



**NUMERICAL and VISUAL TRACKING  
of GROUND WATER FLOWS  
and CONTAMINANTS**

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# **TOOLS FOR GEOLOGIC AND GROUND WATER FLOW MODELS**

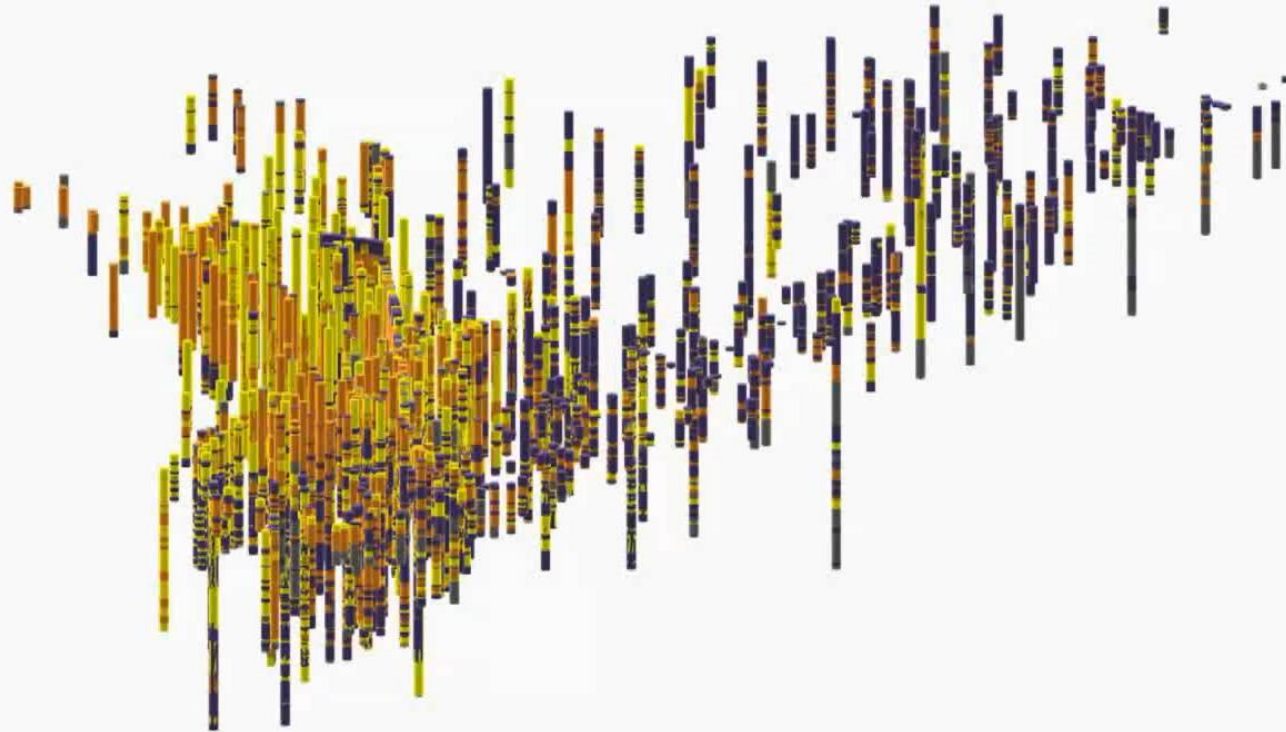
- ▶ **GEOLOGY/HYDROGEOLOGY MAY BE VERY COMPLEX**
- ▶ **RESULTANT GROUND WATER FLOW ALSO COMPLEX**
- ▶ **CAN BE DIFFICULT TO UNDERSTAND AND EXPLAIN**
- ▶ **VISUALIZATION TOOLS CAN GREATLY FACILITATE UNDERSTANDING OF COMPLEX ISSUES**
- ▶ **PARTICULARLY USEFUL IN CONVEYING MESSAGES TO LAYPEOPLE**

# **GEOLOGIC/FLOW MODEL OF BASIN**

- ▶ 175 mi<sup>2</sup>
- ▶ COMPLEX GEOLOGY, INCLUDING EXTENSIVE FAULTING AND VARIABLE DEPOSITIONAL ENVIRONMENT
- ▶ EXTENSIVE MUNICIPAL AND INDUSTRIAL PUMPING
- ▶ HISTORIC CONTAMINANT SOURCES

