Geospatial Model

Vashon Island Transfer Station & Former Landfill

Prepared for

Closed Landfills & Environmental Engineering Group

KC DNRP/SWD Engineering Services Section

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206-296-8029

King County

Content

- Geospatial model area
- Methods
  - Preparation
  - Modeling
- Results:
  - Fence diagrams
  - Base model
  - Water in Unit Cc2
  - Vinyl chloride in Unit Cc2

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Geospatial model area

LEGEND

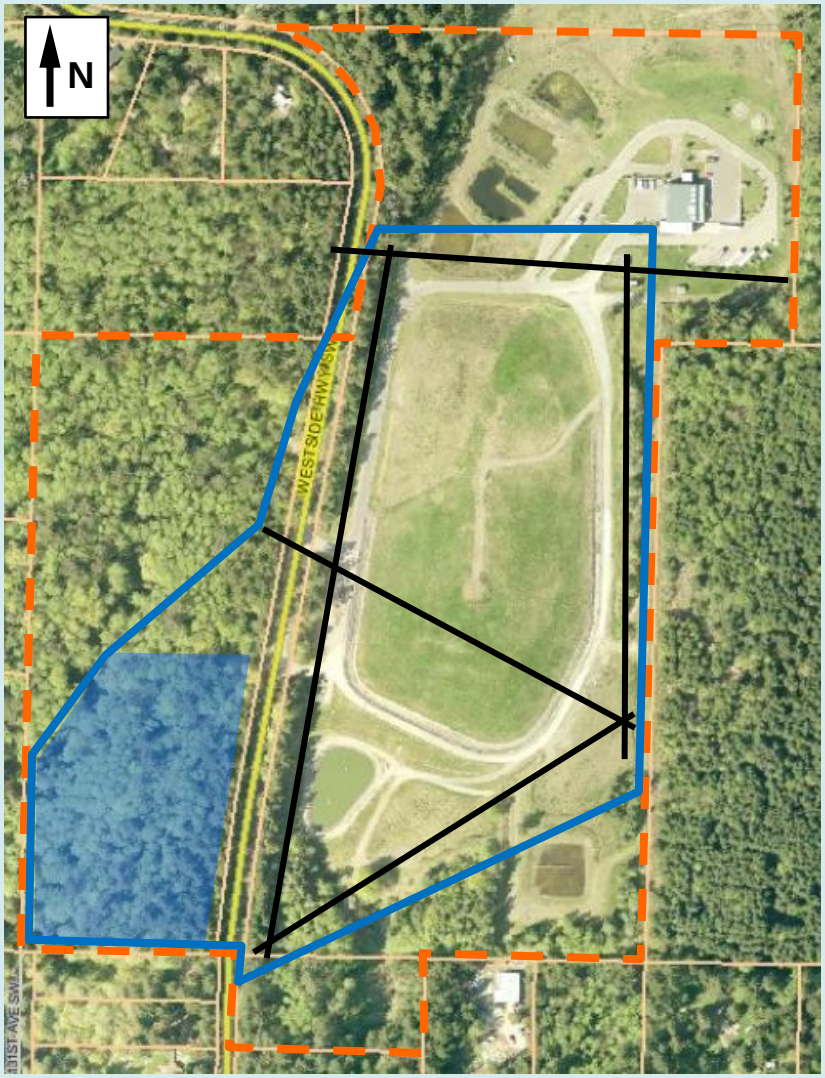
KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

Why limited to this area?



Interested in linking west hillslope data to main landfill area and locations of geologic cross sections.

LEGEND

- Western hillslope study area
- Cross section lines
  (B&H/UES,2006)
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

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Methods

- Preparation
- Modeling
  - Base model
  - Water in Cc2 unit
  - Vinyl chloride in Cc2 unit

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Preparation

- Reviewed reports for geologic logs, cross sections and surface maps
- Identified X, Y and Z for all data points
- Converted all report CAD drawings into dxf files for use in Rockworks15
- Generated spreadsheets with XYZ data, stratigraphic unit information and well construction details into files compatible for importing into RockWorks15

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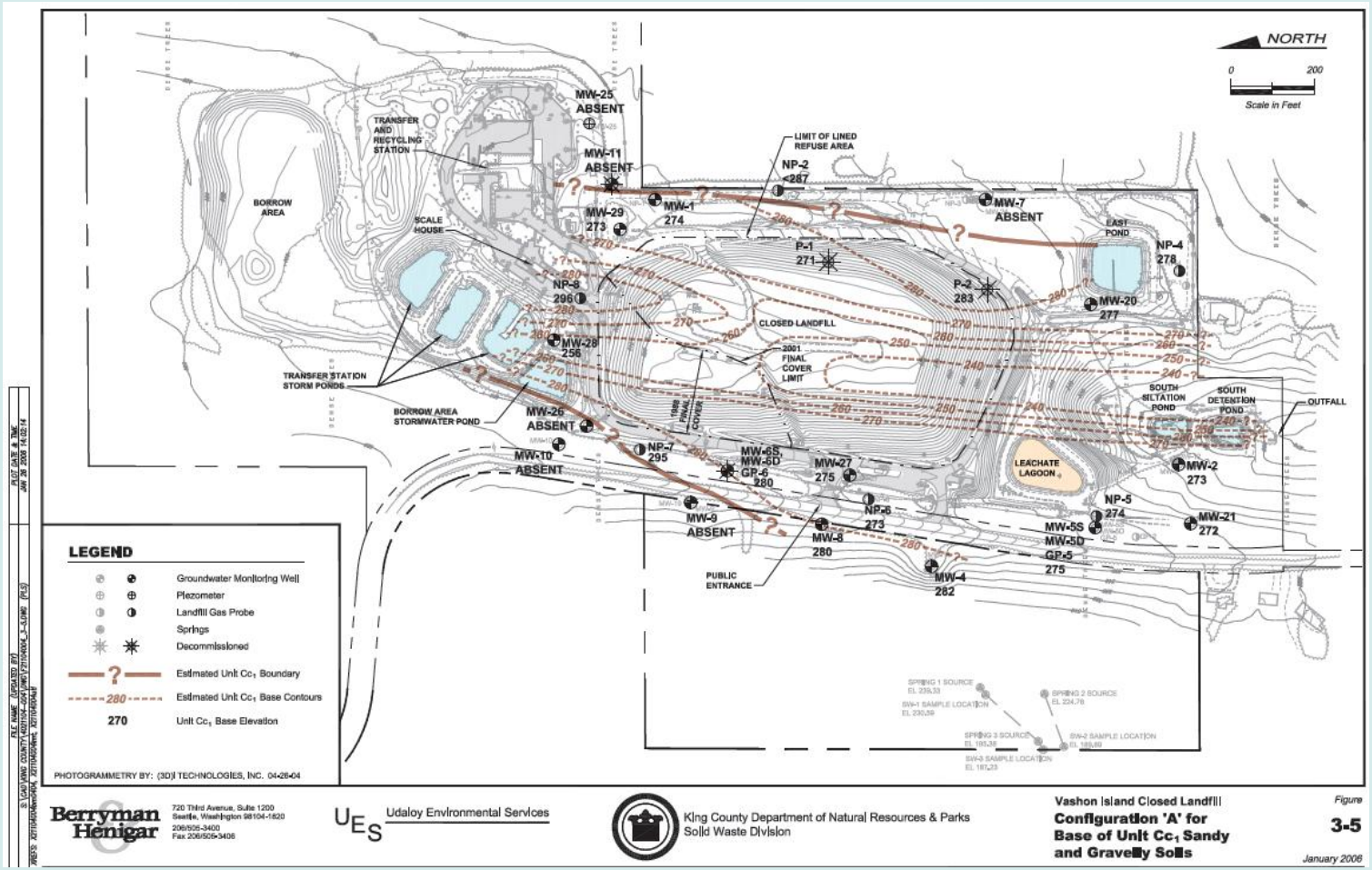
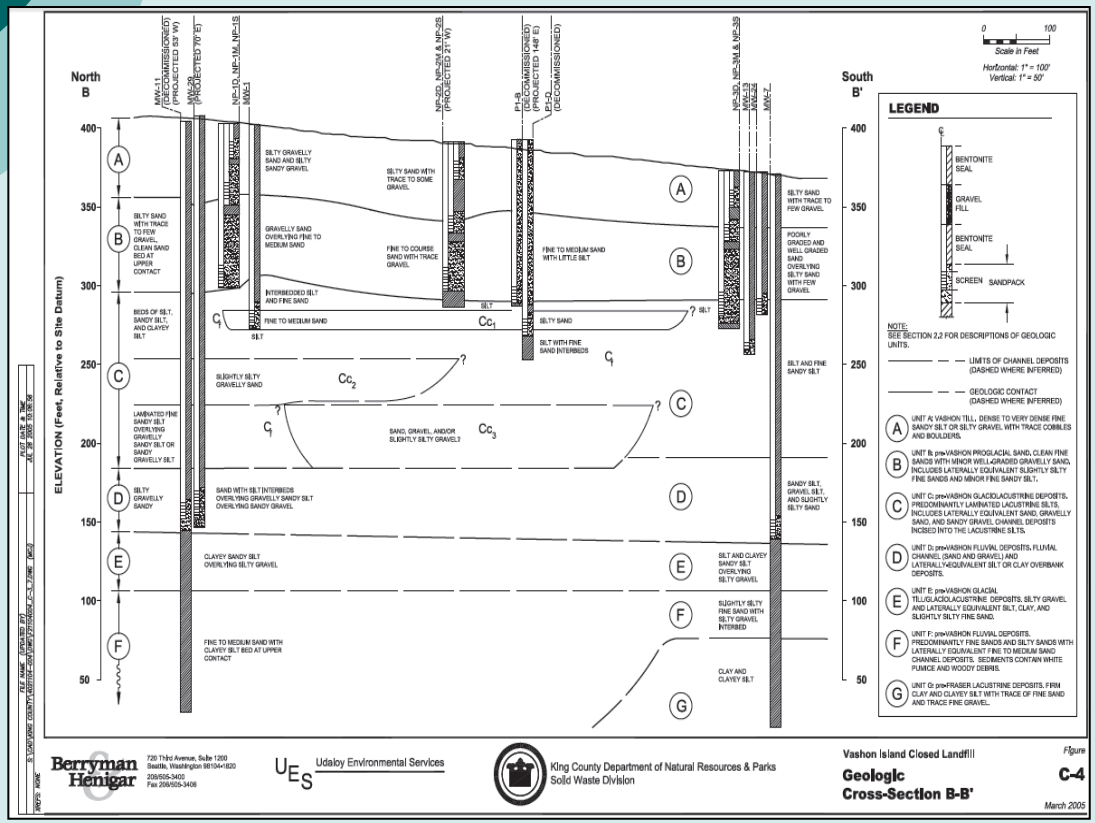
Preparation – examples of data sources

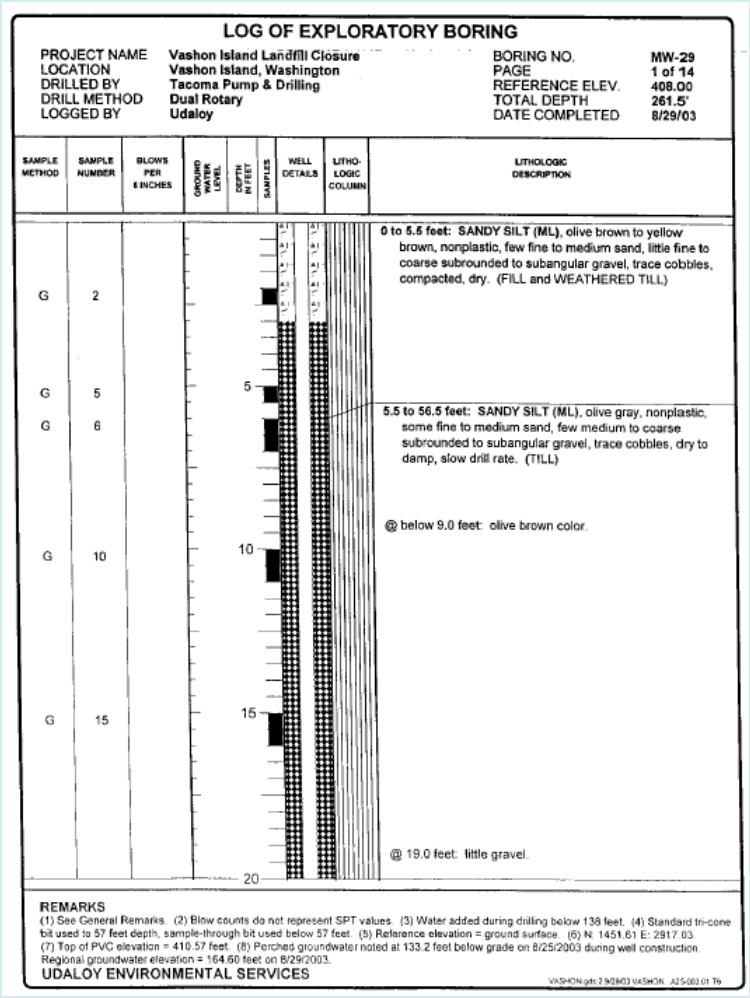
- Unit base contour maps *(B&H/UES,2006)*



Preparation – examples of data sources

- Logs and cross sections *(B&H/UES,2006)*





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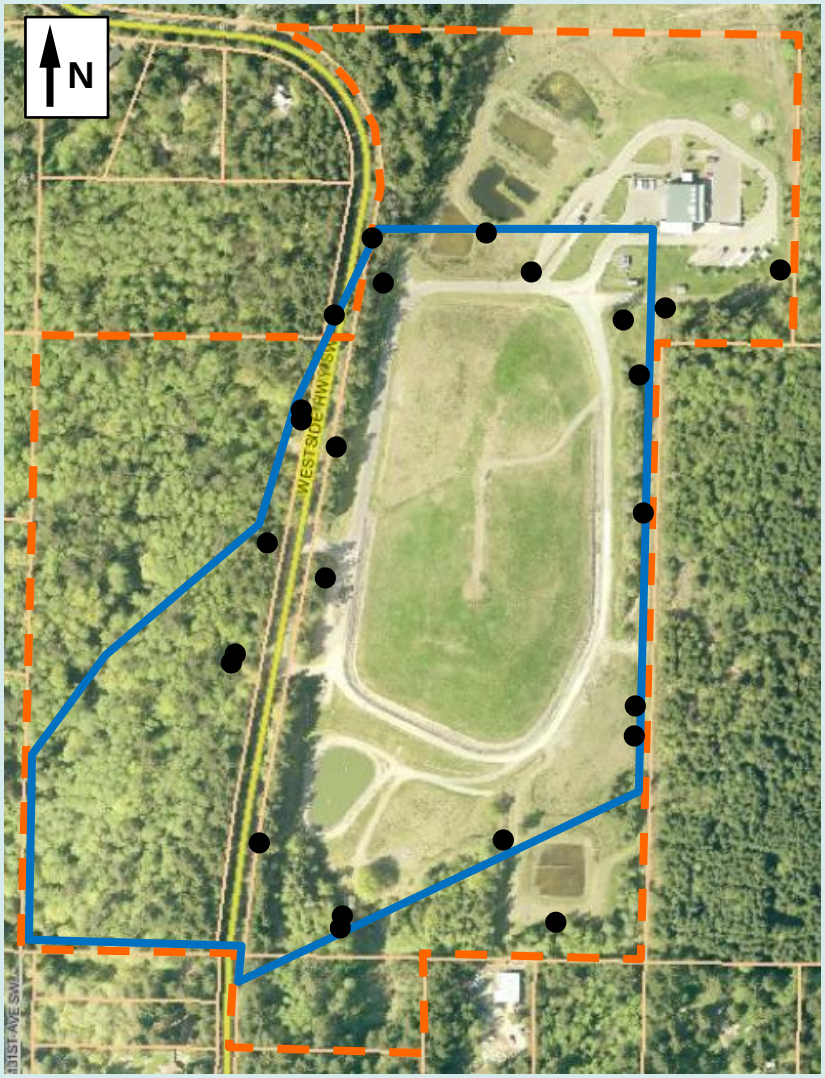
Preparation - Initial data points



LEGEND

- Initial data points (wells and boreholes)
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

King County

Modeling

- Initial tasks
- Adding data points to refine model
- Finalize draft model for all but water in Cc2 unit
- Adding water level data to Unit Cc2 layer
- Finalize draft model with water in Cc2 unit
- Adding vinyl chloride data to Unit Cc2 layer

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Modeling – initial tasks

- Imported XYZ and stratigraphic data into RockWorks15 project file.
- Ran series of gridding options for layers
- Ran fence diagram model and solid model
- Model needed physical lateral and vertical extent boundaries for excavations, ponds, landfill base, eroded areas, and each unit. Added control points based on cross-sections, additional stratigraphy data, and surface contour maps

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Modeling – Refining model

- Additional data points
  - Western hillslope study
  - Southern hillslope study
- Control points
  - Landfill, excavation and pond features
  - Geologic cross sections
  - Base of unit data and control points
  - Missing Unit A control points

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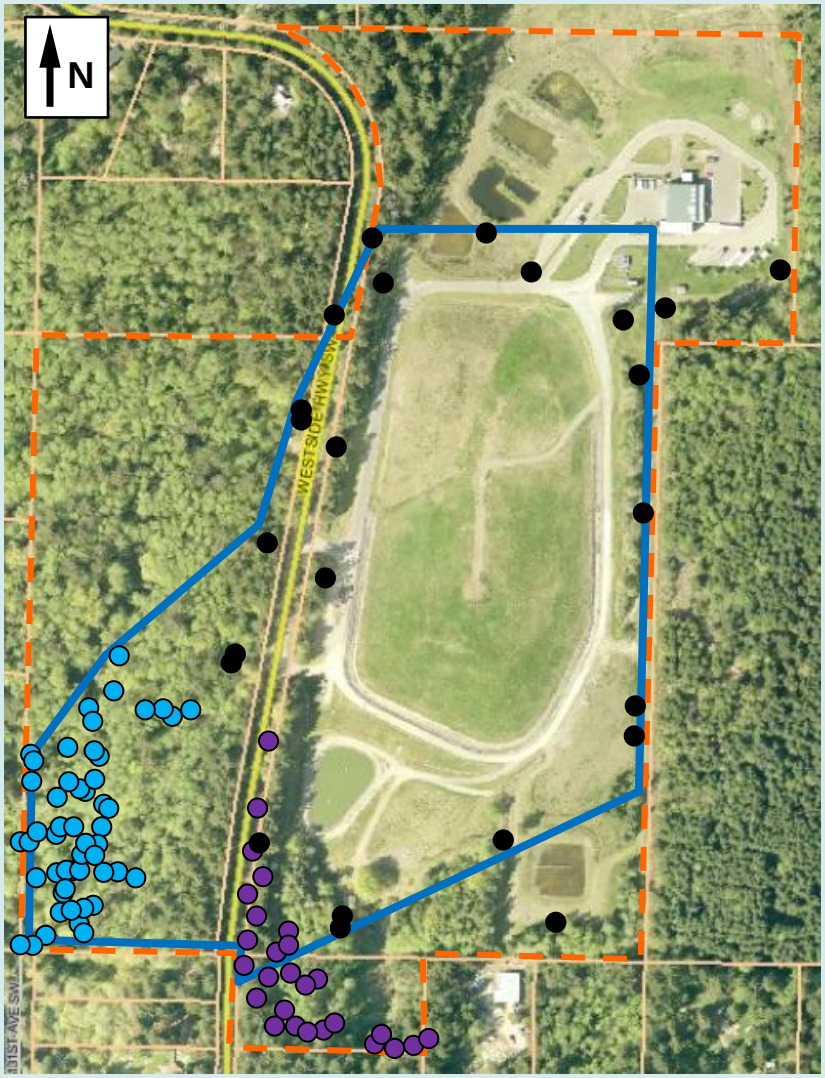
Modeling – Additional data points

- Western hillslope study
  - Purpose was to characterize hillslope connection with landfill area geology and to map saturated areas
  - Shallow sediment descriptions
  - Surface mapping
  - Results presented in report
- Southern hillslope study
  - Purpose was to evaluate if Cc1 unit was saturated at surface
  - Shallow sediment descriptions
  - Surface mapping
  - Results presented in report

Modeling – Additional data points



LEGEND

- Initial data points (wells and boreholes)
- Southern hillslope study
- Western hillslope study
- KC SWD property
- Geospatial model area

0 800 feet

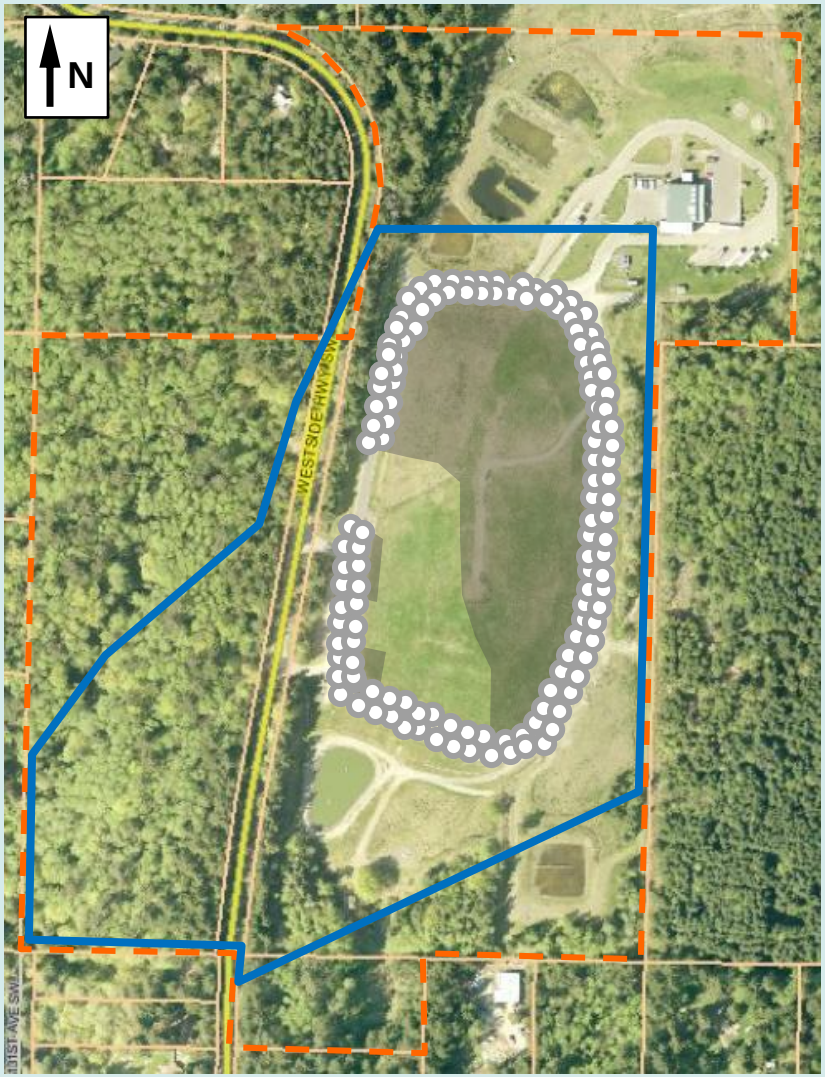
Note: Locations are approximate

King County

Modeling – Control points

- Landfill base and outline
- Excavation bases and outlines
- Pond bases and outlines
- Geologic cross section control points
- Base of Units A, Cc1, Cc2 and Cc3 data and control points
- Areas where Unit A is likely missing due to erosion in creek area

Modeling – Landfill base and outline control points



LEGEND

- Landfill base control point area

  Note: Shaded area has many points. Too many to post for clarity at this scale. Base from B&H/UES,2006 and B&H et al, 2001.

- Landfill outline control points

  Note: Total number of points not actually shown. Too many to post for clarity at this scale. Outline from B&H/UES,2006.

- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Excavation base and outline control points

LEGEND

Excavation base control point area

Note: Shaded area has many points. Too many to post for clarity at this scale. Base from B&H/UES,2006.

Excavation outline control points

Note: Total number of points not actually shown. Too many to post for clarity at this scale. Outline from B&H/UES,2006.

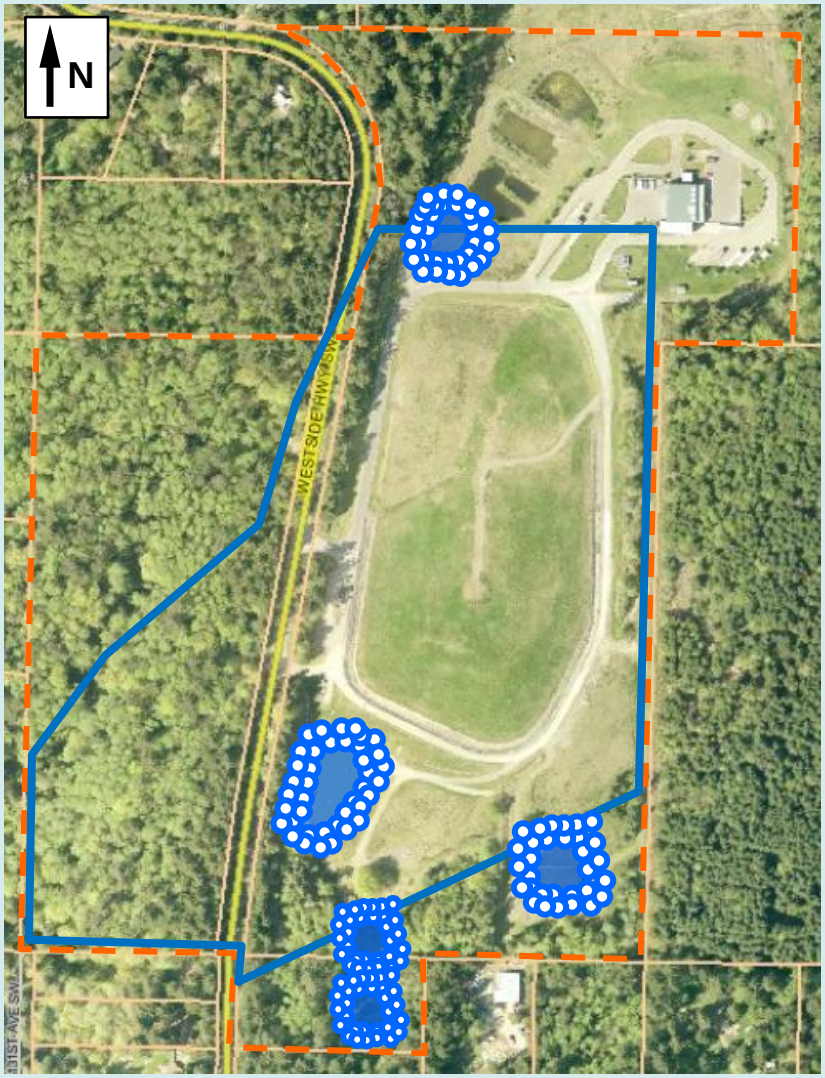
KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Pond base and outline control points



LEGEND

Pond base control point area

Note: Shaded area has many points. Too many to post for clarity at this scale. Base from B&H/UES,2006.

Pond outline control points

Note: Total number of points not actually shown. Too many to post for clarity at this scale. Outline from B&H/UES,2006.

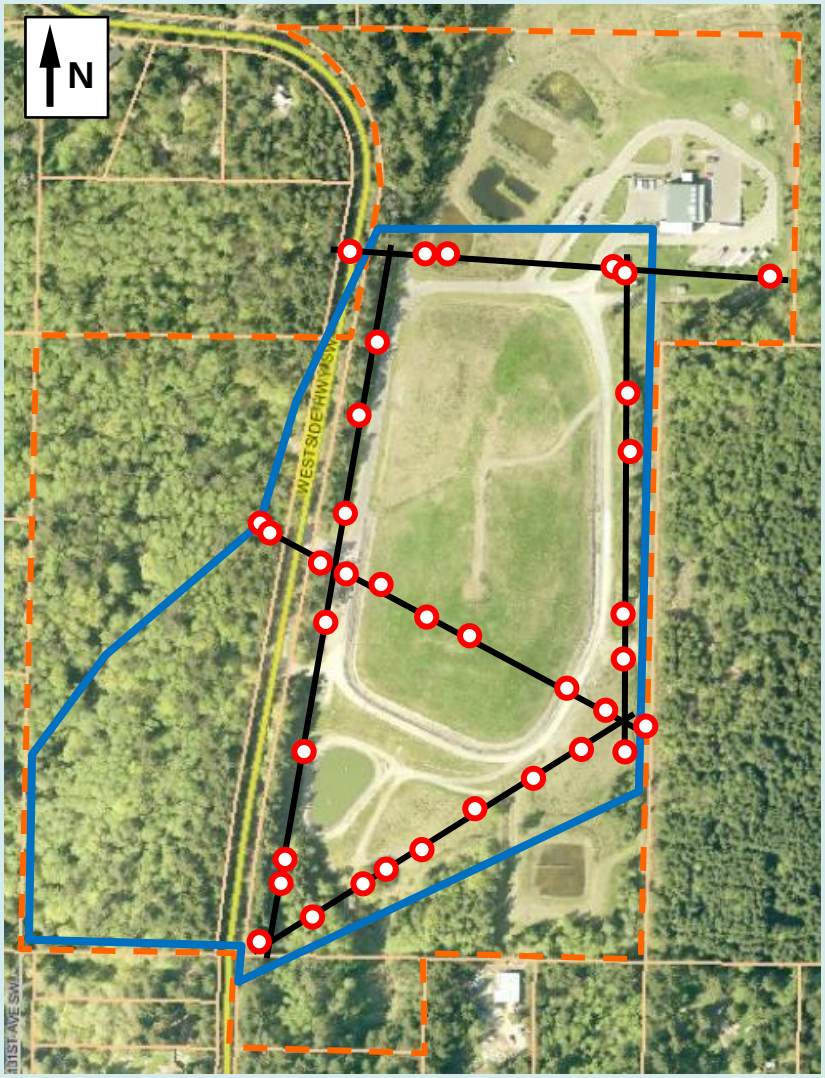
KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Cross section control points



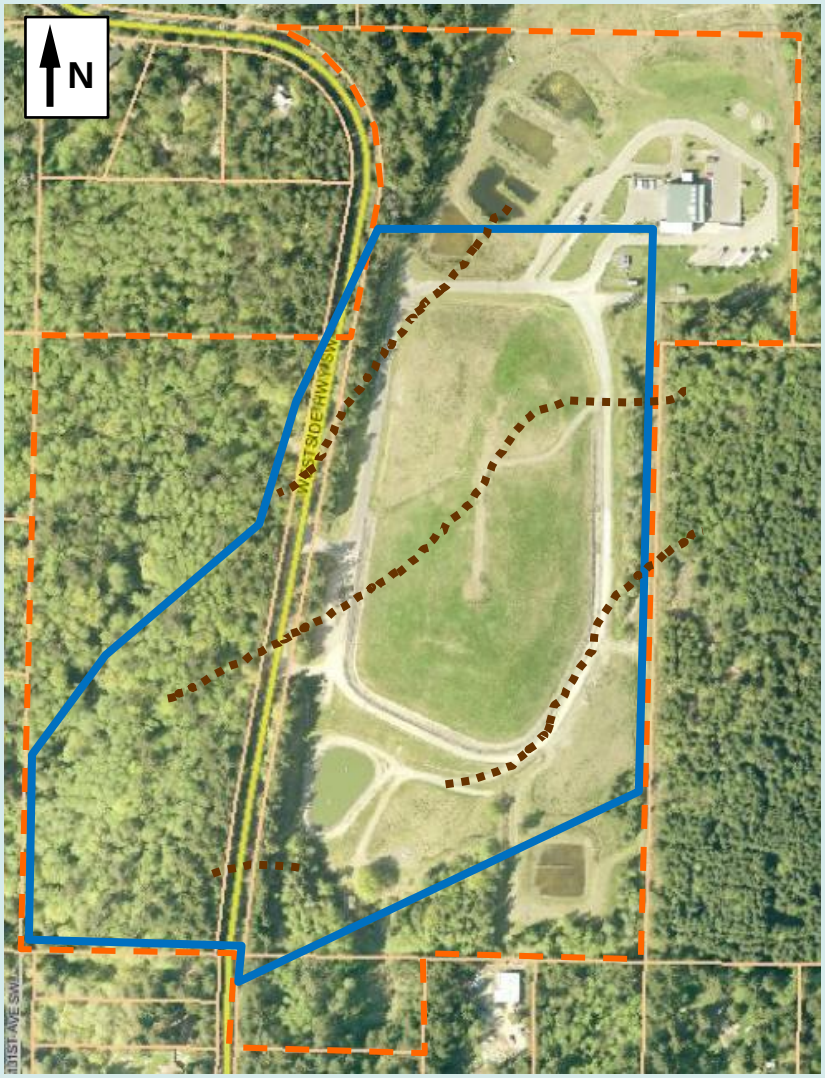
LEGEND

- Cross section control points
  Cross section lines from B&H/UES,2006.
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Unit A base data points



LEGEND

Base of Unit A data points

Note: Total number of points along line not actually shown. Too many to post for clarity at this scale. Base A lines from B&H/UES,2006.

