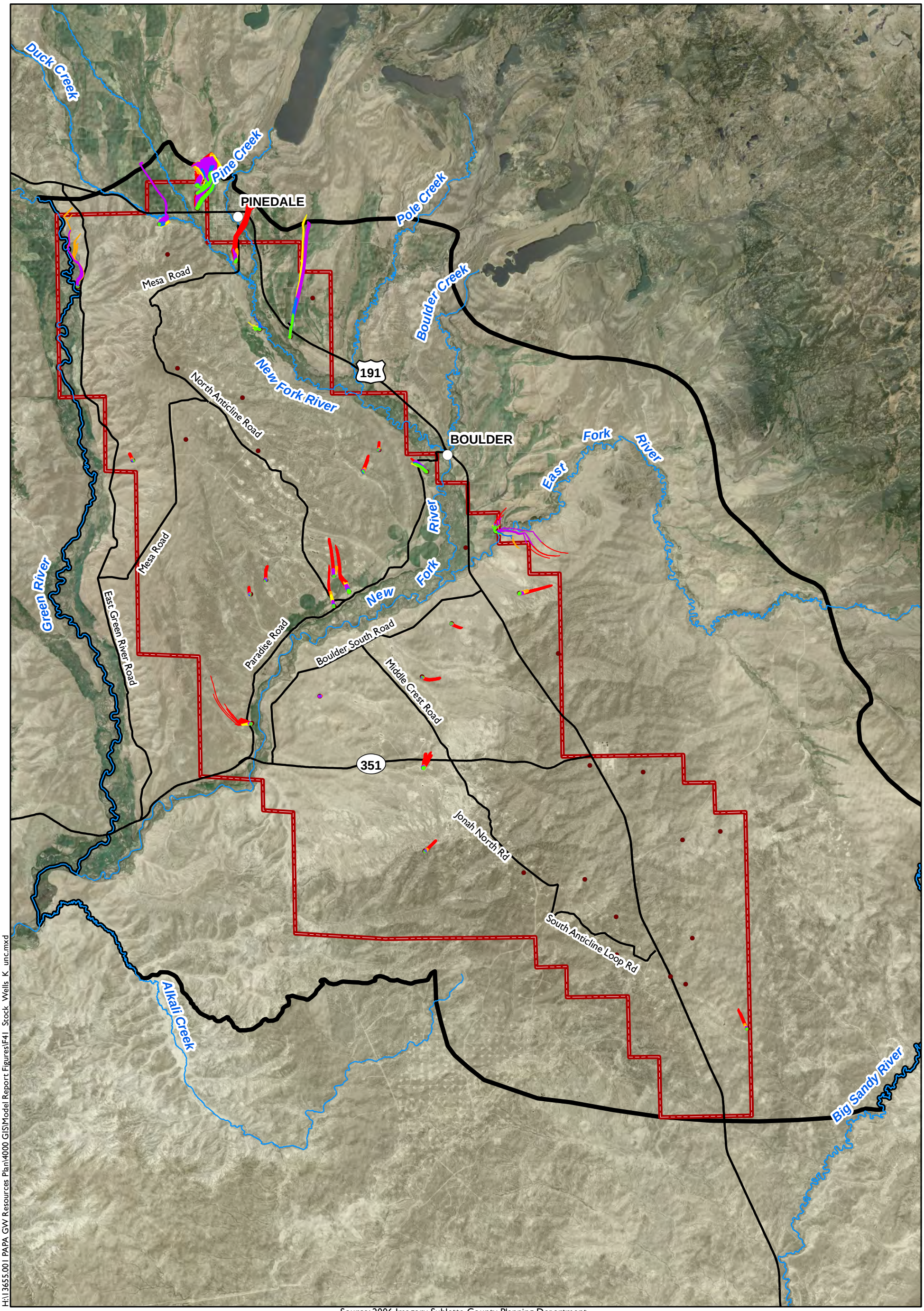
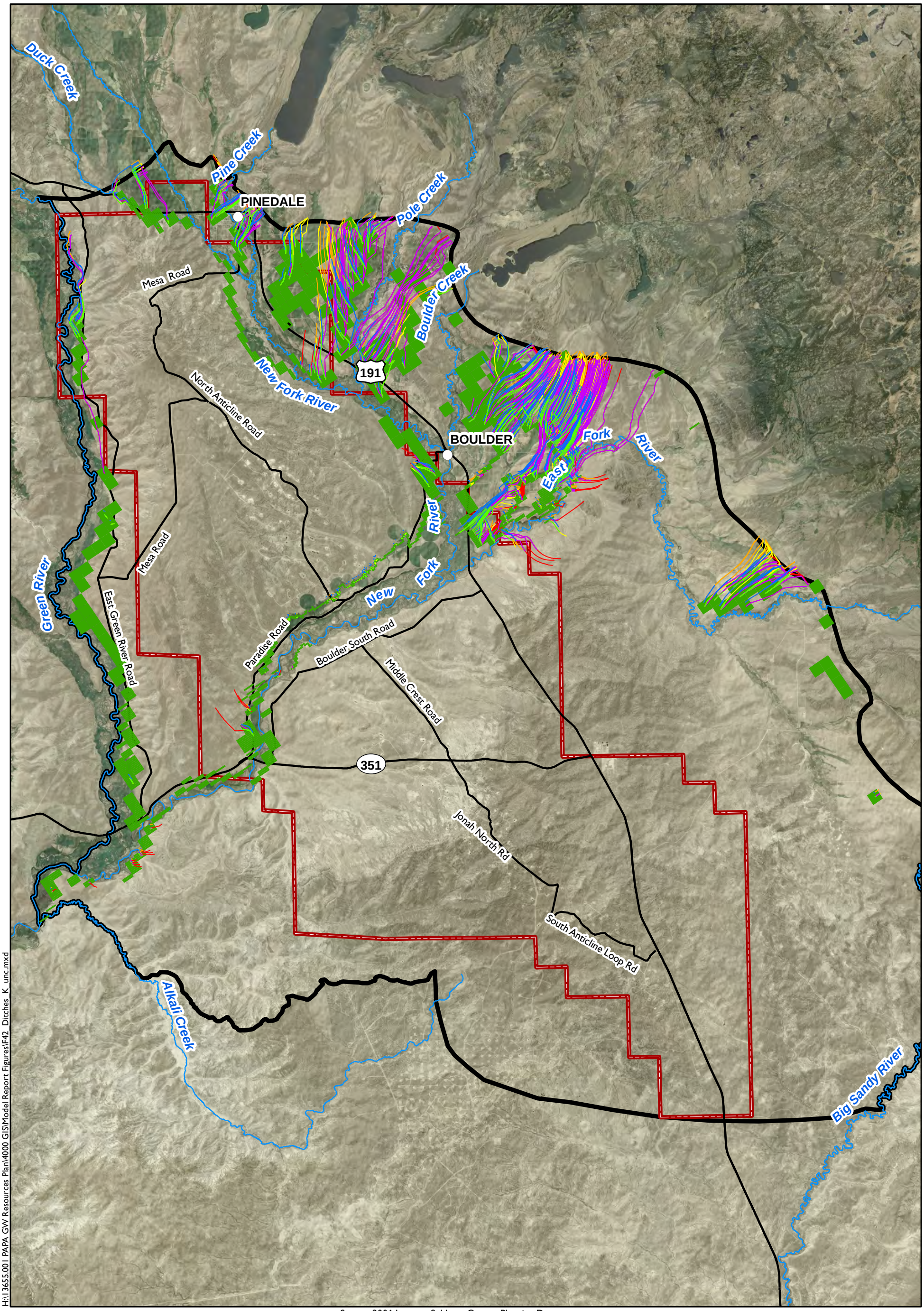
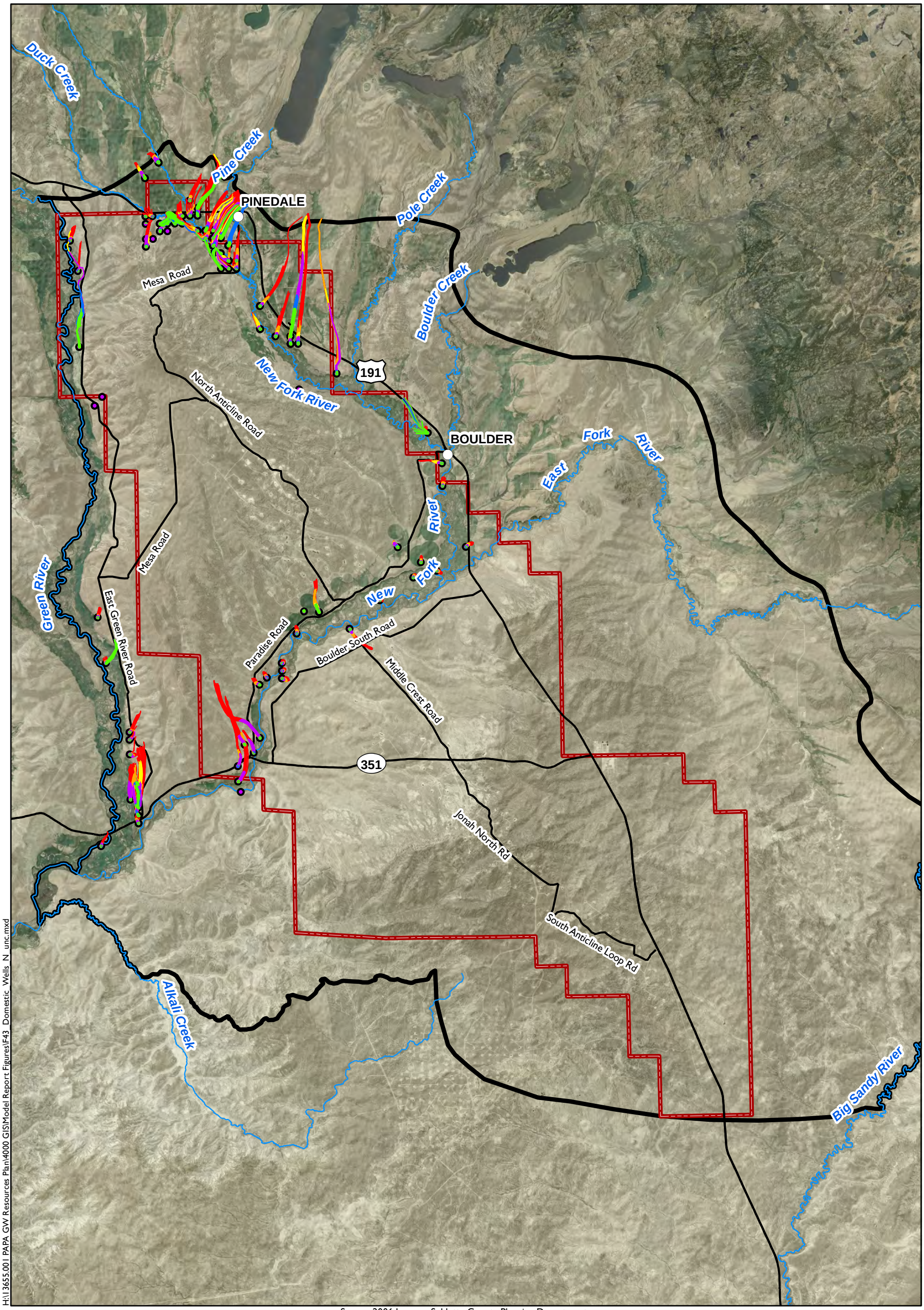


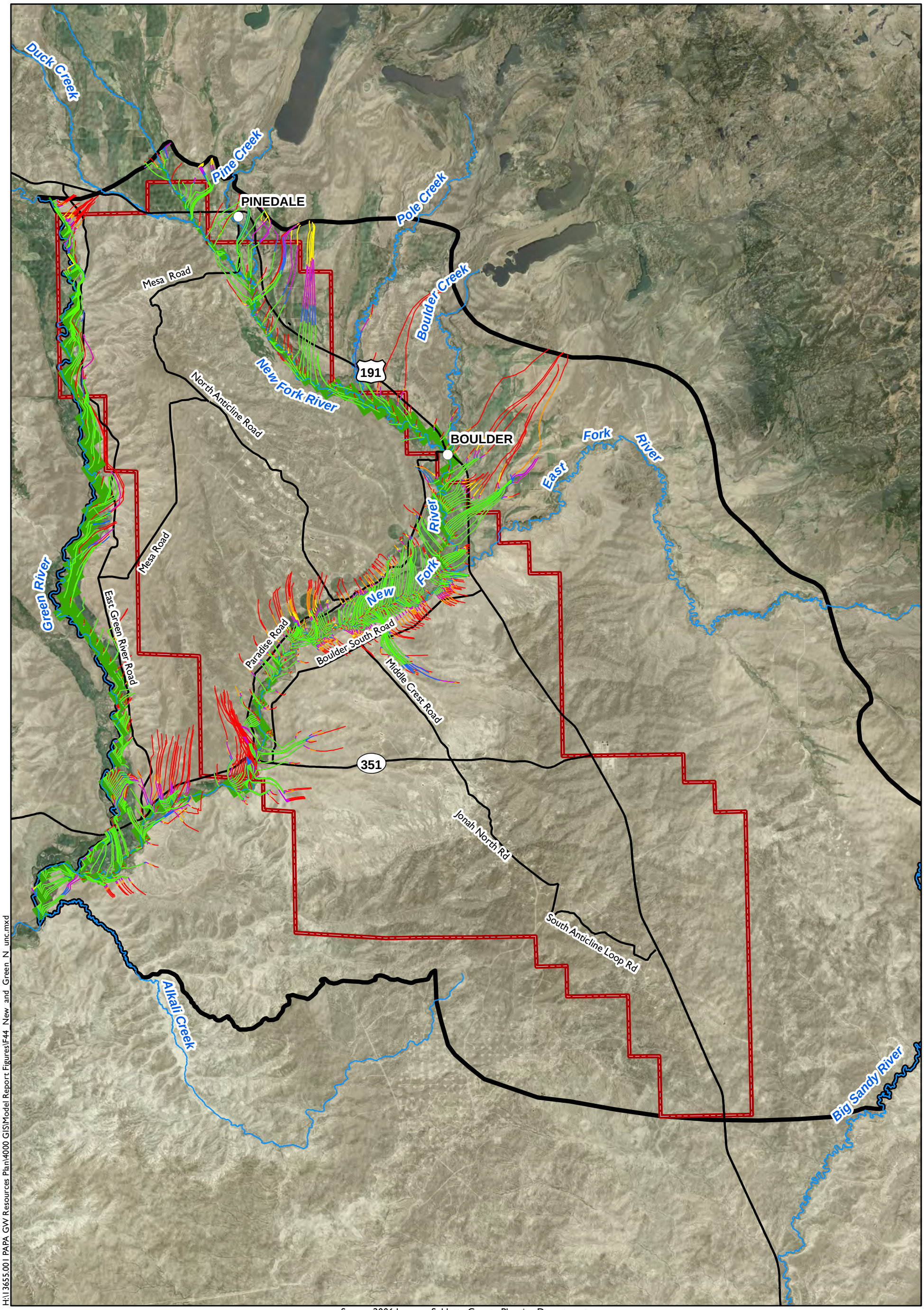
Uncertainty Analysis for Hydraulic Conductivity - Stock Wells
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 41



Uncertainty Analysis for Hydraulic Conductivity - Irrigation Ditches
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 42



Uncertainty Analysis for for Effective Porosity
Domestic Wells in River Corridor
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 43