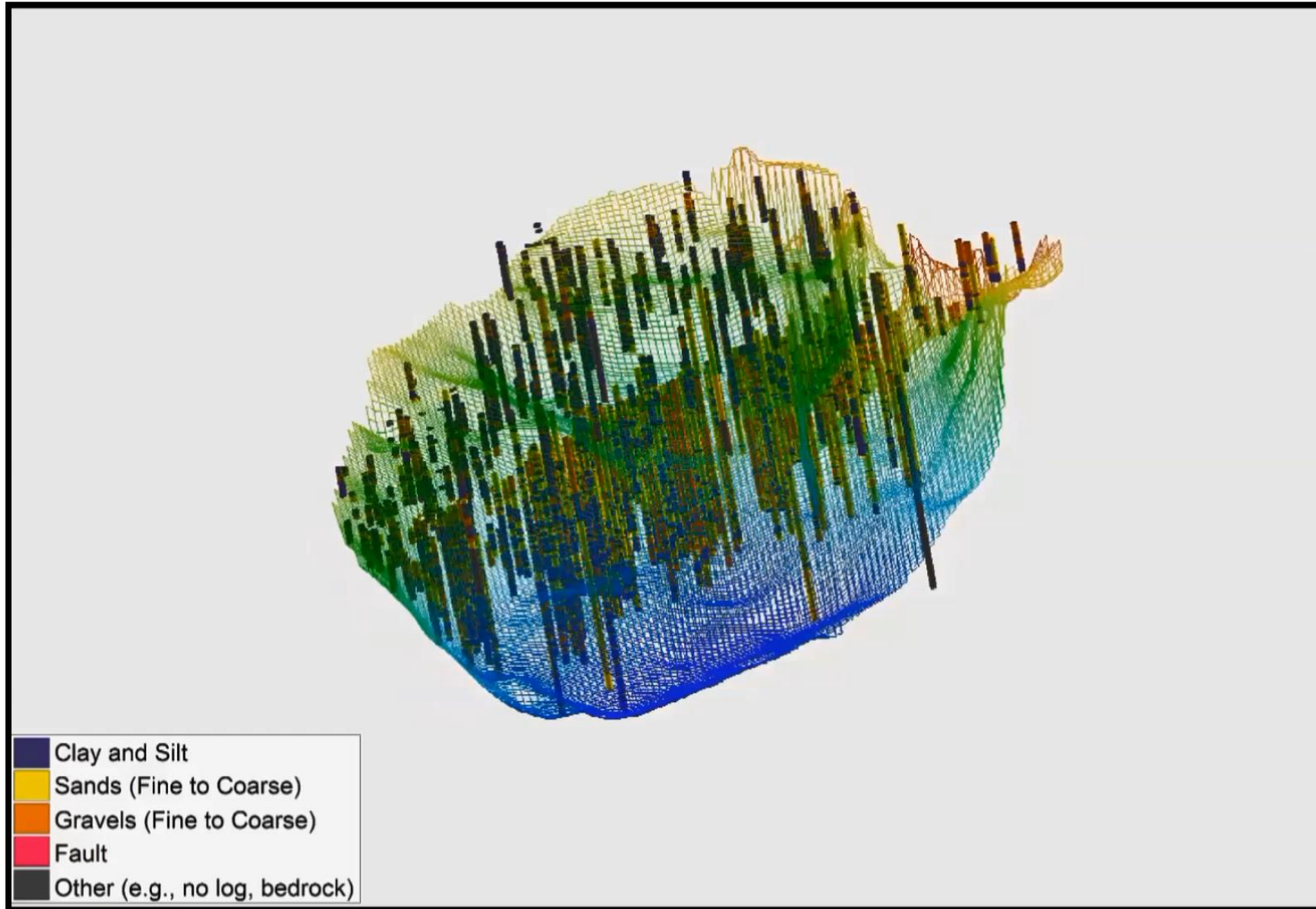
# EXTENT OF THE BASIN

Wells Used for Modeling



- Clay and Silt
- Sands (Fine to Coarse)
- Gravels (Fine to Coarse)
- Fault
- Other (e.g., no log, bedrock)