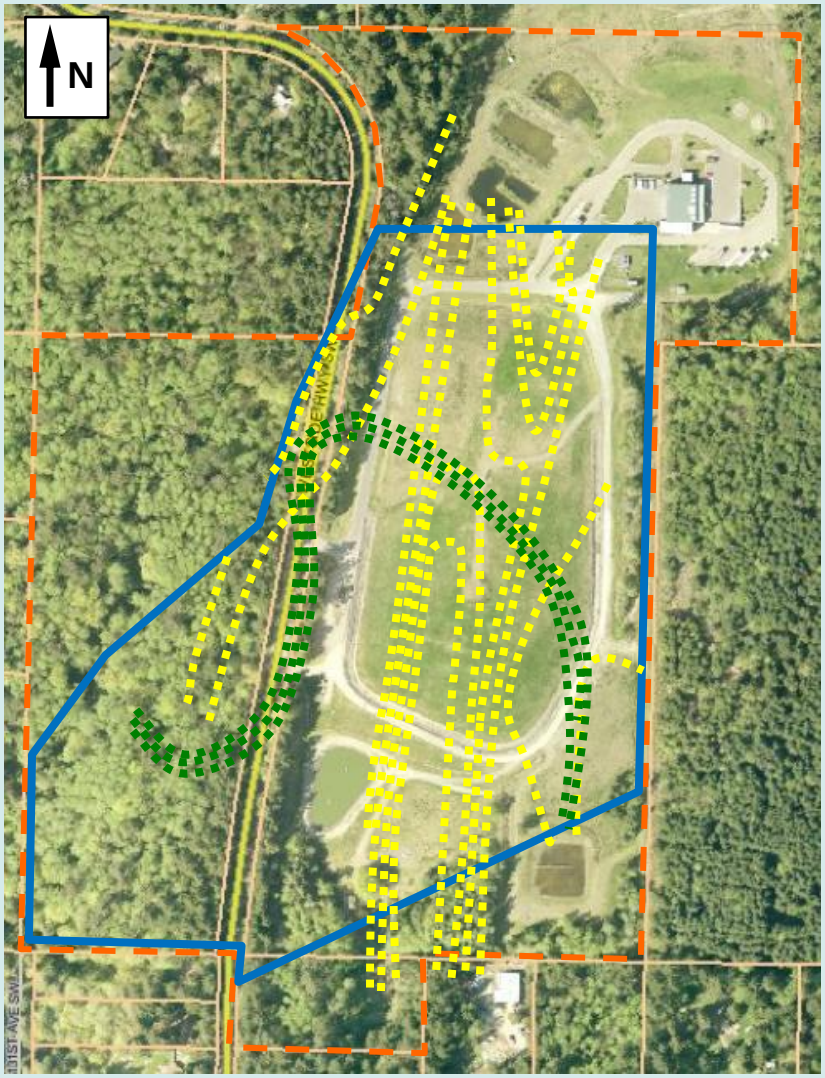
KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Unit Cc1 data and control points



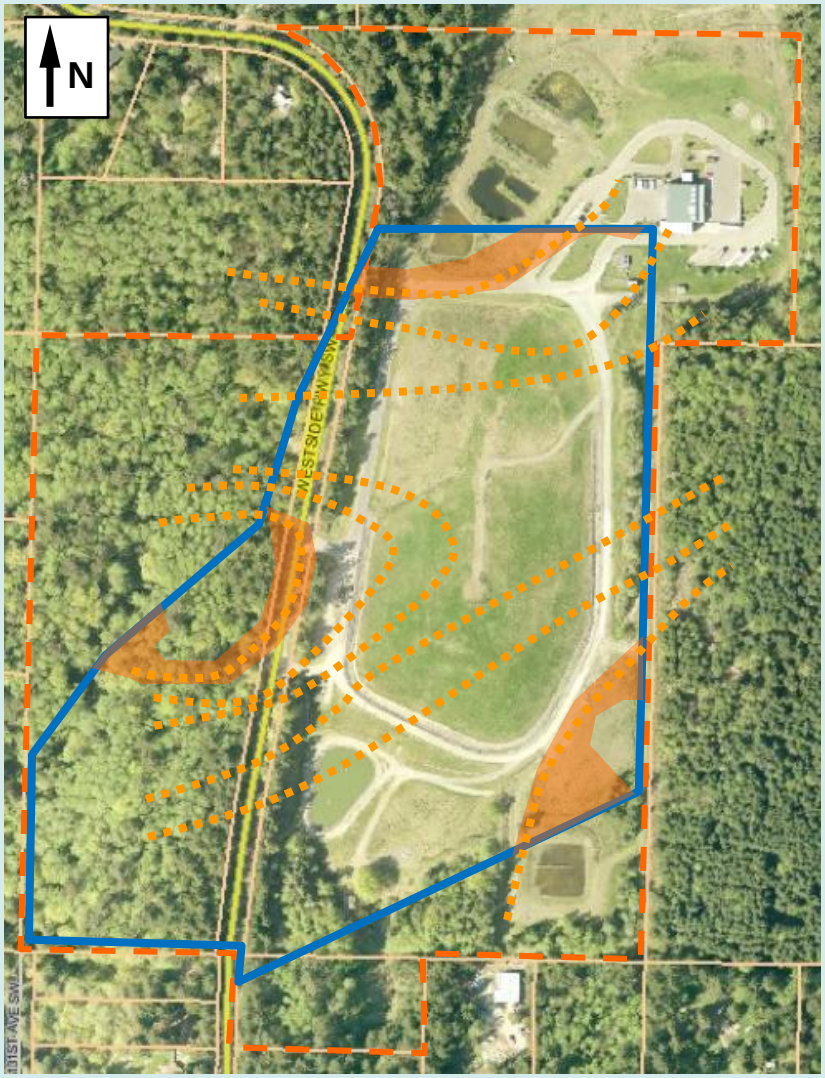
LEGEND

- Top of Unit Cc1 control points
  - *Note: Total number of points along line not actually shown. Too many to post for clarity at this scale. Top Cc1 lines from B&H/UES,2006.*
- Base of Unit Cc1 data points
  - *Note: Total number of points along line not actually shown. Too many to post for clarity at this scale. Base Cc1 lines from B&H/UES,2006.*
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Unit Cc2 base data and control points



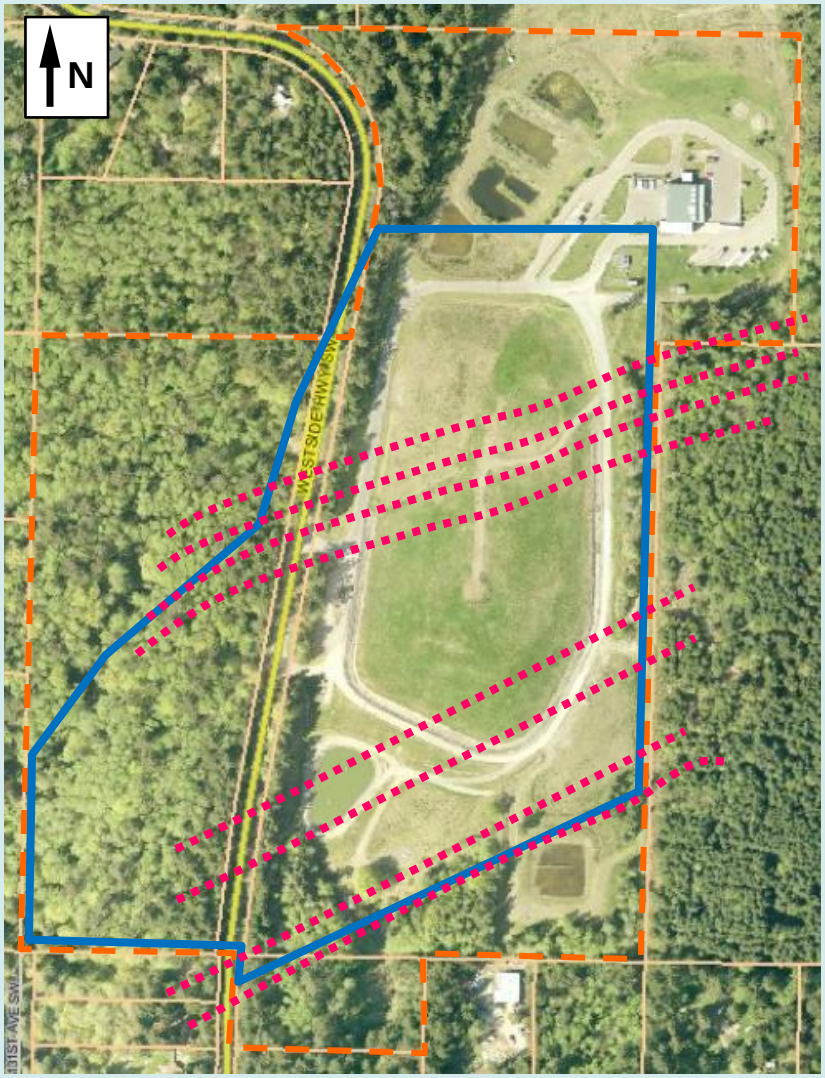
LEGEND

- Base of Unit Cc2 control point area
  - *Note: Shaded area has many points. Too many to post for clarity at this scale. Extent of Cc2 area from B&H/UES,2006.*
- Base of Unit Cc2 data points
  - *Note: Total number of points along line not actually shown. Too many to post for clarity at this scale. Base Cc2 lines from B&H/UES,2006.*
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Unit Cc3 base data and control points



LEGEND

Base of Unit Cc3 data points

Note: Total number of points along line not actually shown. Too many to post for clarity at this scale. Base Cc3 lines from B&H/UES,2006.

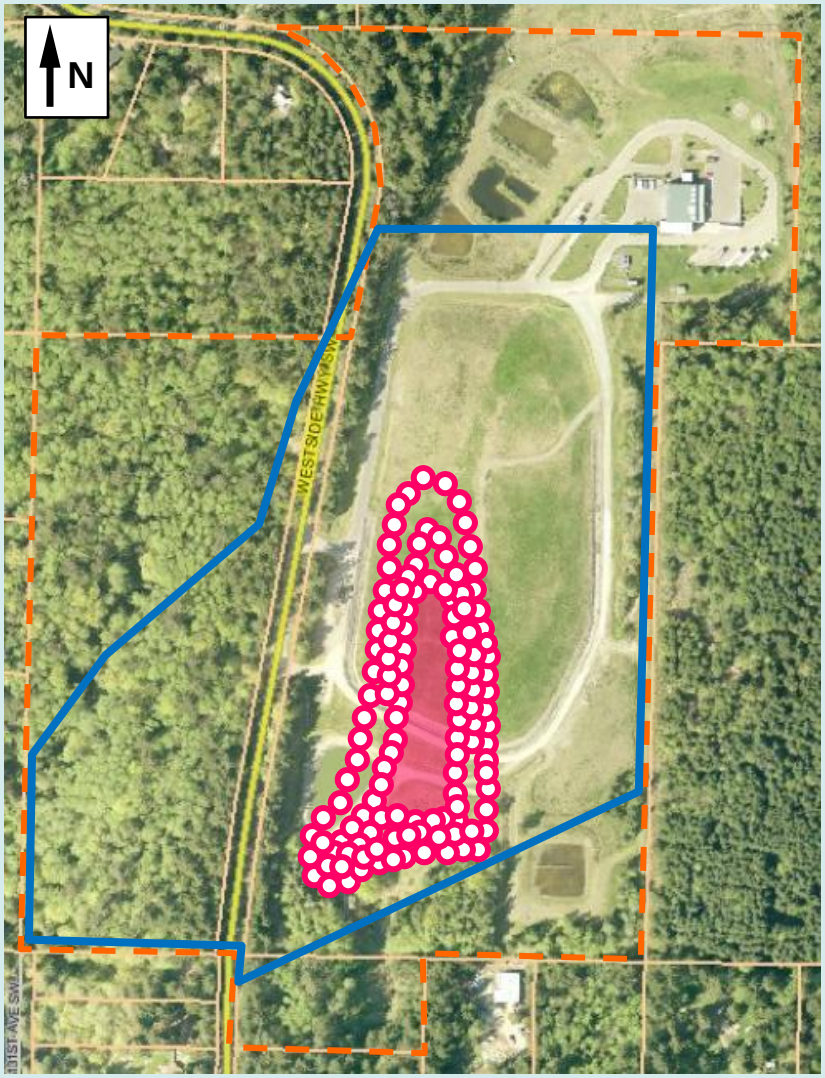
KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Missing Unit A base and outline control points



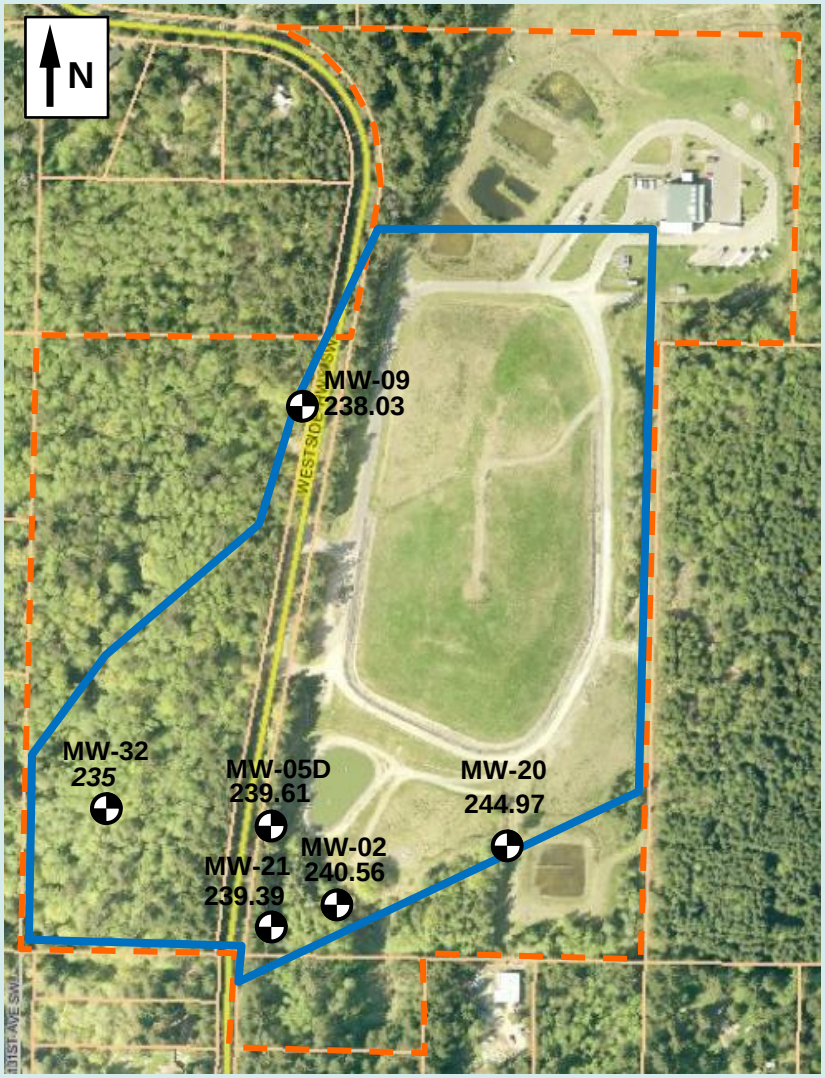
LEGEND

- Missing Unit A control point area
  - *Note: Shaded area has many points. Too many to post for clarity at this scale. Missing A area and base information from B&H/UES,2006 and topography maps.*
- Missing Unit A outline control points
  - *Note: Total number of points not actually shown. Too many to post for clarity at this scale. Base A lines from B&H/UES,2006.*
- KC SWD property
- Geospatial model area

0 800 feet

Note: Locations are approximate

Modeling – Water level data in Unit Cc2



LEGEND

MW-20
244.97

Well screened in Unit Cc2 with water level elevation *(May 2012)*

Note: MW-32 last measured in 2010. Elevation of 235 based on projection onto hillslope of water levels.

KC SWD property

Geospatial model area

0 800 feet

Note: Locations are approximate

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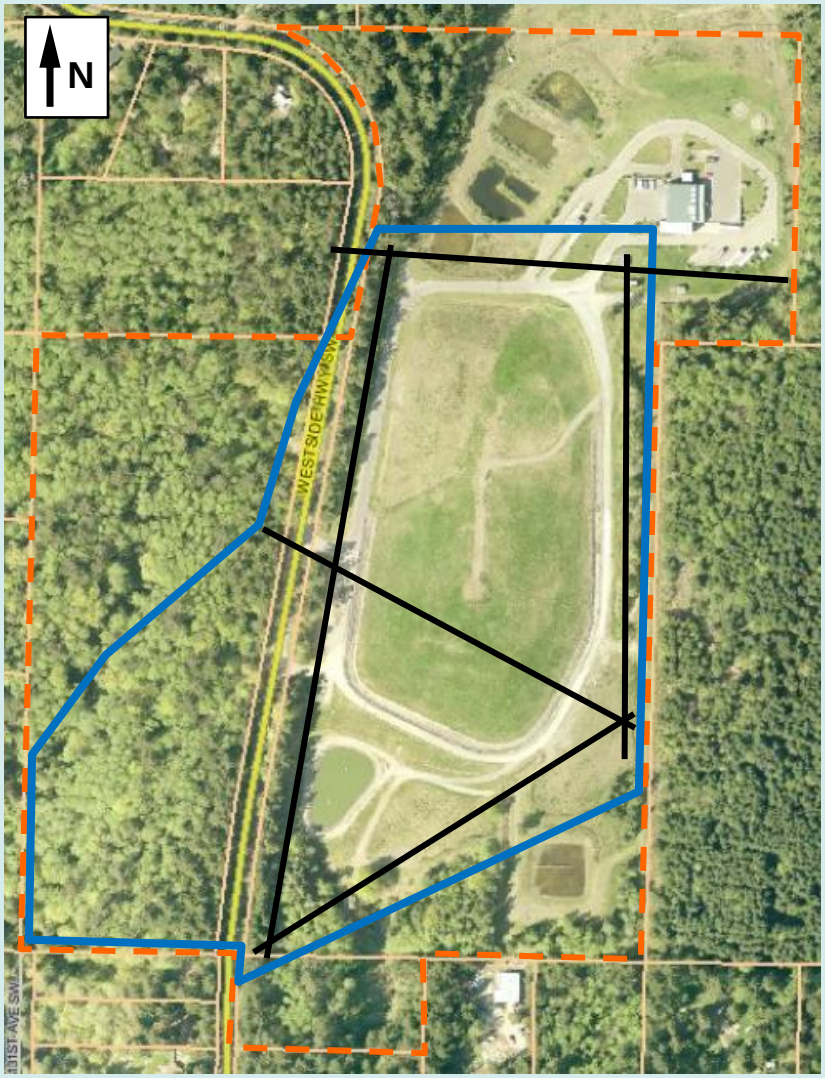
Draft Results

- Fence diagram and profiles
- Base model
- Saturation in Cc2 unit
- Vinyl chloride in Cc2 unit

Fence diagram and profiles



The following slides compare modeled cross sections with drawn cross sections from the VASHON ISLAND CLOSED LANDFILL ENVIRONMENTAL EVALUATION report *(B&H/UES, 2006)*

LEGEND

Fence diagram locations

KC SWD property

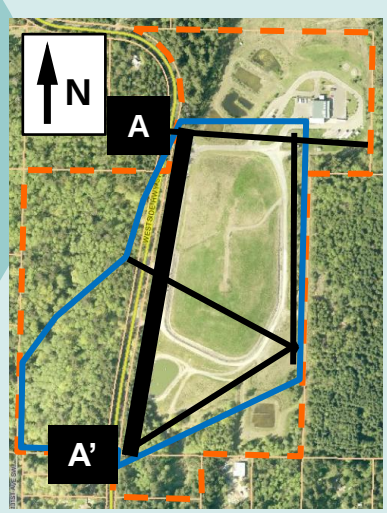
Geospatial model area

0 800 feet

Note: Locations are approximate

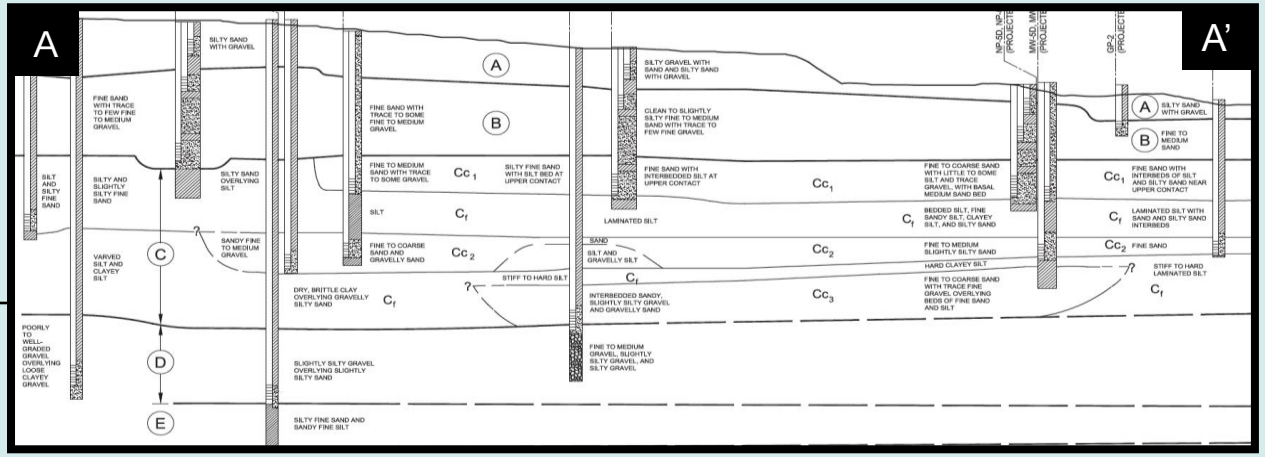
King County

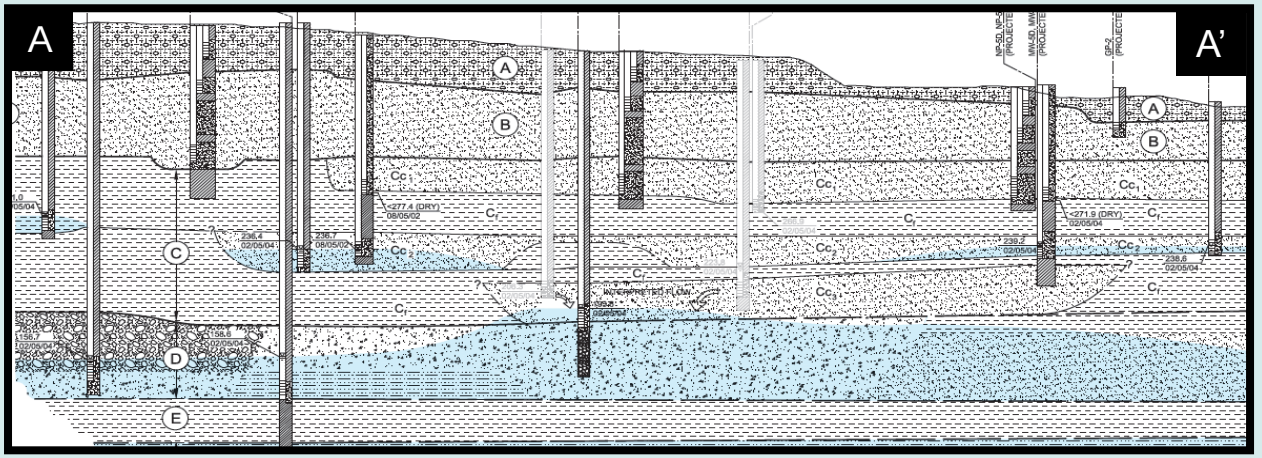
A-A’

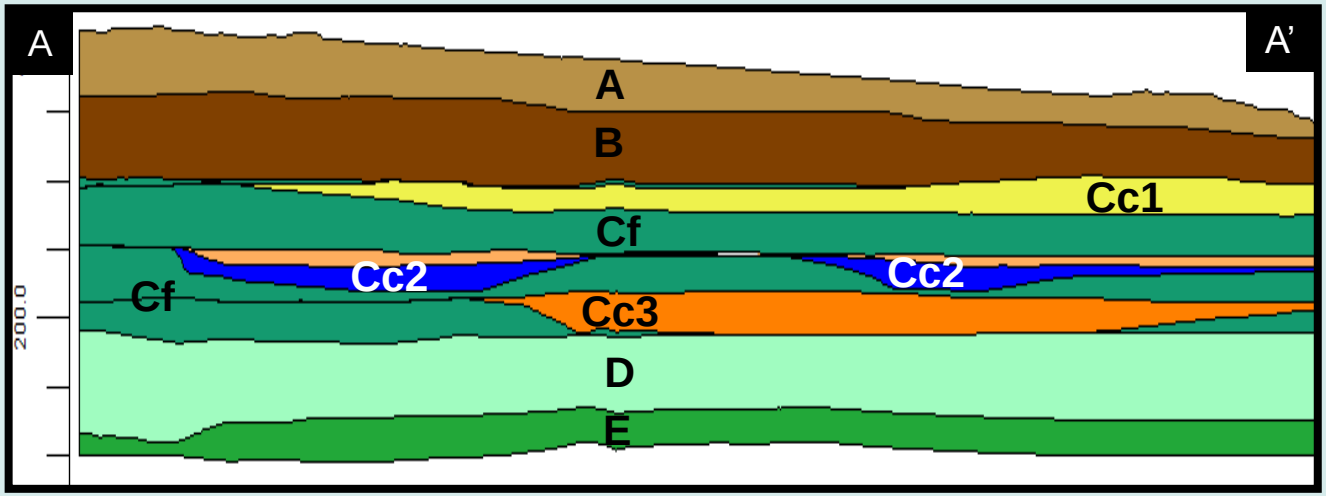


0 800 feet

Stratigraphy
- Ponds
- LF
- AF
- A
- B
- Cf1
- Cc1
- Cf2
- Cc2
- Water
- Cf3
- Cc3
- Cf4
- D
- E

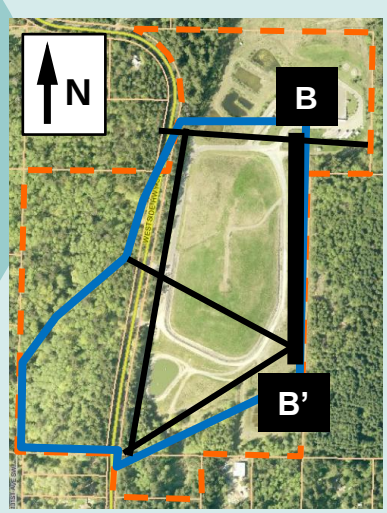






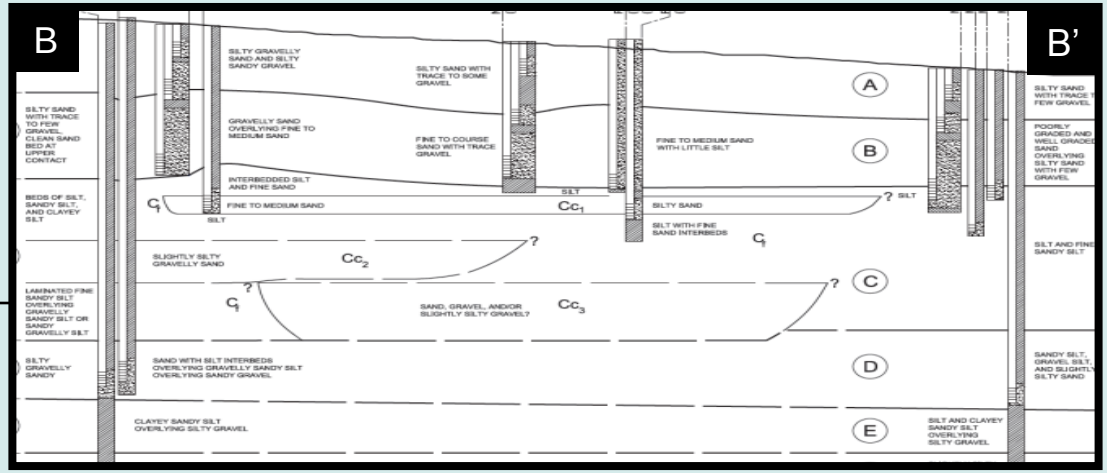
King County

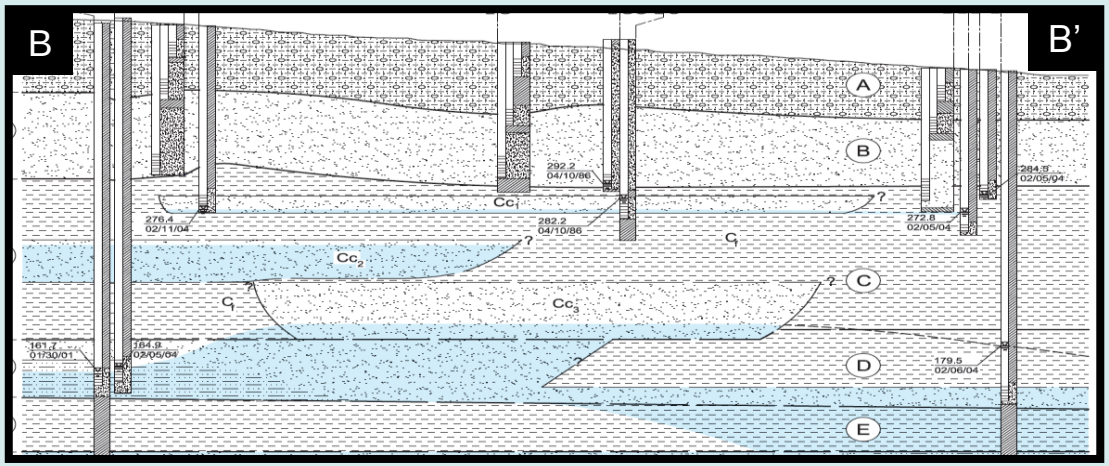
B-B’