Source: 2006 Imagery Sublette County Planning Department

N

0 3
Miles

amec

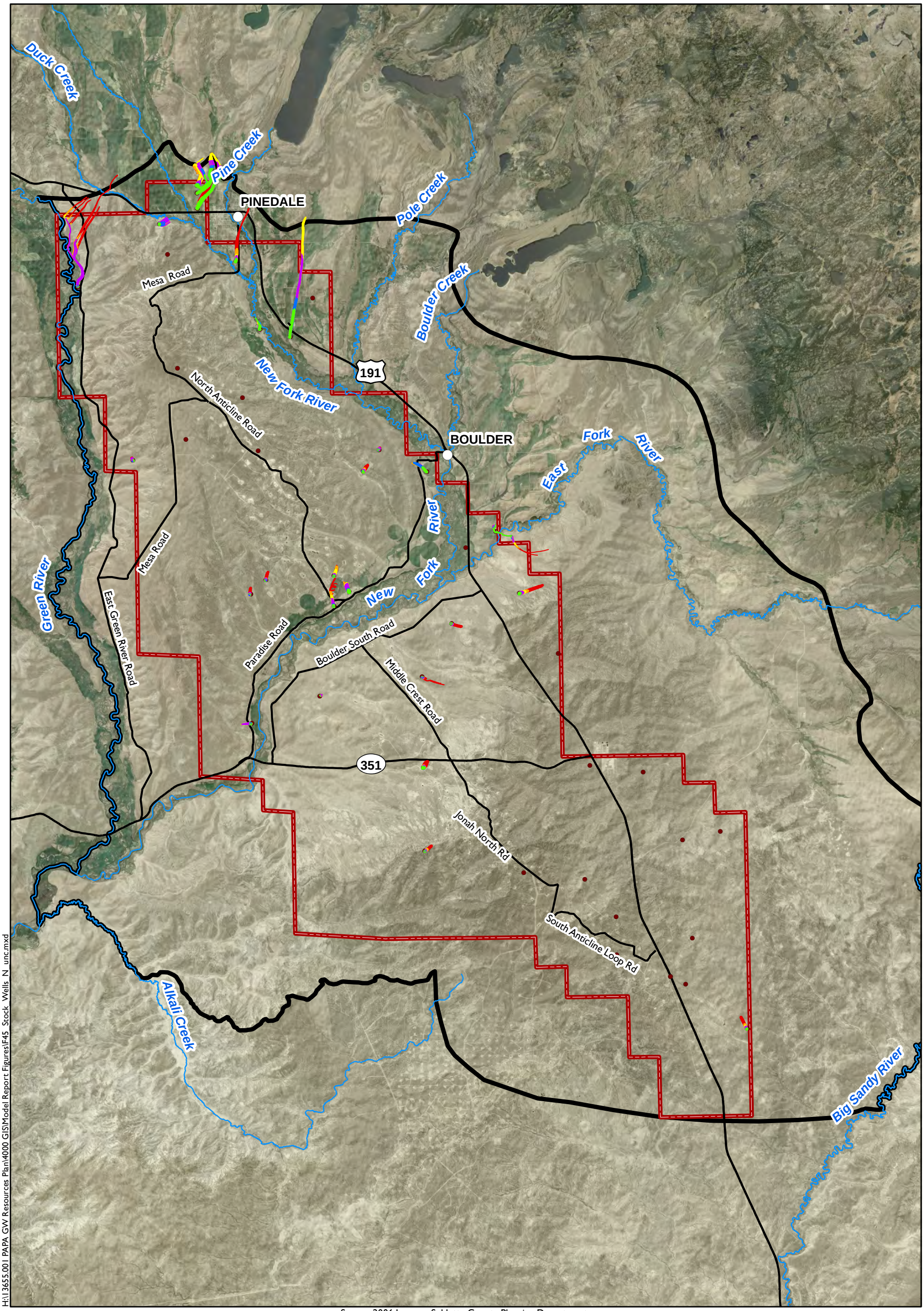
River Cell in Flow Model
10 year Reverse Particle Track - 0.5x
10 year Reverse Particle Track
10 year Reverse Particle Track - 5x
110 year Reverse Particle Track - 0.5x
110 year Reverse Particle Track
110 year Reverse Particle Track - 5x

Pinedale Anticline Project Area (PAPA)

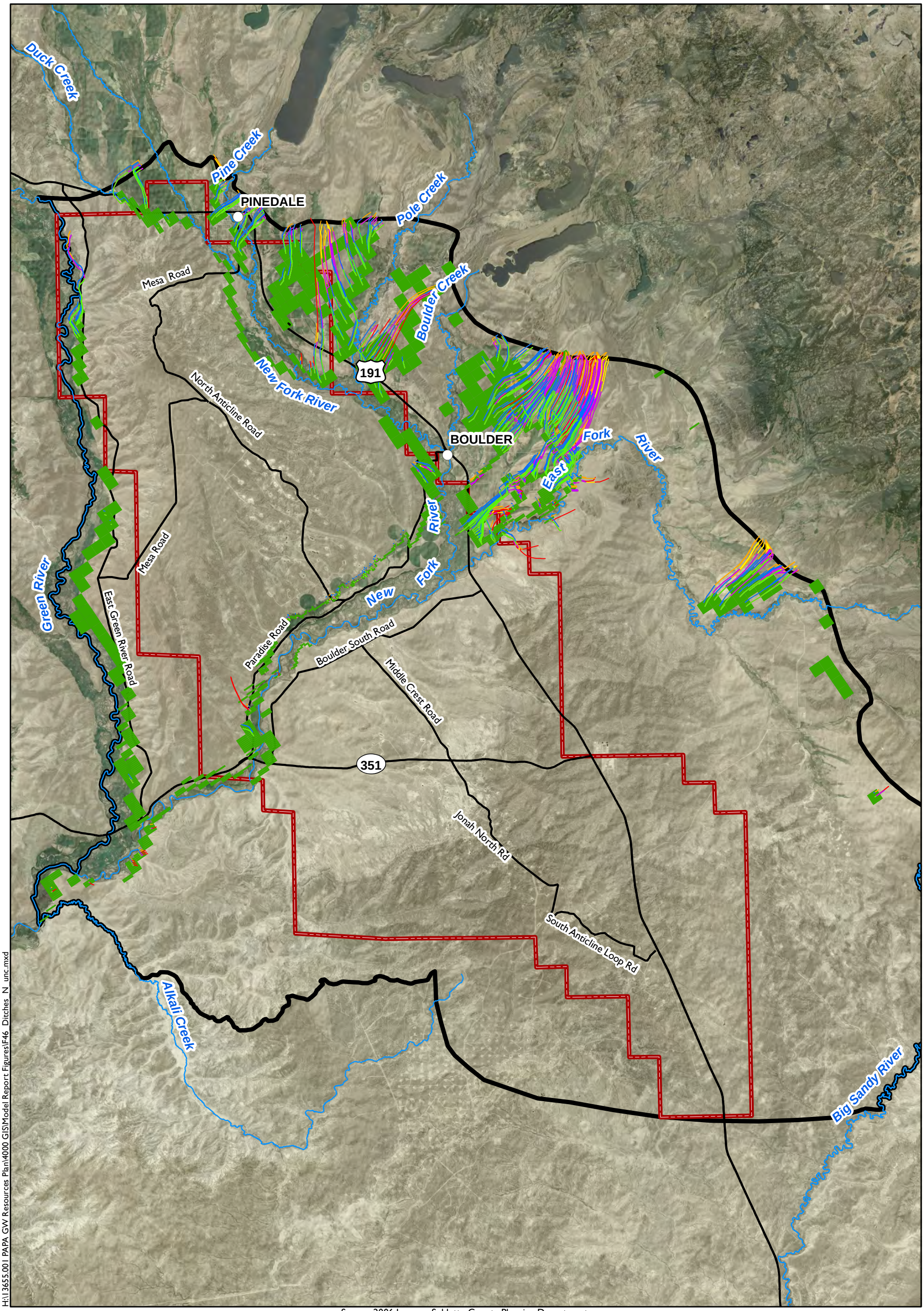
Numerical Model Boundary

Note: Refer to Table 23 for values used during uncertainty analysis.

Uncertainty Analysis for Effective Porosity - New Fork River and Green River
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 44



Uncertainty Analysis of Effective Porosity - Stock Wells
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 45



H:\13655.001 PAPA GW Resources Plan\4000 GIS\Model Report Figures\F46 Ditches N unc.mxd

Source: 2006 Imagery Sublette County Planning Department

N

0 Miles 3

amec

Irrigation Ditch Cell in Flow Model

10 year Reverse Particle Track - 0.5x

10 year Reverse Particle Track

10 year Reverse Particle Track - 5x

110 year Reverse Particle Track - 0.5x

110 year Reverse Particle Track

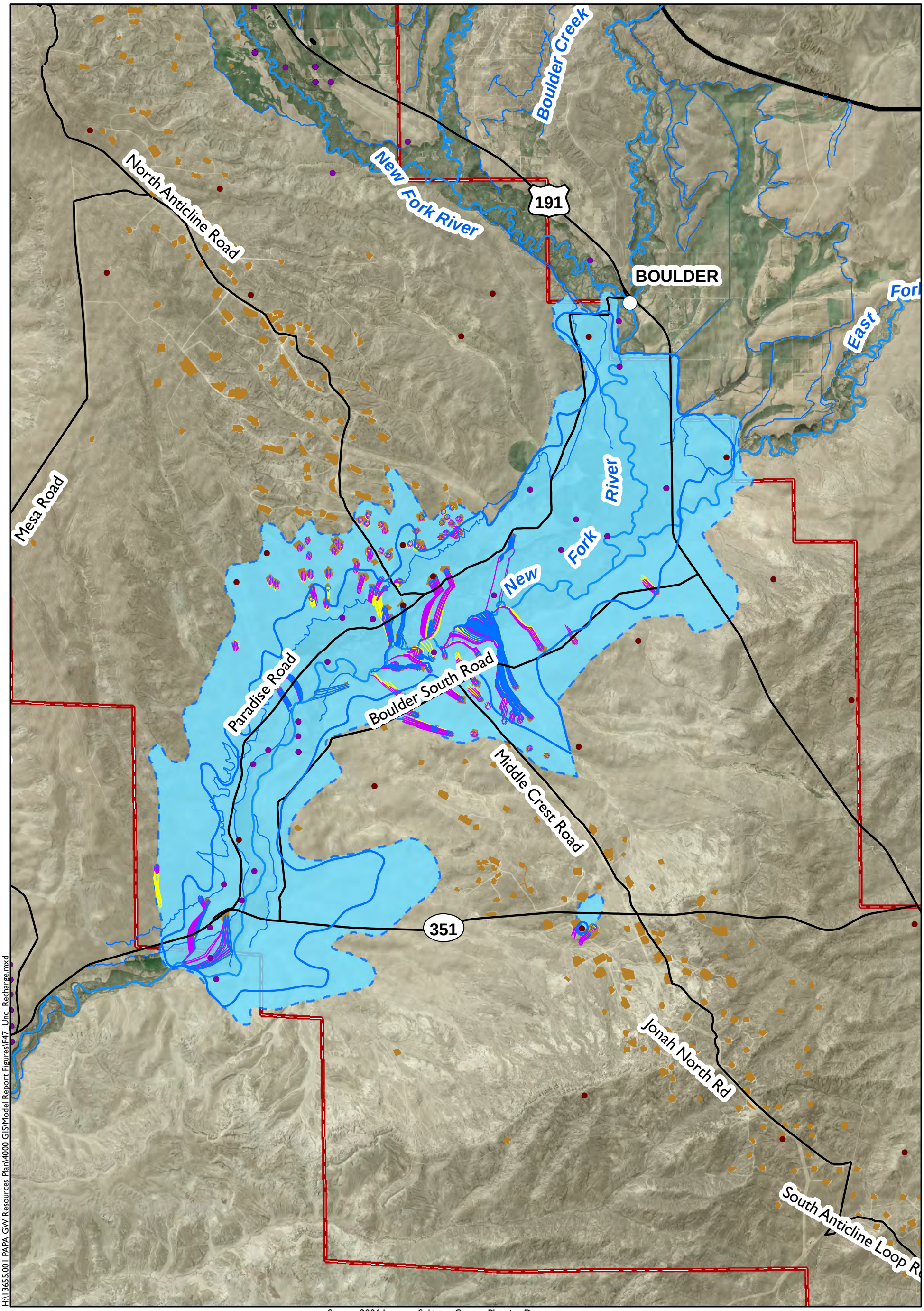
110 year Reverse Particle Track - 5x

Pinedale Anticline Project Area (PAPA)

Numerical Model Boundary

Note: Refer to Table 23 for values used during uncertainty analysis.

Uncertainty Analysis of Effective Porosity - Irrigation Ditches
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 46



Source: 2006 Imagery Sublette County Planning Department

0 Miles 1.5

amec

Natural Gas Pad (Source: BLM 2009)

10 year Forward Particle Track - No Recharge

10 year Forward Particle Track

110 year Forward Particle Track - No Recharge

110 year Forward Particle Track

Pinedale Anticline Project Area (PAPA)

Numerical Model Boundary

110-year Reverse Particle Track with Source (dashed lines include uncertainty; Figure 30)

Receptor

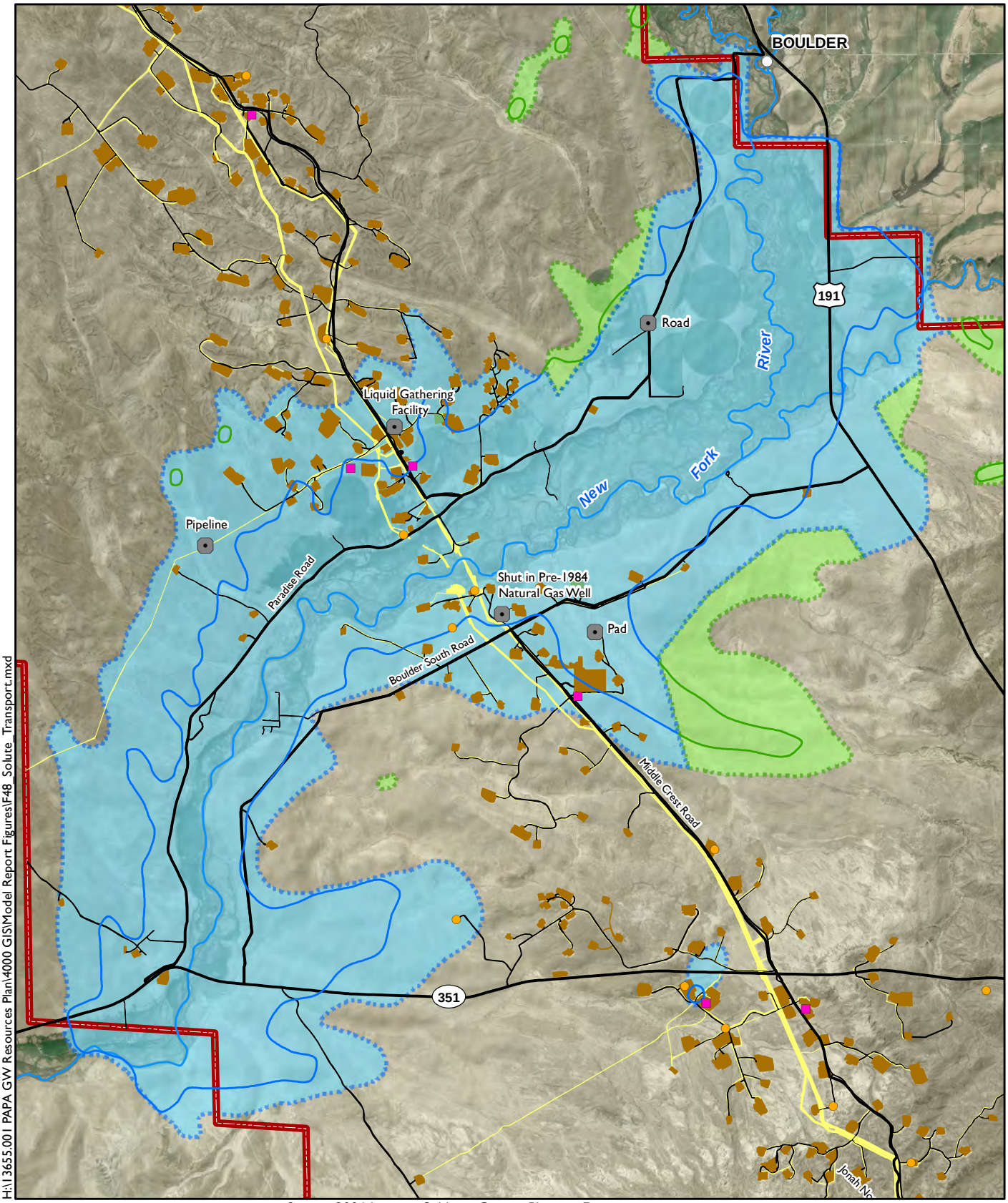
Domestic Well

Stock Well

River, Stream or Ditch

Note: Total recharge was set to zero.