# VERTICAL PROFILES OF GEOLOGY



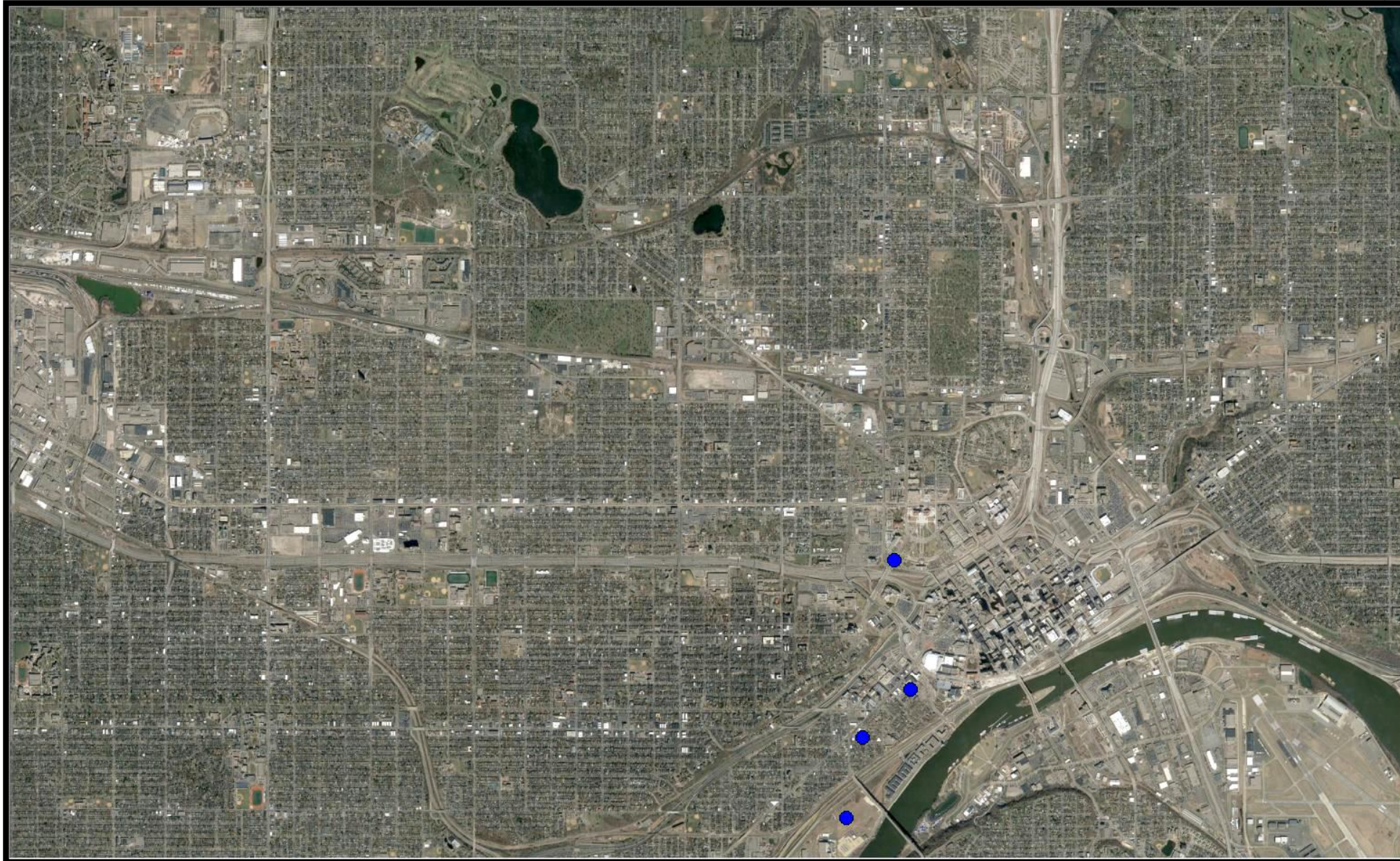
# FENCE DIAGRAMS TO BLOCK MODEL



# USES FOR 3D BLOCK MODELING

- ▶ ASSISTS WITH INTERPRETATION OF COMPLEX GEOLOGIC CONDITIONS
- ▶ STRATIGRAPHIC SEQUENCES IN MODEL HELP TO IDENTIFY CORRELATIONS AND DISCONTINUITIES
- ▶ VISUALIZE AQUIFER BOUNDARY CONDITIONS, FAULTS, FLOW BARRIERS
- ▶ PROVIDE ABILITY TO DEVELOP REPRESENTATIVE FLOW MODEL
- ▶ IDENTIFY PREFERENTIAL FLOW PATHWAYS