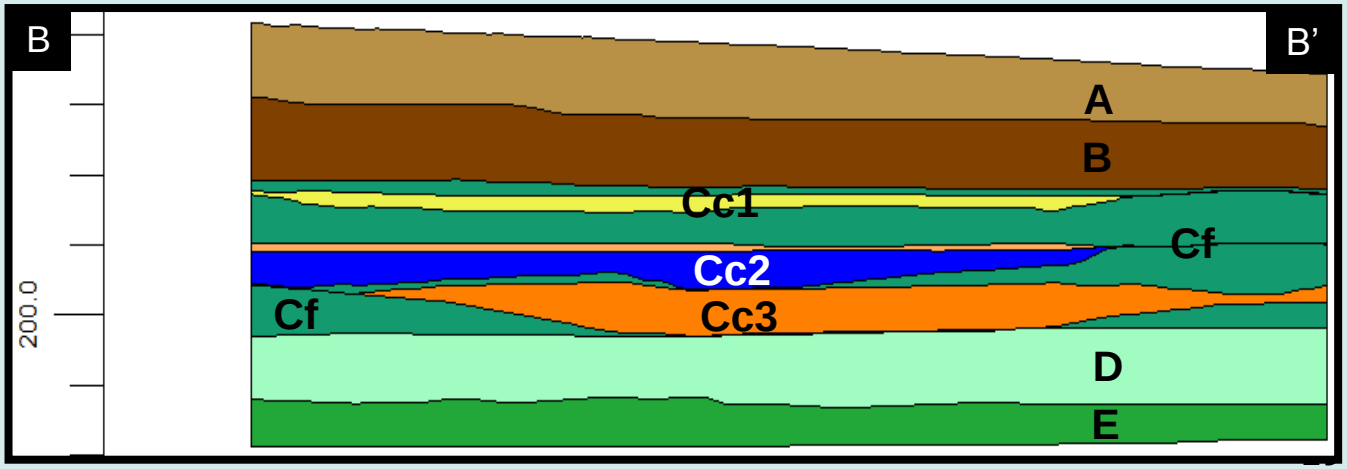


0 800 feet

Stratigraphy
- Ponds
- LF
- AF
- A
- B
- Cf1
- Cc1
- Cf2
- Cc2
- Water
- Cf3
- Cc3
- Cf4
- D
- E

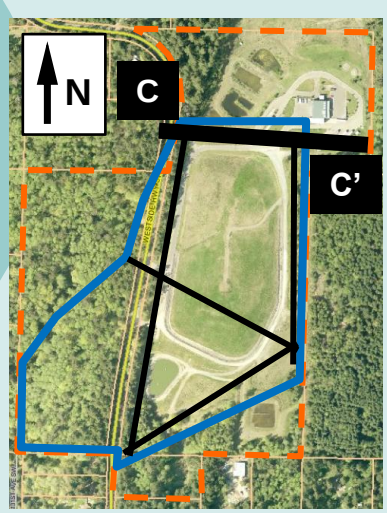






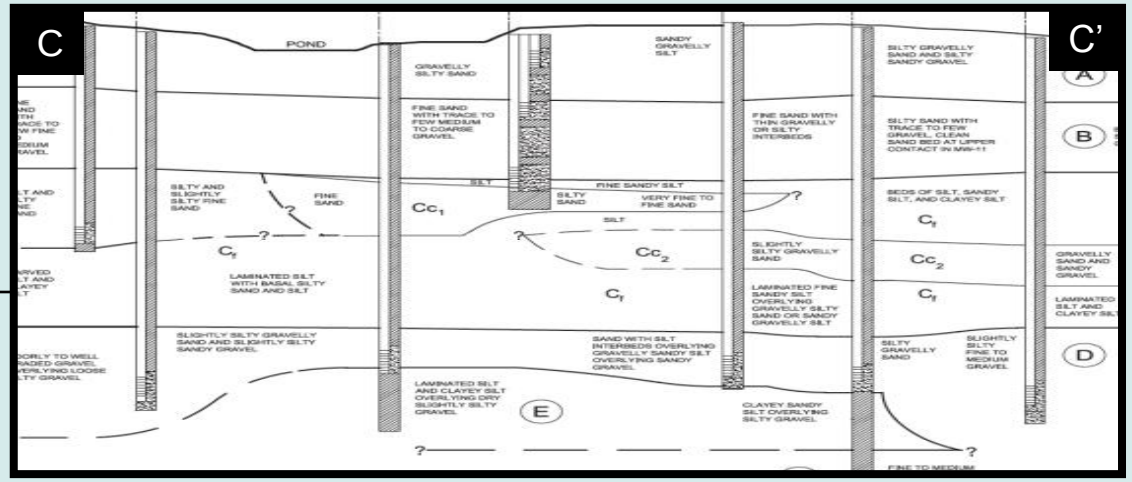
King County

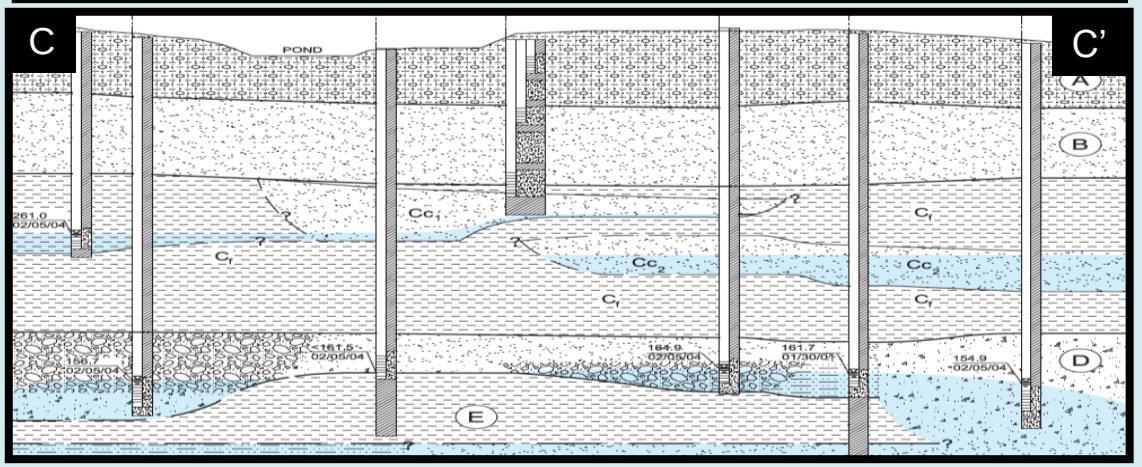
C-C’

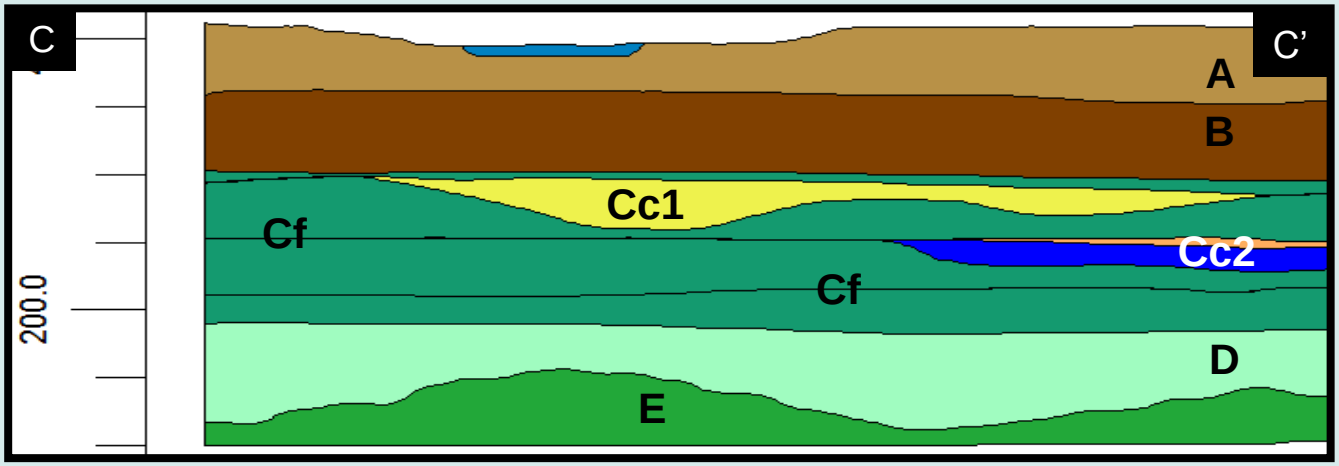


0 800 feet

Stratigraphy
- Ponds
- LF
- AF
- A
- B
- Cf1
- Cc1
- Cf2
- Cc2
- Water
- Cf3
- Cc3
- Cf4
- D
- E

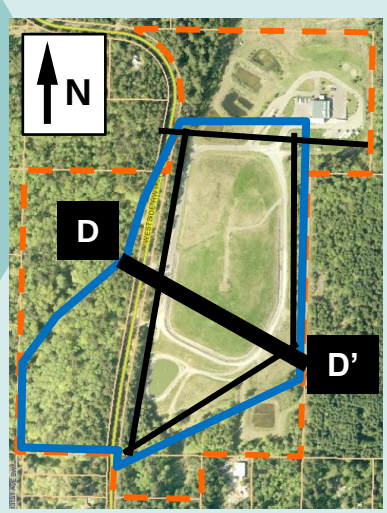






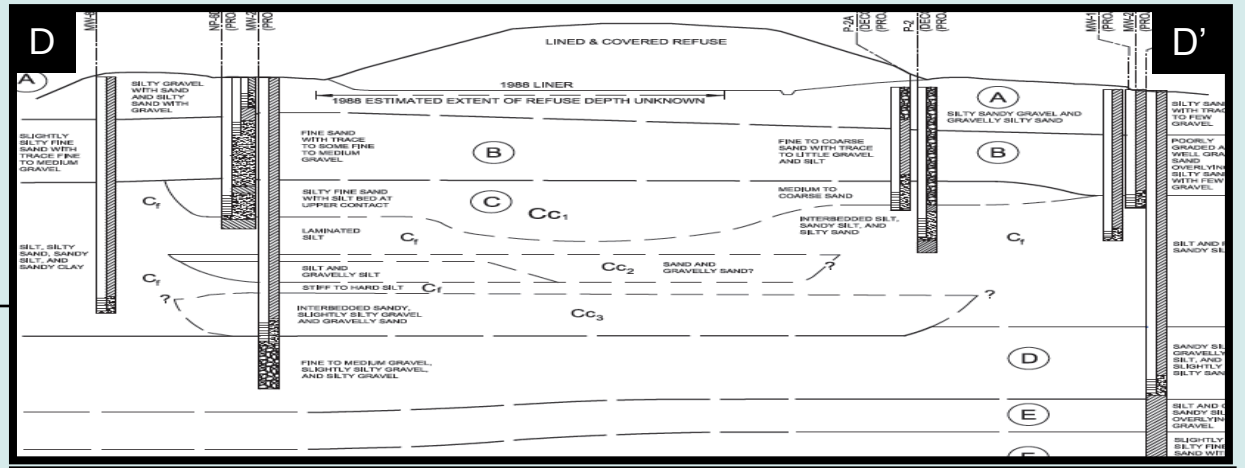
King County

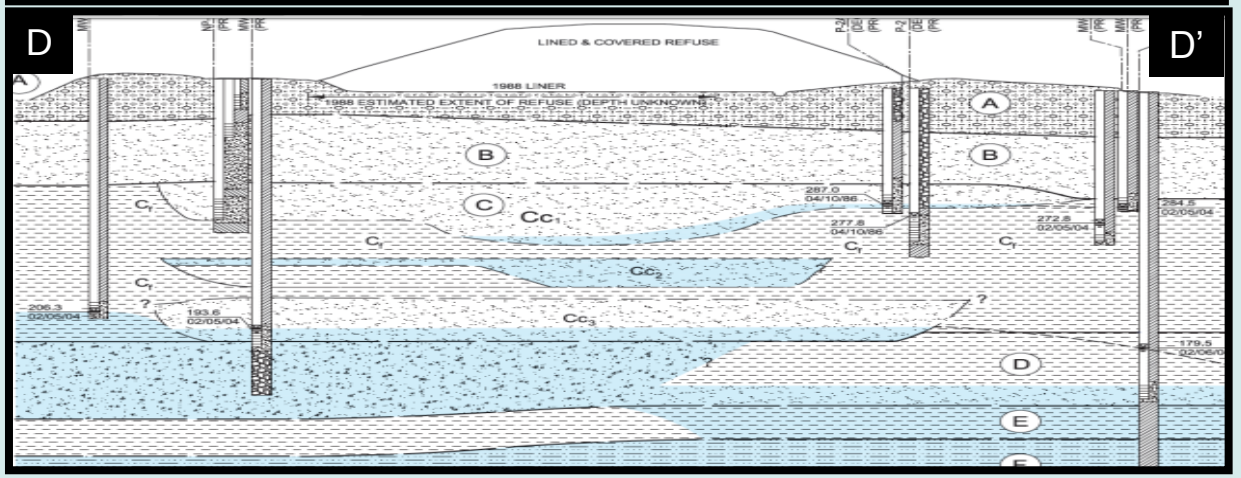
D-D’

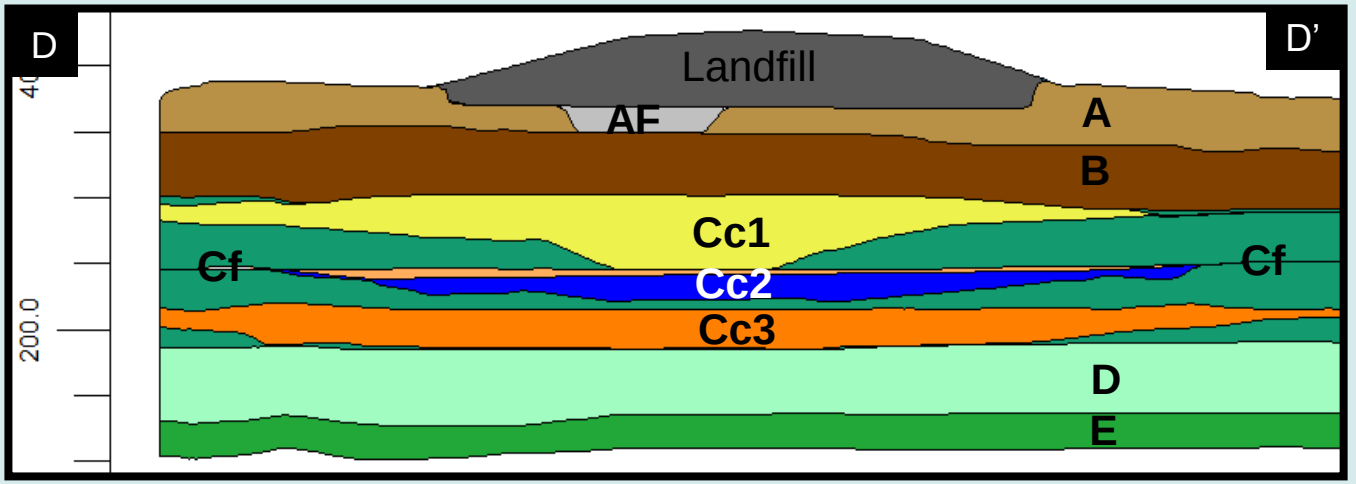


0 800 feet

Stratigraphy
- Ponds
- LF
- AF
- A
- B
- Cf1
- Cc1
- Cf2
- Cc2
- Water
- Cf3
- Cc3
- Cf4
- D
- E

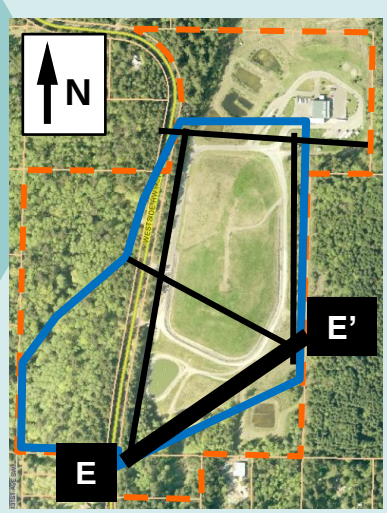






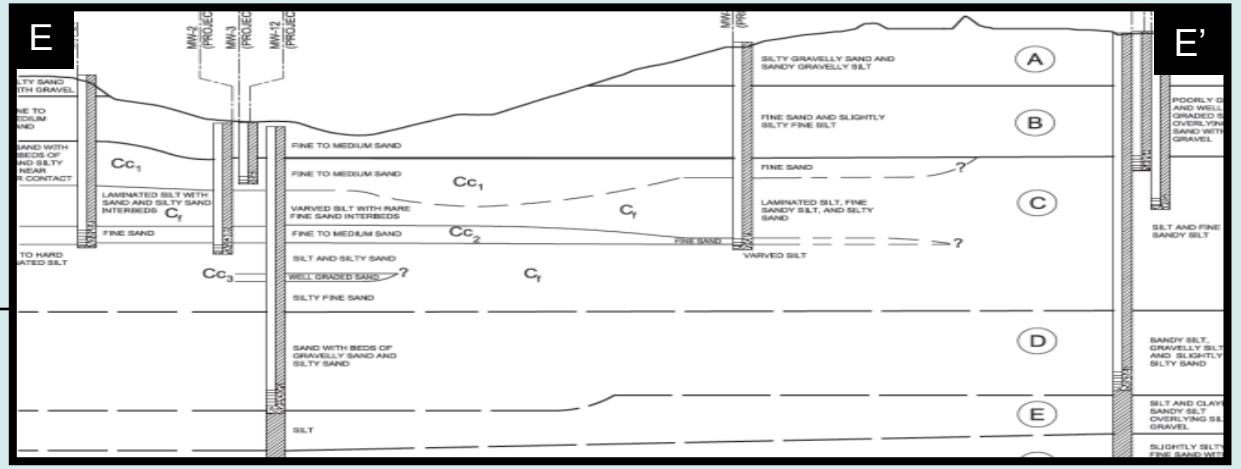
King County

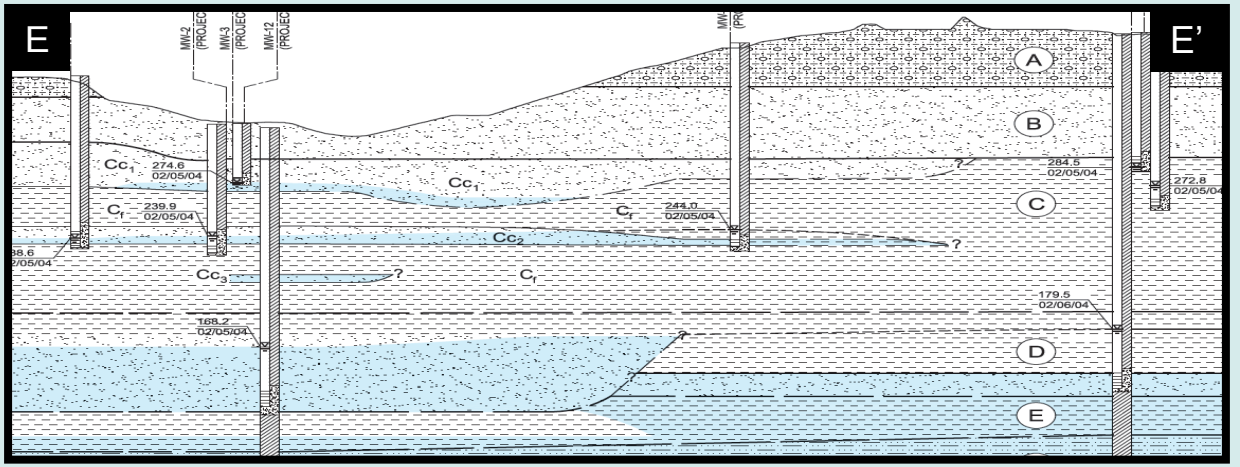
E-E’

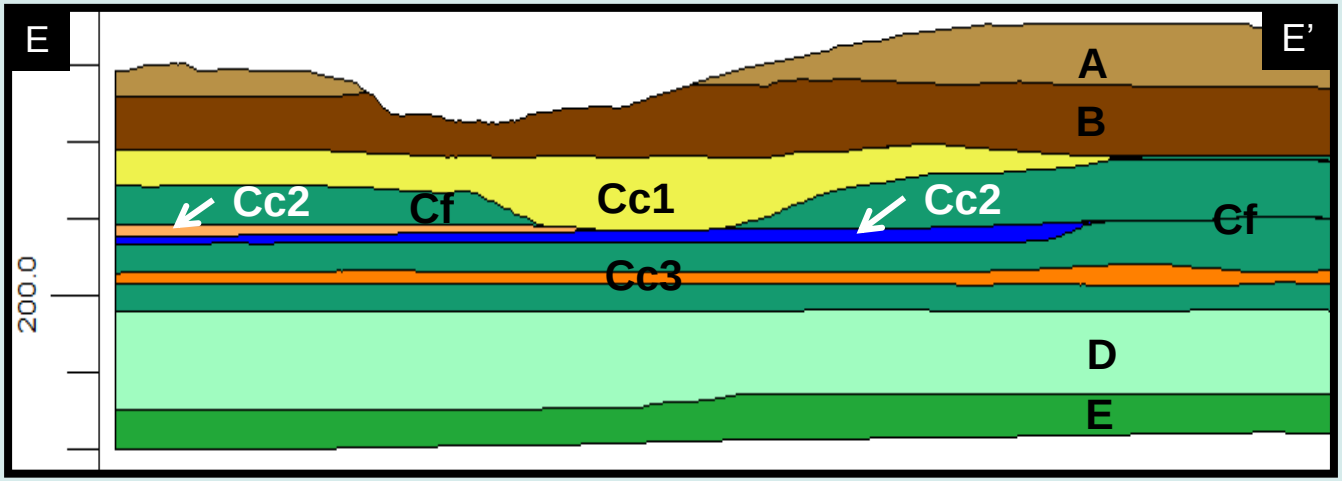


0 800 feet

Stratigraphy
- Ponds
- LF
- AF
- A
- B
- Cf1
- Cc1
- Cf2
- Cc2
- Water
- Cf3
- Cc3
- Cf4
- D
- E





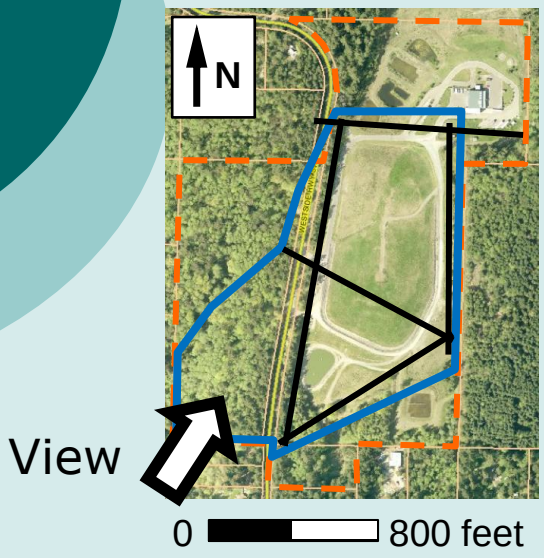


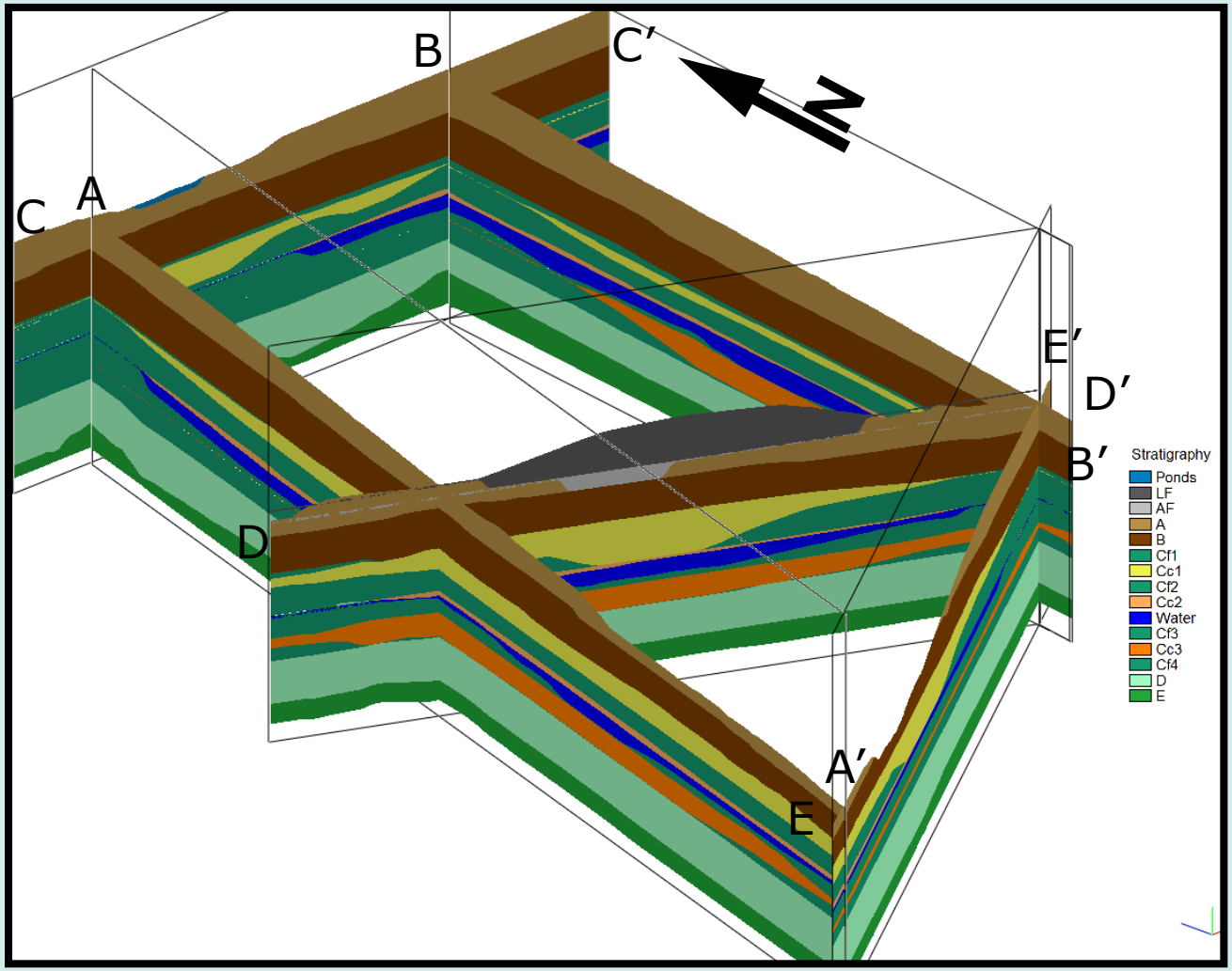
King County

Fence diagrams

The following slides show modeled cross sections on a three-dimensional fenced diagram.