Uncertainty Analysis for Recharge
Natural Gas Pads
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 47



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Source: 2006 Imagery Sublette County Planning Department

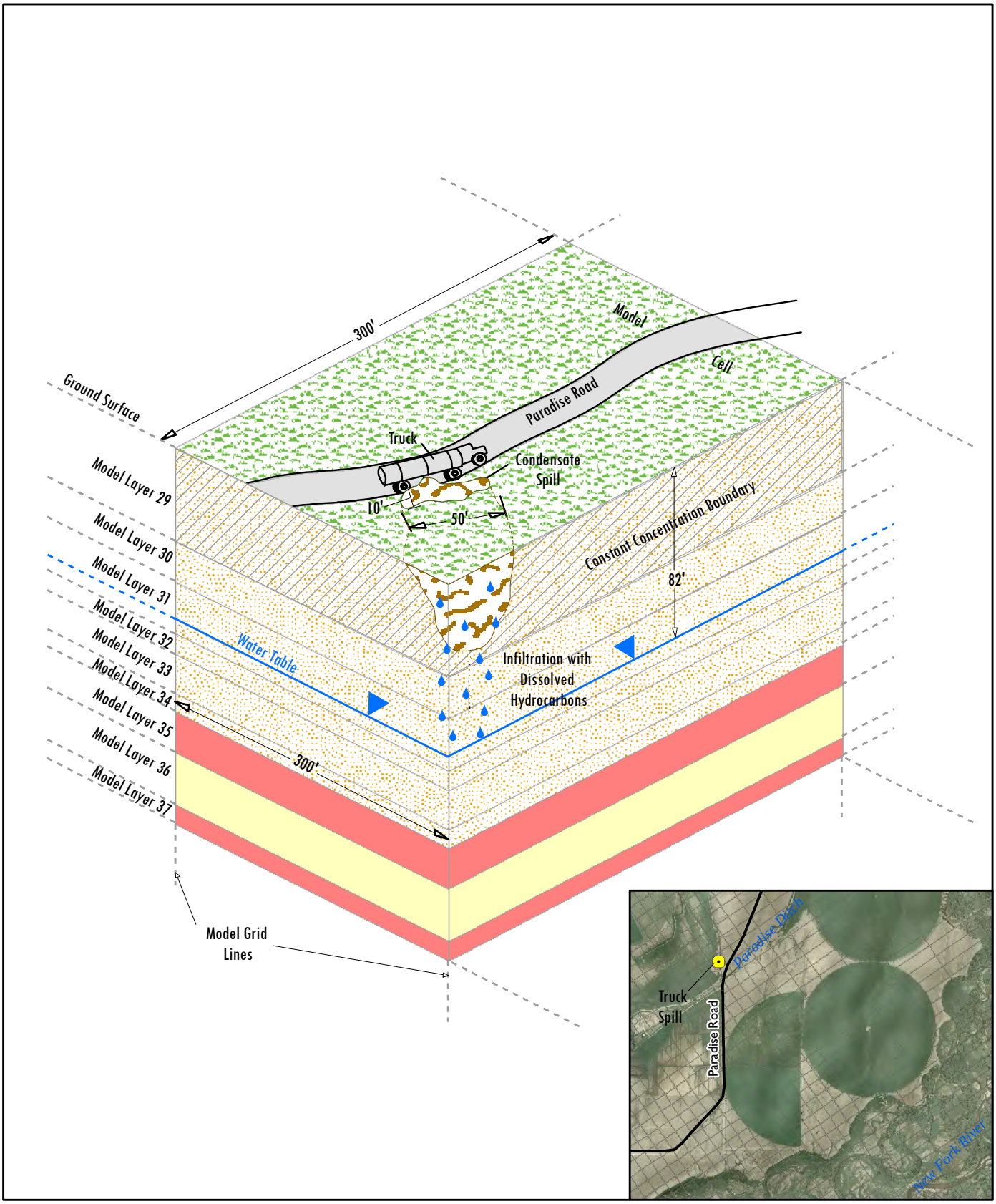
N

0 Feet 8,000

amec

- Hypothetical Solute Transport Location
- Liquid Gathering Facility
- Pre-1984 Natural Gas Well
- Road (Source: BLM 2009)
- Natural Gas Pad and Industrial Facility Disturbed Areas Determined by BLM (Source: BLM 2009)
- Natural Gas Pipeline (Source: BLM 2009)
- 110-year Reverse Particle Track with Source (dashed lines include uncertainty)
- 110-year Reverse Particle Track without Source (dashed lines include uncertainty)
- Pinedale Anticline Project Area (PAPA)
- Numerical Model Boundary

Hypothetical Solute Transport Locations PAPA Numerical Groundwater Modeling Pinedale Anticline Project Area Sublette County, Wyoming FIGURE 48



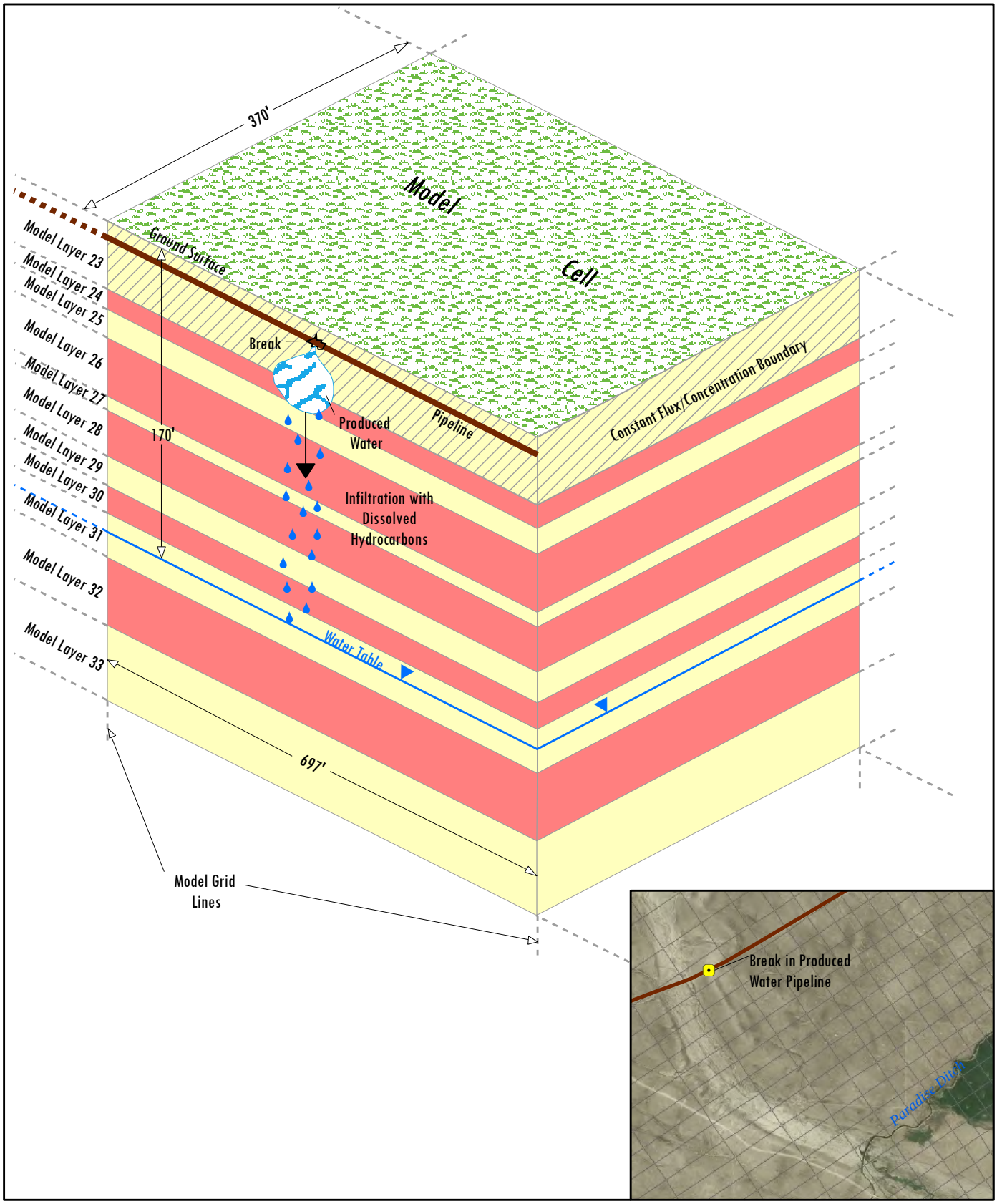
Lithology/Boundary Condition

- Constant Concentration Boundary
- Sandstone
- Alluvial Deposits
- Shale/Siltstone

Not To Scale

amec

Road Scenario Conceptualization
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 49



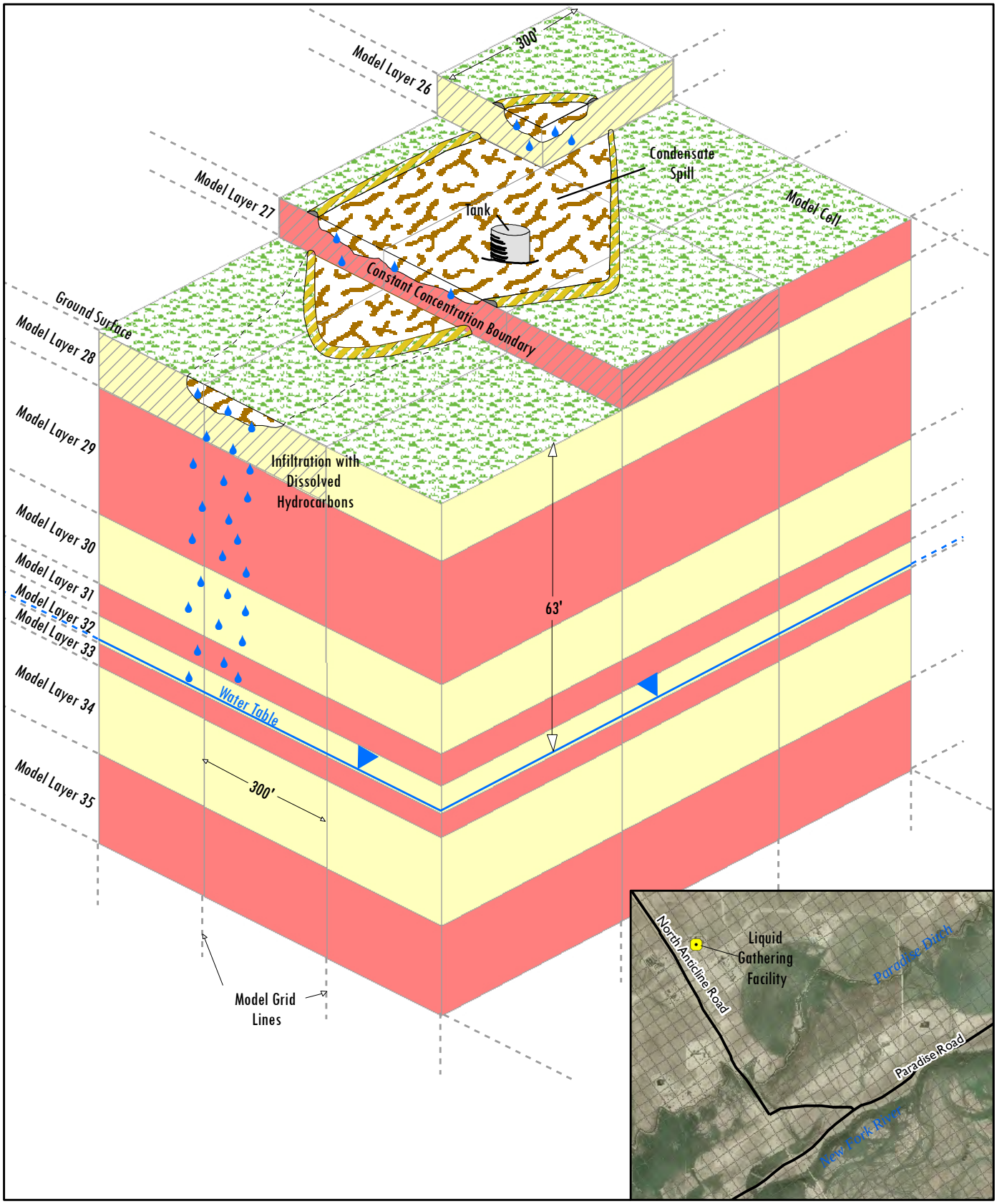
Lithology/Boundary Condition

- Constant Flux/Concentration Boundary
- Sandstone
- Shale/Siltstone

Not To Scale

amec

Pipeline Scenario Conceptualization
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 50



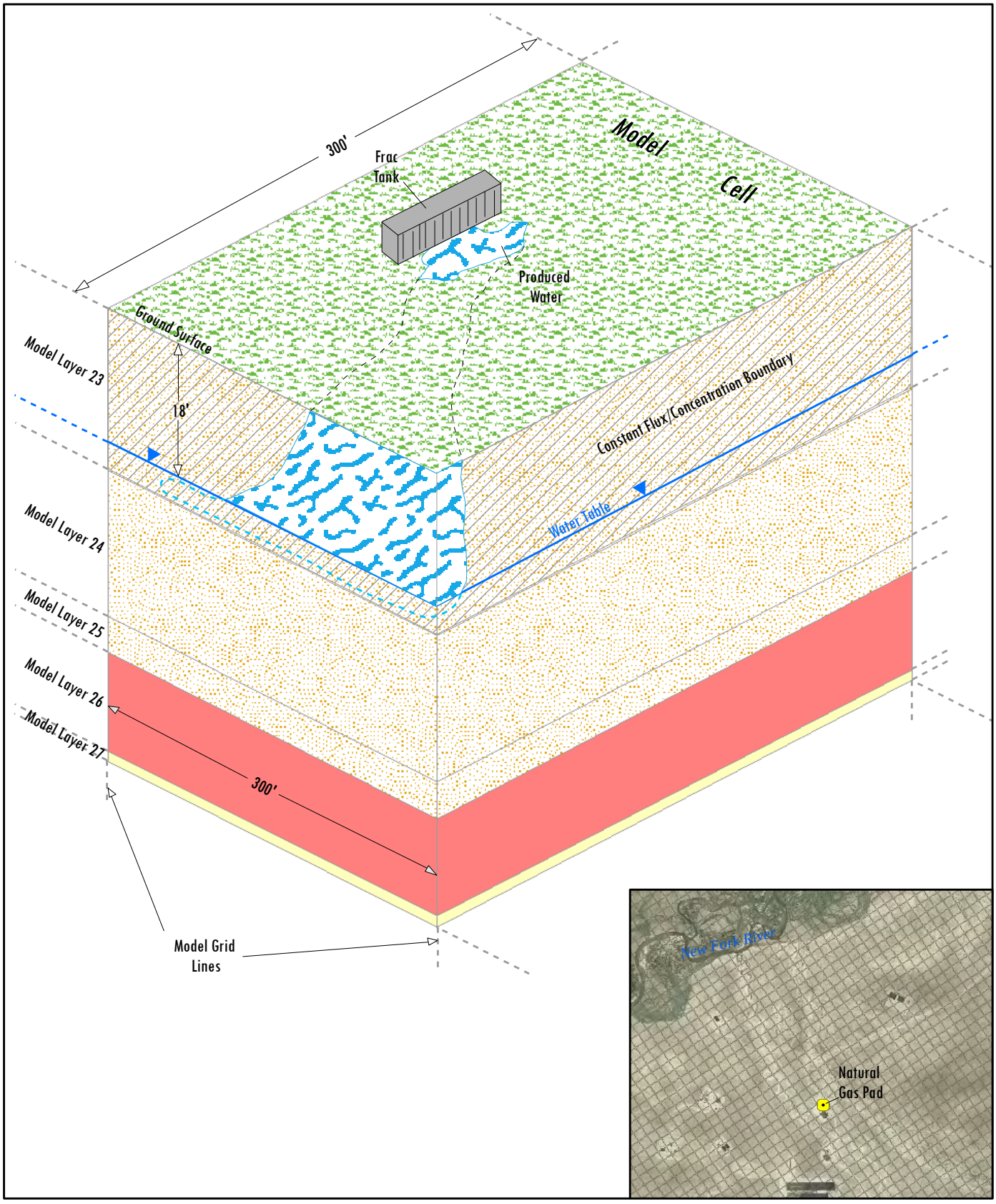
Lithology/Boundary Condition

- Constant Concentration Boundary
- Sandstone
- Shale/Siltstone

Not To Scale

amec

Liquid-Gathering Facility
Scenario Conceptualization
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 51



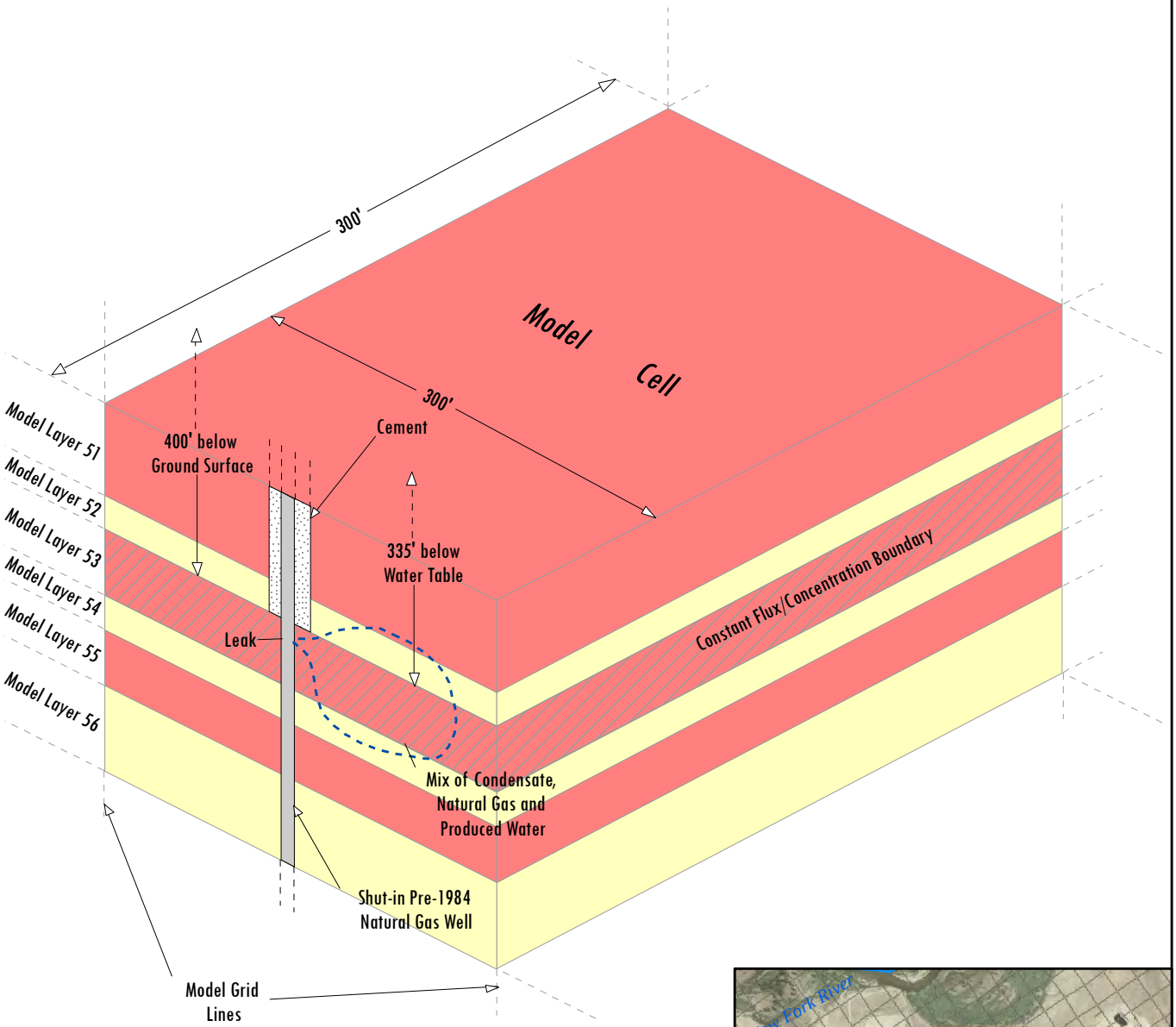
Lithology/Boundary Condition

- Constant Flux/Concentration Boundary
- Sandstone
- Alluvial Deposits
- Shale/Siltstone

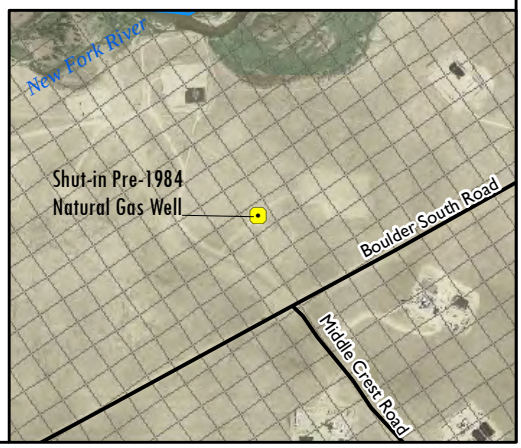
Not To Scale

amec

Natural Gas Pad
Scenario Conceptualization
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 52



Note: The top of model layer 51 is 354 feet below land surface (model layer 31) and 289 feet below the water table.