# BACKWARD PARTICLE TRACKING

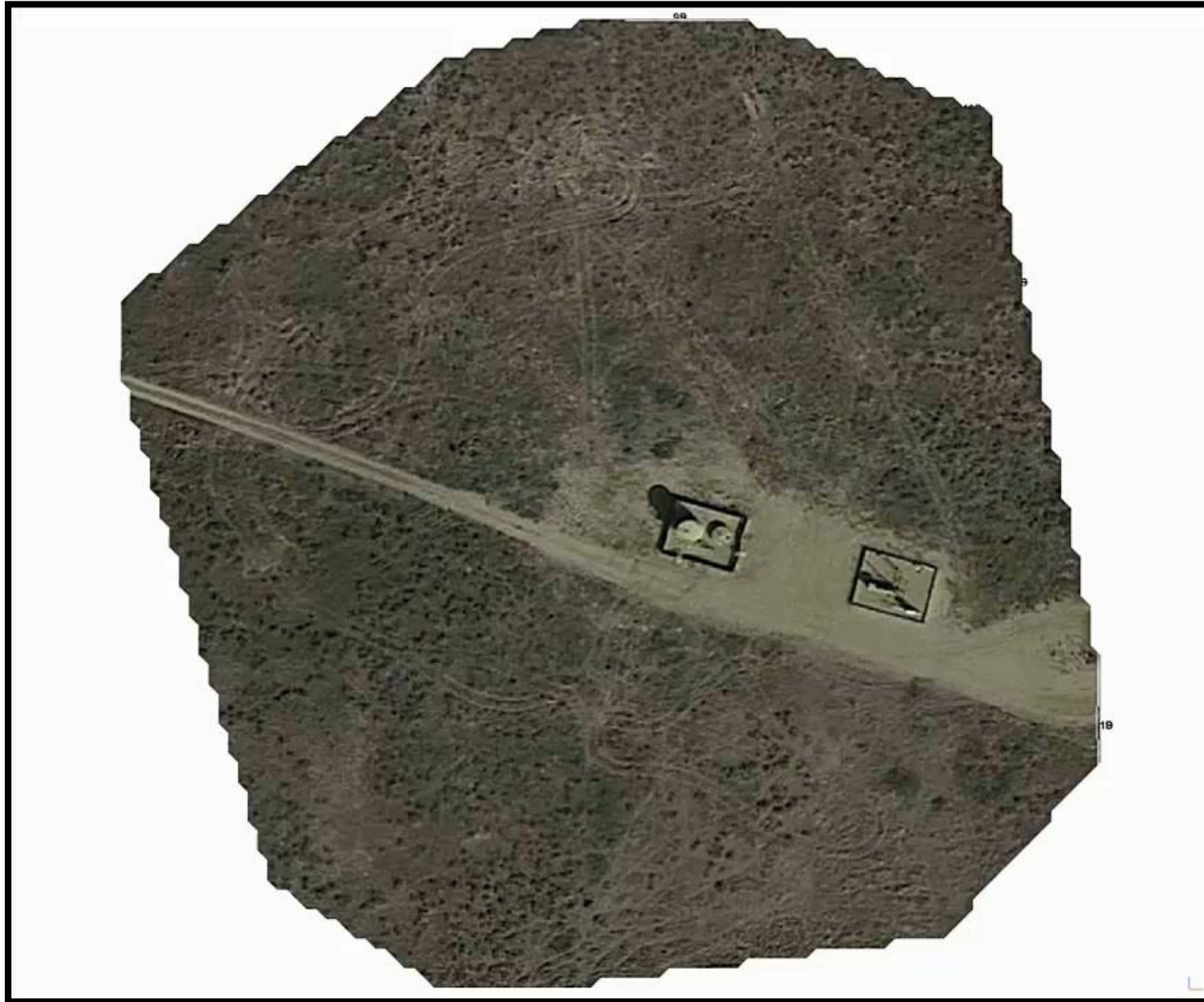




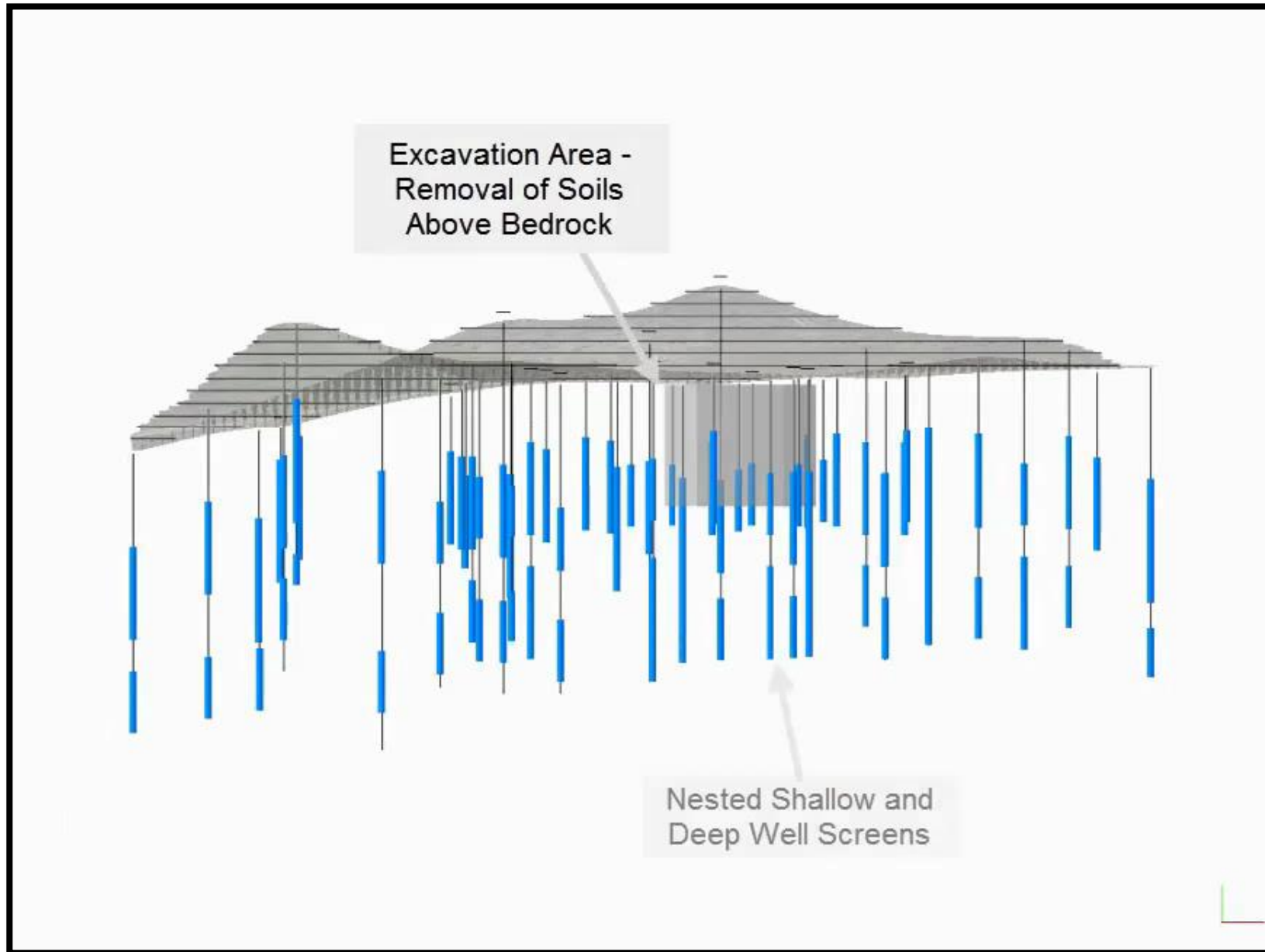
# **GEOLOGIC MODEL OF PETROLEUM SPILL**

- ▶ **TANK FAILURE**
- ▶ **LOSS OF PETROLEUM PRODUCT TO SUBSURFACE**
- ▶ **NEED TO TRACK RATE/DIRECTION OF MIGRATION**
- ▶ **MONITORING WELL NETWORK PROVIDES DATA  
FOR GEOLOGIC AND WATER QUALITY MODELING**