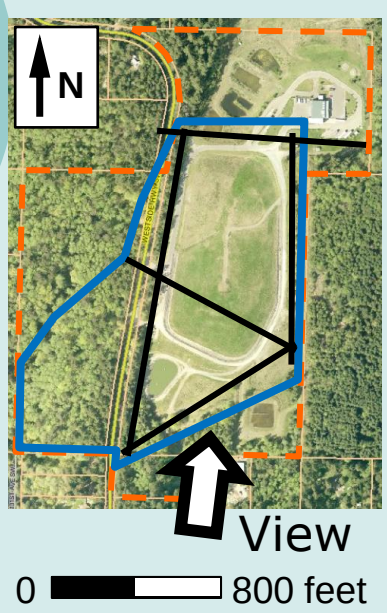
Fence diagram – view from southwest

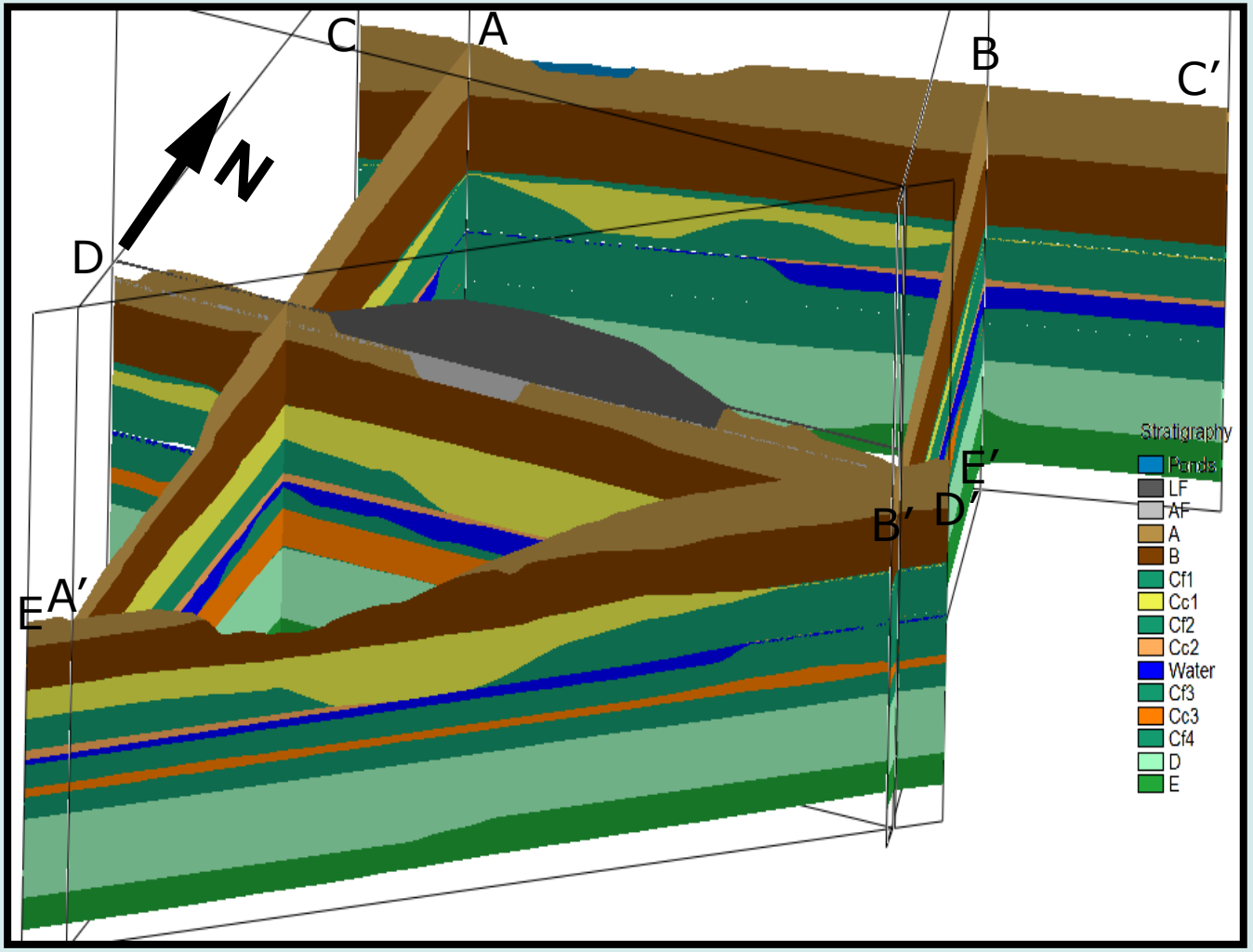




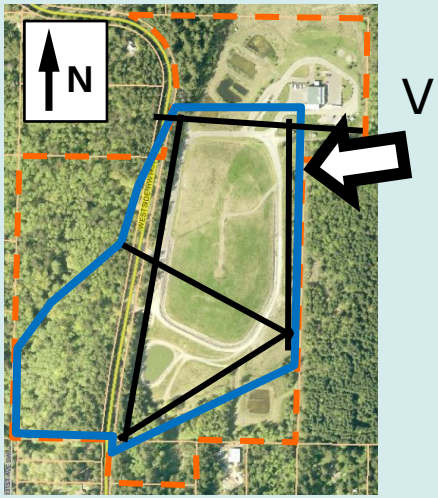
King County

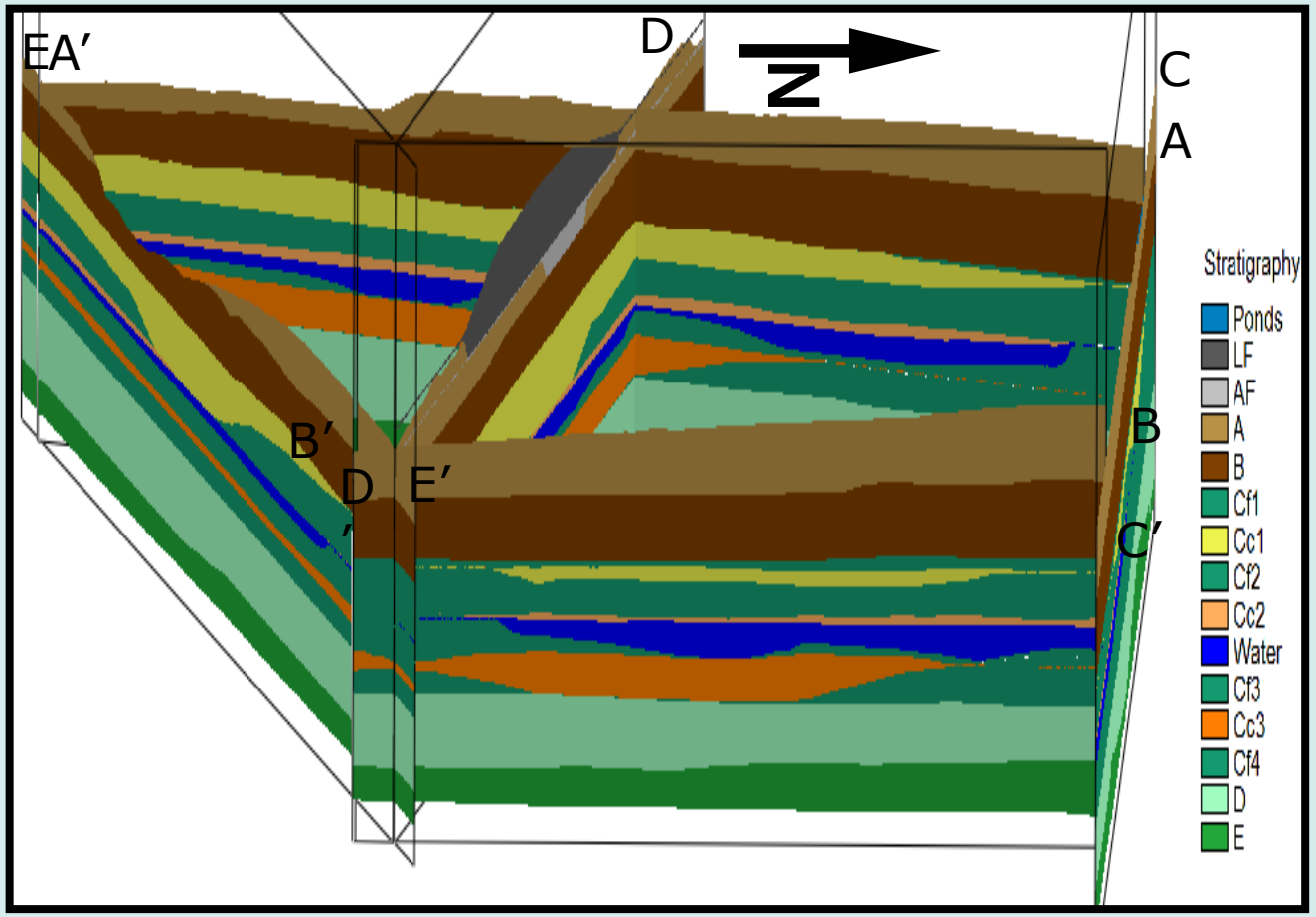
Fence diagram – view from southeast



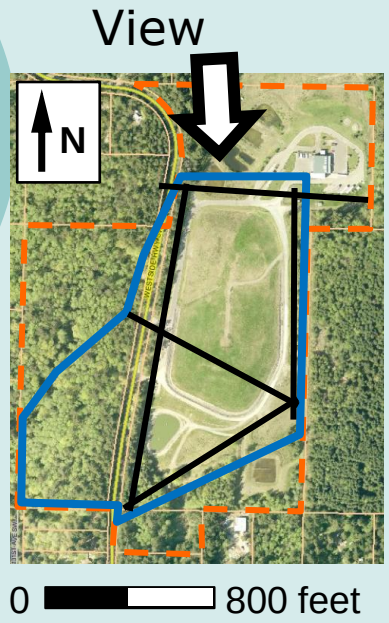


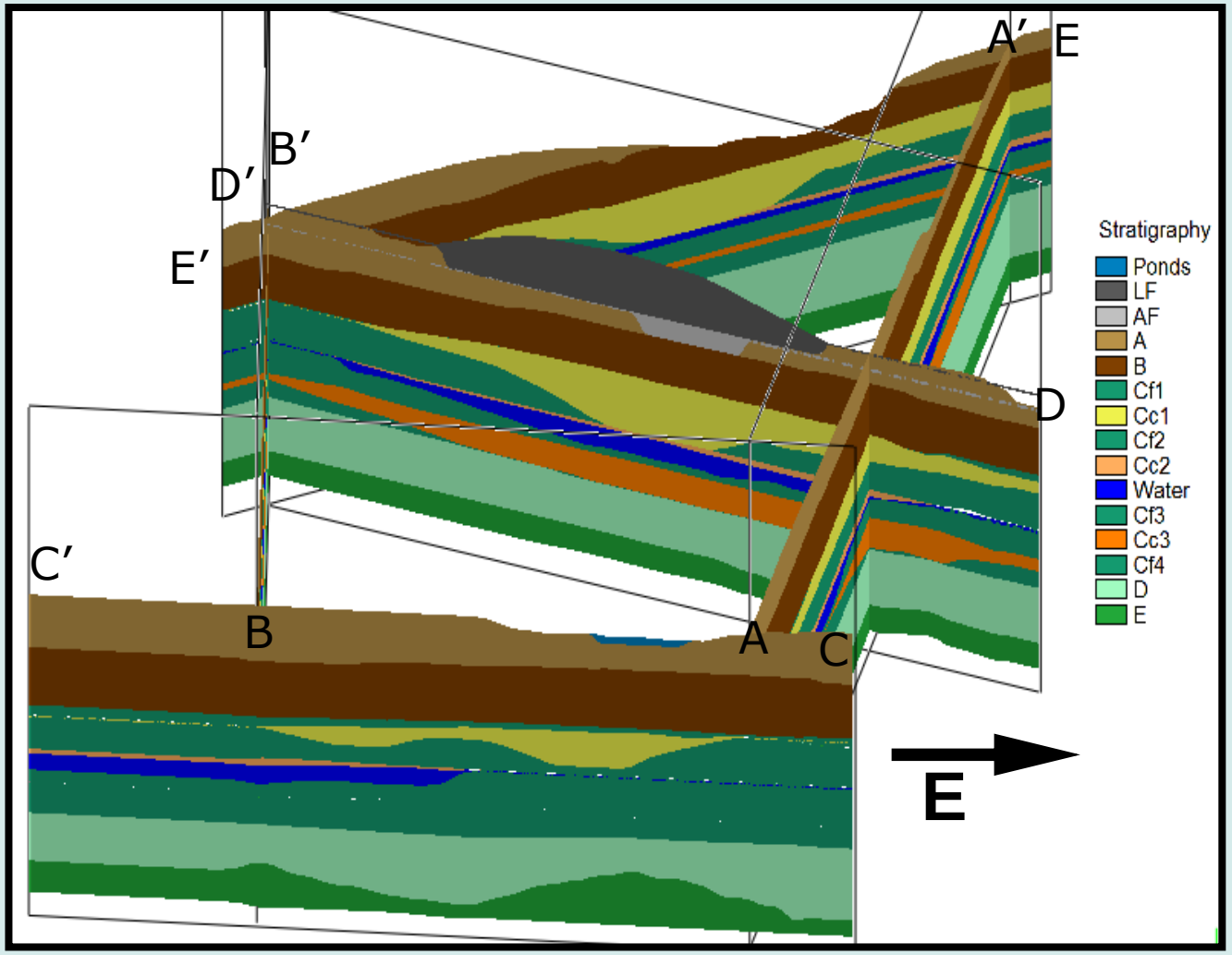
Fence diagram – view from east





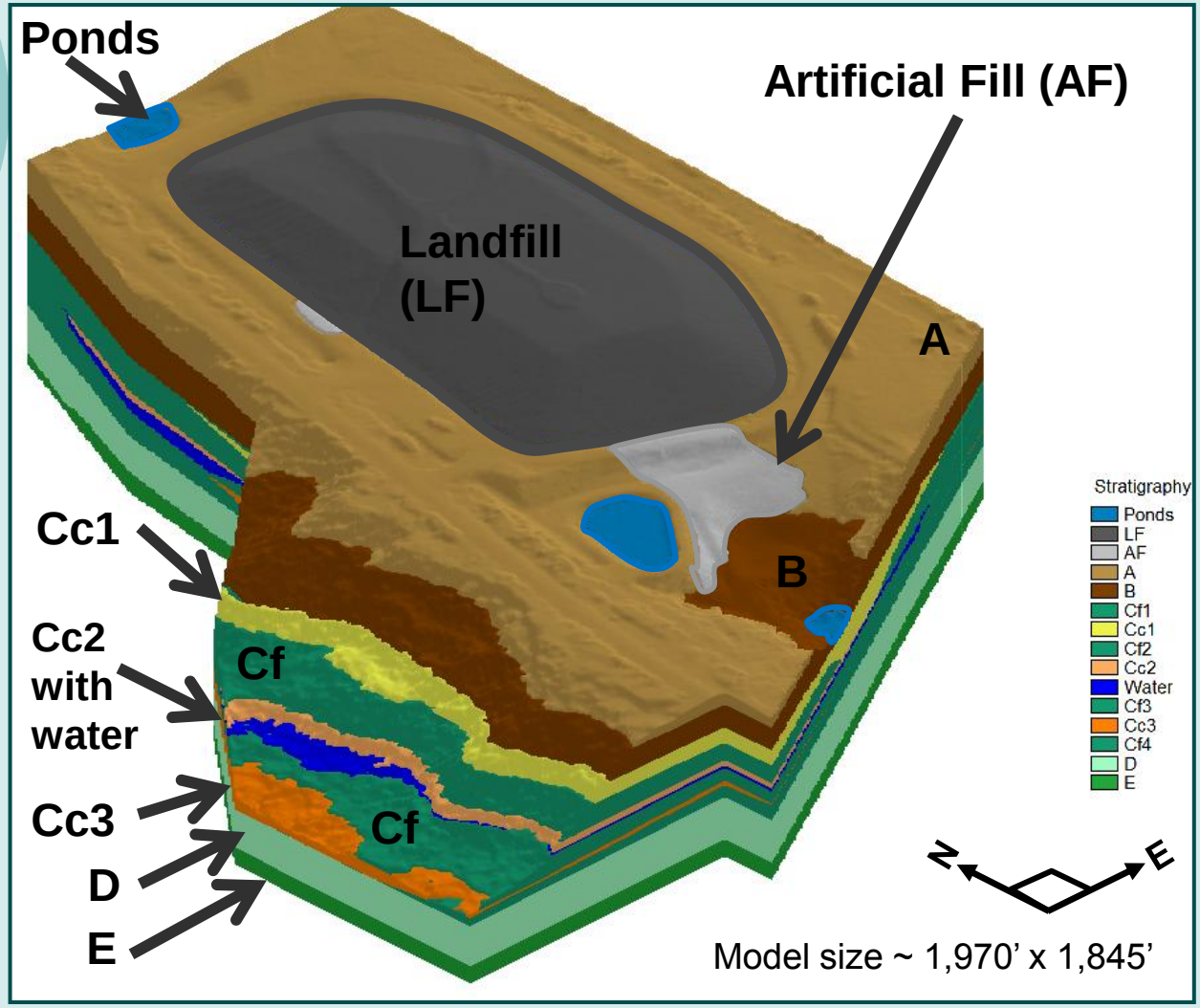
Fence diagram – view from north

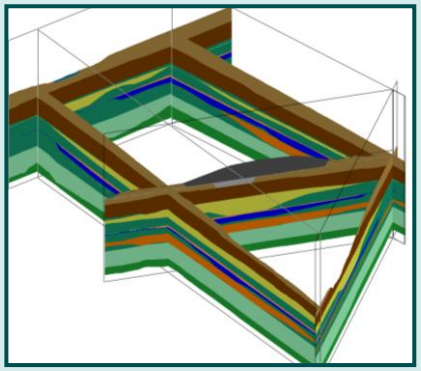




King County

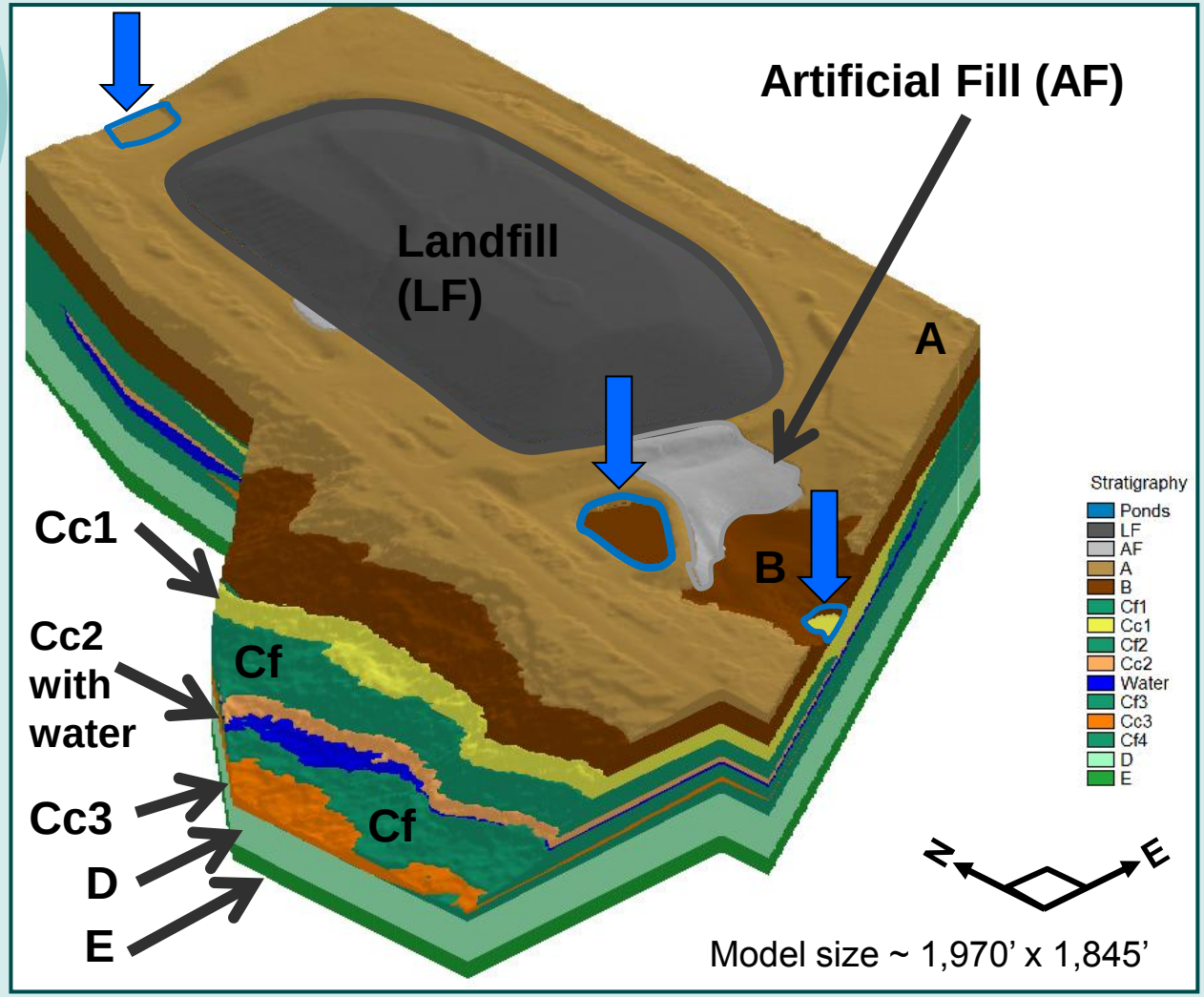
Geospatial solid model

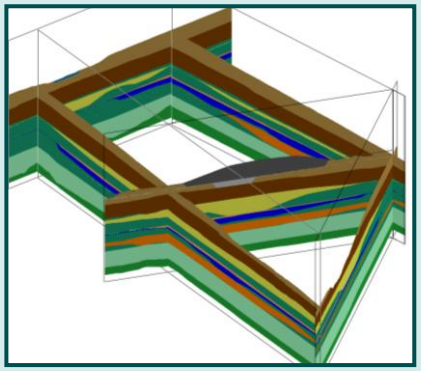




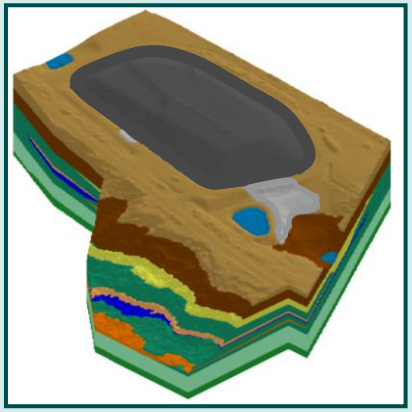
King County

Ponds removed



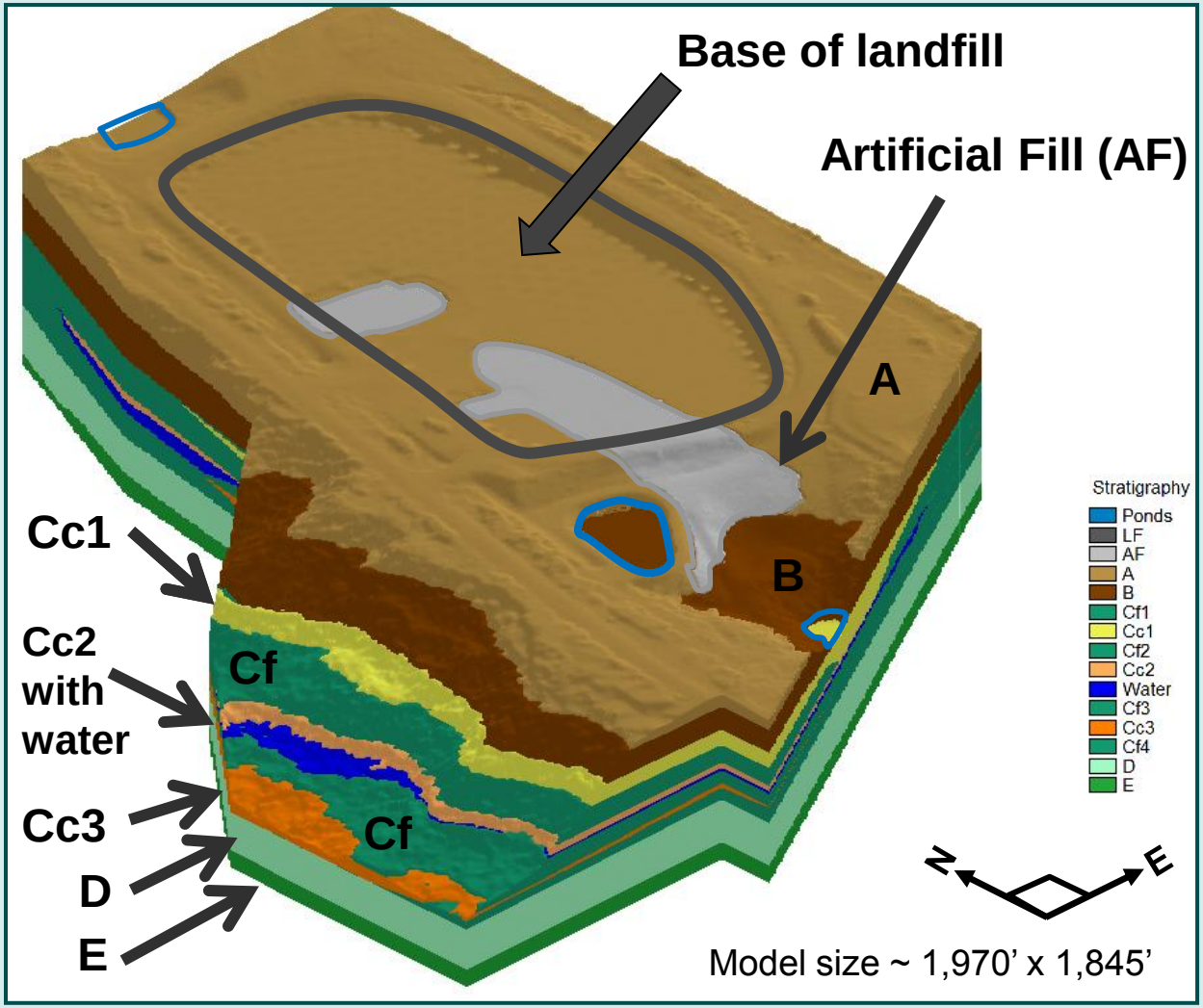


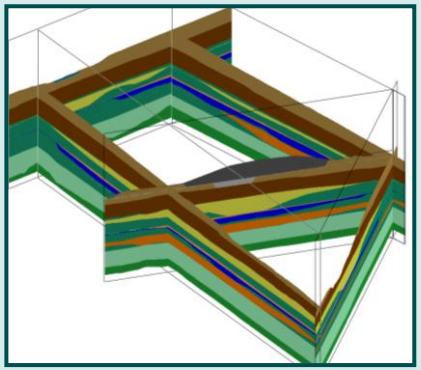
Full model



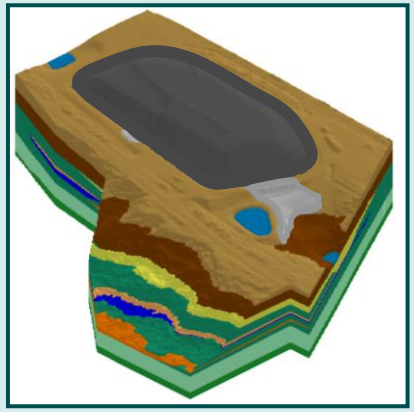
King County

Landfill removed



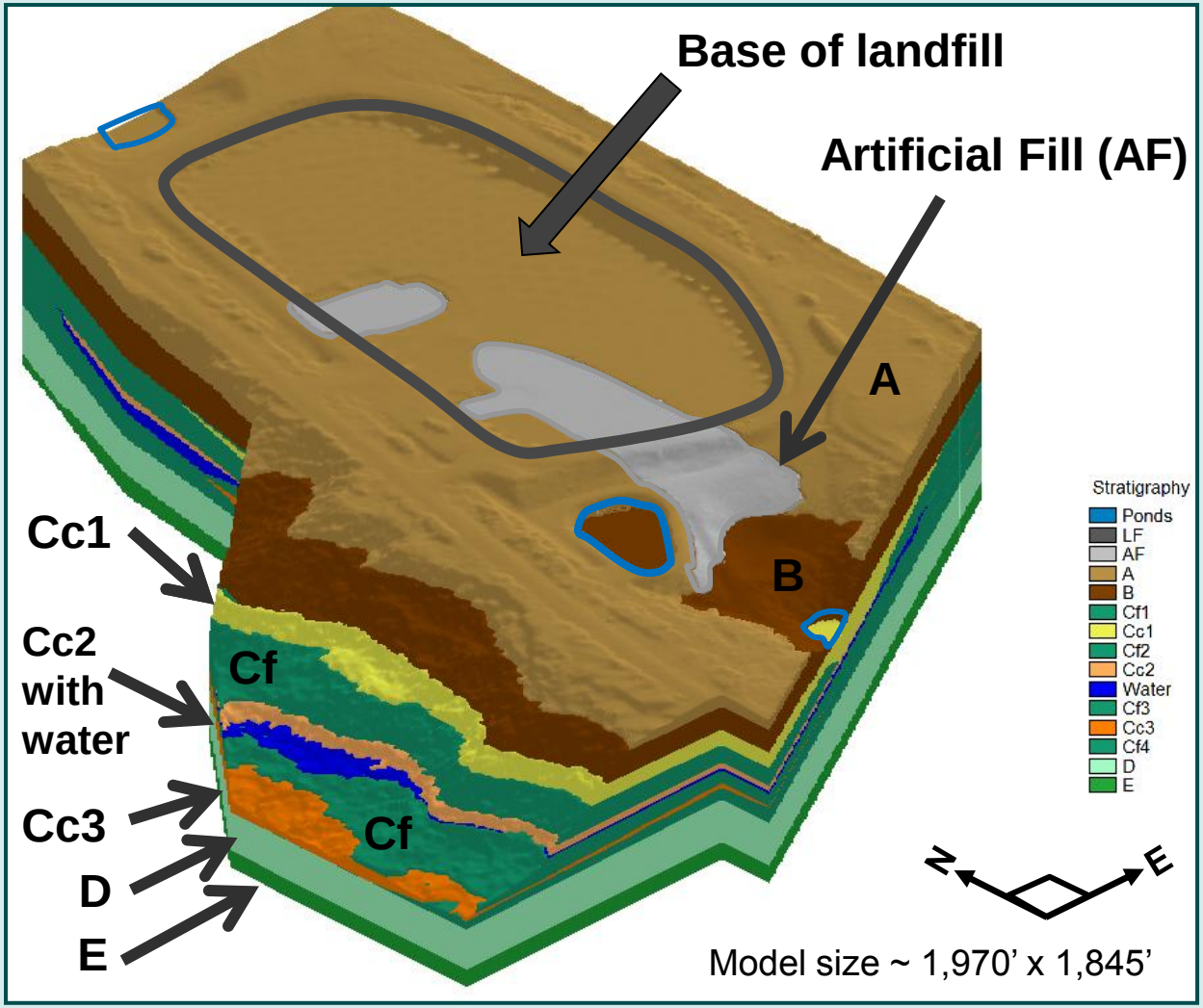


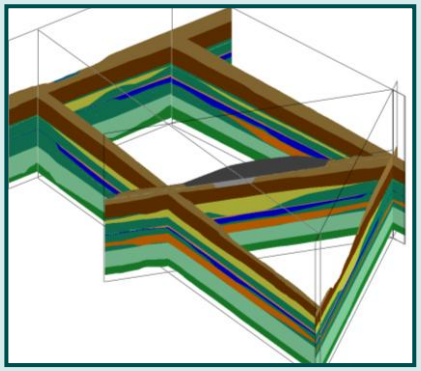
Full model



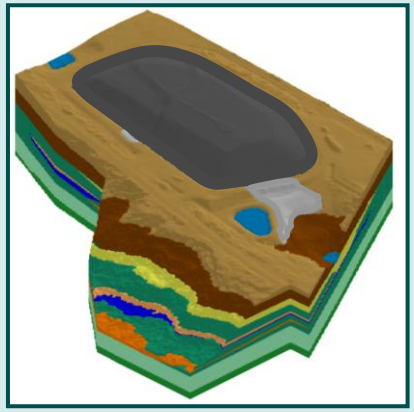
King County

Landfill removed



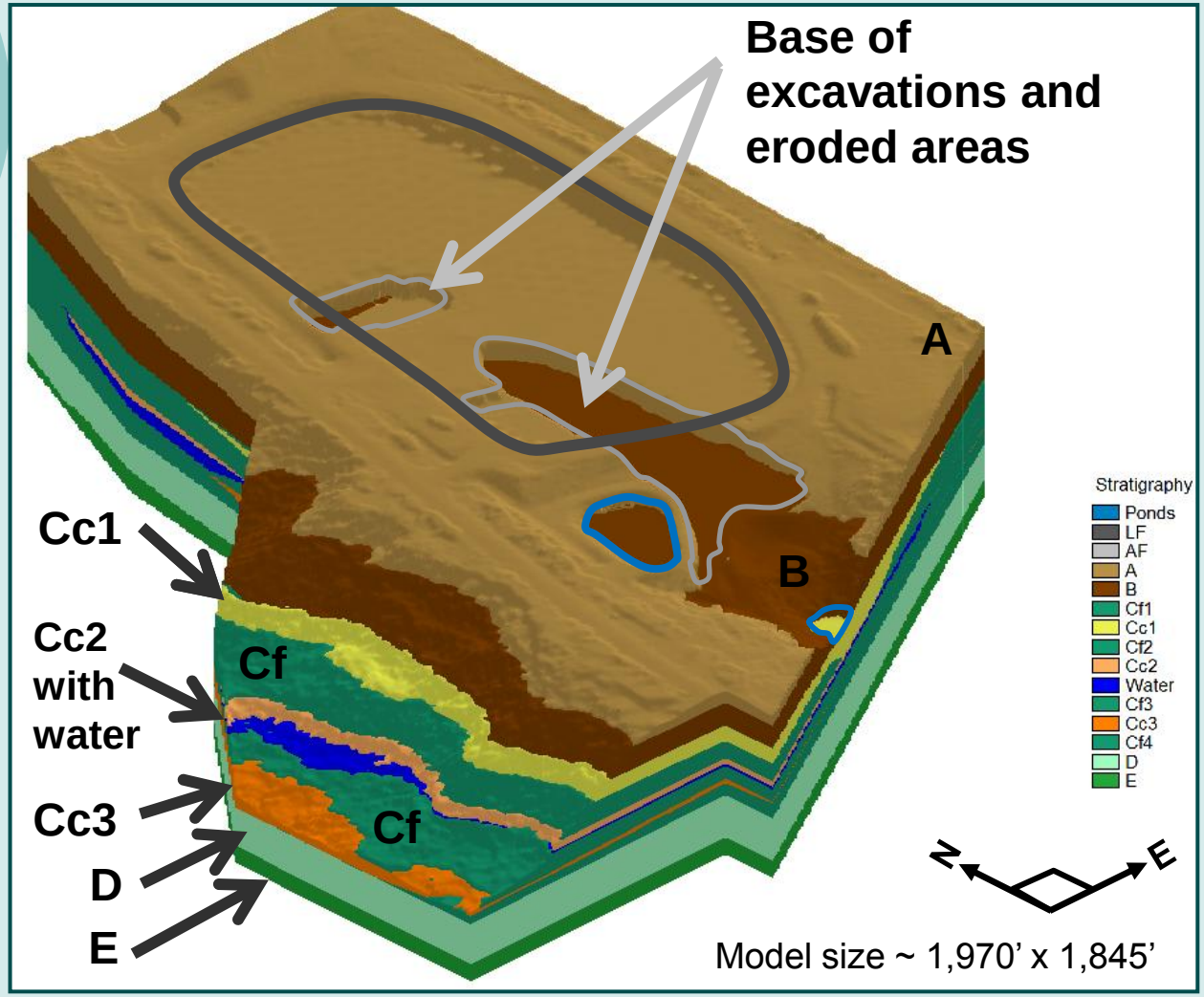


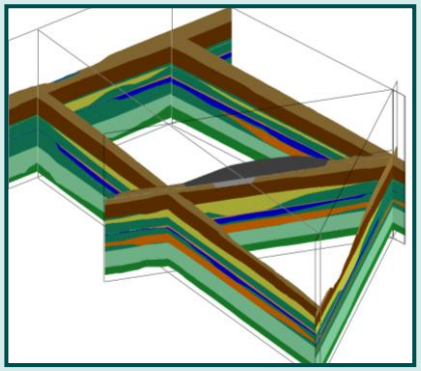
Full model



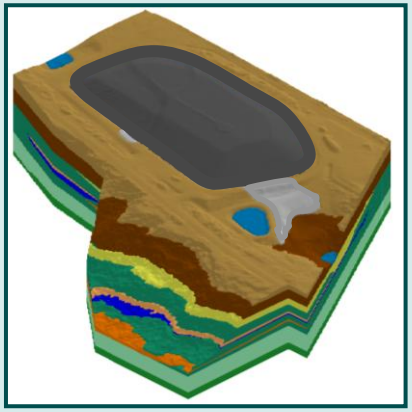
King County

Artificial Fill removed



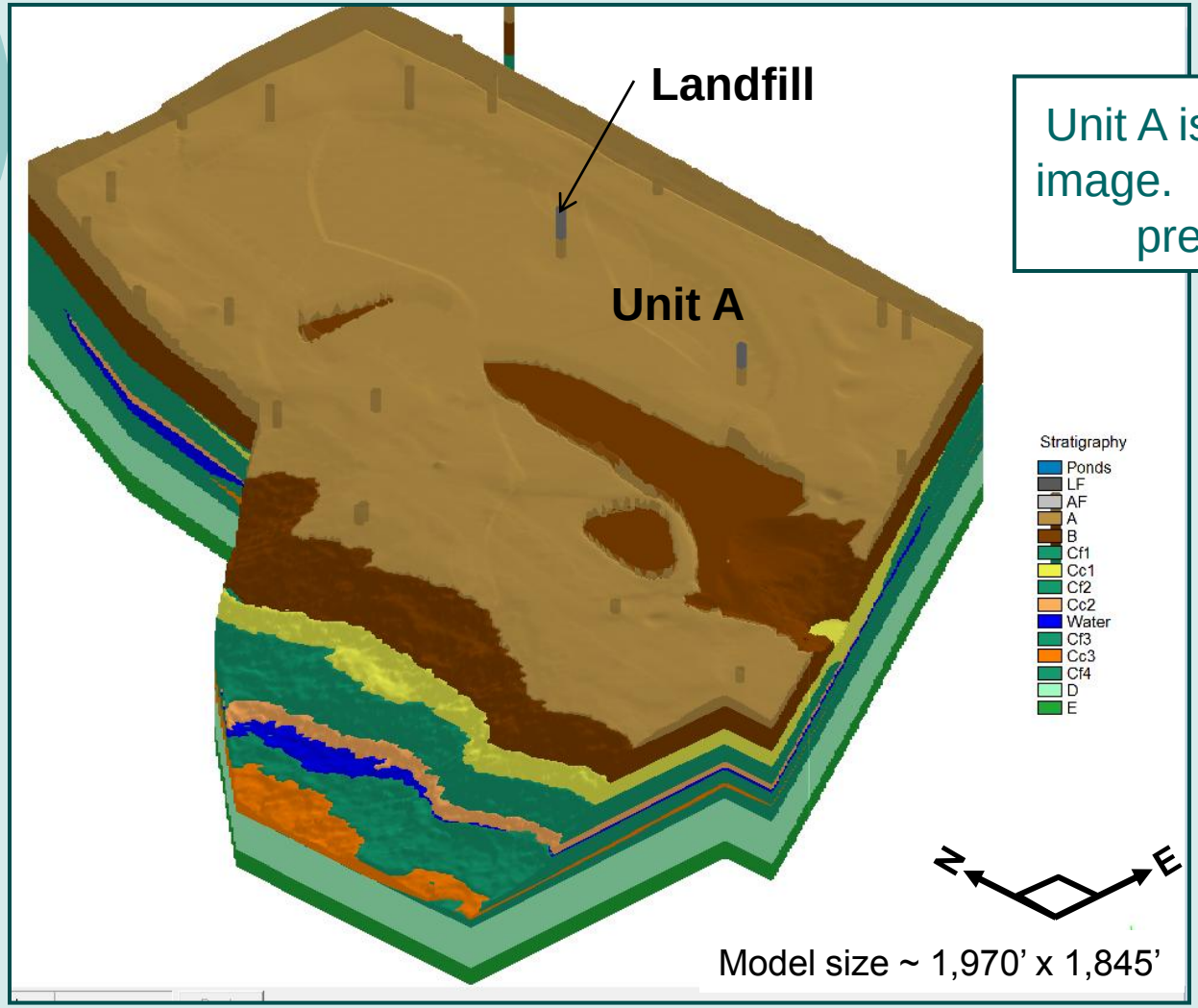


Full model



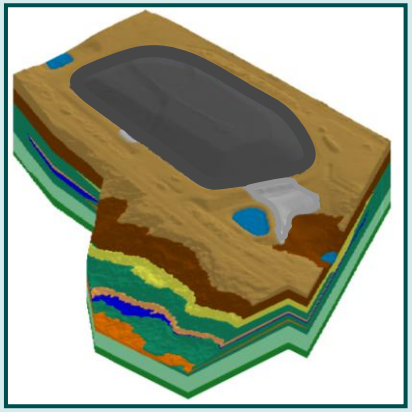
King County

Borehole data from wells for Unit A