Lithology/Boundary Condition

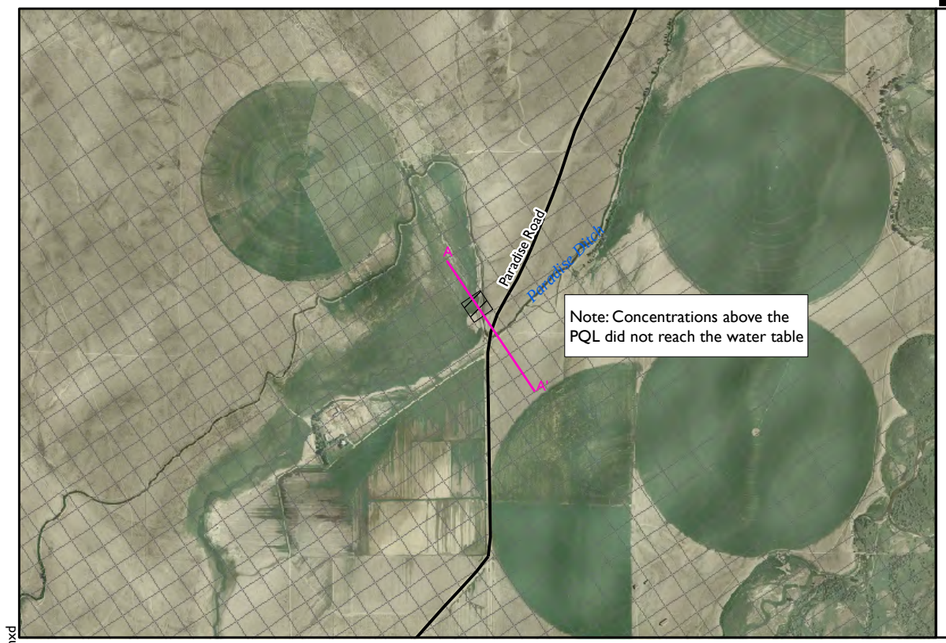
- Constant Flux/Concentration Boundary
- Sandstone
- Shale/Siltstone

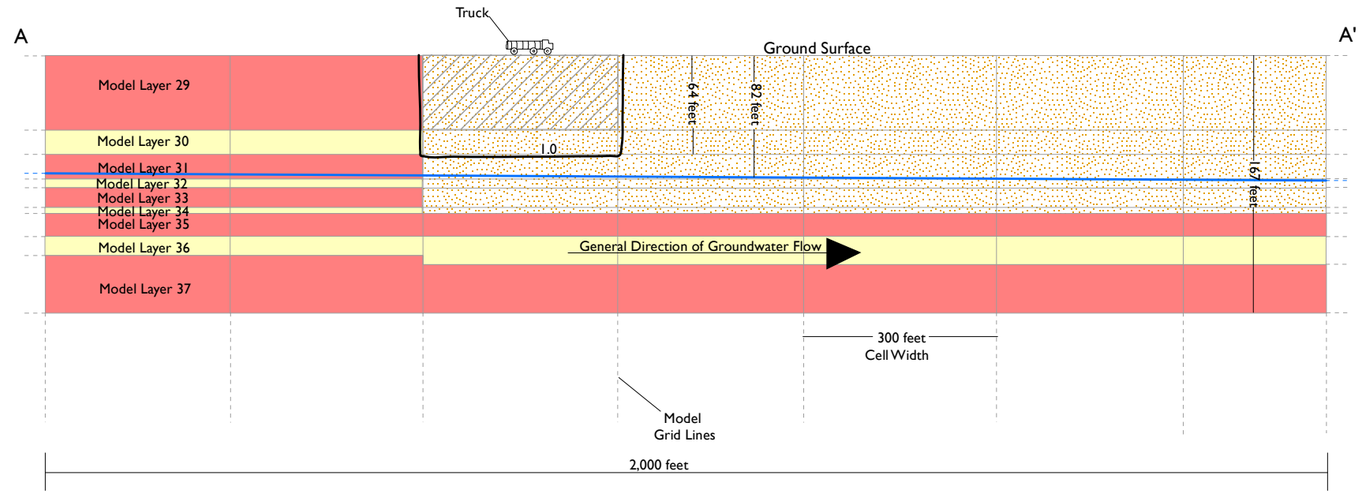
Not To Scale

amec

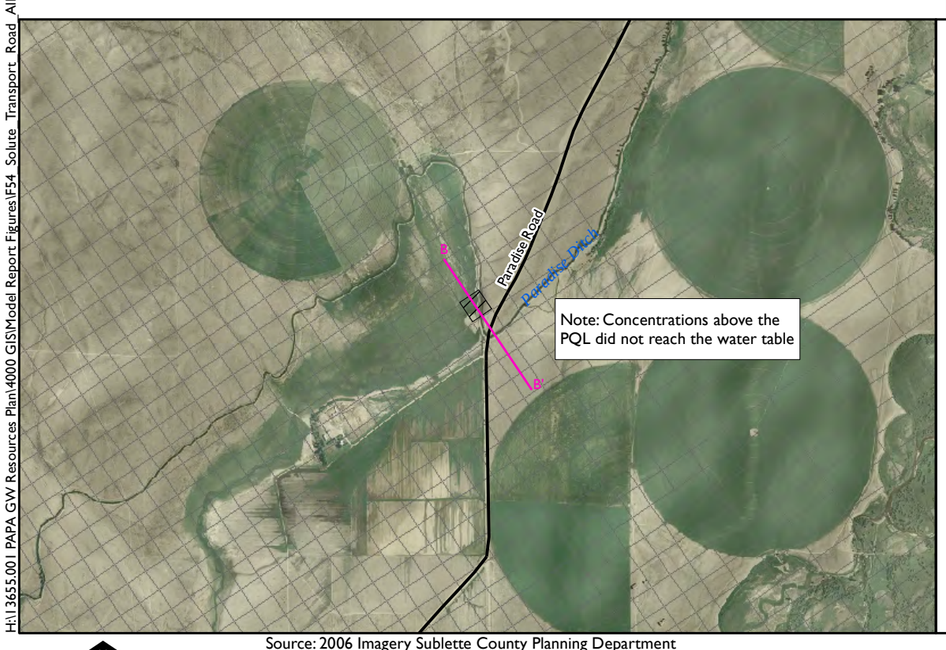
Shut-in Pre-1984 Natural Gas Well
Scenario Conceptualization
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 53

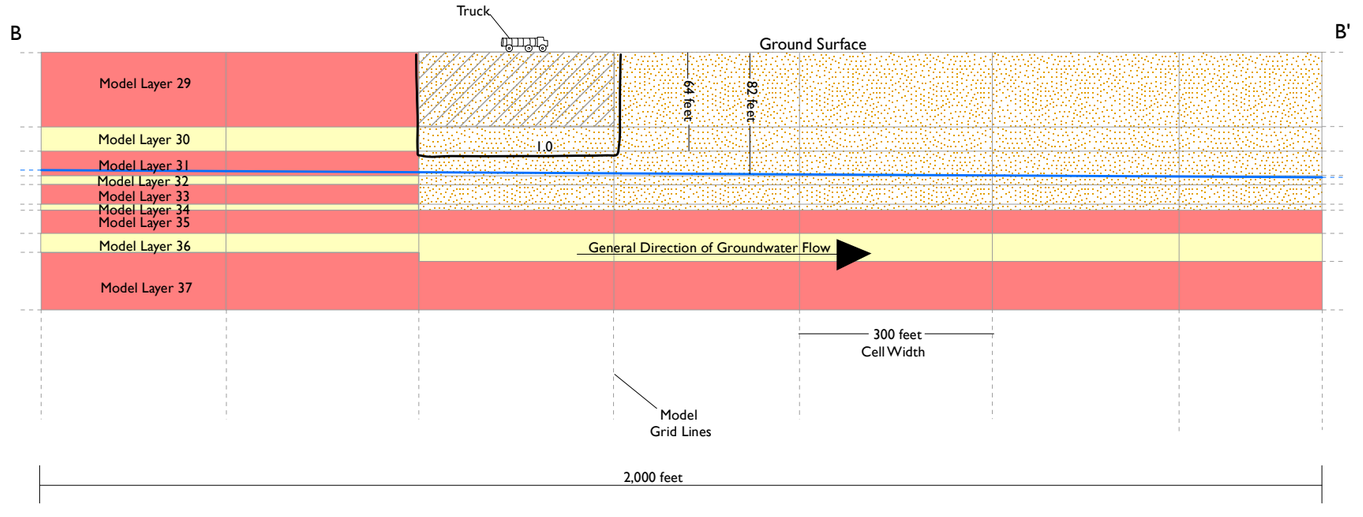
Benzene - Year 14.8 of Simulation





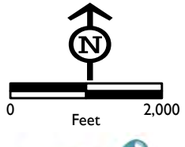
Toluene - Day 120 of Simulation





H:\13655.001 PAPA GW Resources Plan\4000 GIS\Model Report Figures\F54 Solute Transport Road All.mxd

Source: 2006 Imagery Sublette County Planning Department



amec

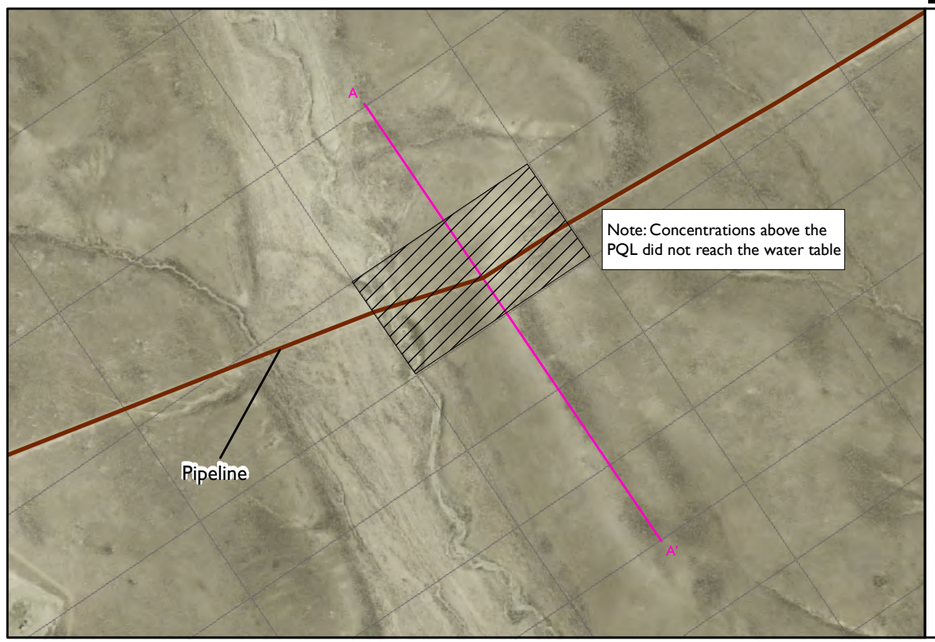
Lithology/Boundary Condition

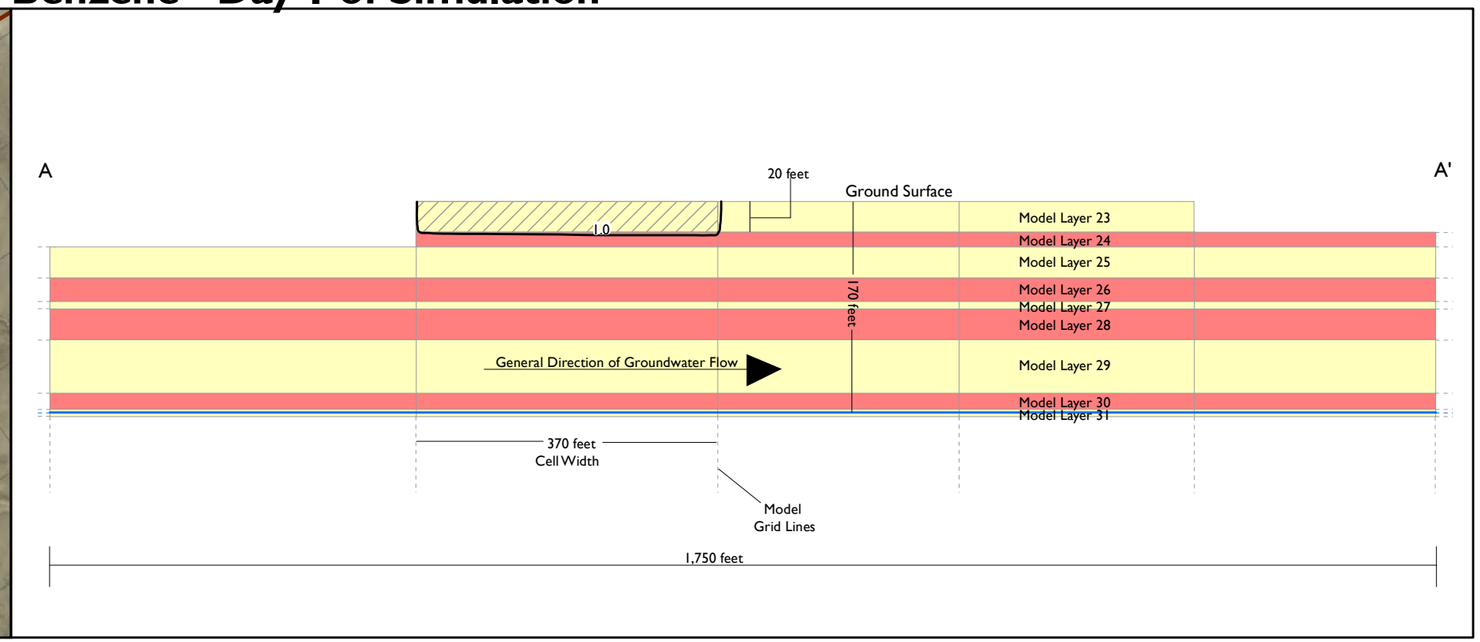
- Constant Concentration Boundary
- Sandstone
- Alluvial Deposits
- Shale/Siltstone

- 1.0 — Isoconcentration Contour (micrograms/liter)
- Simulated Groundwater Level

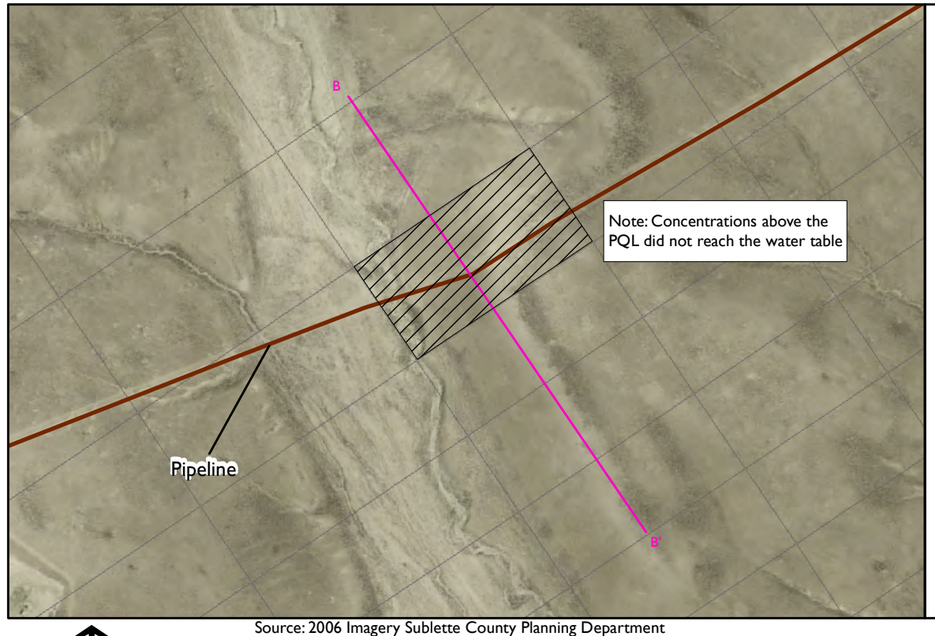
Solute Transport Results for Road Scenario: Benzene and Toluene
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 54