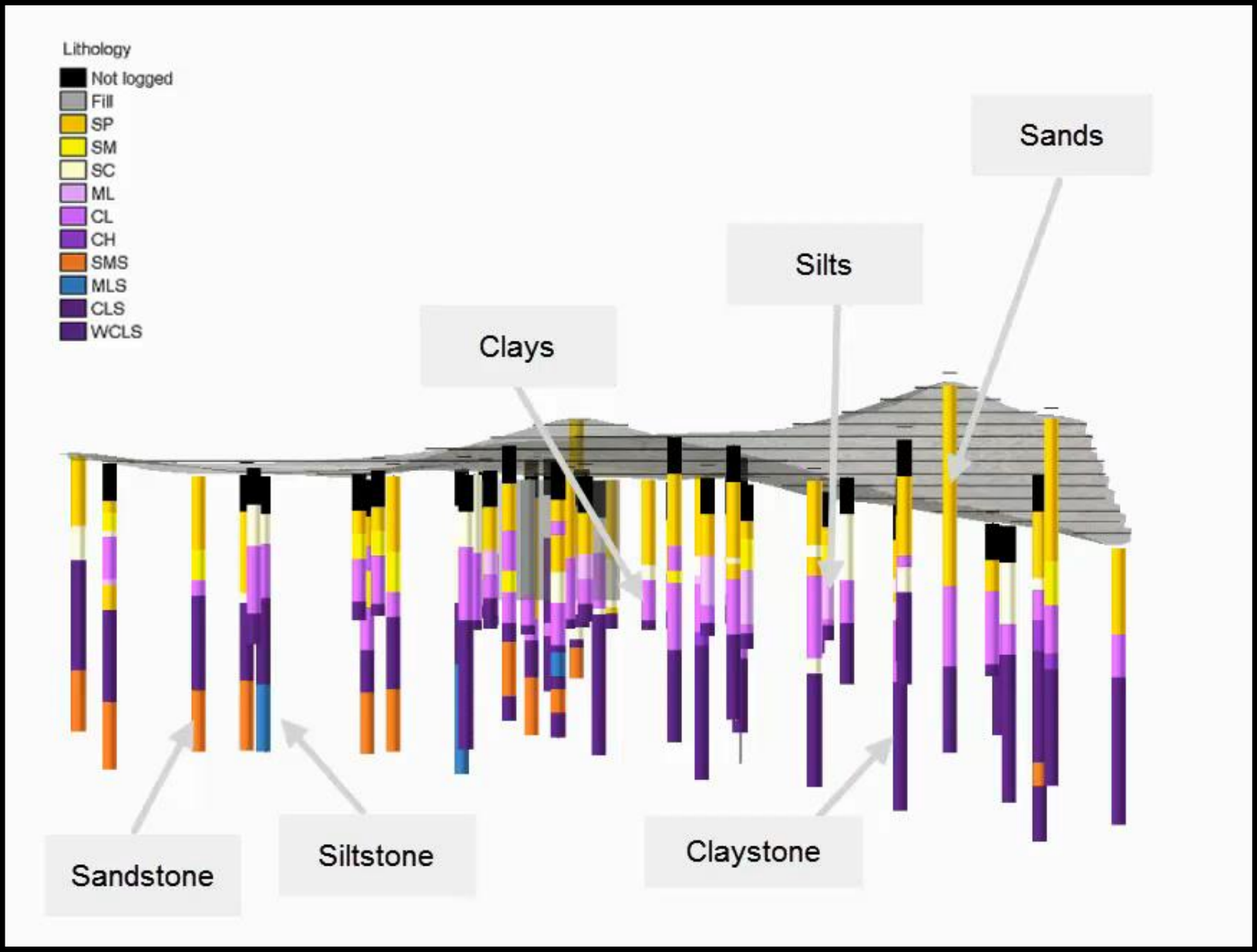
# SPILL SITE AND MONITORING WELLS



# MONITORING WELLS AND GEOLOGY

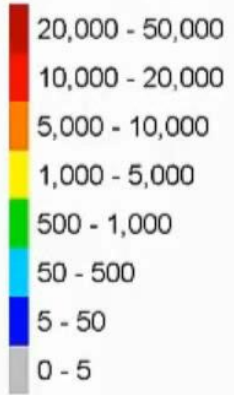


# BEDROCK SURFACE AND WATER LEVELS

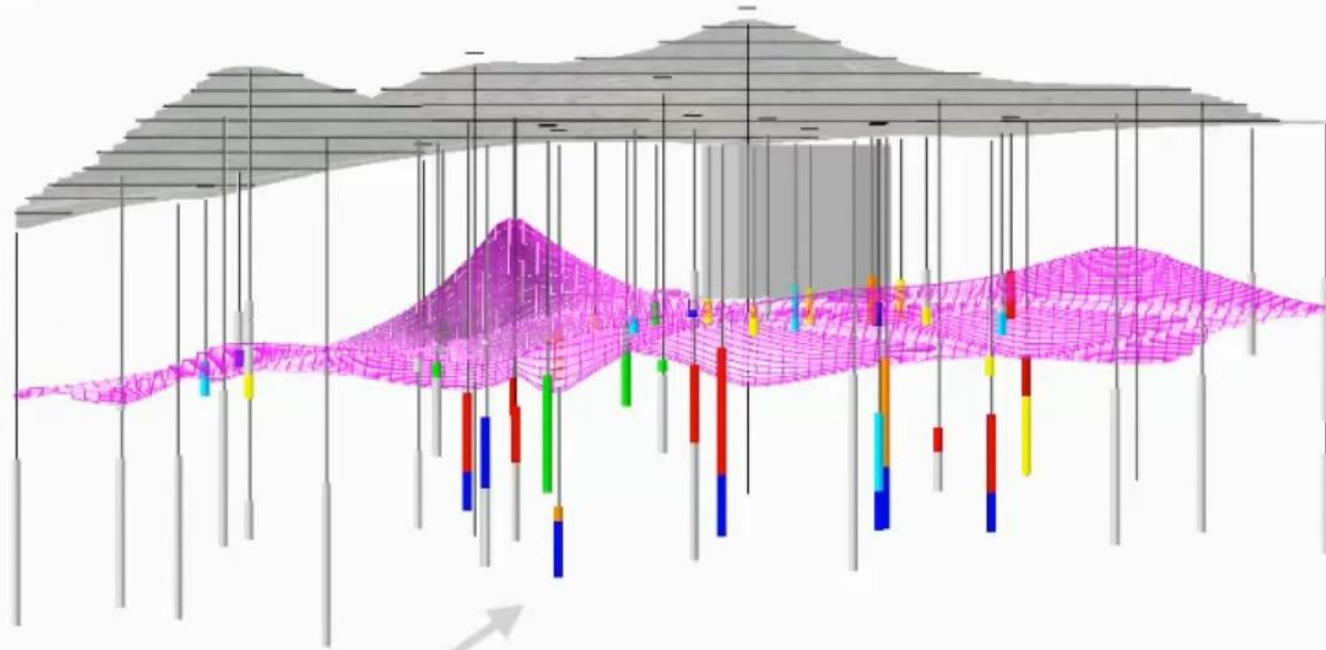


# BENZENE CONCENTRATIONS

Benzene (ppb)