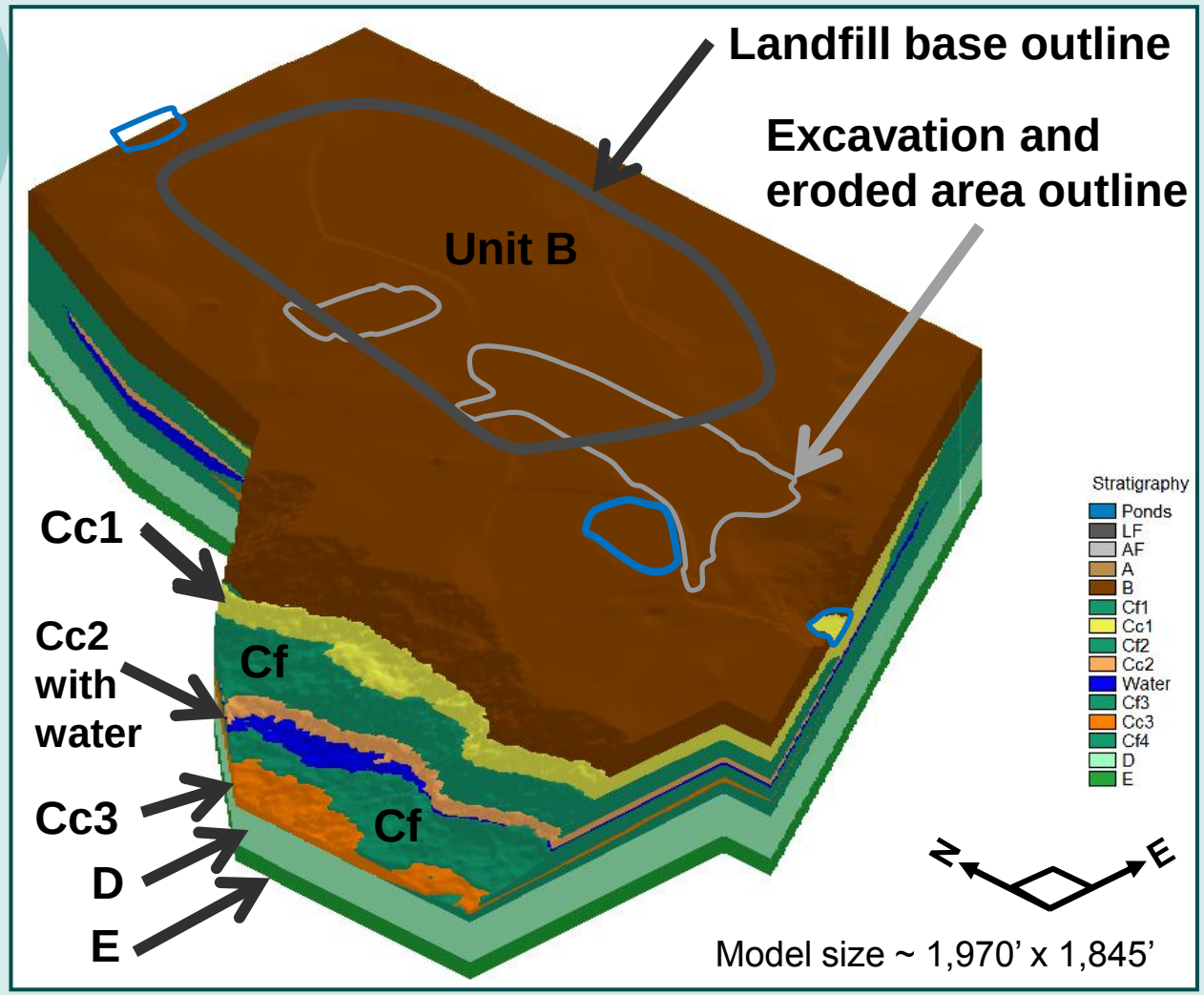
Unit A is transparent in this image. Borehole logs show presence of Unit A

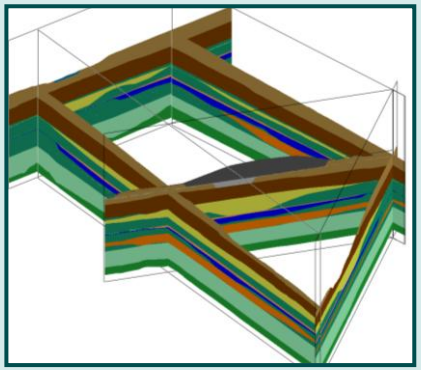
Full model



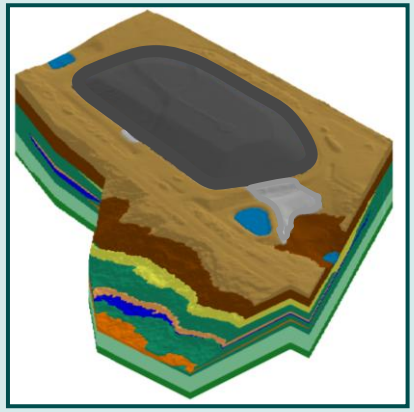
King County

Unit A removed



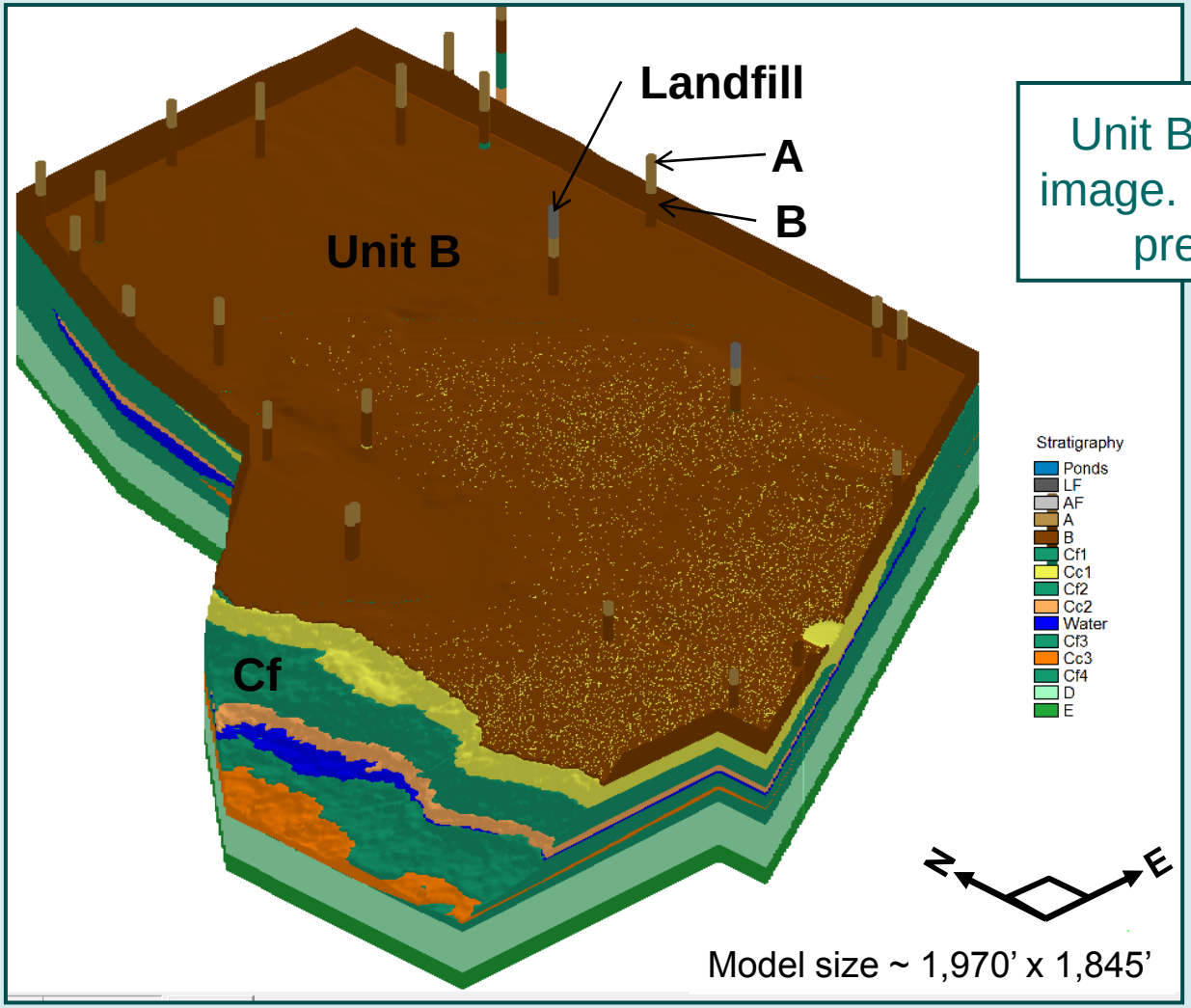


Full model



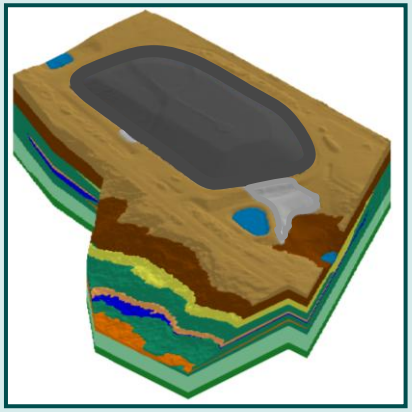
King County

Borehole data from wells for Unit B



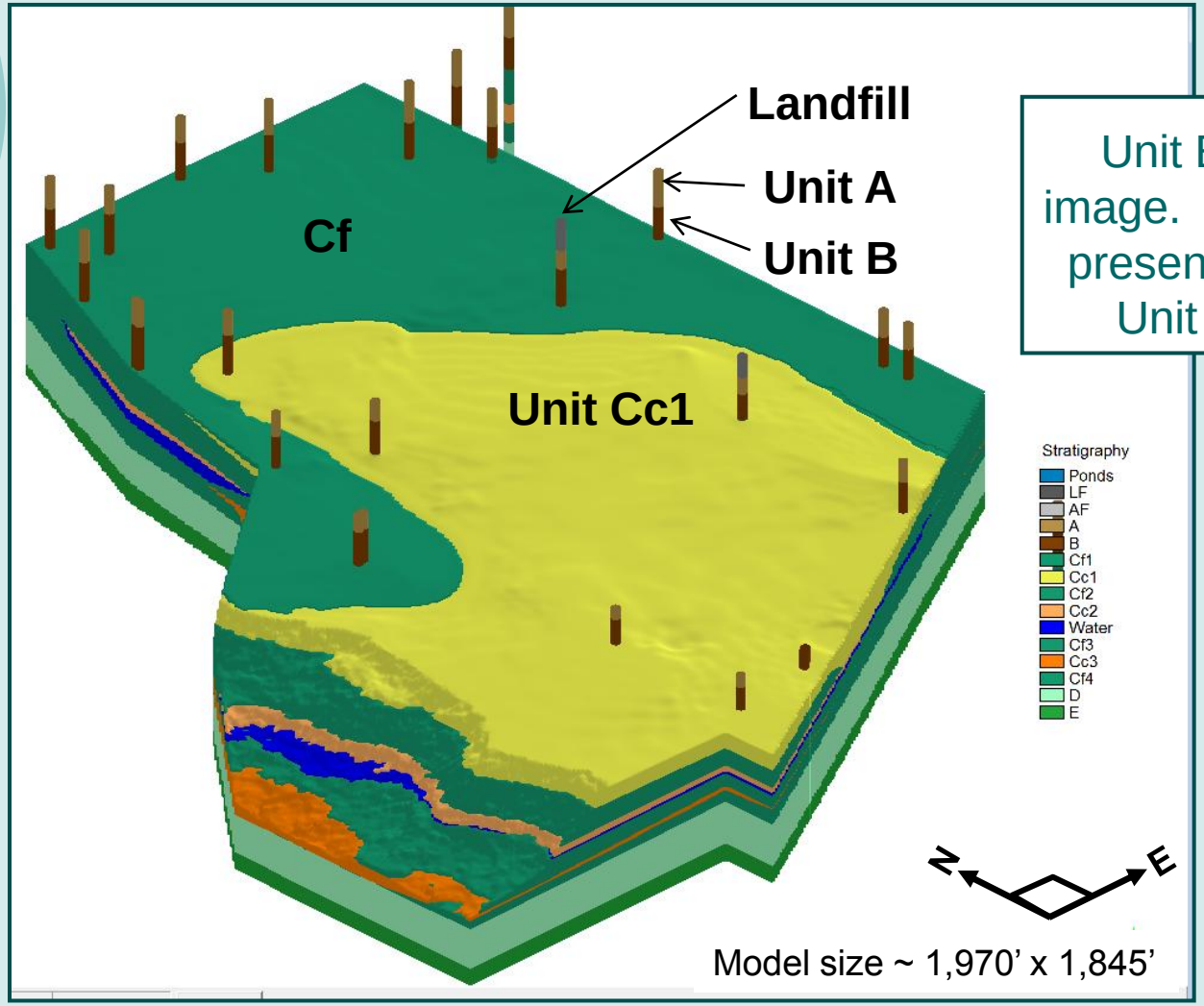
Unit B transparent in this image. Borehole logs show presence of Unit B

Full model



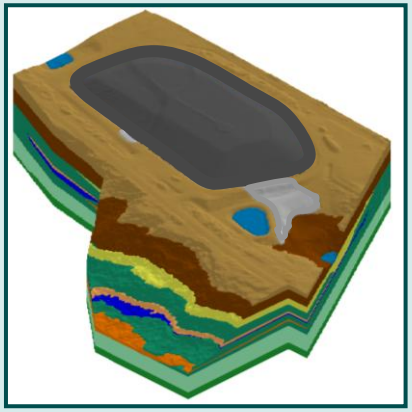
King County

Borehole data from wells for Unit B



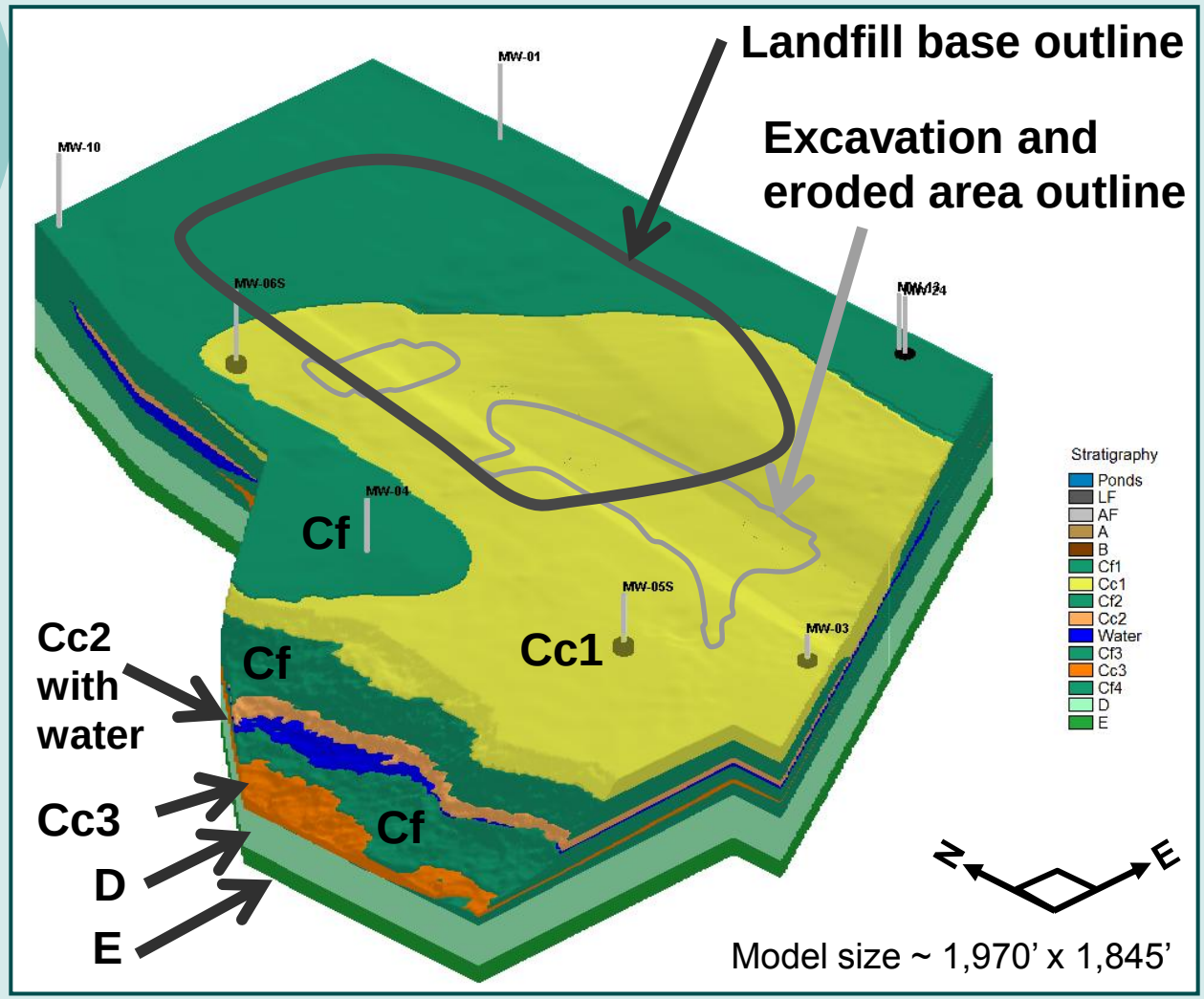
Unit B removed in this image. Borehole logs show presence of Unit B above Unit Cc1 and Unit Cf

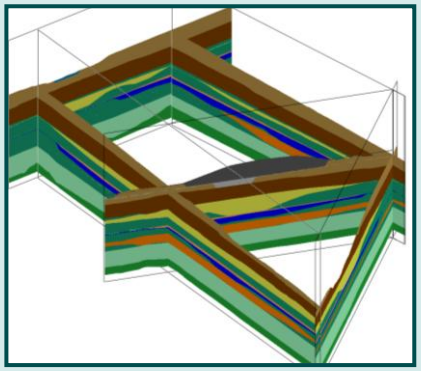
Full model



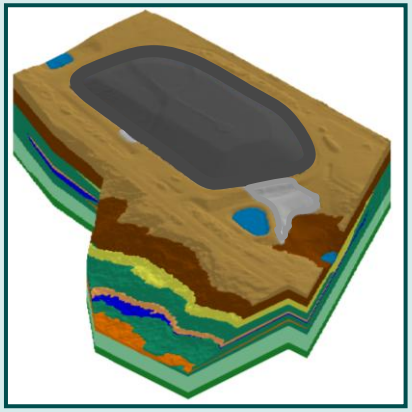
King County

Unit B removed



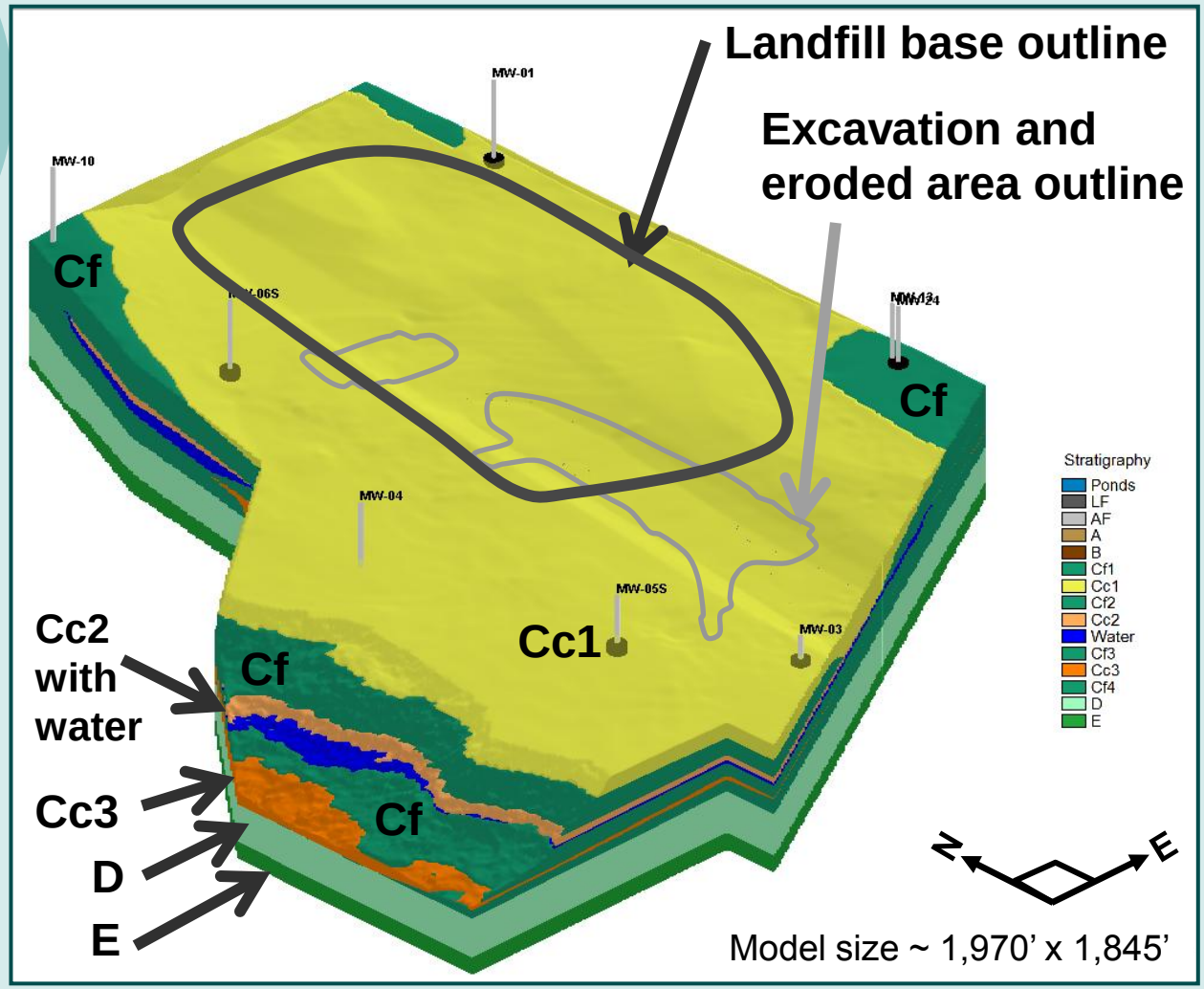


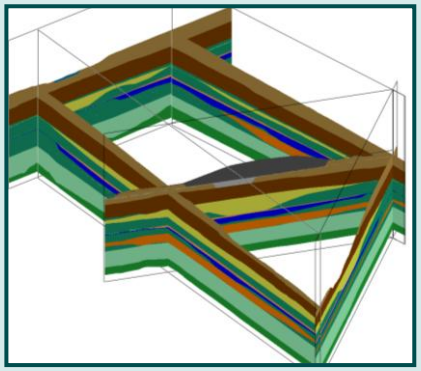
Full model



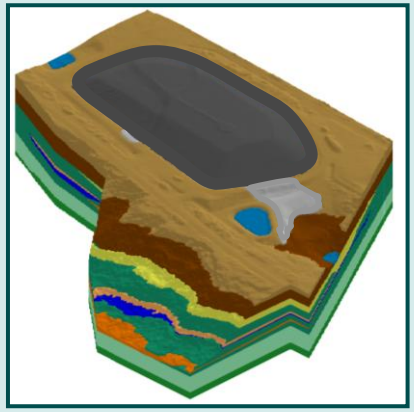
King County

Upper Cf unit removed



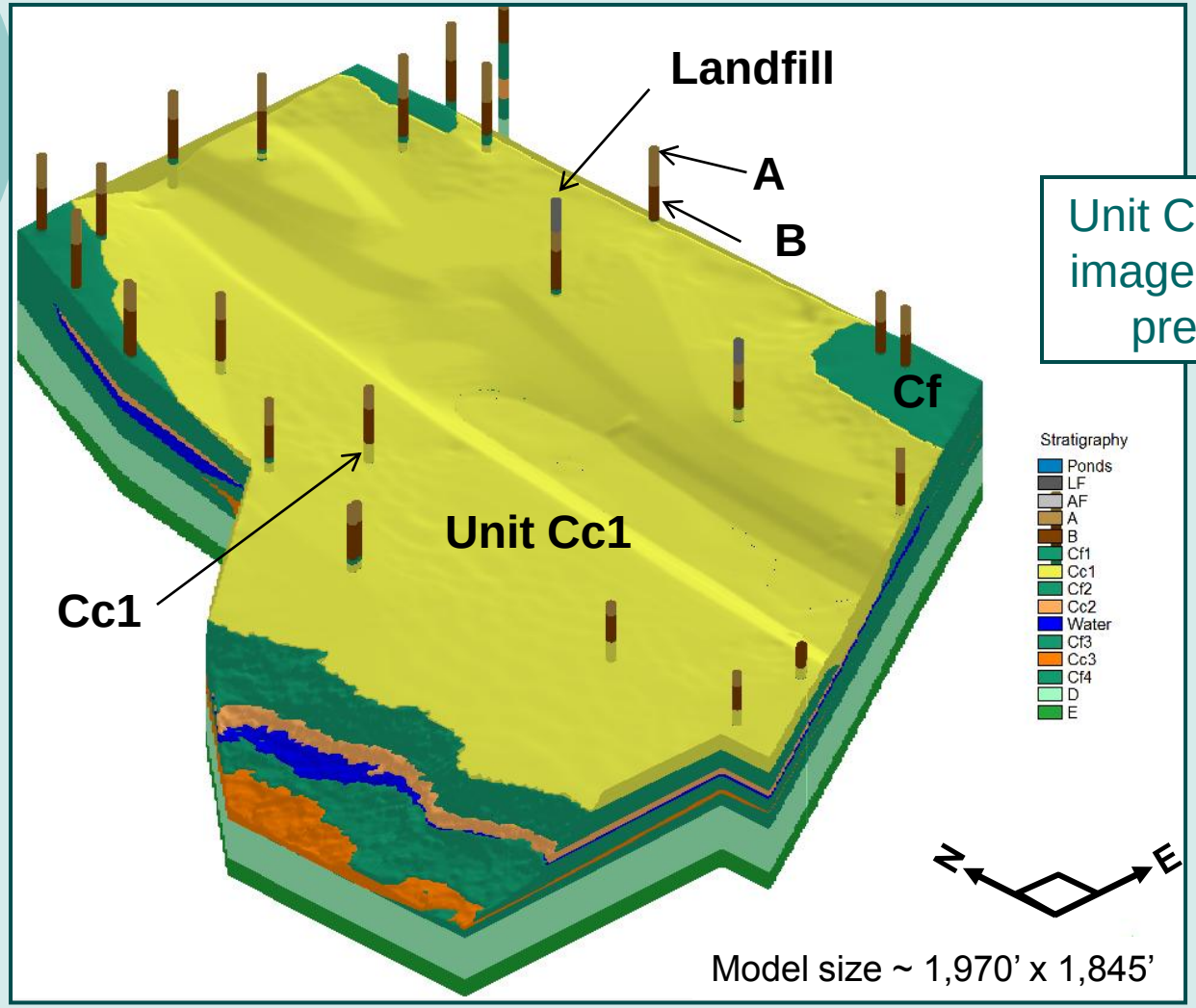


Full model



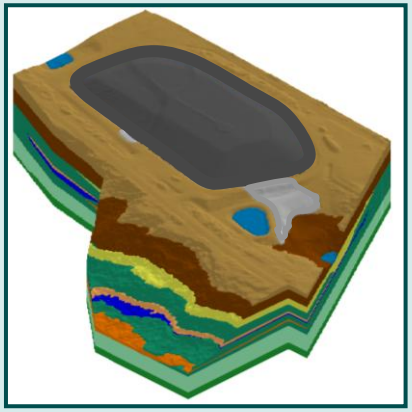
King County

Borehole data from wells for Unit Cc1



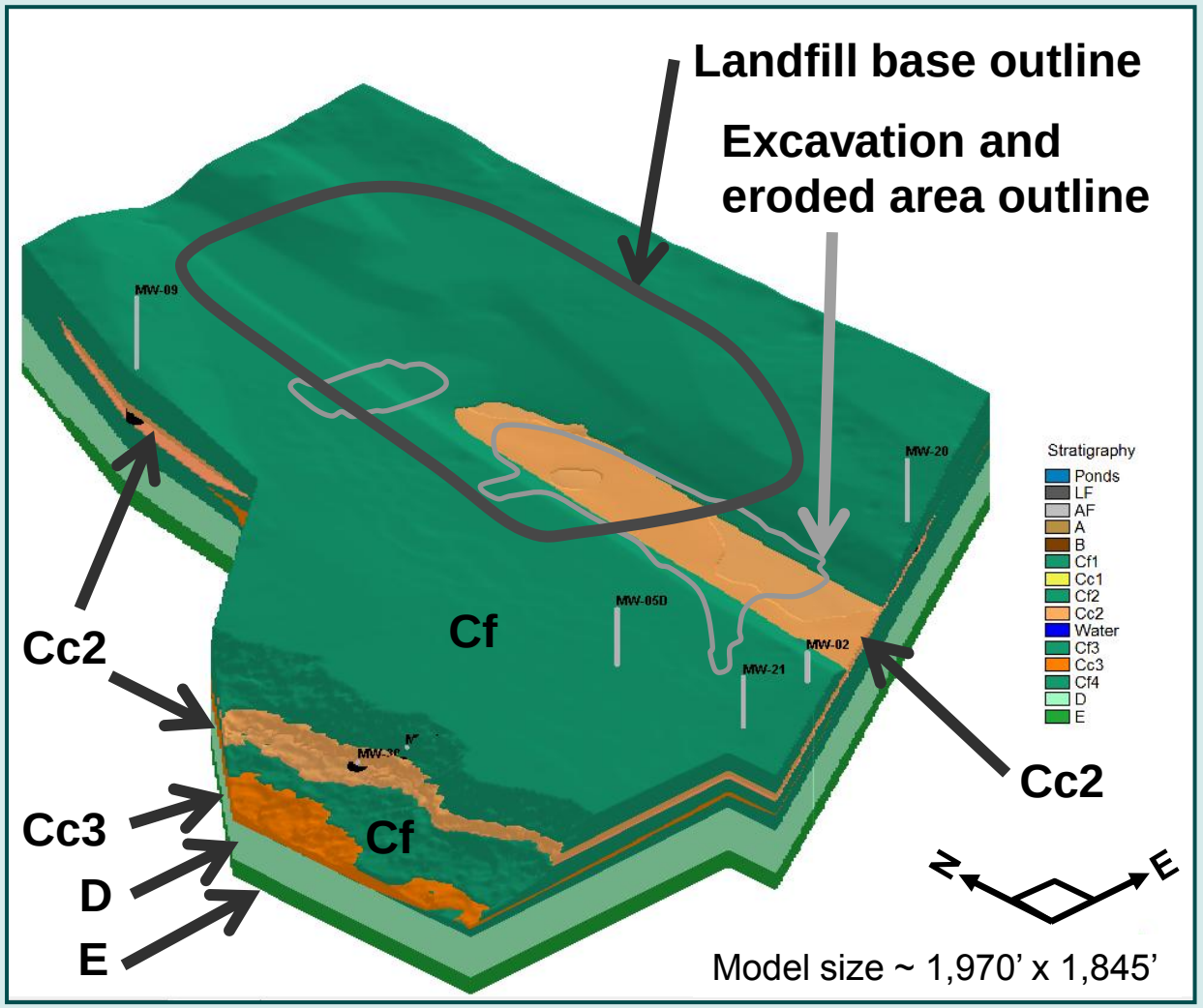
Unit Cc1 transparent in this image. Borehole logs show presence of Unit Cc1