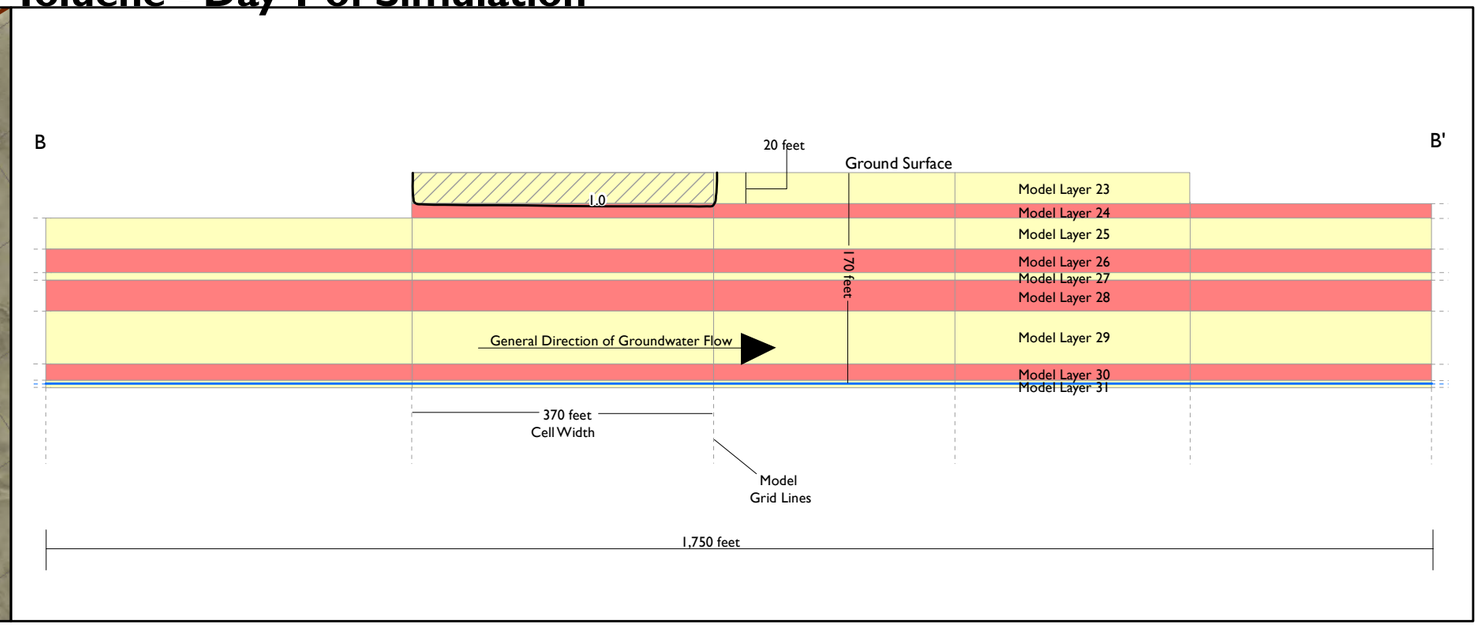
Benzene - Day 1 of Simulation



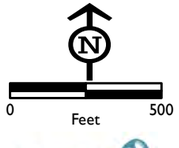


Toluene - Day 1 of Simulation





Source: 2006 Imagery Sublette County Planning Department



amec

Lithology/Boundary Condition

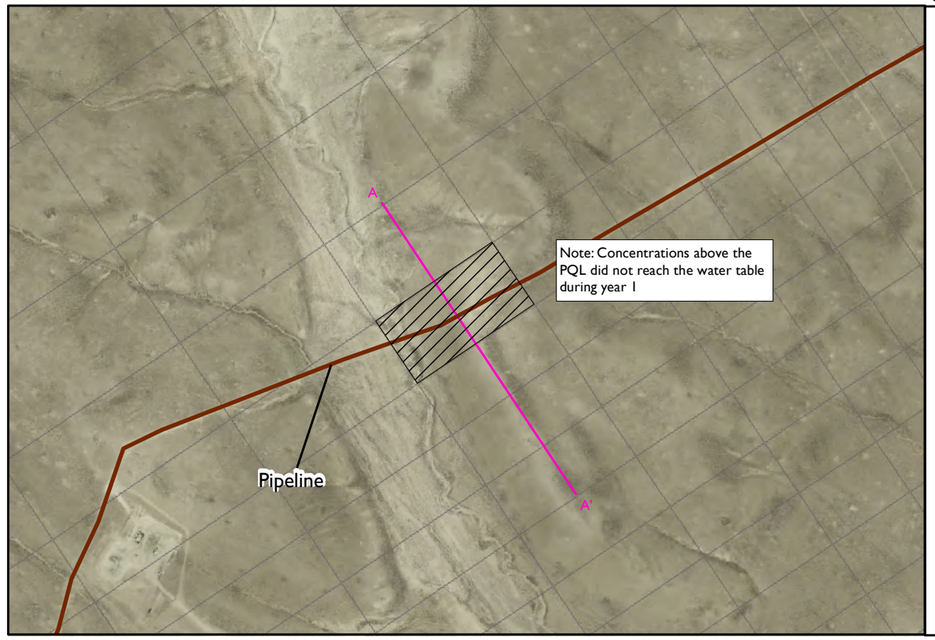
- Constant Flux/Concentration Boundary
- Sandstone
- Shale/Siltstone

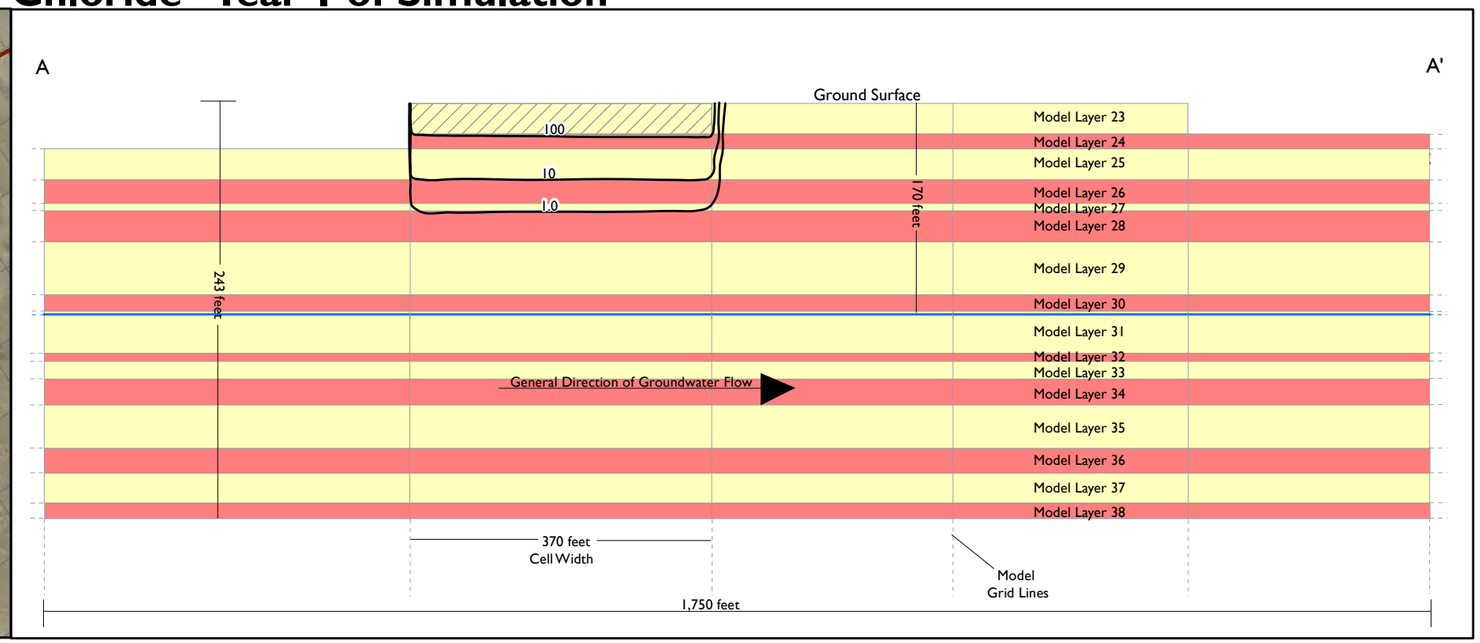
1.0 — Isoconcentration Contour (micrograms/liter)

Simulated Groundwater Level

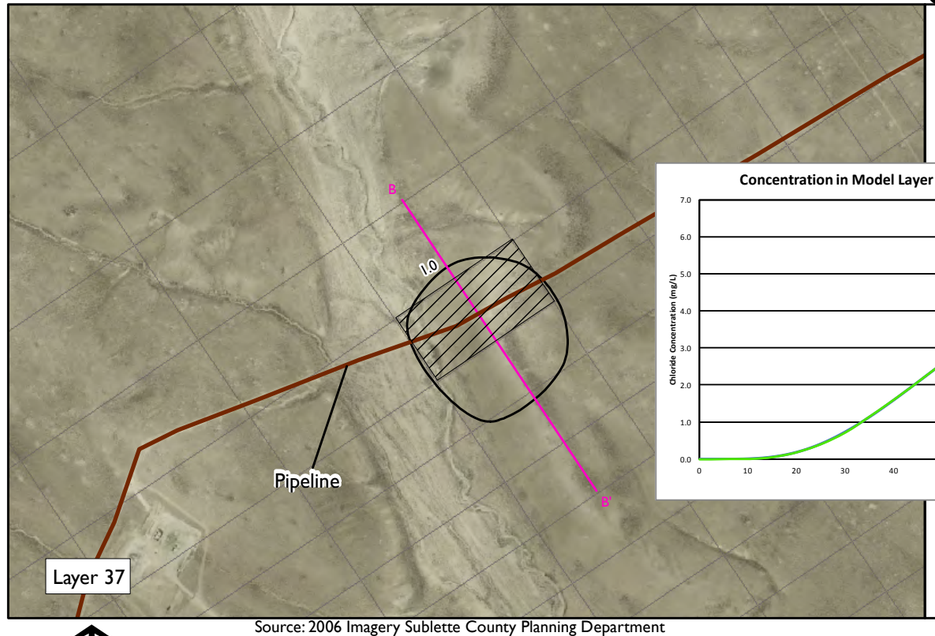
Solute Transport Results for
Pipeline Scenario:
Benzene and Toluene
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 55

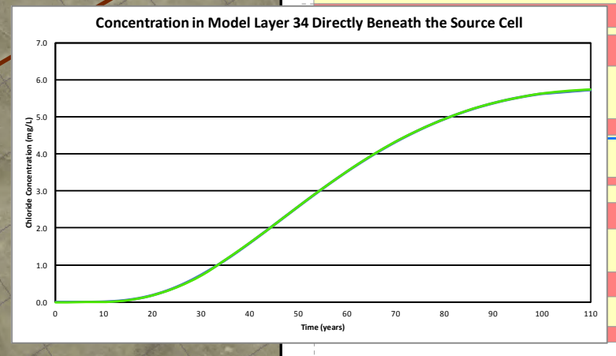
Chloride - Year 1 of Simulation

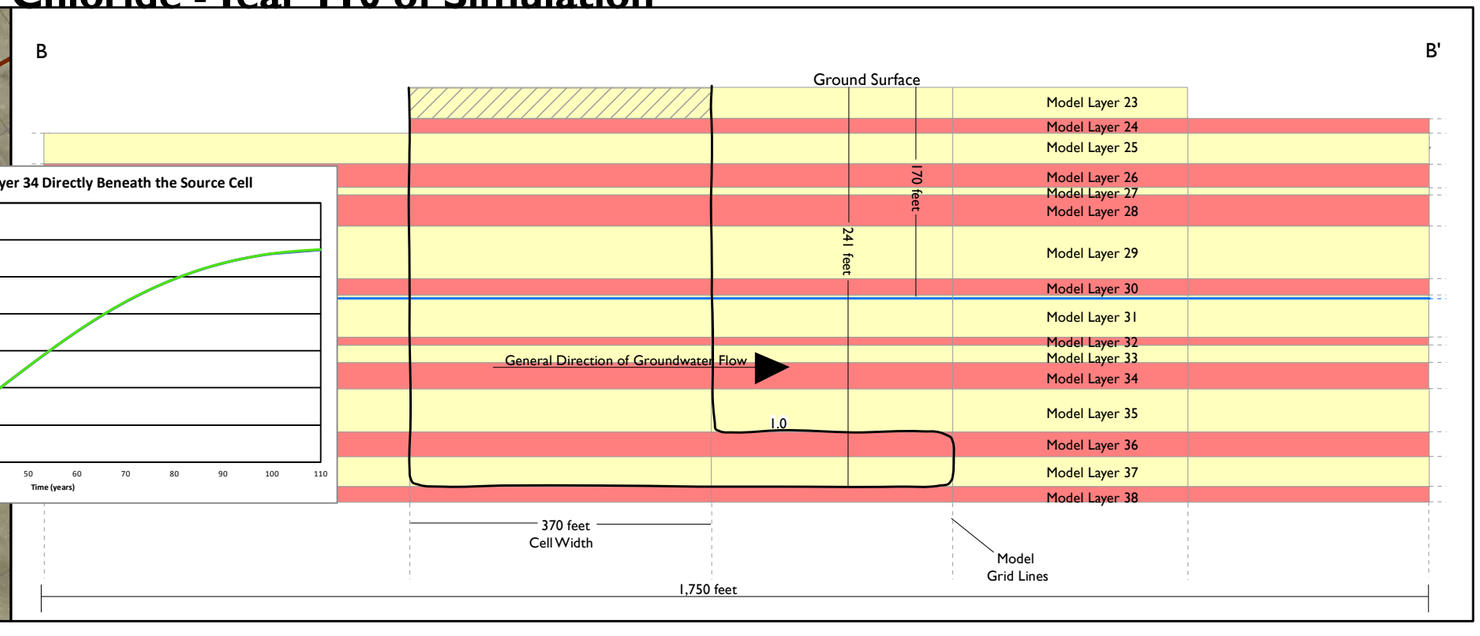




Chloride - Year 110 of Simulation







Source: 2006 Imagery Sublette County Planning Department

N

0 Feet 750

amec

Lithology/Boundary Condition

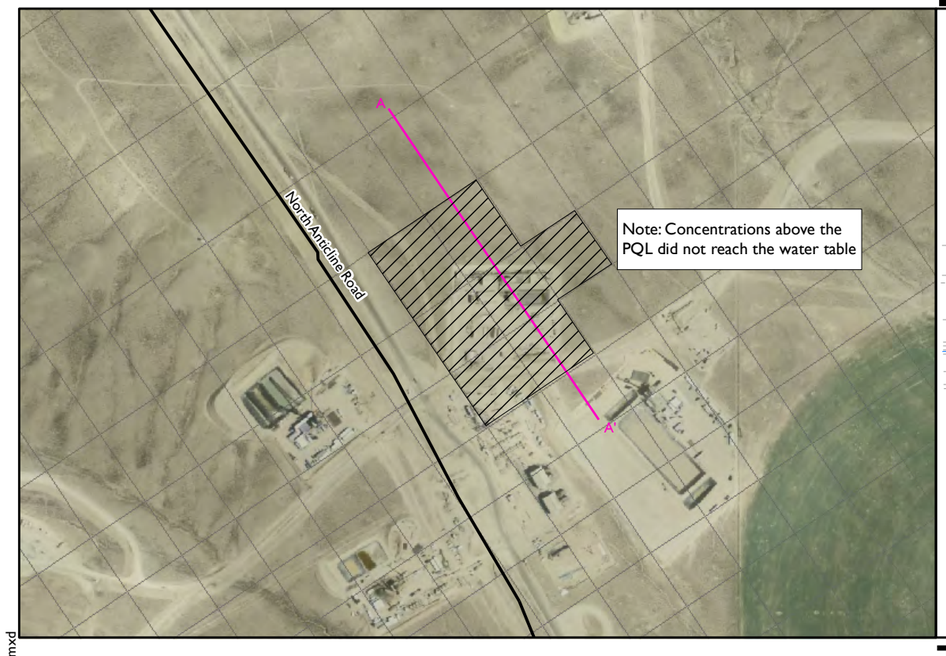
- Constant Flux/Concentration Boundary
- Sandstone
- Shale/Siltstone