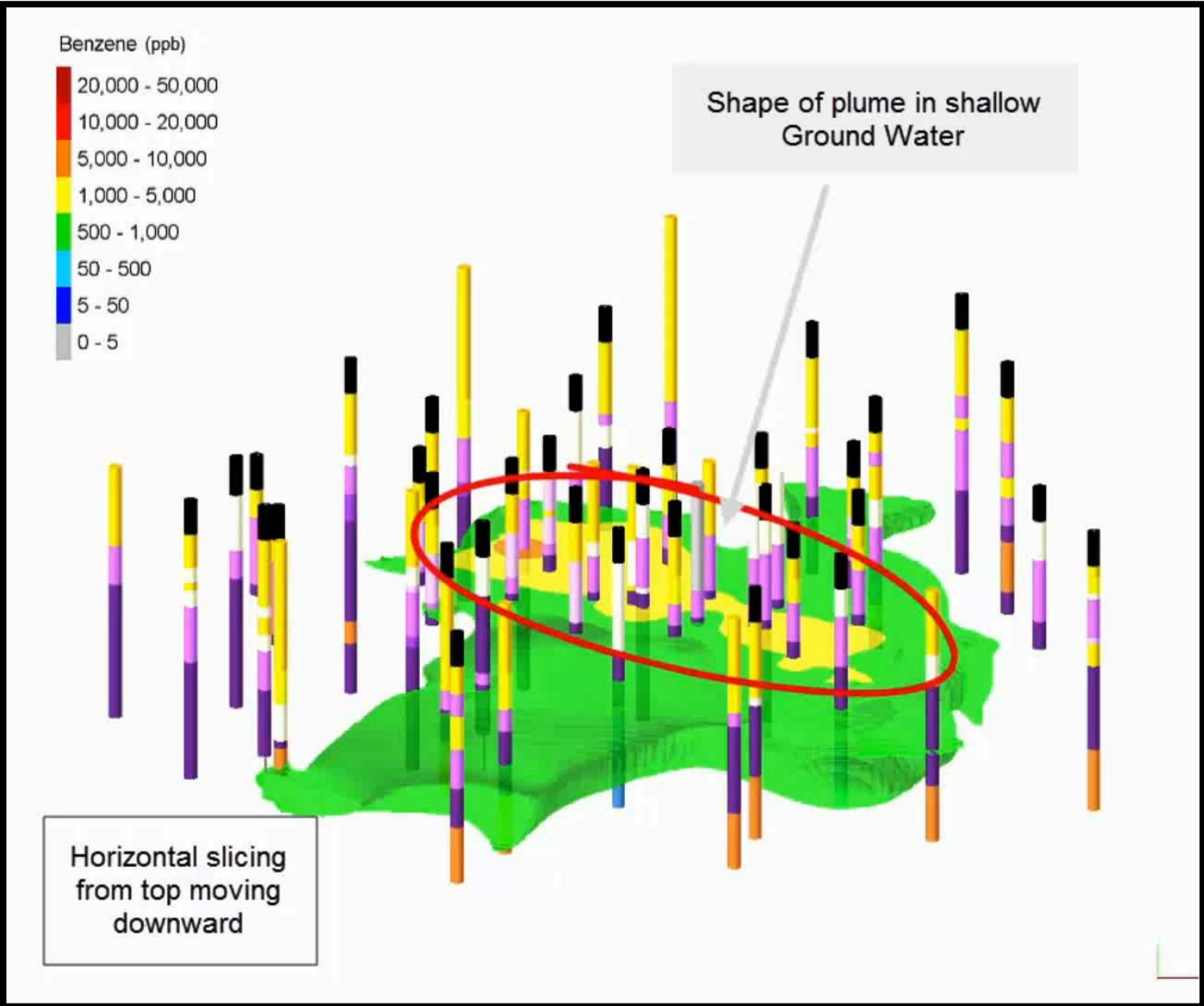


Most impact is below bedrock surface.