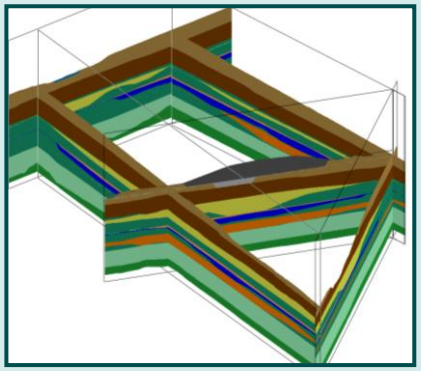
Full model



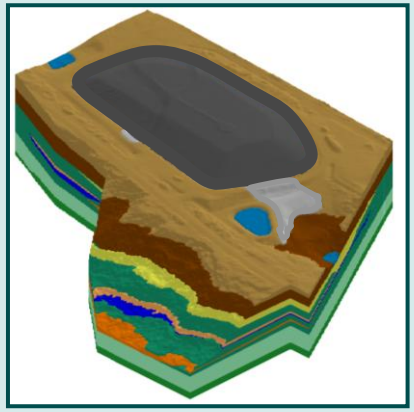
King County

Unit Cc1 removed



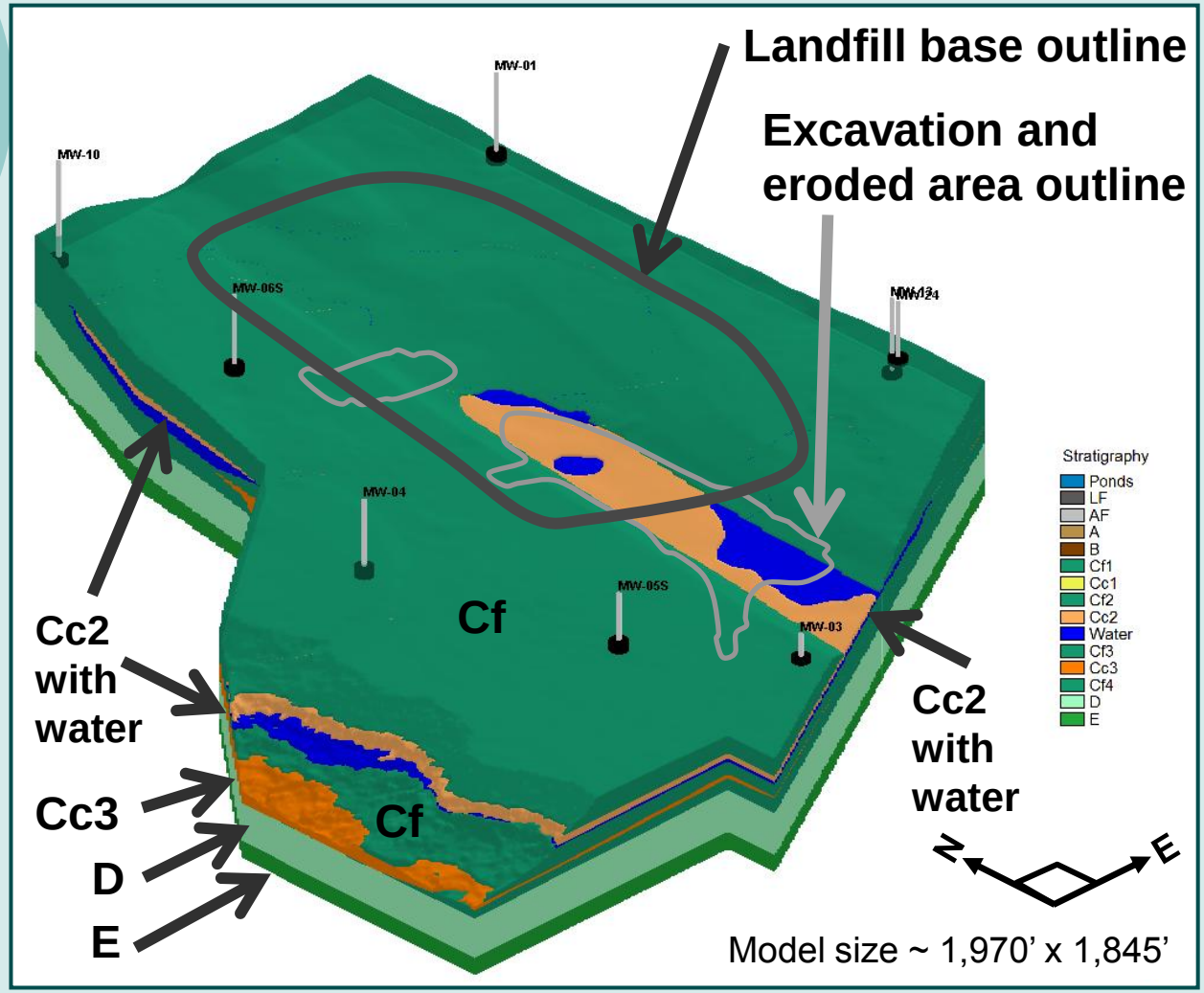


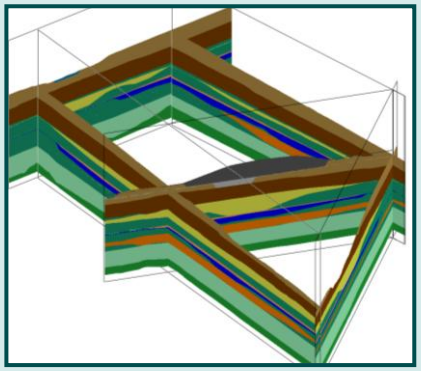
Full model



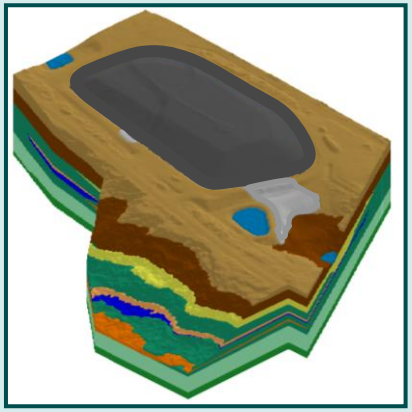
King County

Unit Cc2 shown with saturation



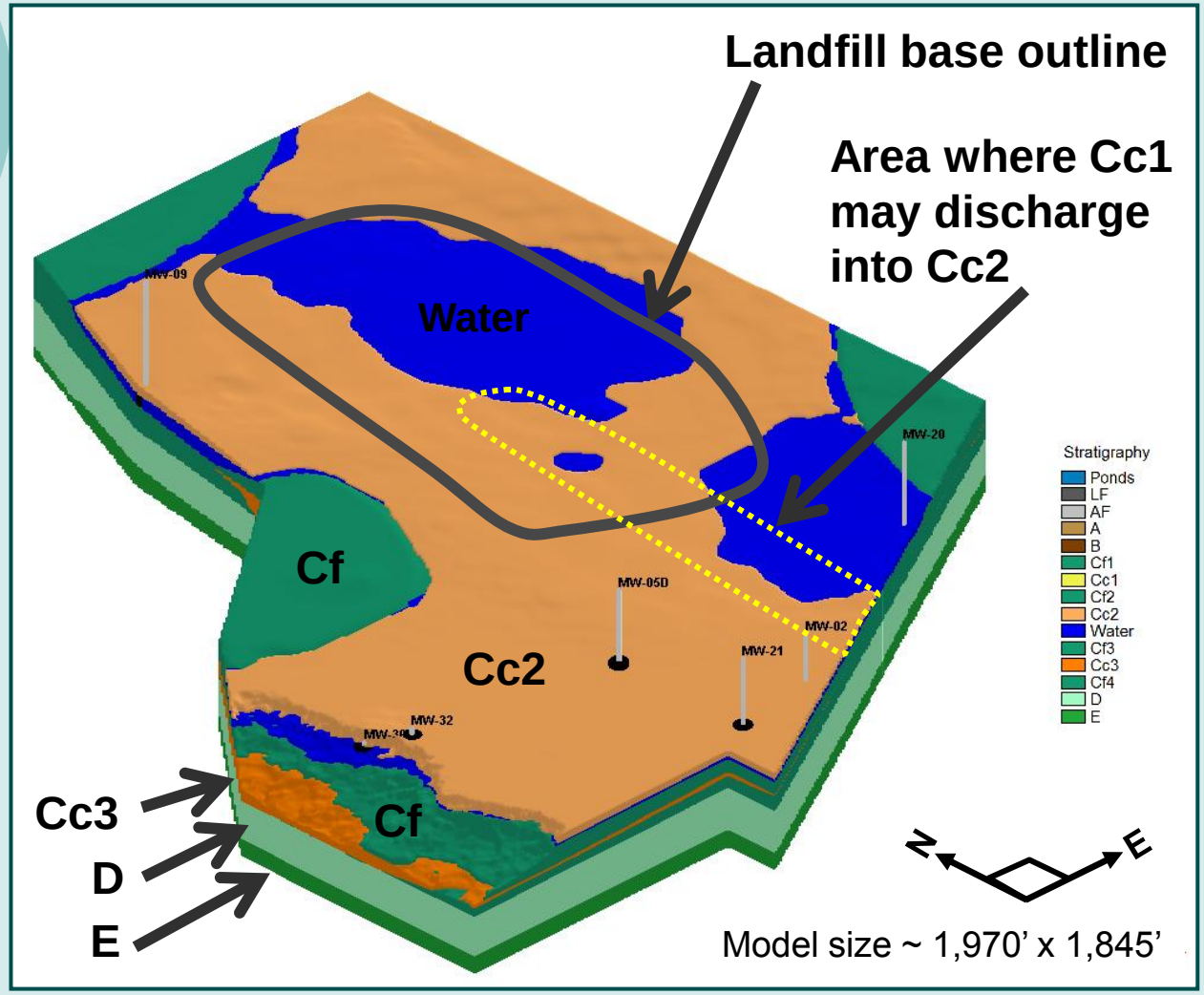


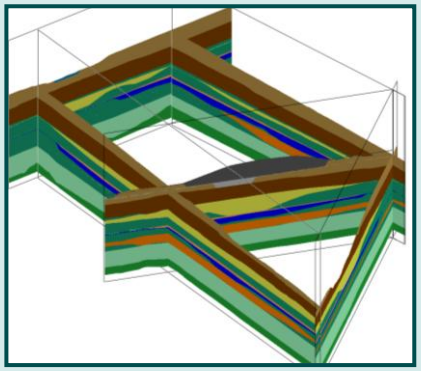
Full model



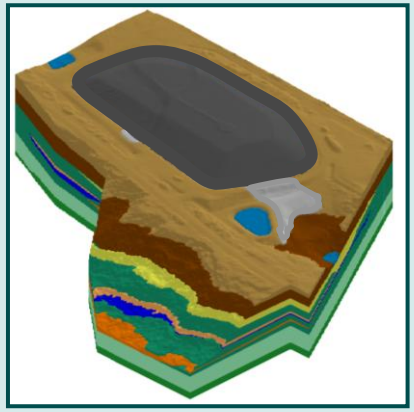
King County

Cf unit beneath Cc1 removed

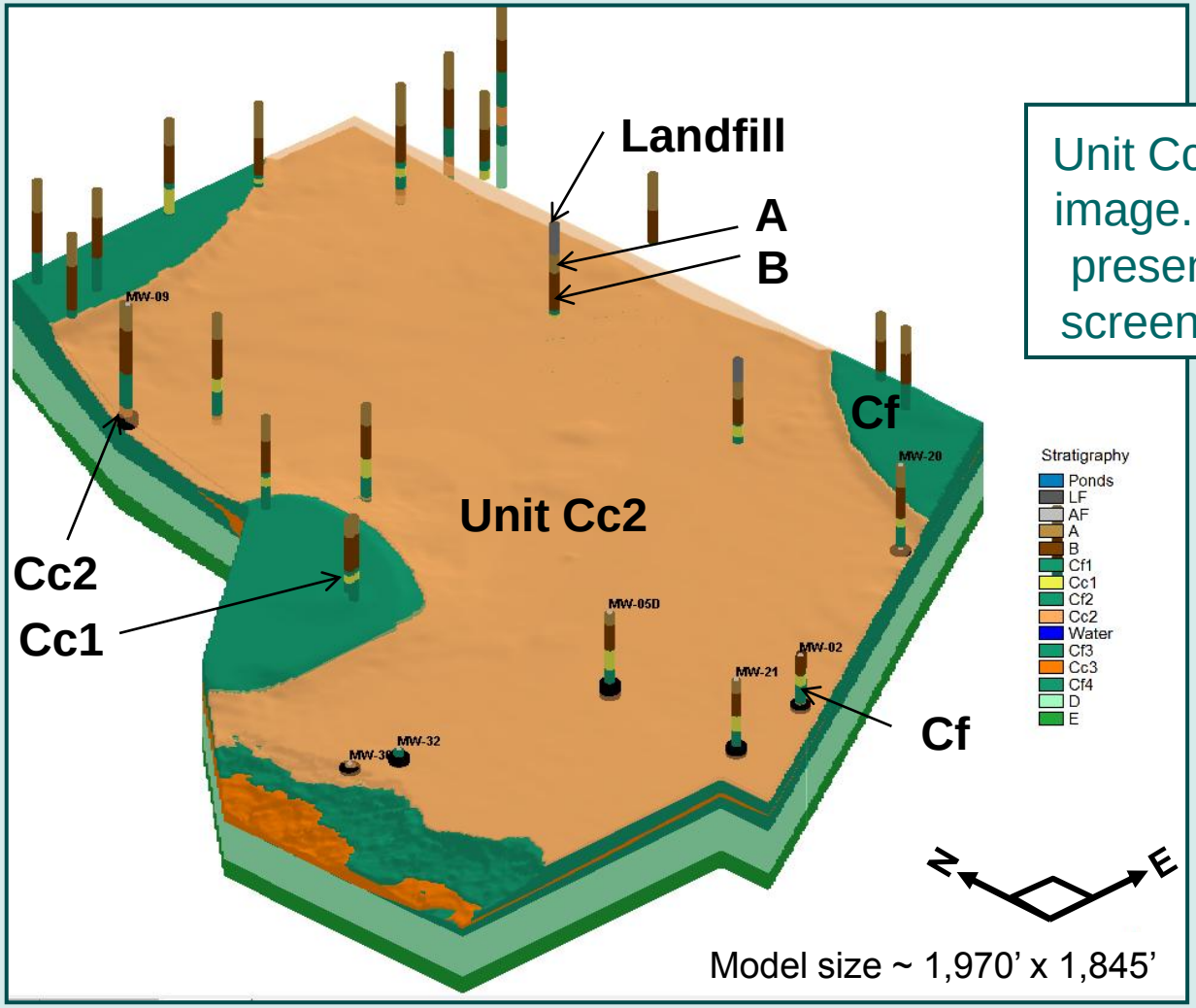




Full model

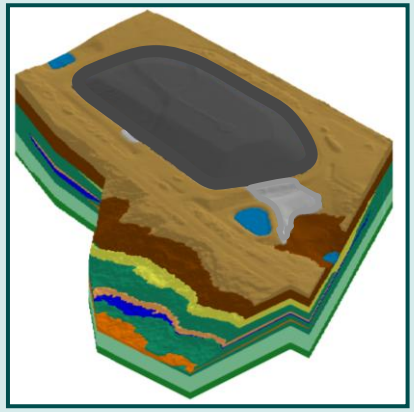


Borehole data from wells for Unit Cc2



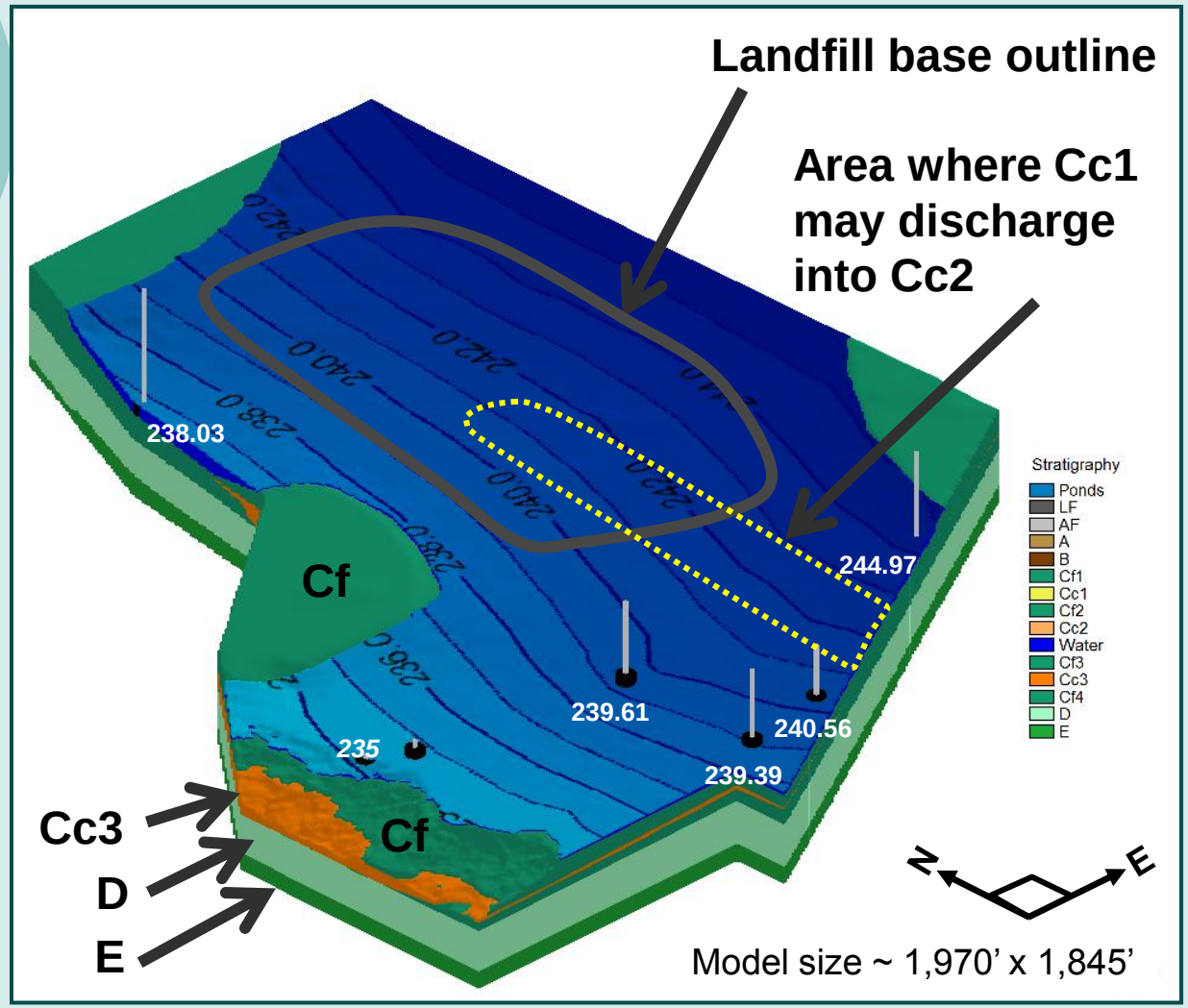
Unit Cc2 transparent in this image. Borehole logs show presence of Unit Cc2 and screened intervals of wells