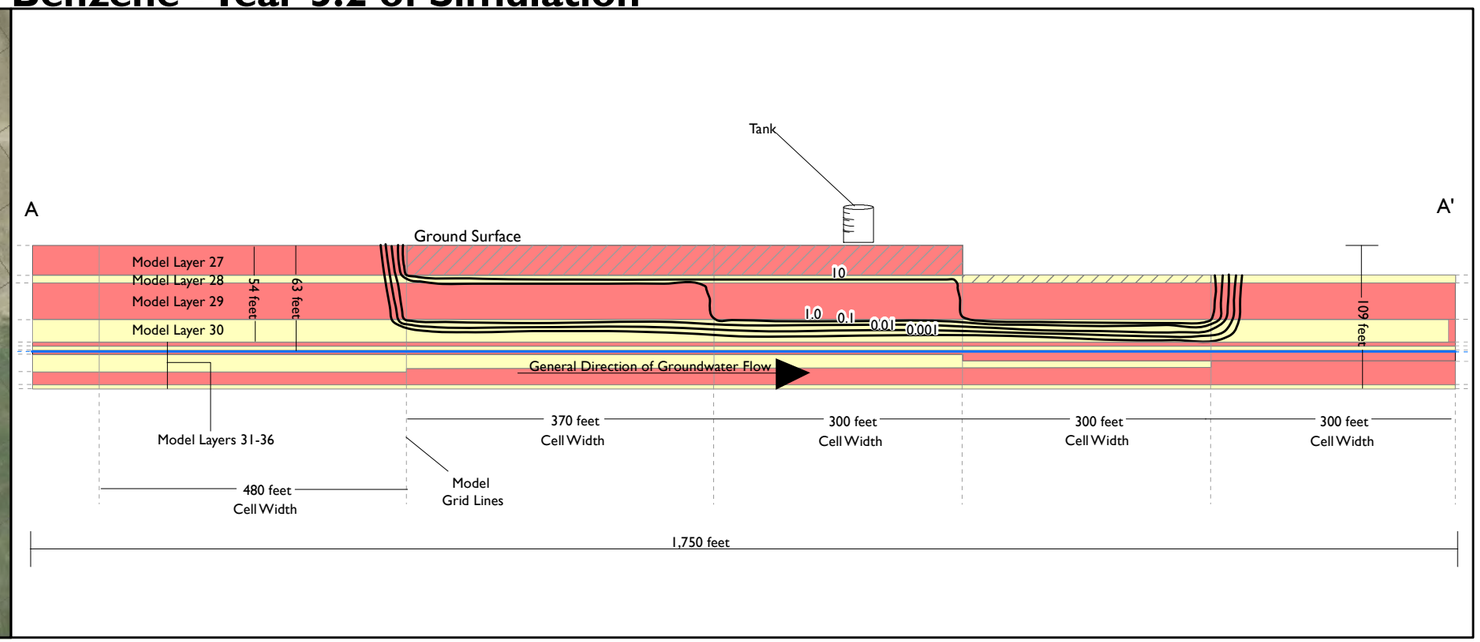
1.0 — Isoconcentration Contour (milligrams/liter)

Simulated Groundwater Level

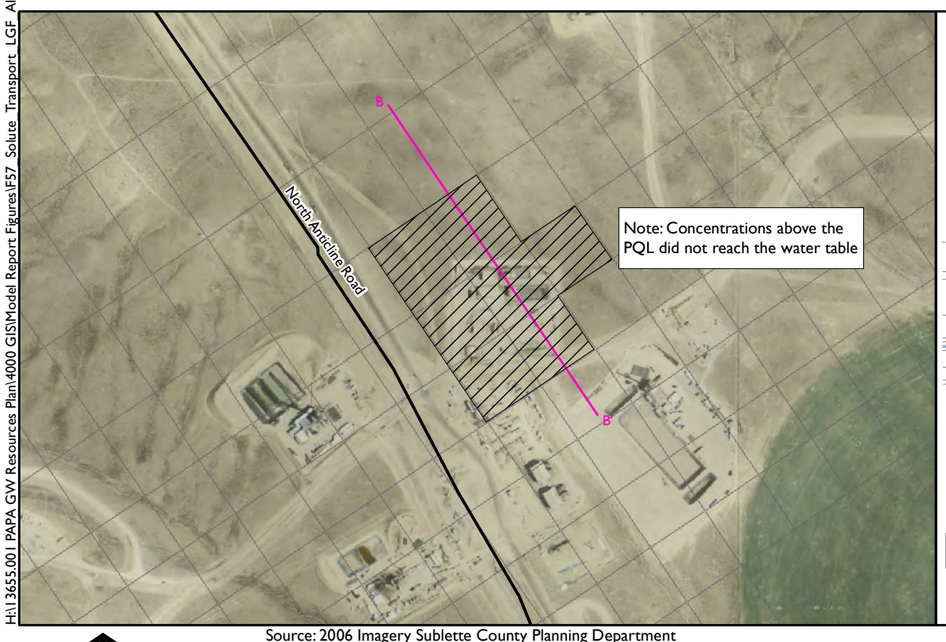
Solute Transport Results for
Pipeline Scenario:
Chloride
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 56

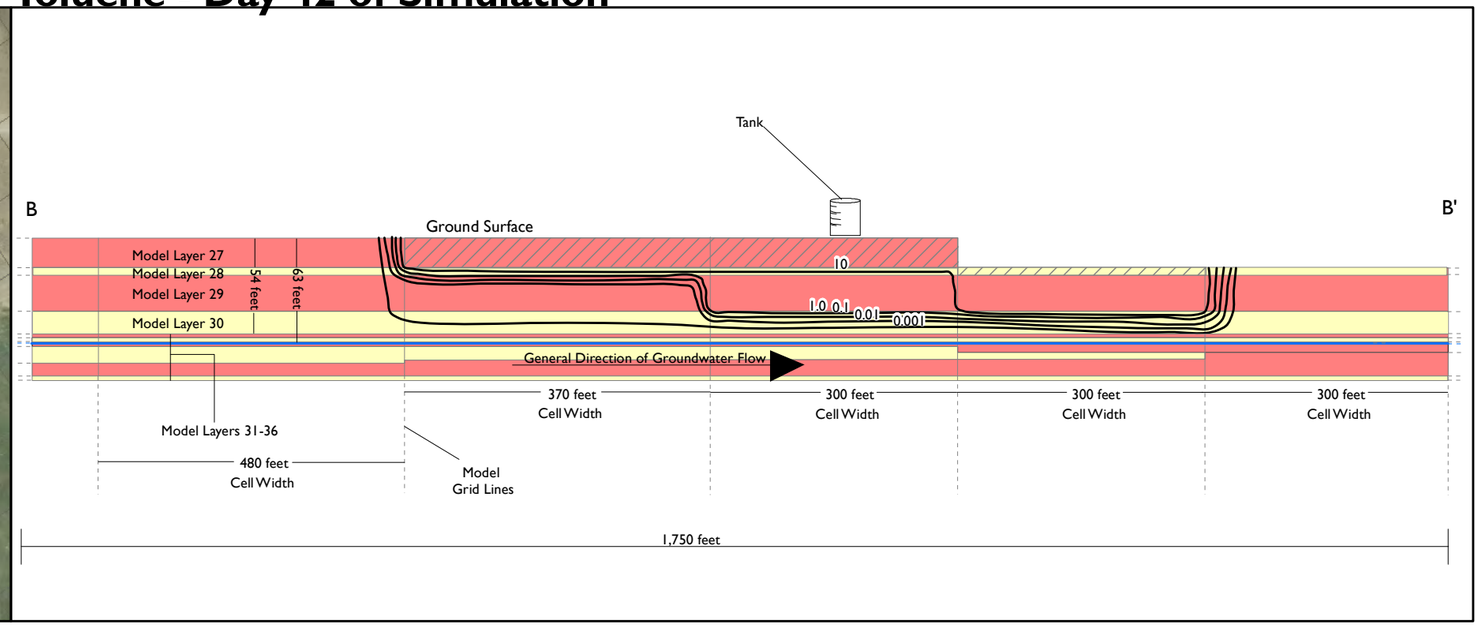
Benzene - Year 5.2 of Simulation





Toluene - Day 42 of Simulation





H:\13655.001 PAPA GW Resources Plan\4000 GIS\Model Report Figures\F57_Solute_Transport_LGF_All.mxd

Source: 2006 Imagery Sublette County Planning Department

0 700
Feet

Lithology/Boundary Condition

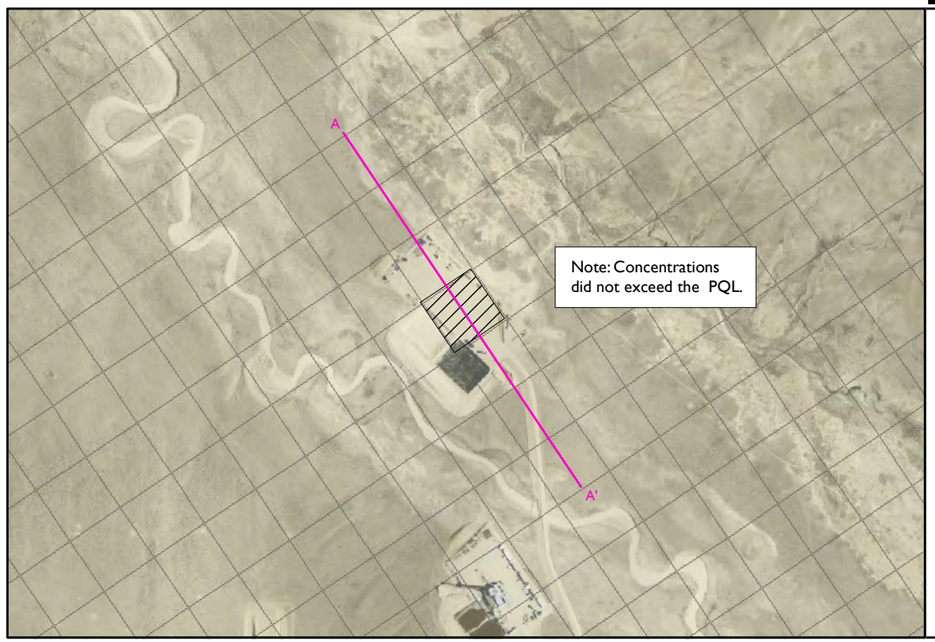
- Constant Concentration Boundary
- Sandstone
- Shale/Siltstone

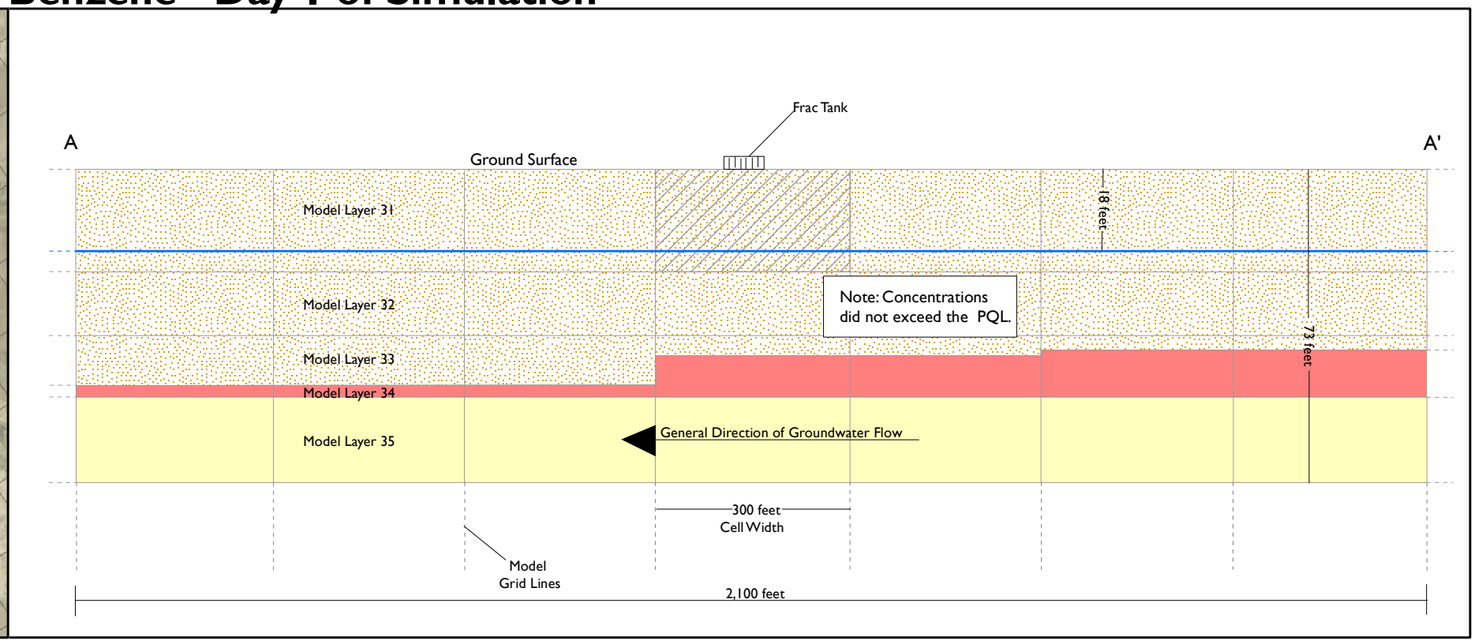
1.0 — Isoconcentration Contour (micrograms/liter)

Simulated Groundwater Level

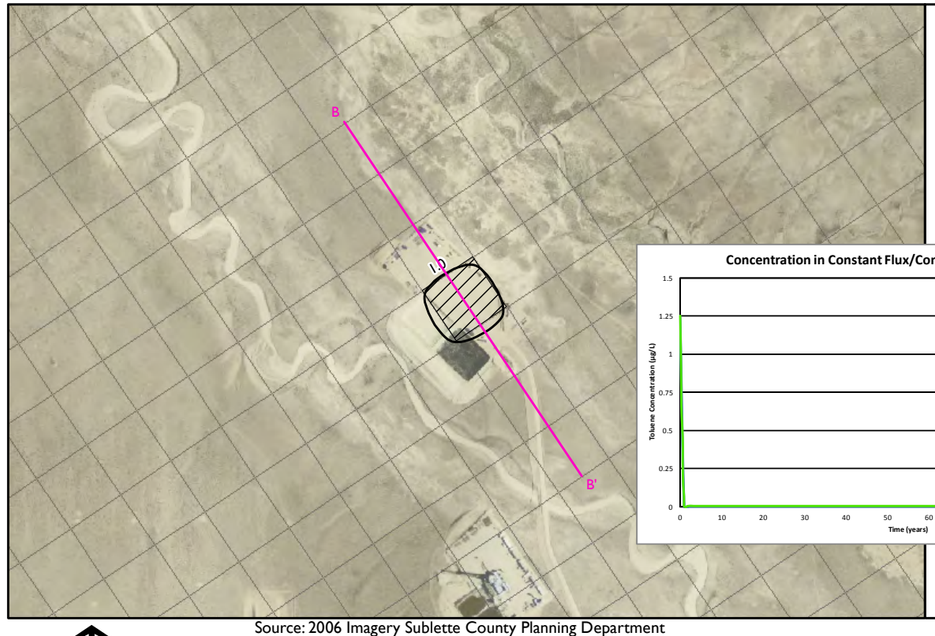
Solute Transport Results for Liquid-Gathering Facility Scenario: Benzene and Toluene
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 57