Vertical Distribution of Benzene Concentrations in Ground Water

# BENZENE PLUME



# USES FOR GEOLOGIC PLUME MODEL

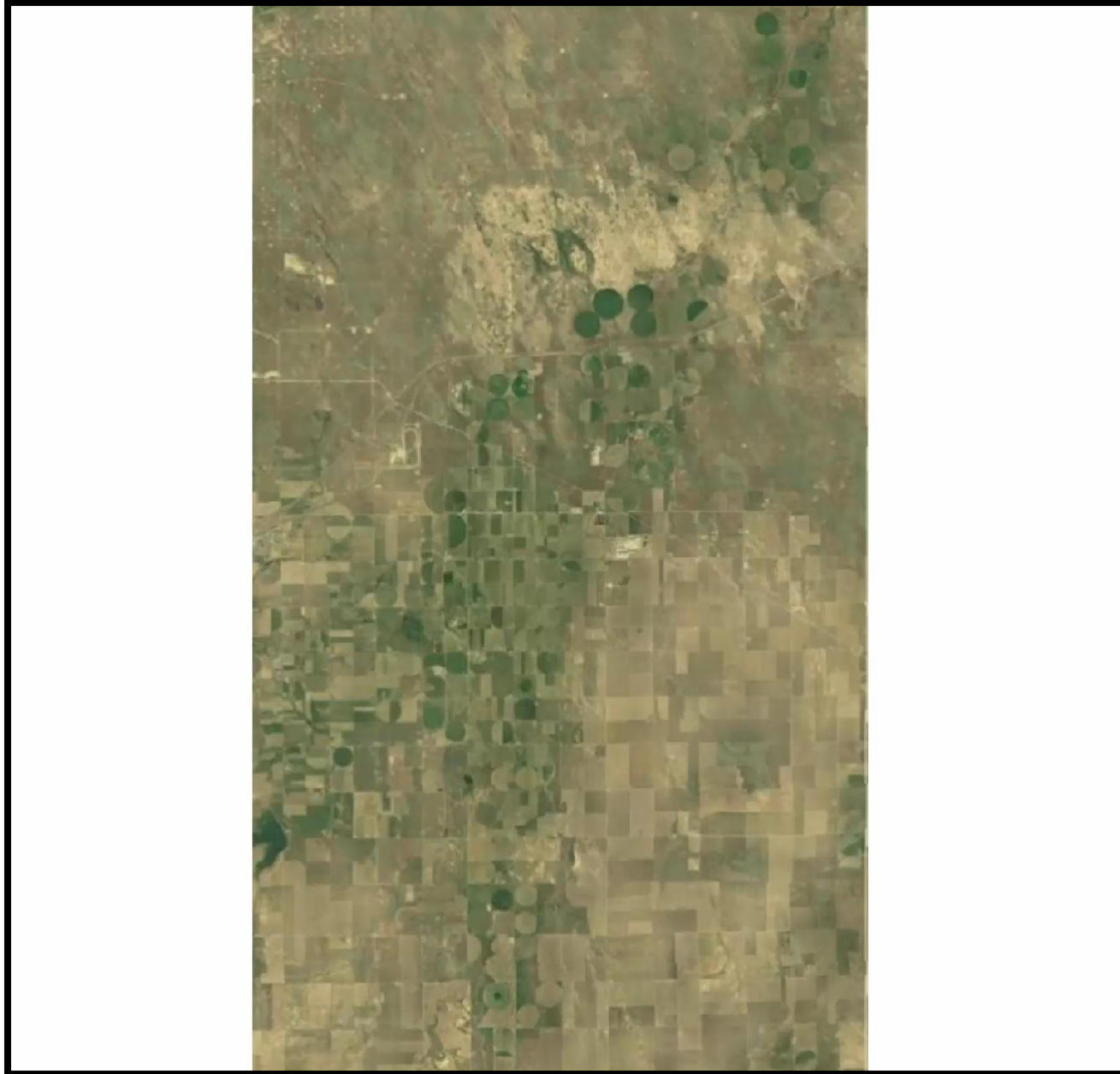
- ▶ IDENTIFIED AREAS WHERE VERTICAL MIGRATION OCCURRING
- ▶ IDENTIFIED DIRECTION AND MOVEMENT OF PLUME
- ▶ USED FOR DEMONSTRATING REMEDIATION
- ▶ SNAPSHOTS OF MAGNITUDE AND EXTENT OF CONTAMINATION

# **FLOW MODEL OF CONTAMINANT RELEASE AND PARTIAL CAPTURE**

- ▶ **432 mi<sup>2</sup> BASIN**
- ▶ **ALLUVIAL AQUIFER WITH LOW-PERMEABILITY  
BASEMENT ROCK**
- ▶ **PREFERENTIAL FLOW BASED ON HYDRAULIC  
CONDUCTIVITY**
- ▶ **CONSERVATIVE ION**
- ▶ **EXTENSIVE POTENTIAL RECEPTORS (ALLUVIAL  
PRODUCTION WELLS)**



# OBLIQUE VIEW OF RELEASES



# PLAN VIEW OF MIGRATION AND PARTIAL CAPTURE



# **USES FOR TIME SERIES CONTAMINANT MODEL AND VIDEO**

- ▶ **DEMONSTRATE MIGRATION OF A PLUME IN TIME AND SPACE**
- ▶ **EVALUATE INTENTIONAL/UNINTENTIONAL CAPTURE OF CONTAMINANTS**
- ▶ **CAN DO SLICES THROUGH PLUME TO EVALUATE VERTICAL MIGRATION**
- ▶ **MANAGE AQUIFER USE BASED ON CONTAMINATION**

# MODELING AND 3D VIDEOS



by



[www.lytlewater.com](http://www.lytlewater.com)

[www.rockware.com](http://www.rockware.com)

***VIDEOS CAN BE VIEWED AT  
<https://www.lytlewater.com/lws-youtube/>***

**THANK YOU!**

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