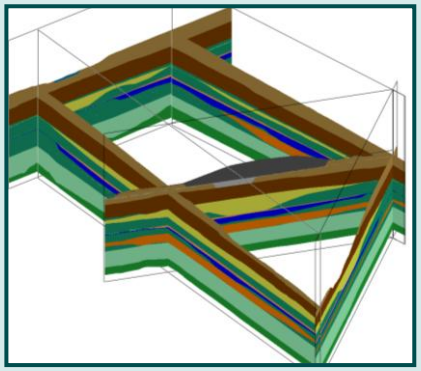
Full model



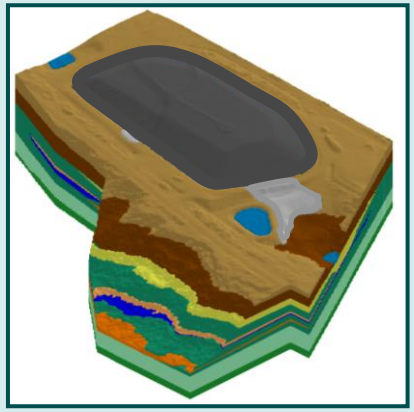
King County

Saturation in Cc2 unit



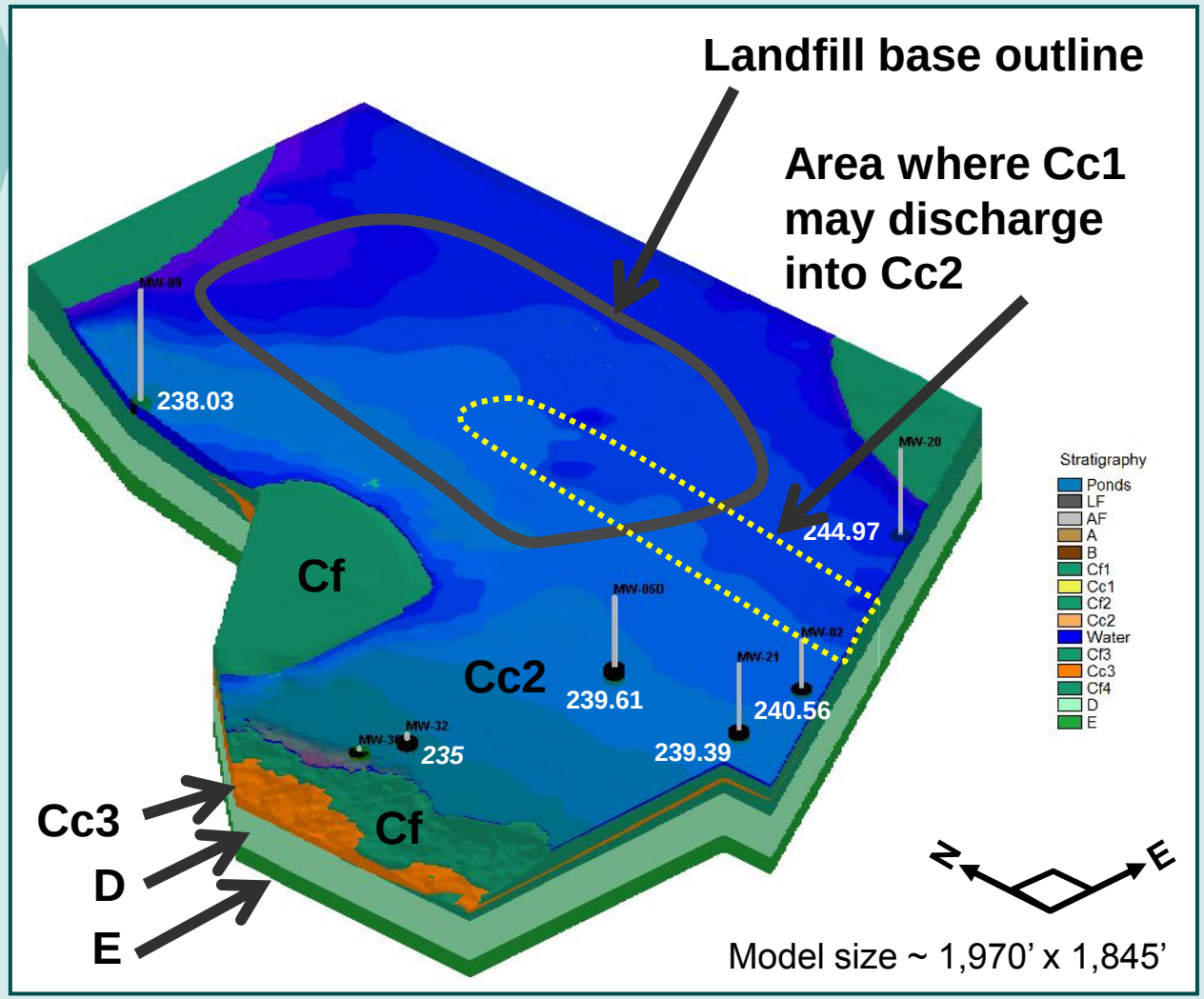


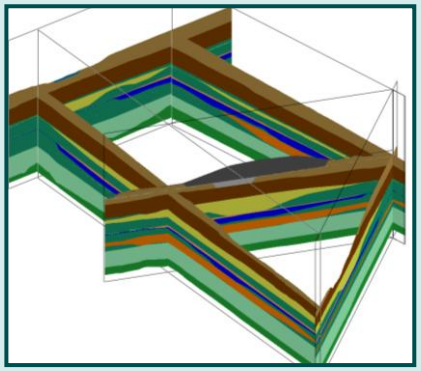
Full model



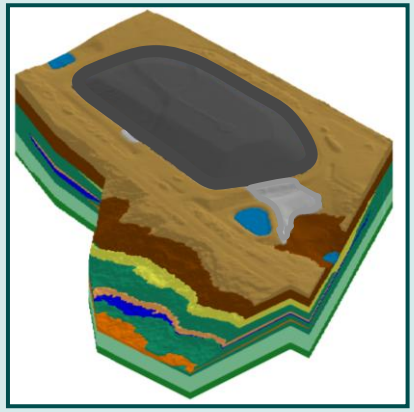
King County

Saturation in Cc2 unit



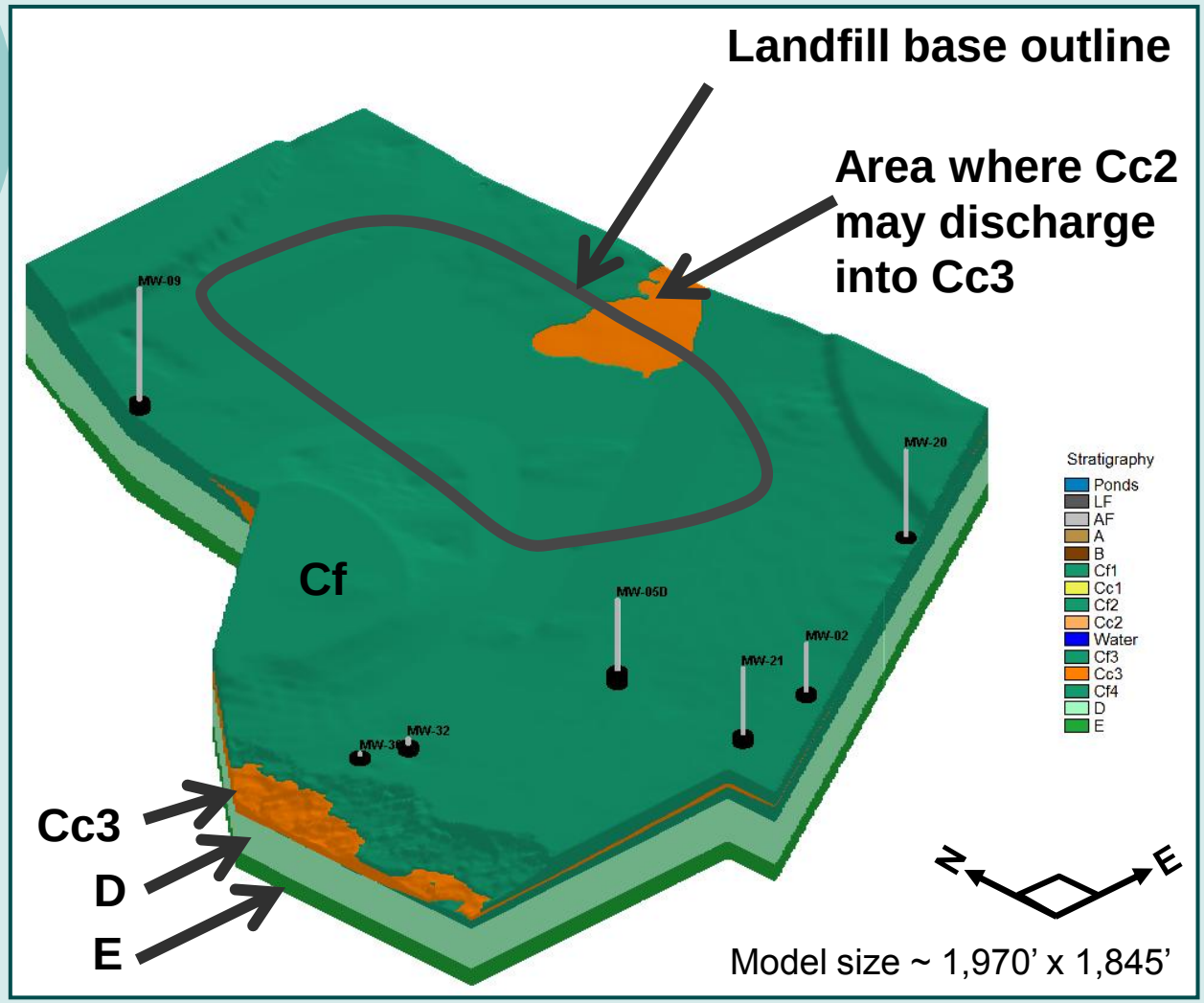


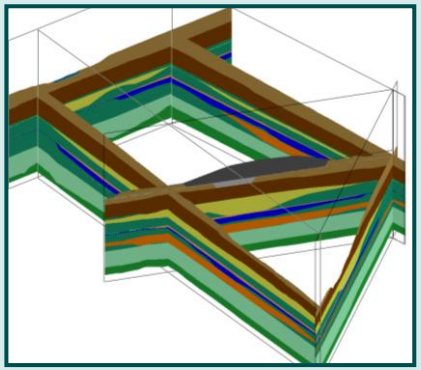
Full model



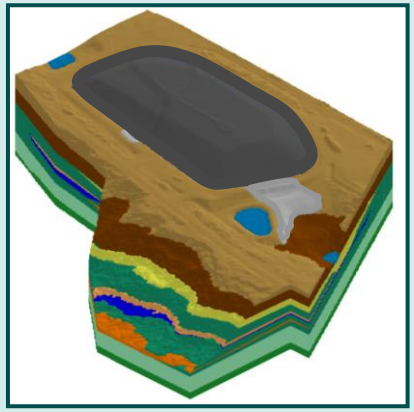
King County

Unit Cc2 removed

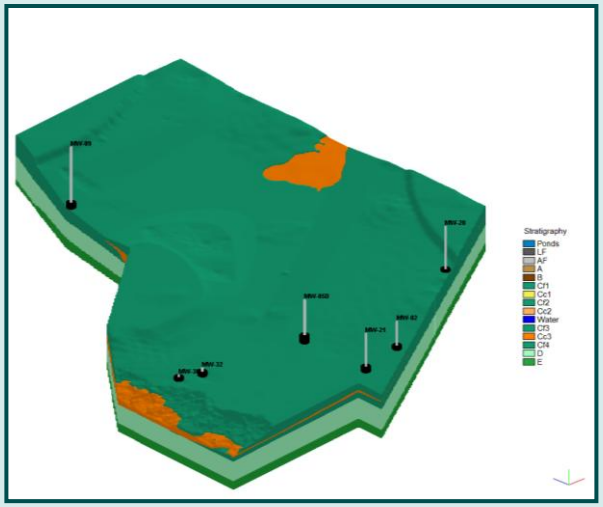


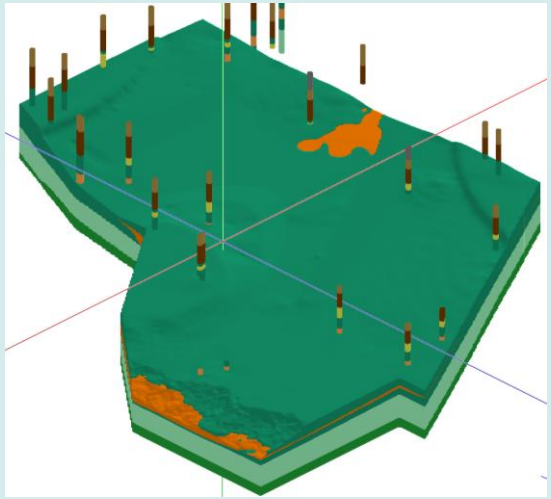


Full model

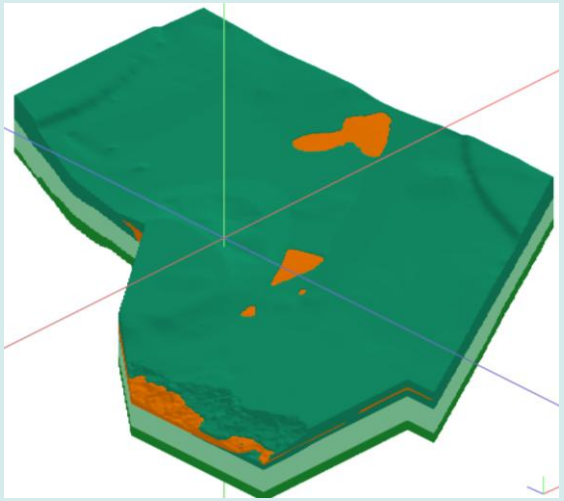


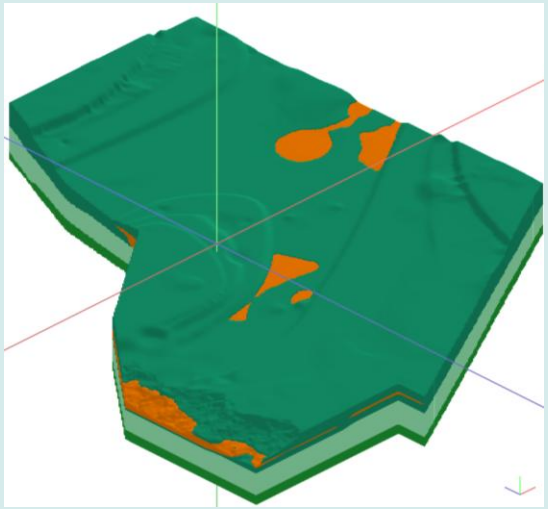
Results using different gridding methods, smoothing, and densifying grids

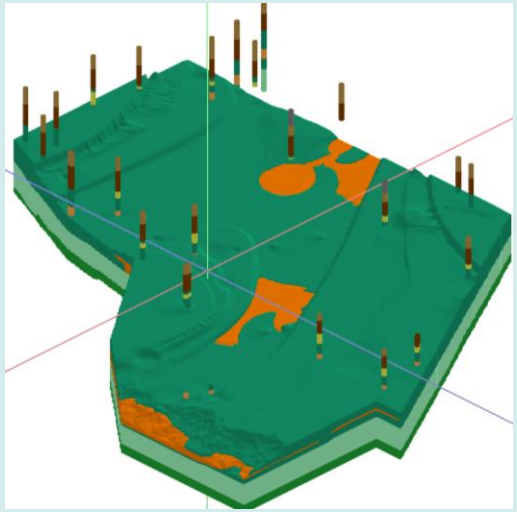




Model size ~ 1,970’ x 1,845’

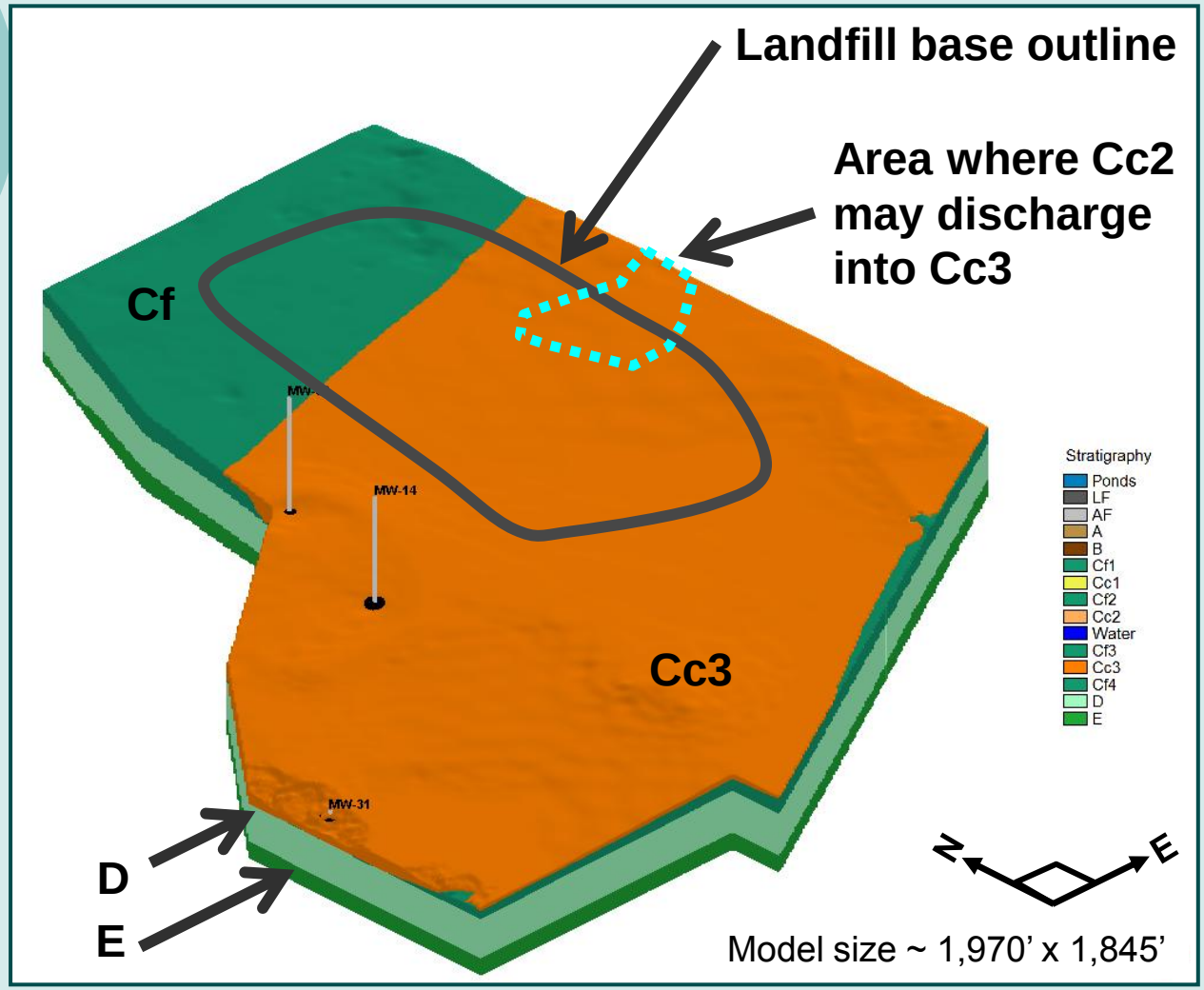


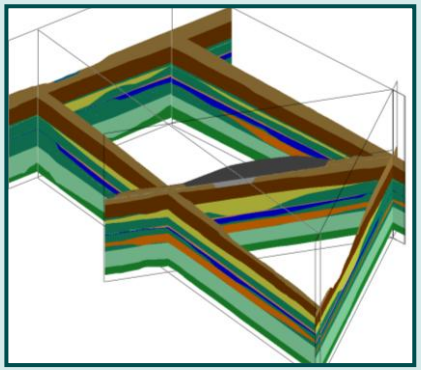




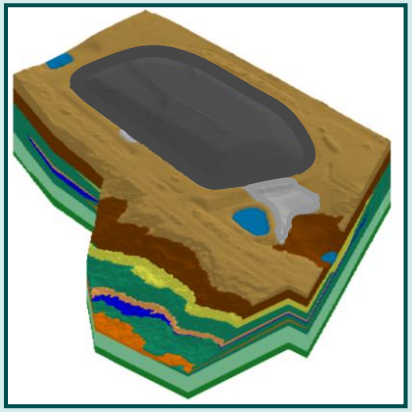
King County

Cf unit beneath Cc2 removed



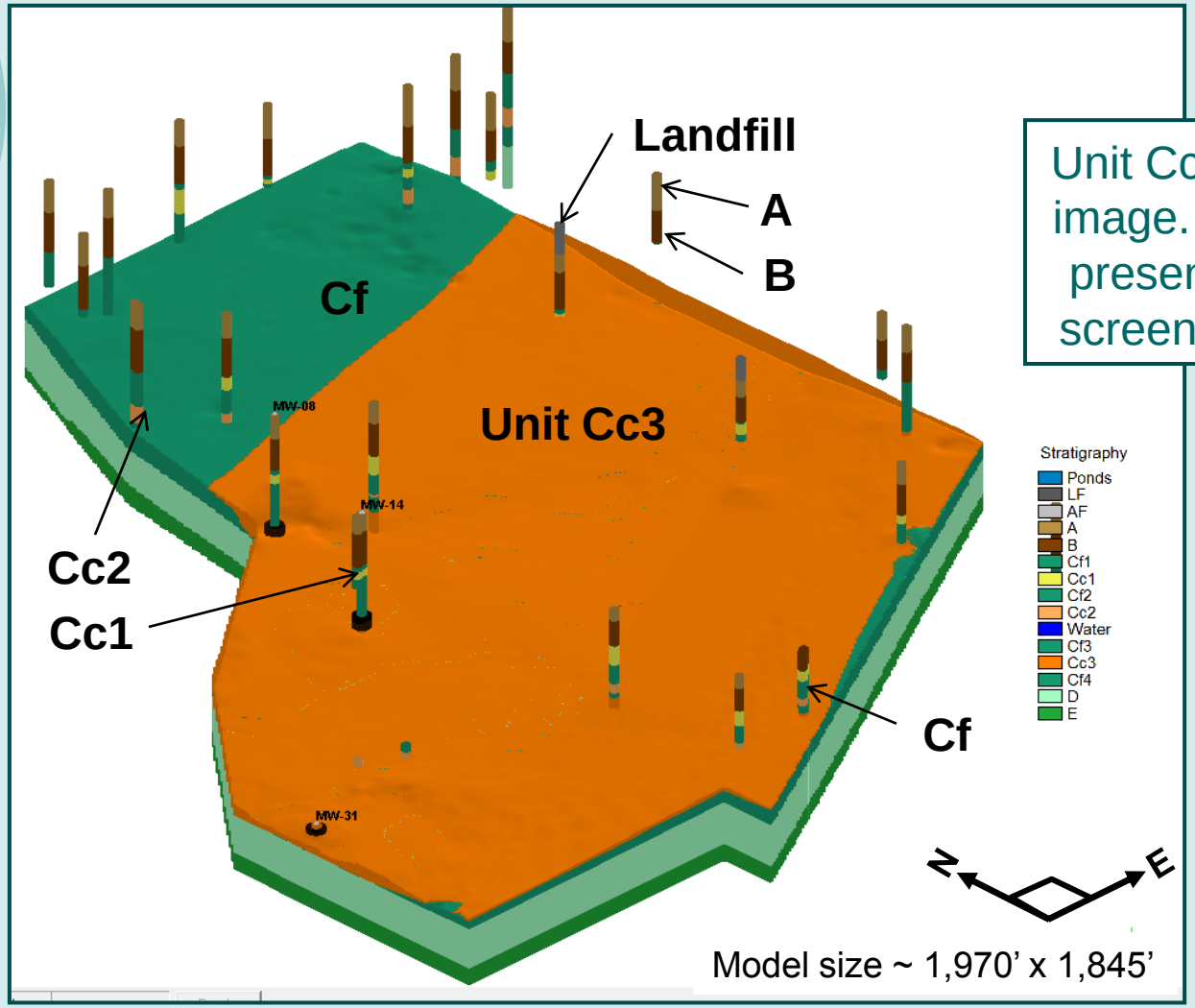


Full model



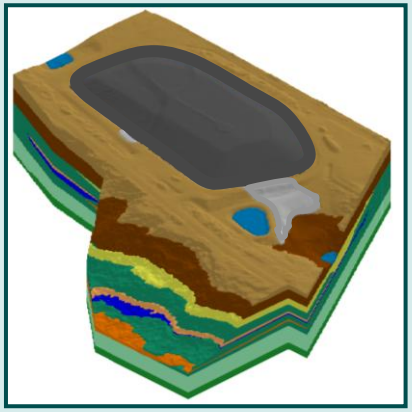
King County

Borehole data from wells for Unit Cc3



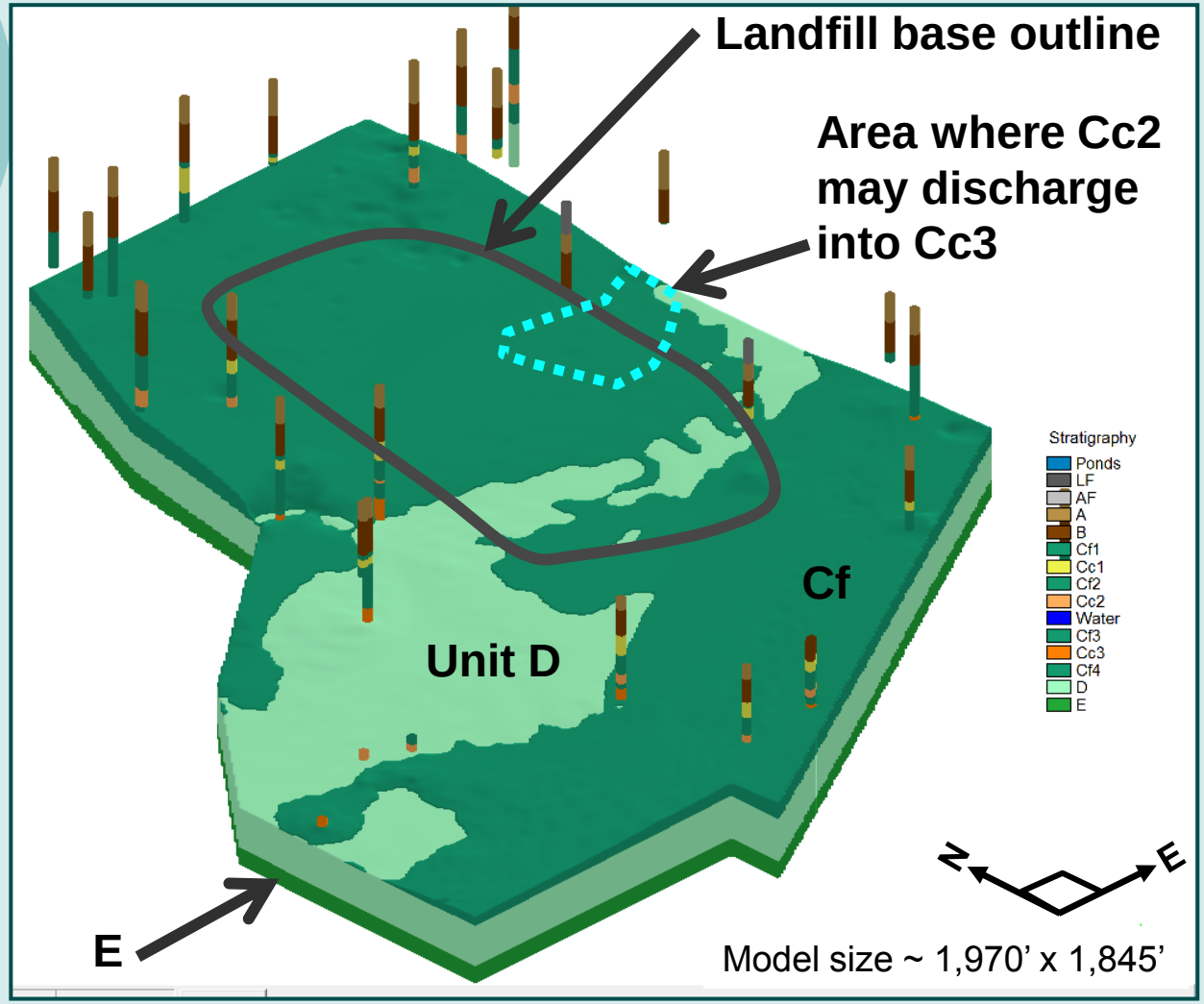
Unit Cc3 transparent in this image. Borehole logs show presence of Unit Cc3 and screened intervals of wells

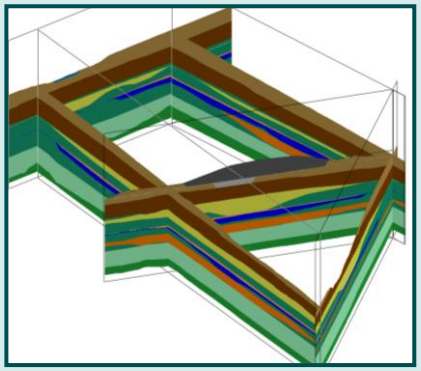
Full model



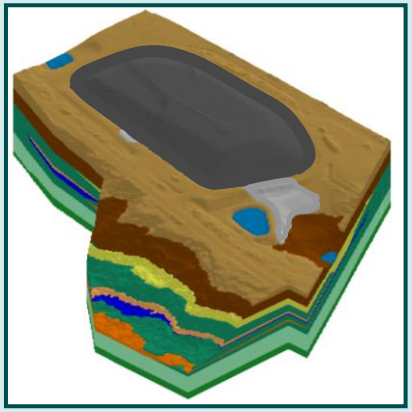
King County

Unit Cc3 removed

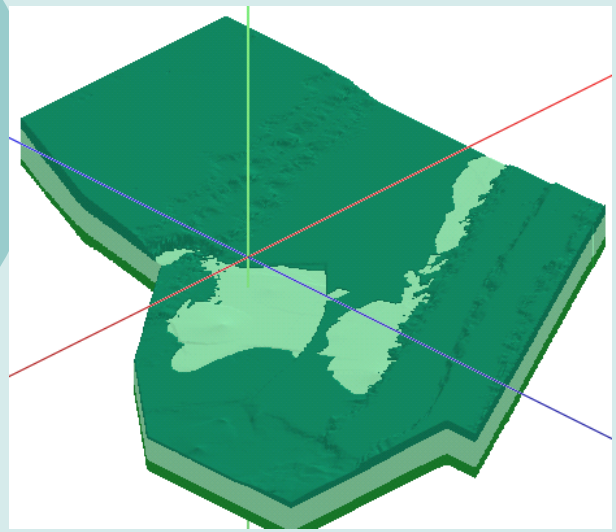


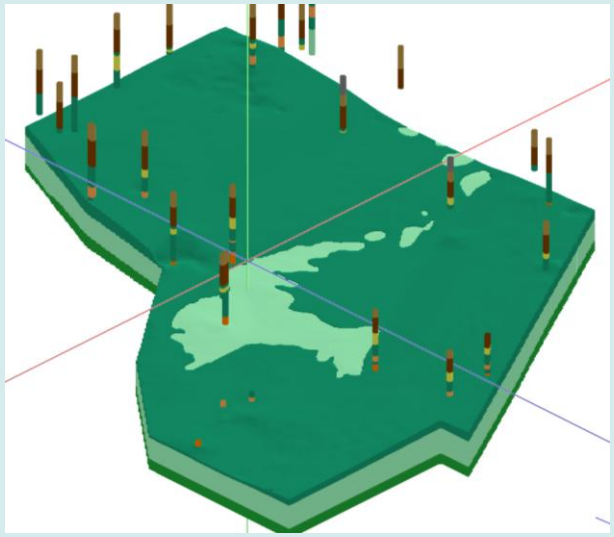


Full model

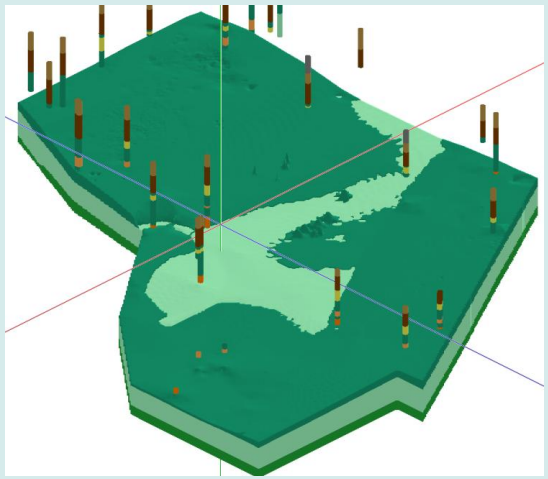


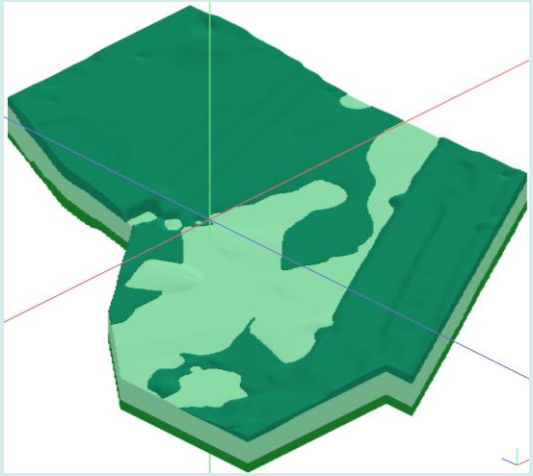
Results using different gridding methods, smoothing, and densifying grids

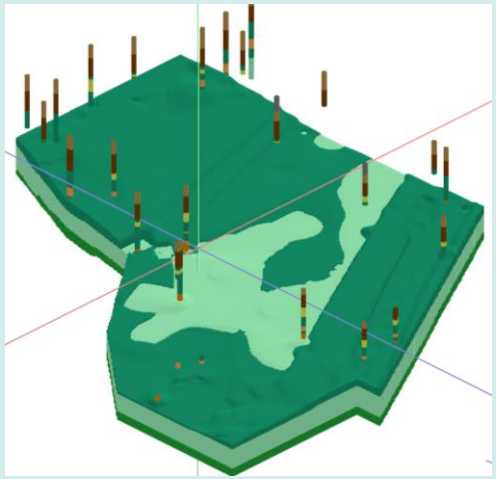




Model size ~ 1,970’ x 1,845’