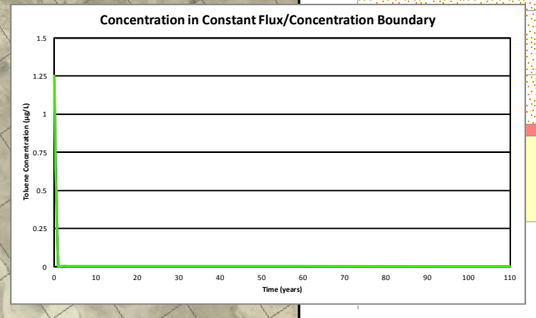
Benzene - Day 1 of Simulation

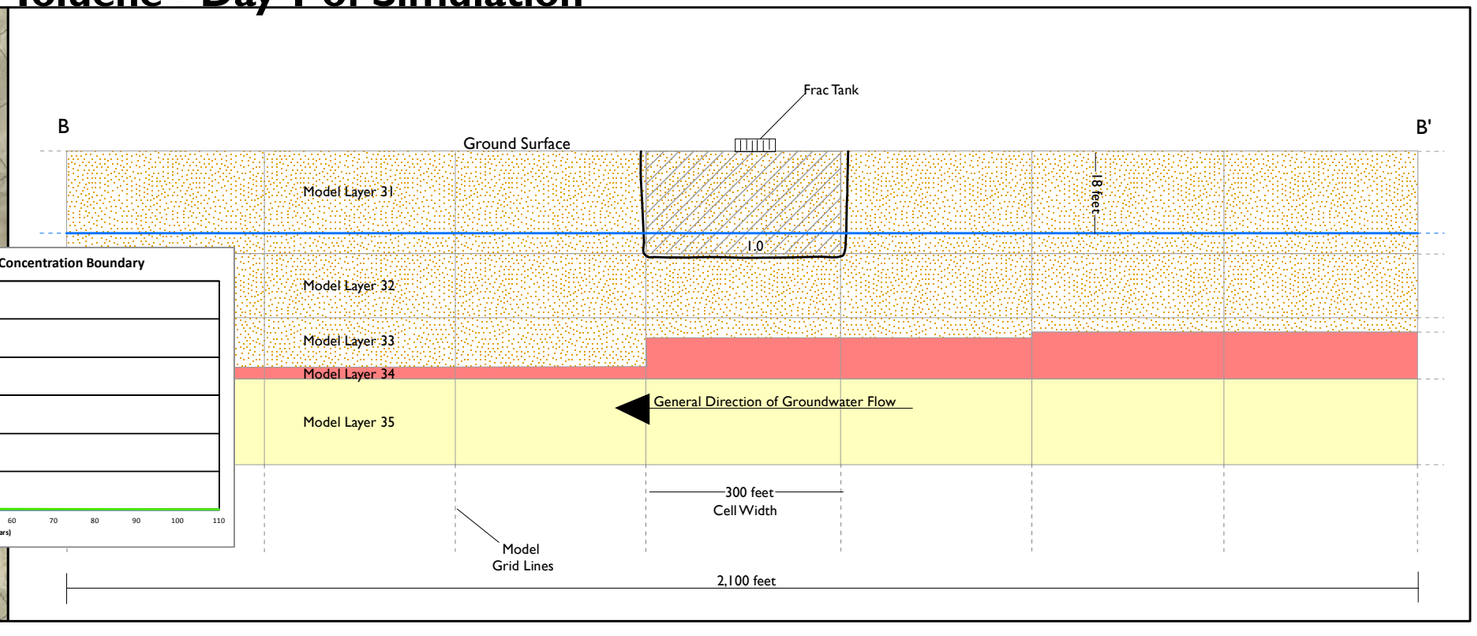




Toluene - Day 1 of Simulation







Source: 2006 Imagery Sublette County Planning Department

N

0 Feet 750

amec

Lithology/Boundary Condition

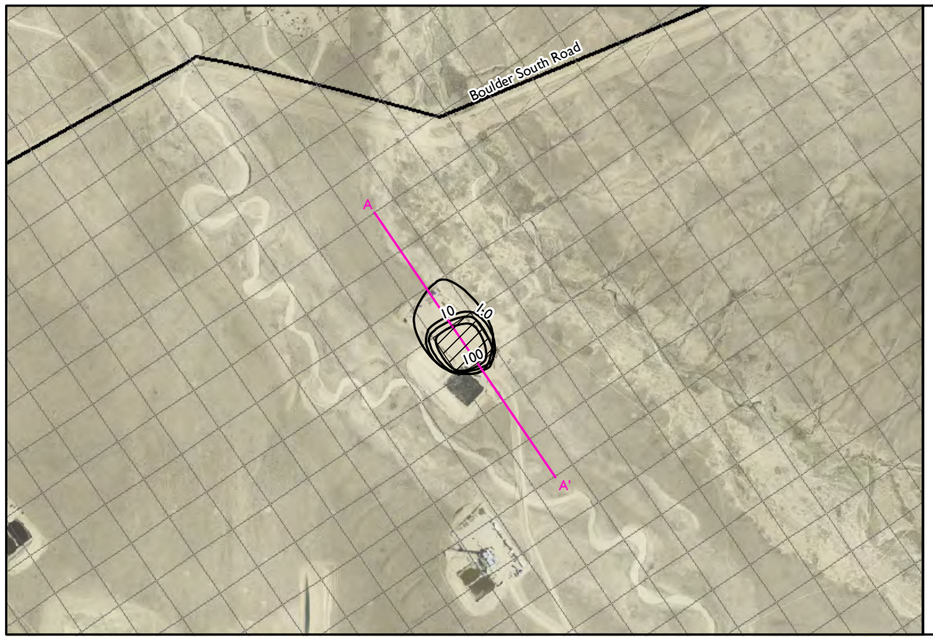
- Constant Flux/Concentration Boundary
- Sandstone
- Alluvial Deposits
- Shale/Siltstone

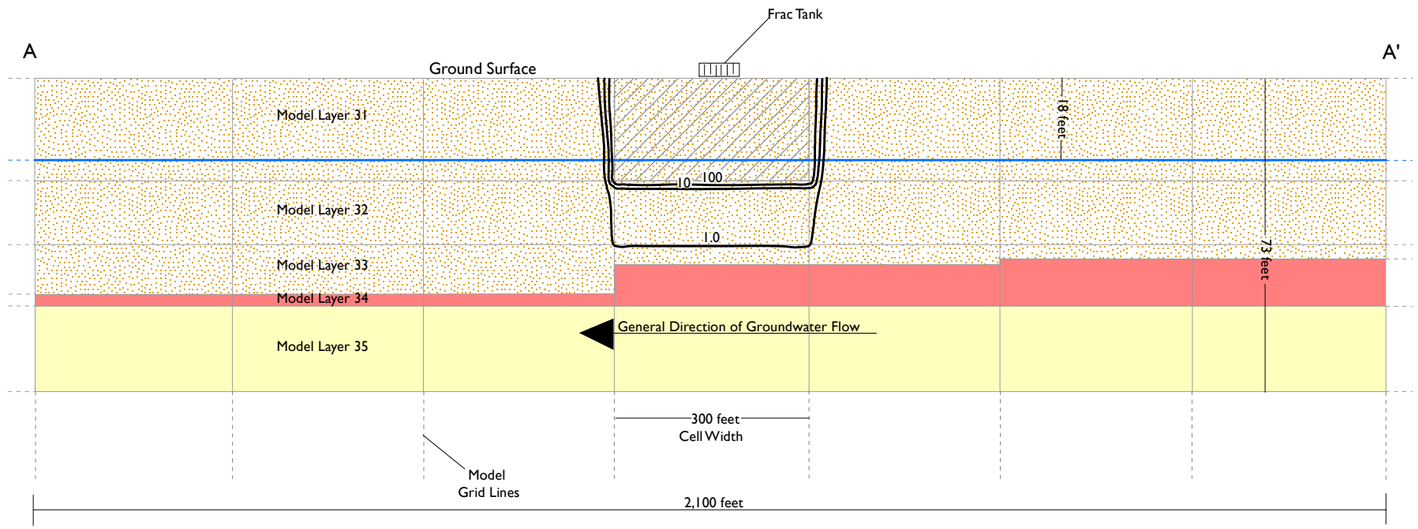
1.0 — Isoconcentration Contour (micrograms/liter)

Simulated Groundwater Level

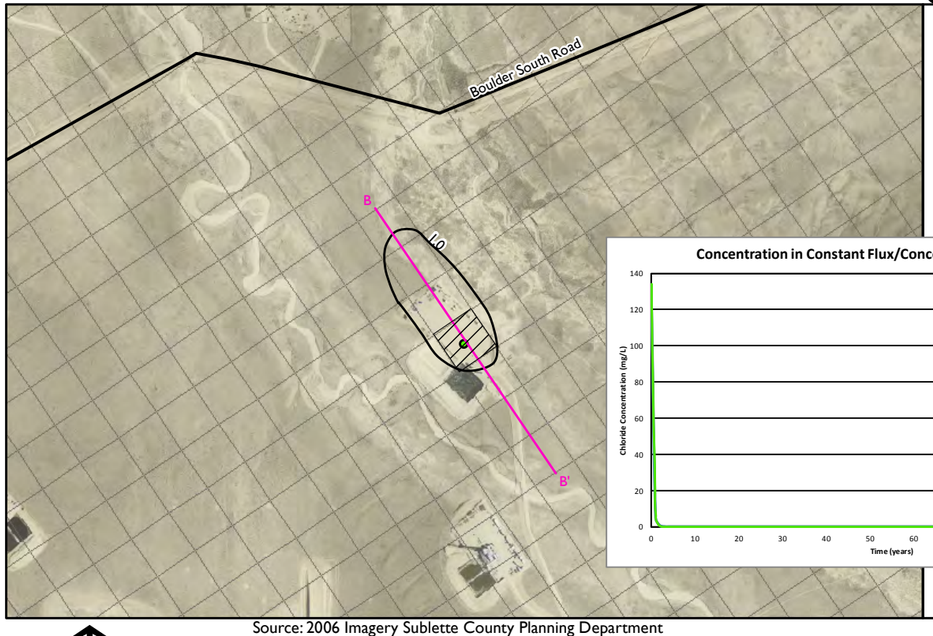
Solute Transport Results for
Natural Gas Pad Scenario:
Benzene and Toluene
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 58

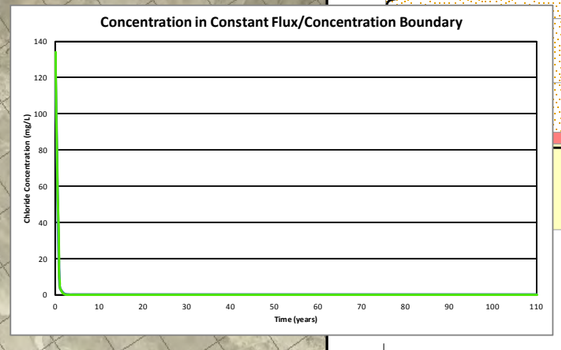
Chloride - Day 1 of Simulation

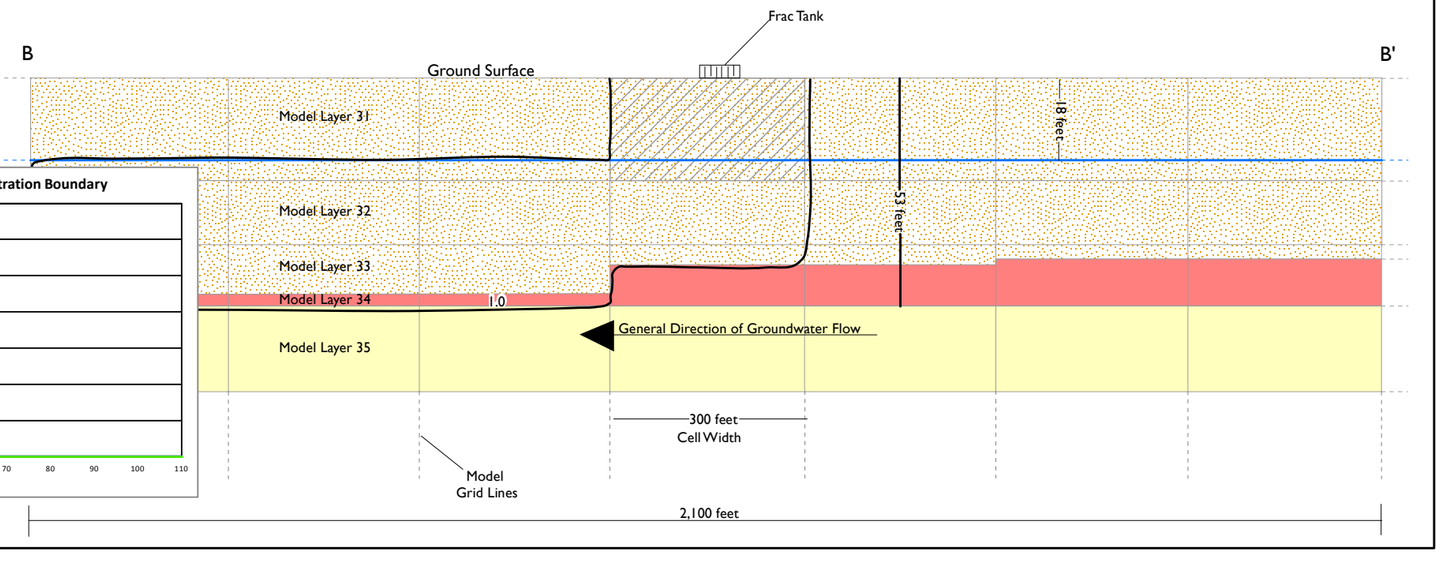




Chloride - Year 1 of Simulation







Source: 2006 Imagery Sublette County Planning Department

N

0 Feet 1,000

amec

Lithology/Boundary Condition

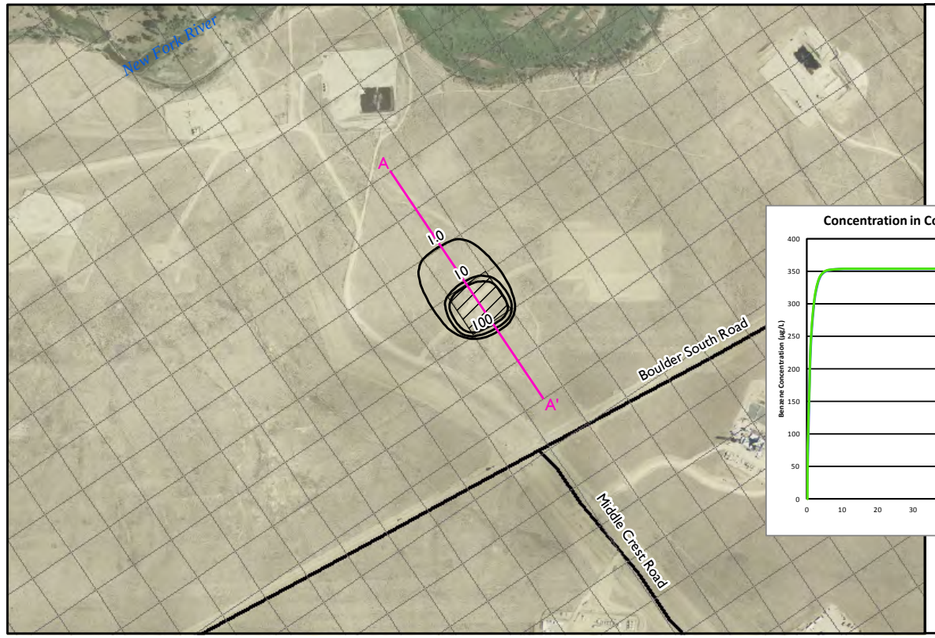
- Constant Flux/Concentration Boundary
- Sandstone
- Alluvial Deposits
- Shale/Siltstone

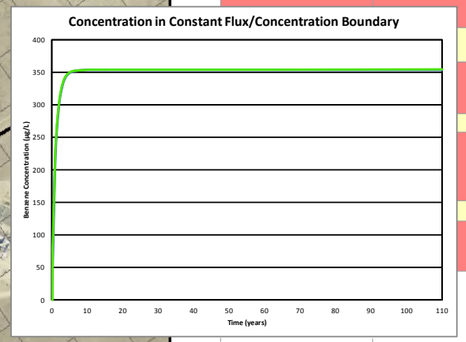
1.0 Isoconcentration Contour (milligrams/liter)

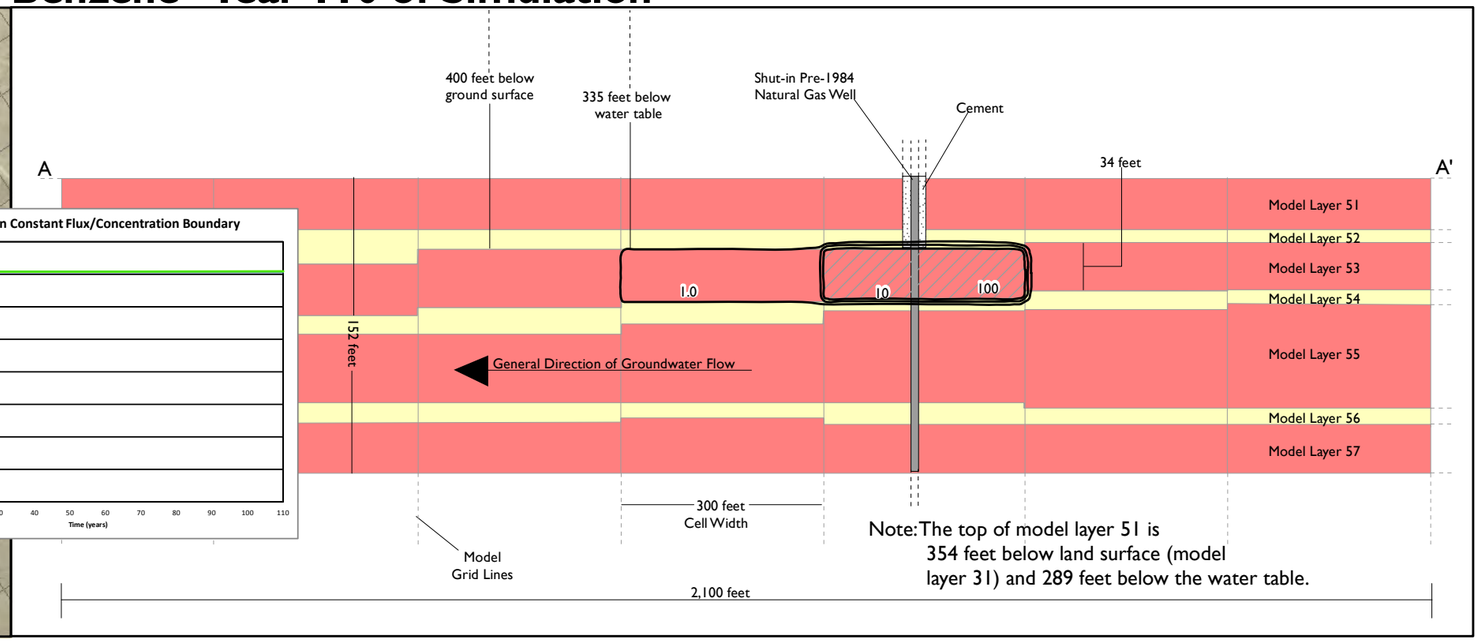
Simulated Groundwater Level

Solute Transport Results for Natural Gas Pad Scenario: Chloride
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 59