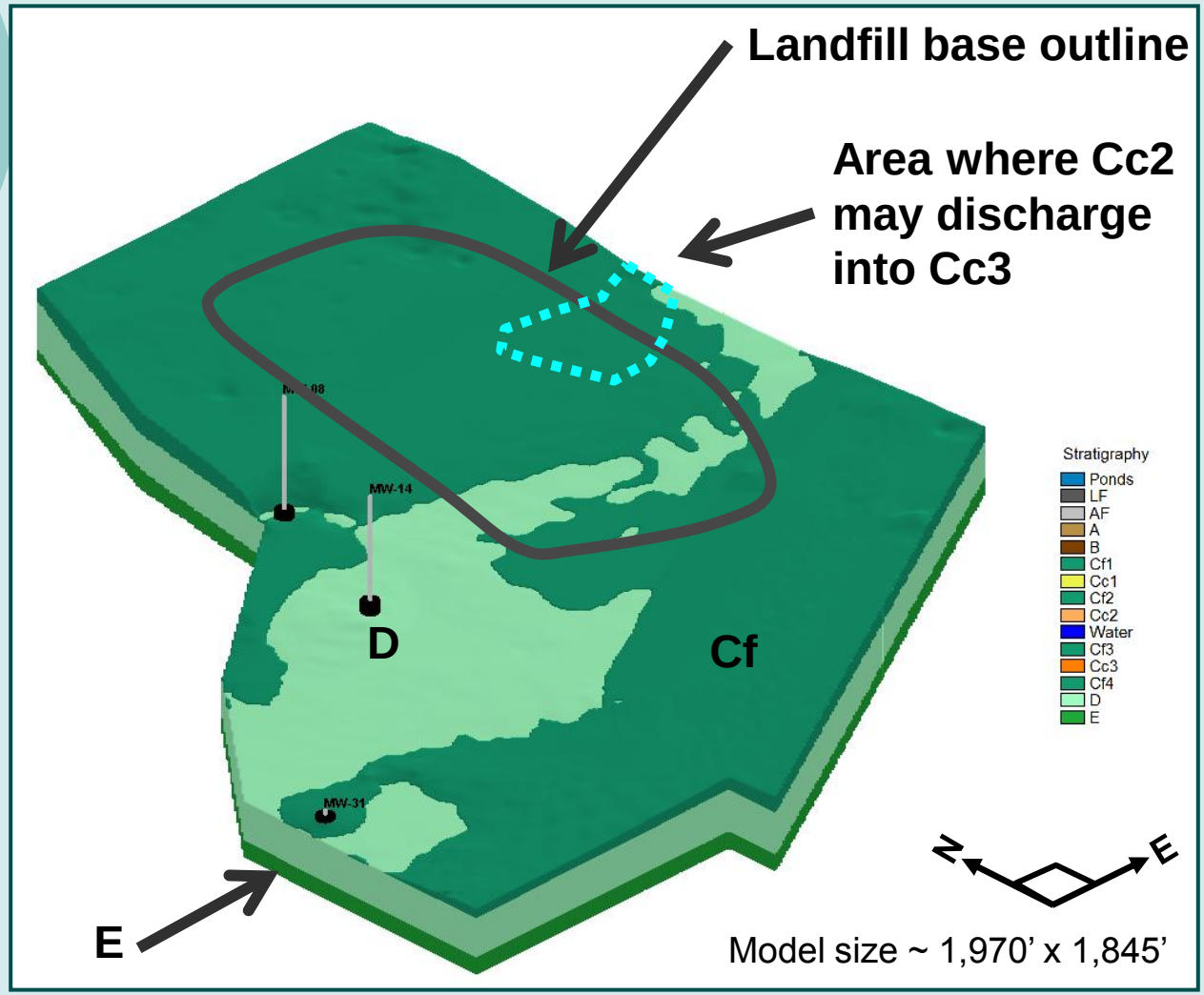


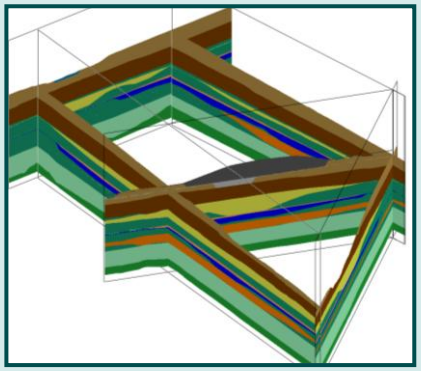




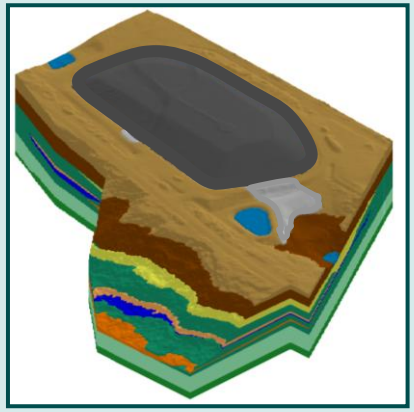
King County

Unit Cc3 removed

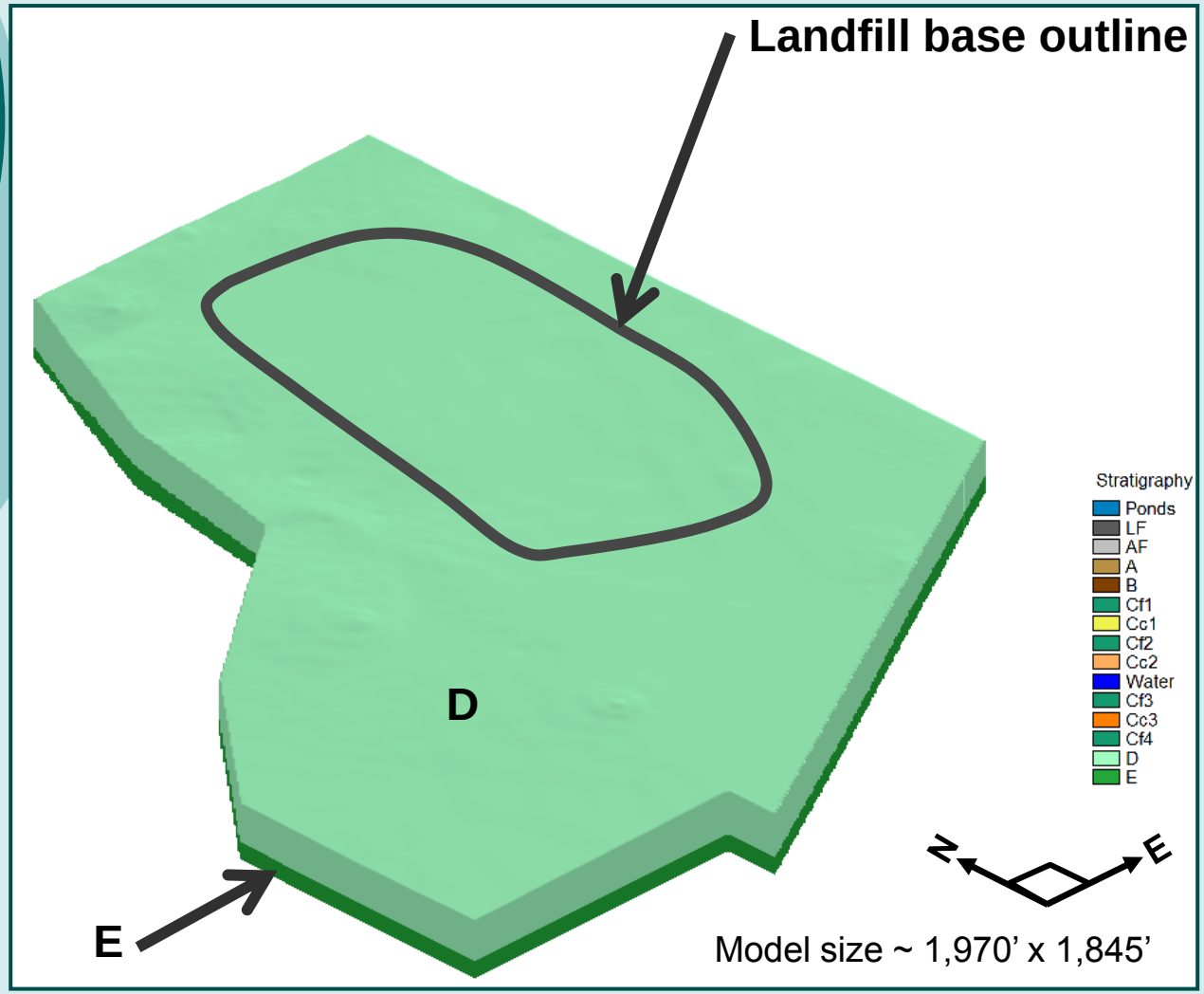


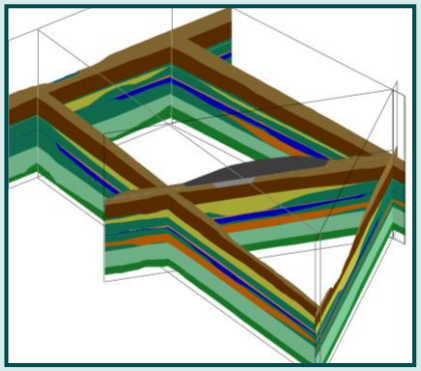


Full model

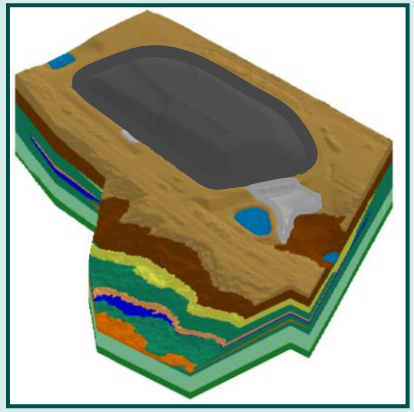


Cf unit beneath Cc3 removed



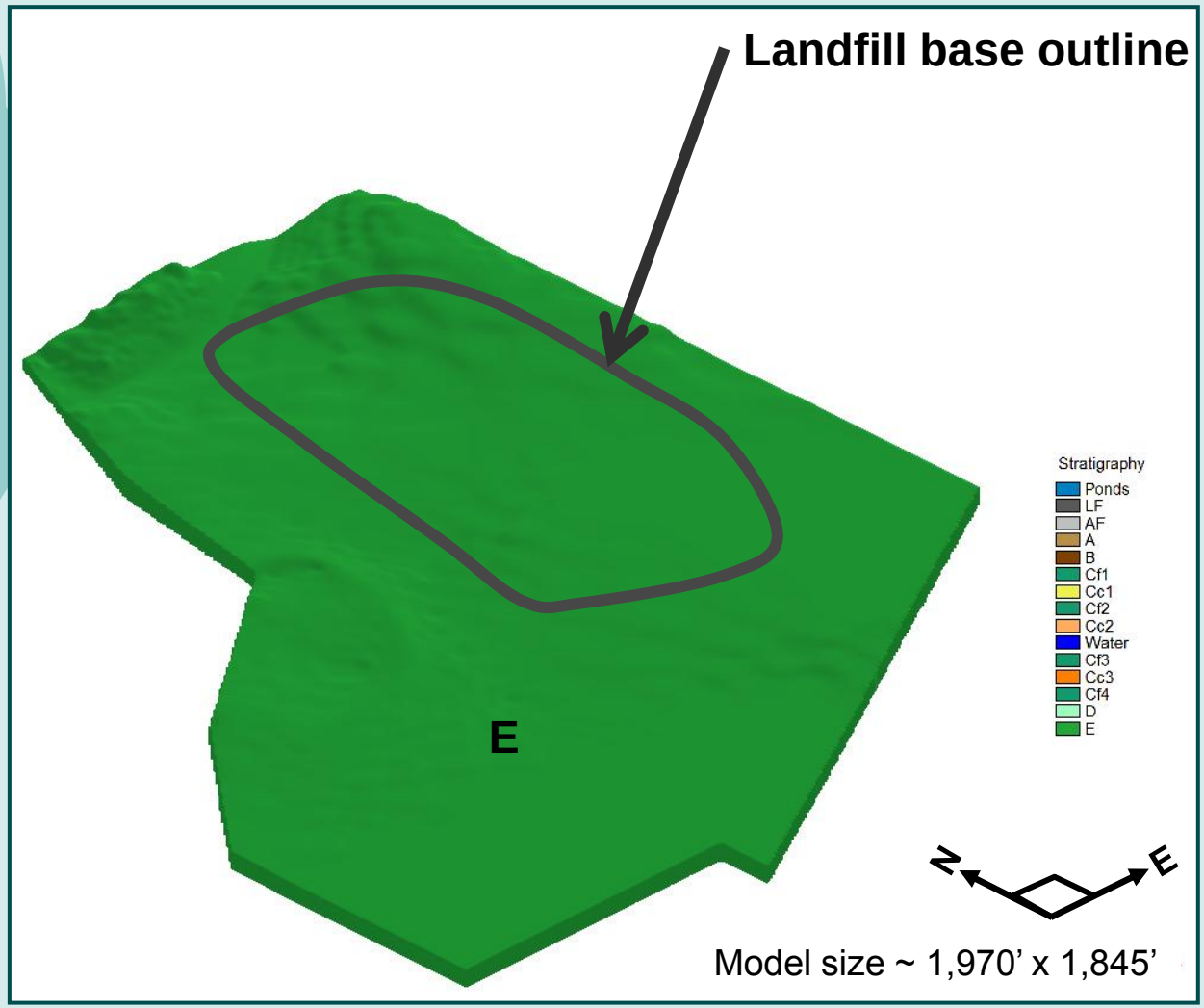


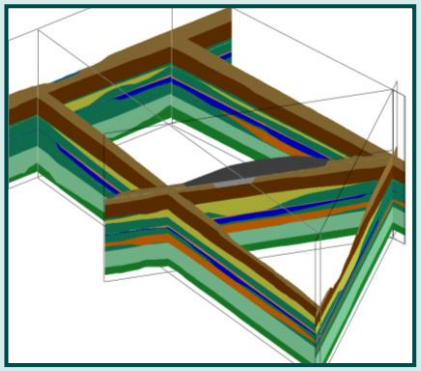
Full model



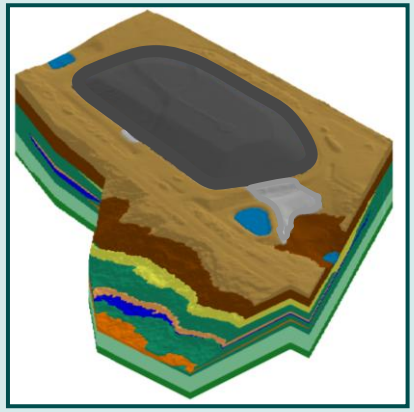
King County

Unit D removed





Full model



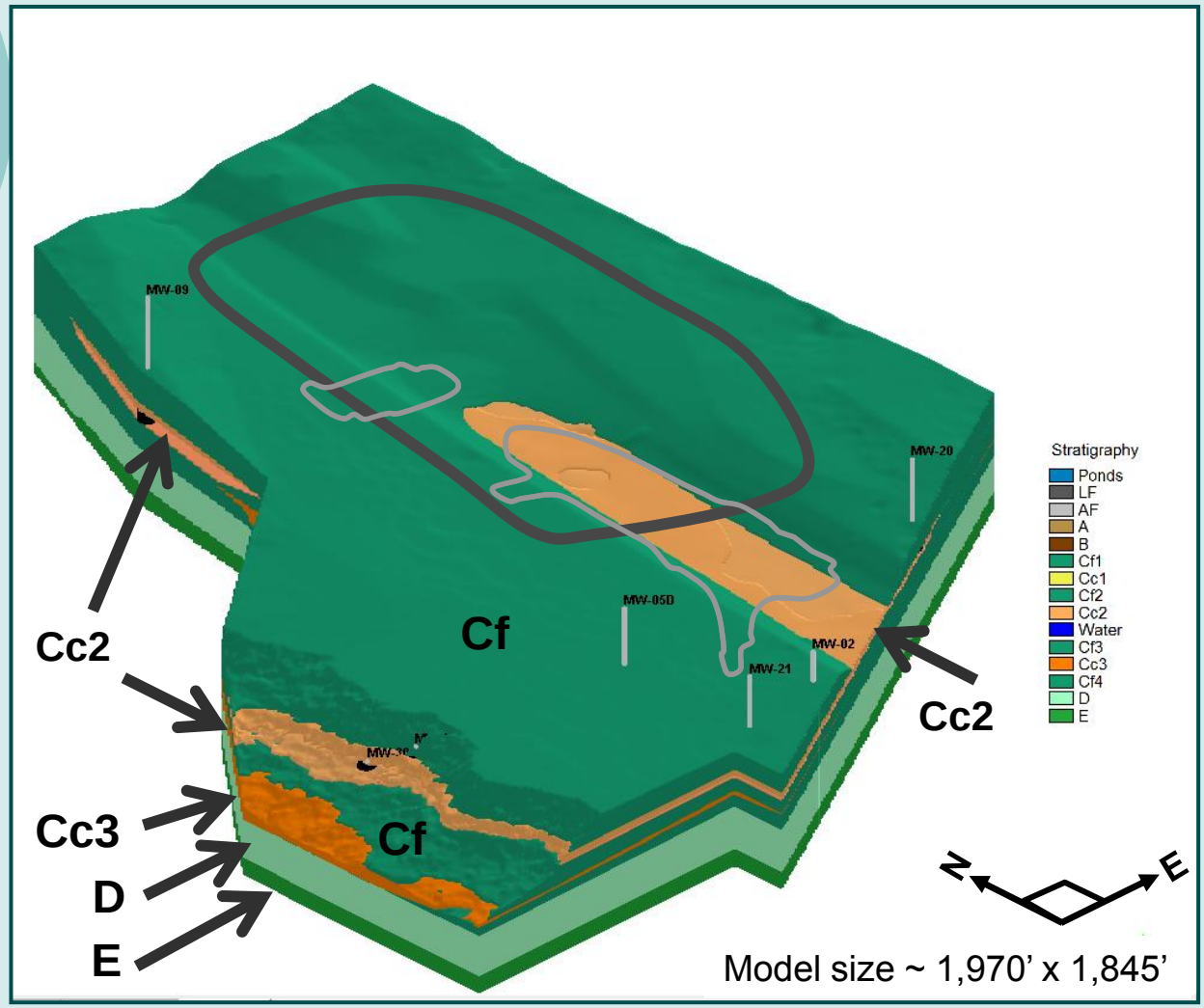
King County

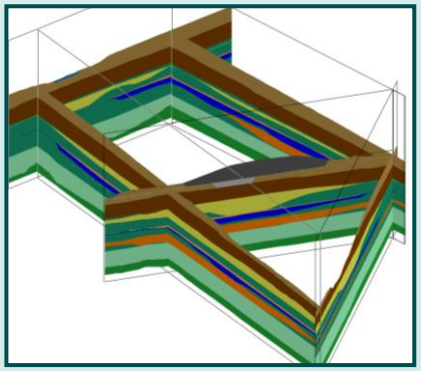
Vinyl chloride in Cc2 unit

- Different gridding methods used to evaluate best option
- Best option bidirectional method. However, results not accurate representation. Image is a generalization
- Drape images of vinyl chloride on top of water in Unit Cc2

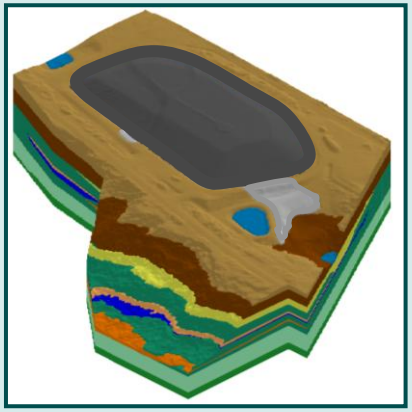
King County

Cc2 unit



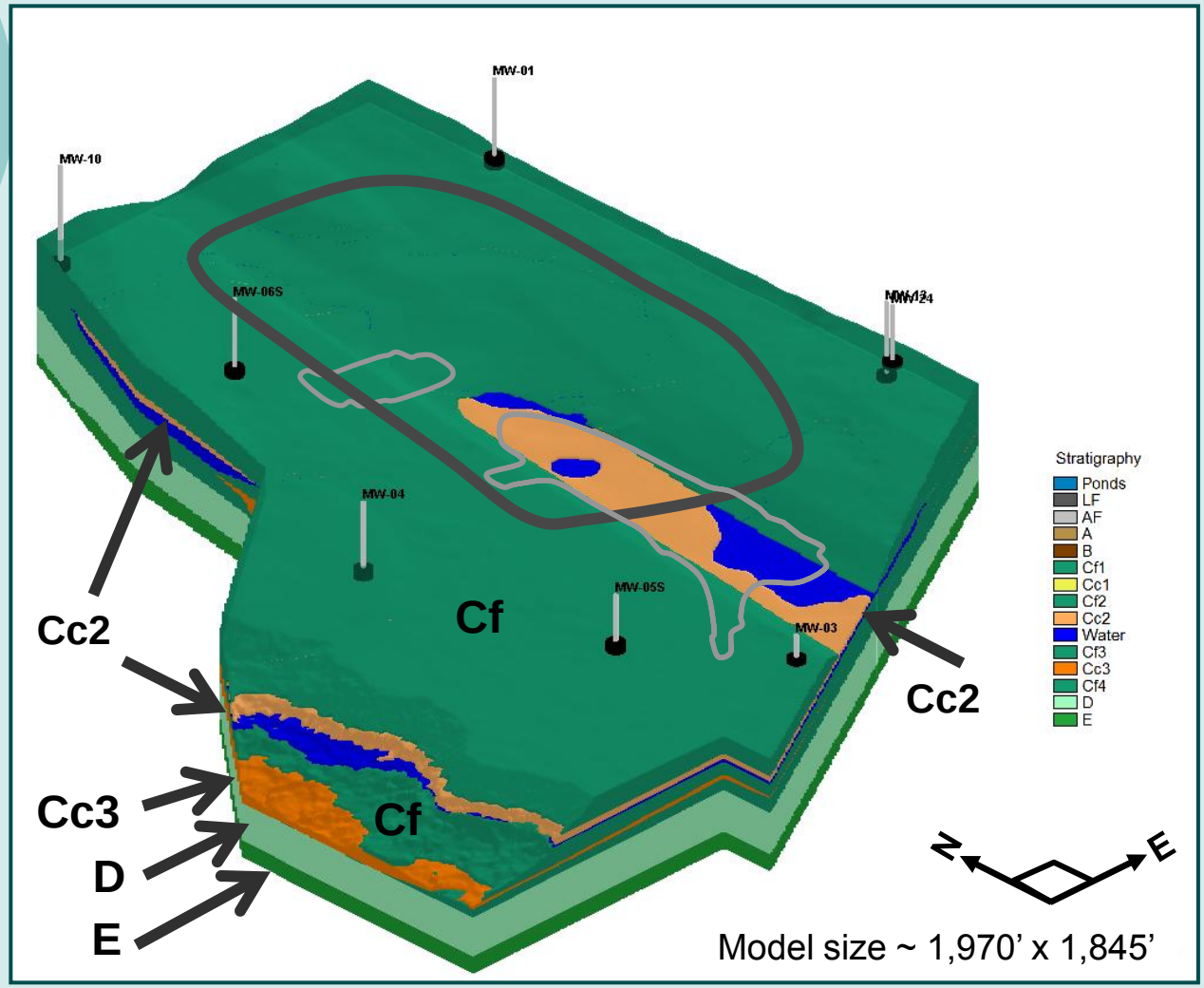


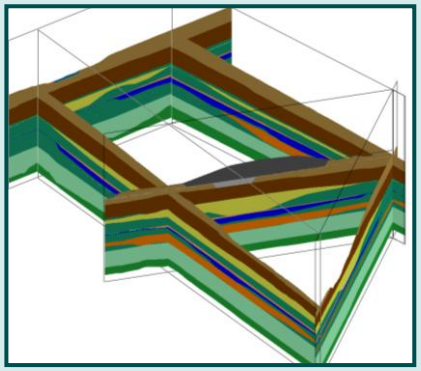
Full model



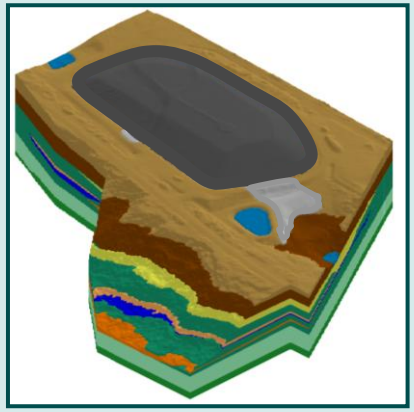
King County

Water in Cc2 unit



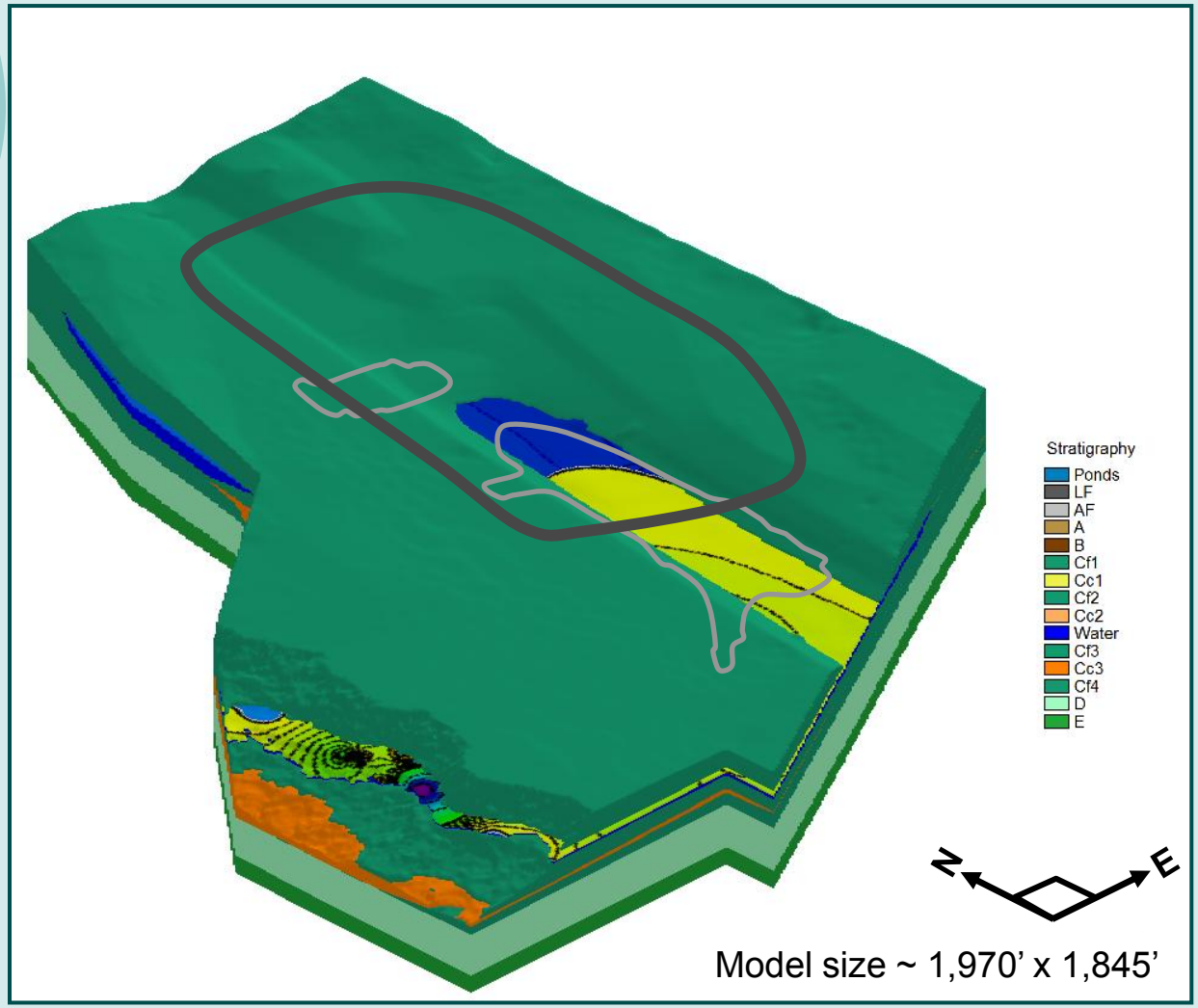


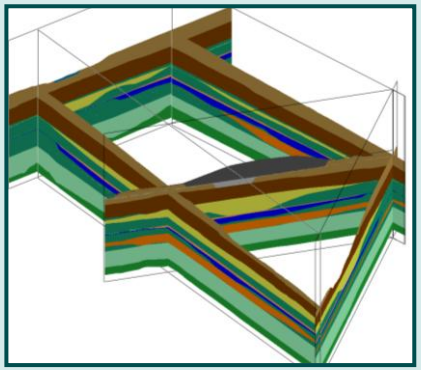
Full model



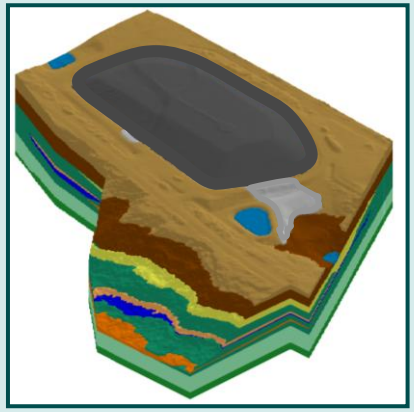
King County

Vinyl chloride on water in Cc2 unit





Full model



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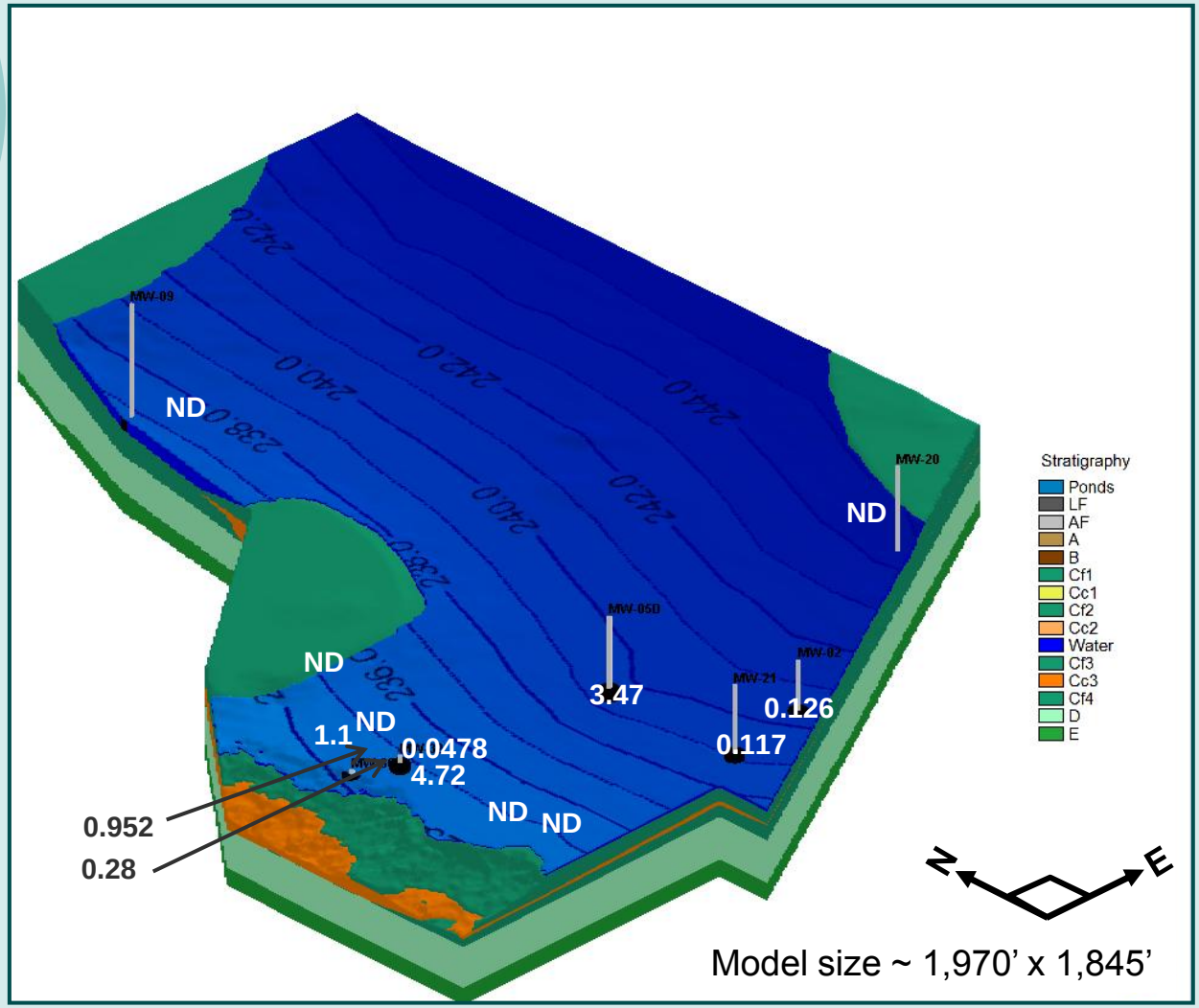
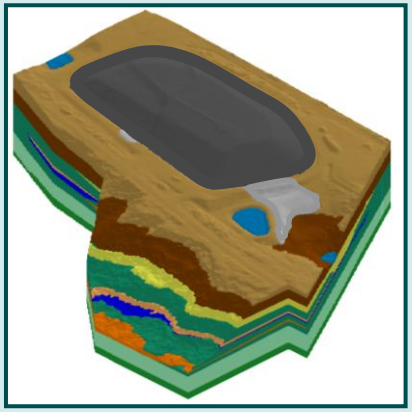
Vinyl chloride levels (ppb) in Cc2 unit



Well data (5/2011) Samples along west hillslope (2005-2010)

Note: Non detect (ND) is <0.02 ppb)

Full model



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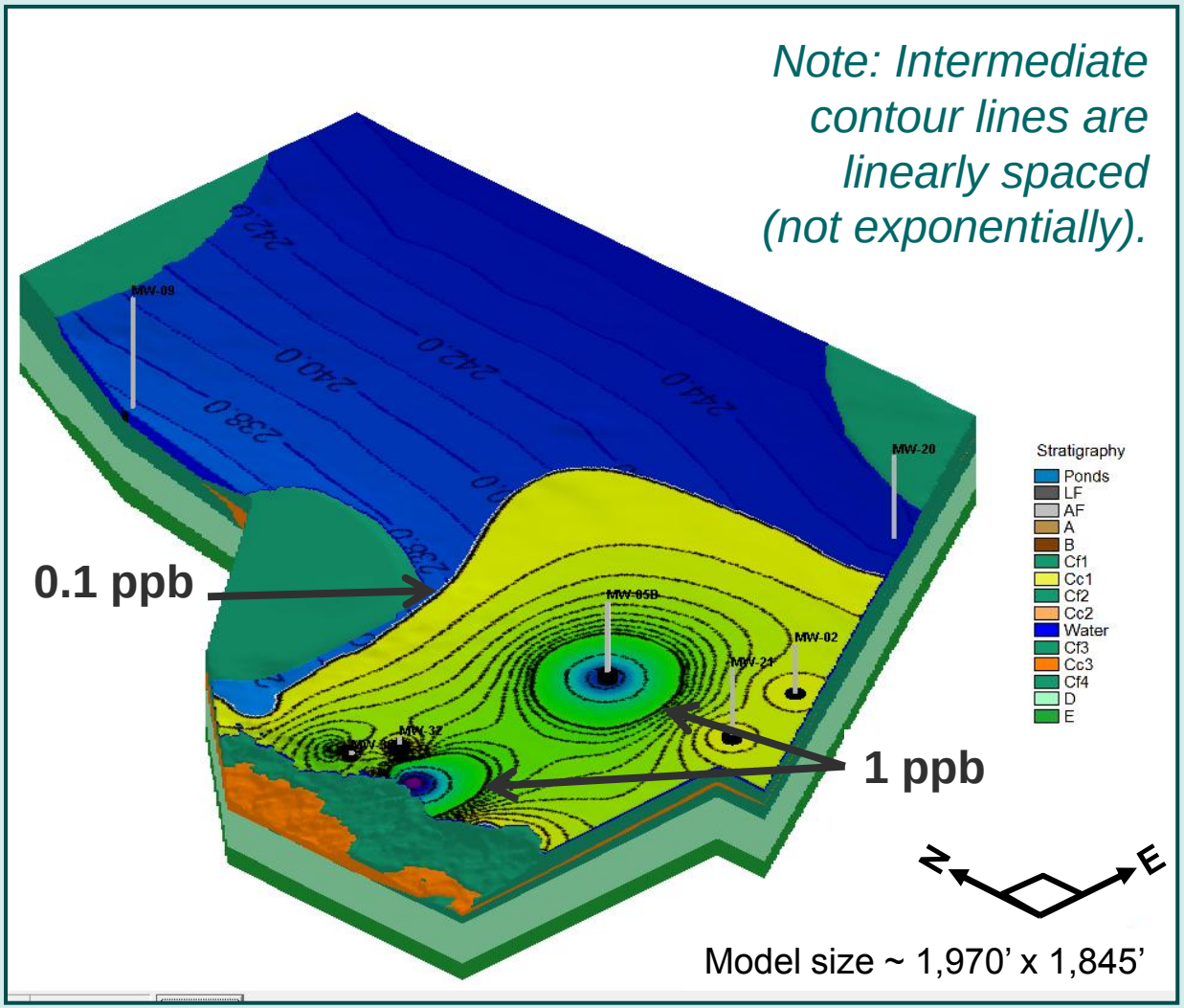
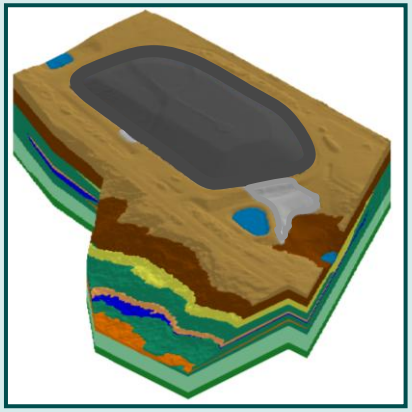
Vinyl chloride in Cc2 unit



Well data (5/2011) Samples along west hillslope (2005-2010)

Note: Non detect (ND) is <0.02 ppb)

Full model



King County

References

Berryman&Henigar ; HDR Engineering; HWA Geosciences (B&H et al). 2001. ***Contract Drawings for Vashon Landfill Final Closure Contract No. C13037C.*** *March.*

Berryman&Henigar ; Udaloy Environmental Services (B&H/UES). 2006. ***Vashon Island Closed Landfill Environmental Evaluation Report.***