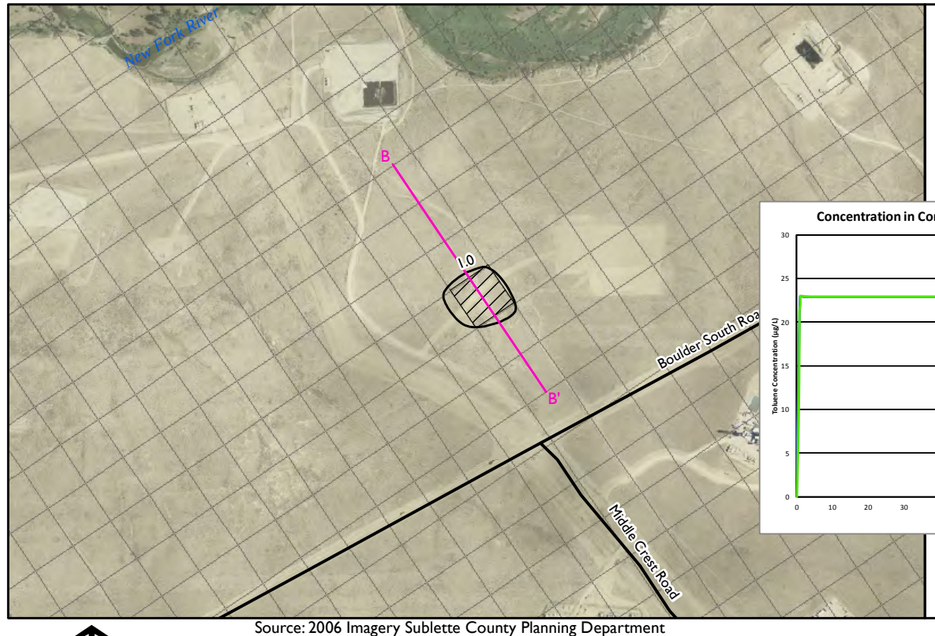
Benzene - Year 110 of Simulation

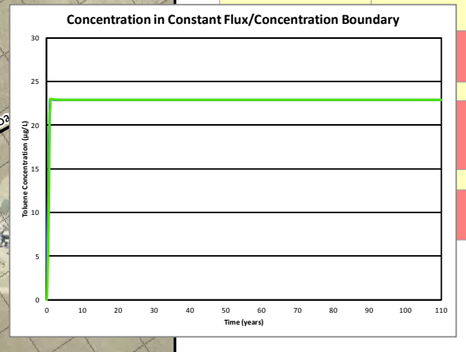


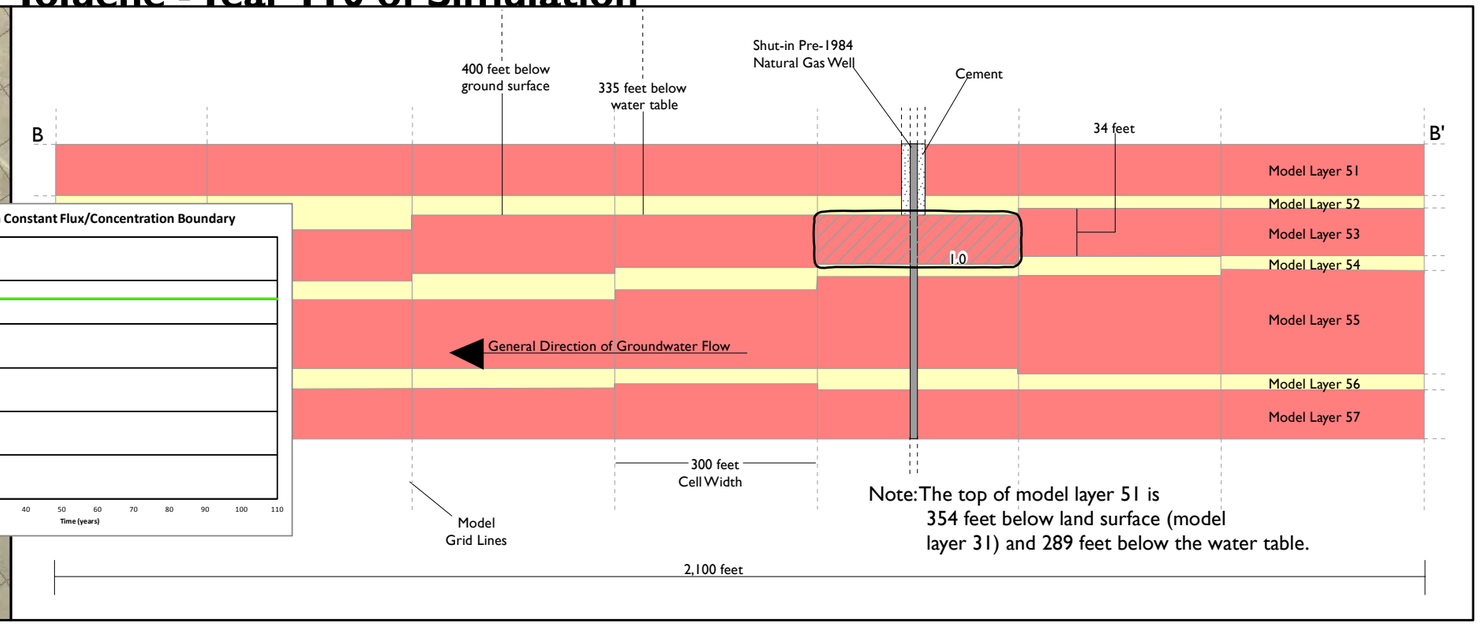




Toluene - Year 110 of Simulation







Source: 2006 Imagery Sublette County Planning Department

N

0 1,000
Feet

amec

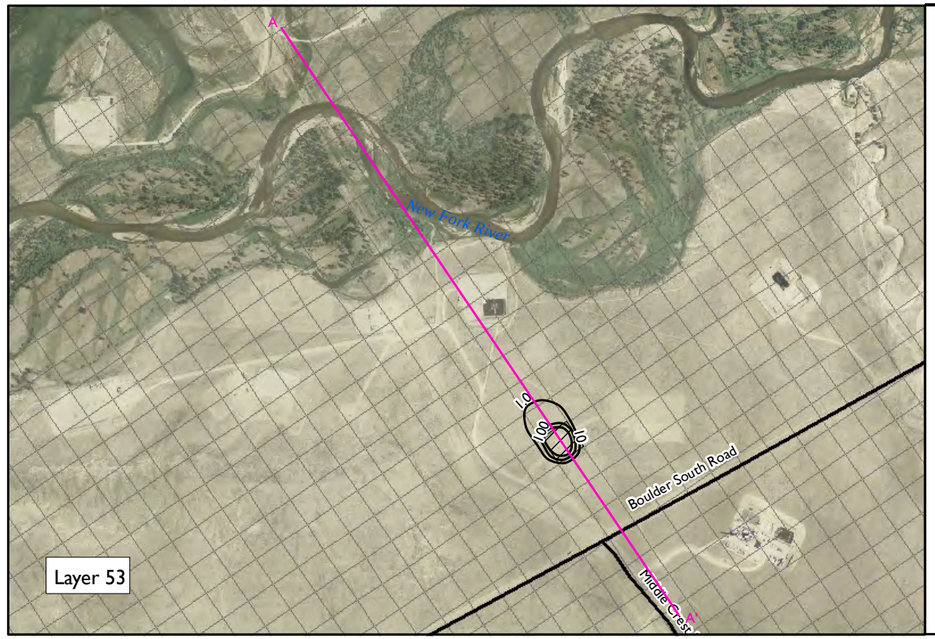
Lithology/Boundary Condition

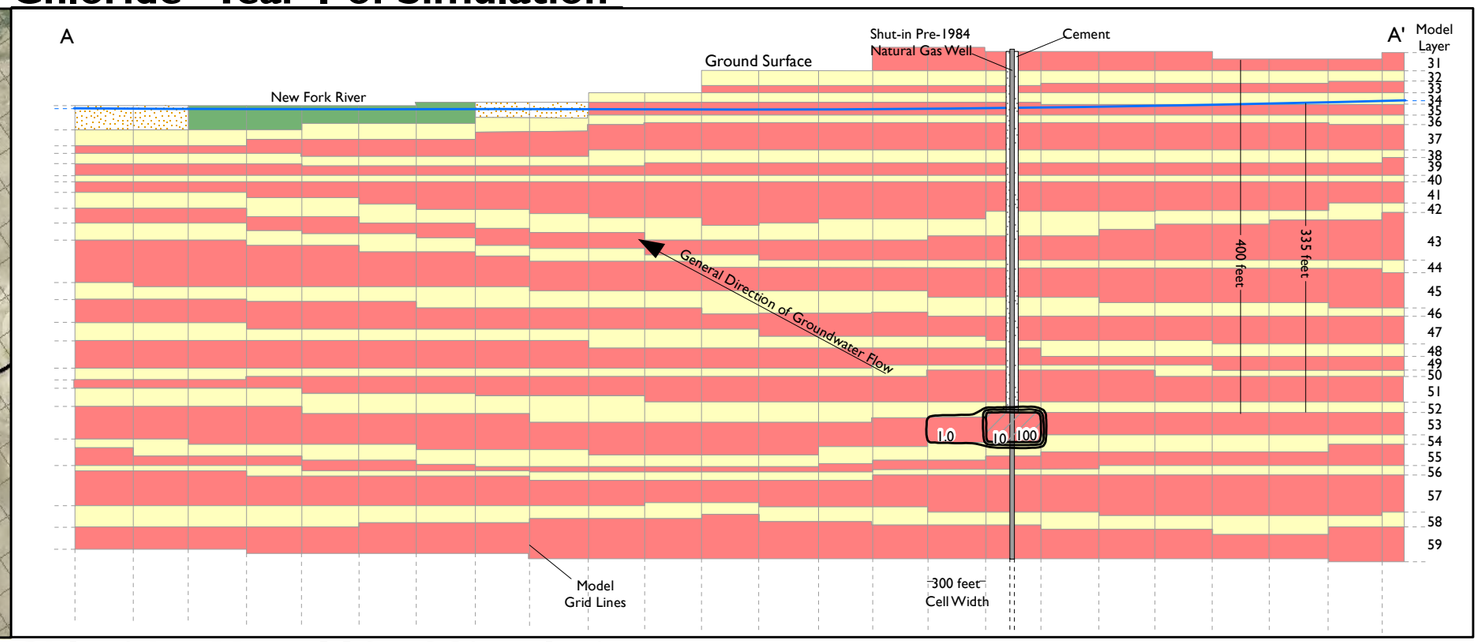
- Constant Flux/Concentration Boundary
- Sandstone
- Shale/Siltstone

1.0 — Isoconcentration Contour (micrograms/liter)

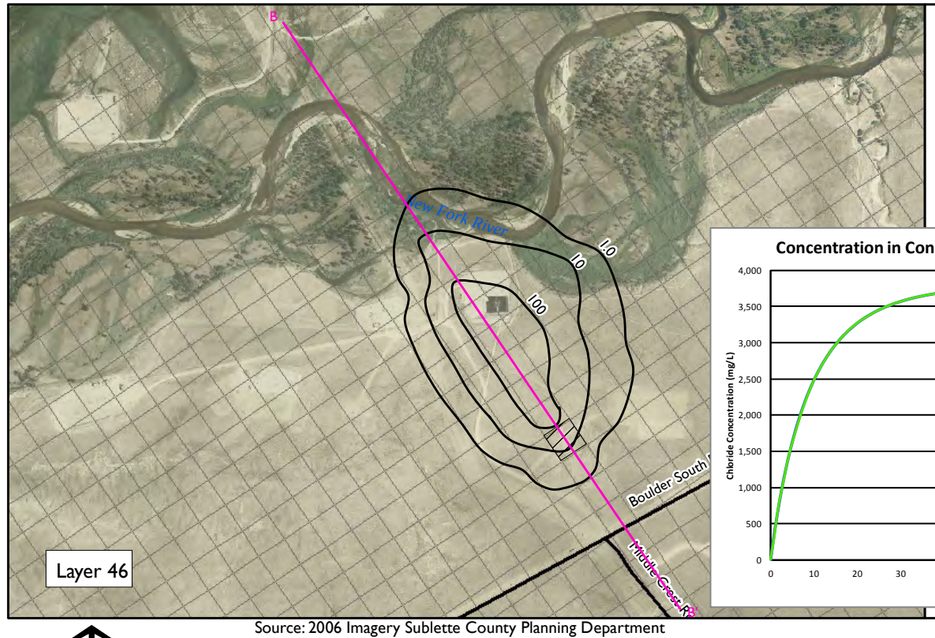
Solute Transport Results for
Shut-in Pre-1984 Natural Gas Well Scenario:
Benzene and Toluene
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 60

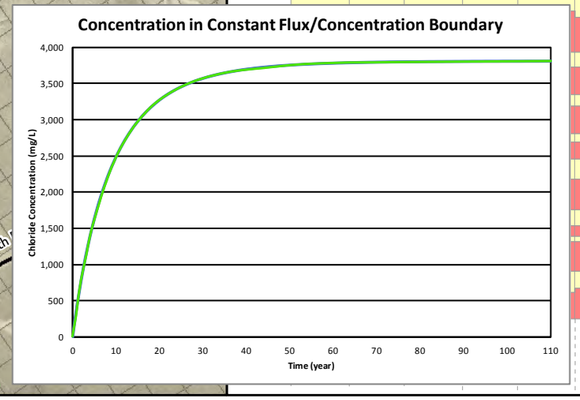
Chloride - Year 1 of Simulation

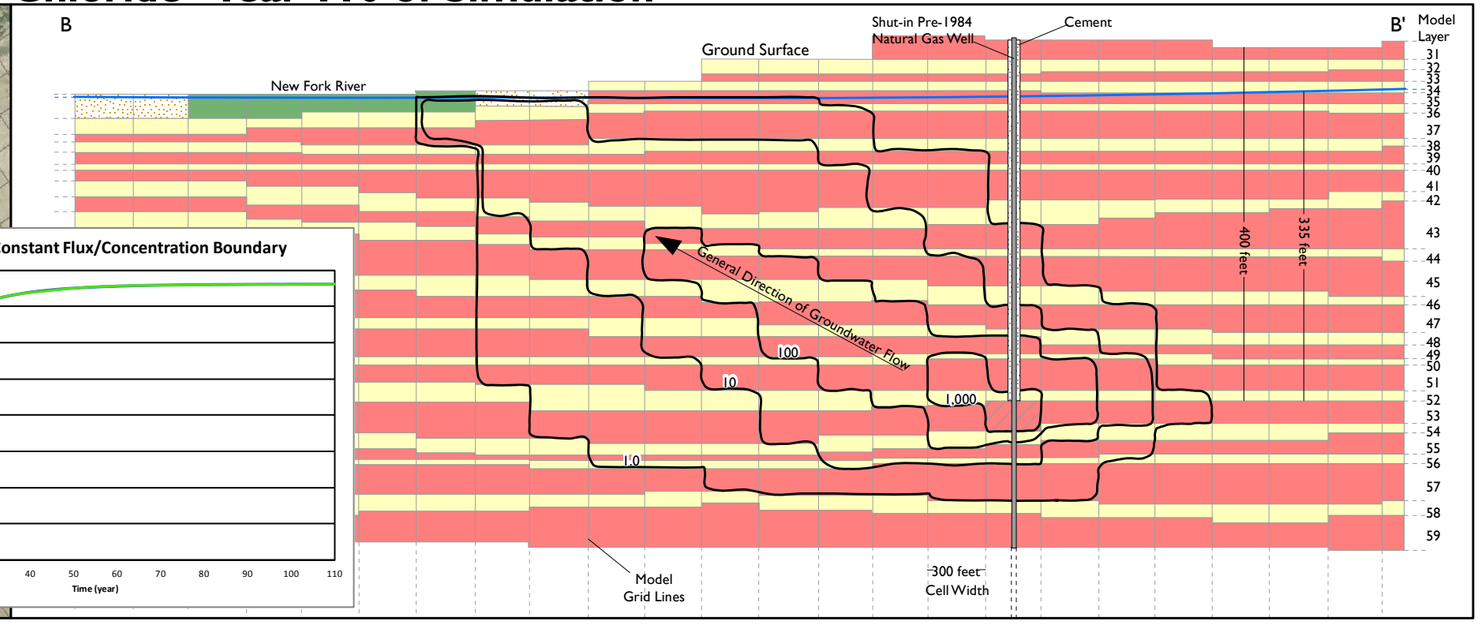




Chloride - Year 110 of Simulation







Source: 2006 Imagery Sublette County Planning Department

N

0 Feet 1,500

amec

Lithology/Boundary Condition

- Constant Flux/Concentration Boundary
- River Boundary
- Alluvial Deposits
- Sandstone
- Shale/Siltstone

1.0 — Isoconcentration Contour (milligrams/liter)

Simulated Groundwater Level

Solute Transport Results for
Shut-in Pre-1984 Natural Gas Well Scenario:
Chloride
PAPA Numerical Groundwater Model
Pinedale Anticline Project Area
Sublette County, Wyoming
FIGURE 61