CPCC-00872 -VA
Revision 0

Geoframework Models A Force Multiplier

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

P.O. Box 1464
Richland, Washington 99352

CPCC-00872 -VA
Revision 0

Geoframework Models A Force Multiplier

T. D. Winslow
Central Plateau Cleanup Company LLC (CPCCo)

Date Published
October 2023

To be Presented at
RemPlex 2023 Summit

Pacific Northwest National Laboratory
Richland, WA

11/13/2023 - 11/17/2023

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

P.O. Box 1464
Richland, Washington 99352

APPROVED
By Julia Raymer at 2:17 pm, Oct 12, 2023

Release Approval Date

Geoframework Models
A Force Multiplier

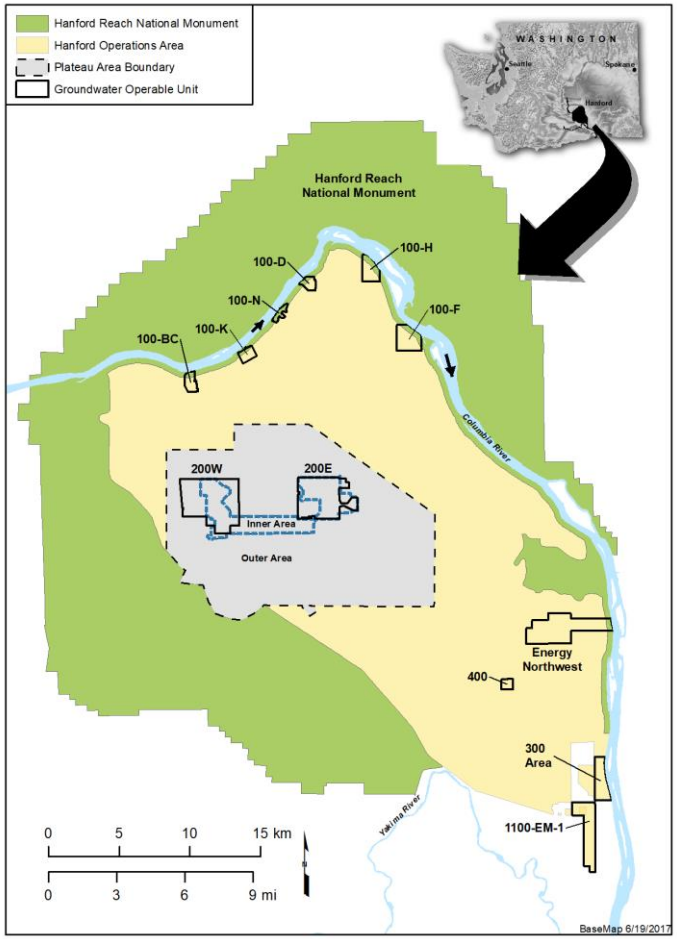
Tollef Winslow

Central Plateau Cleanup Company

Geoframework Models: A Force Multiplier

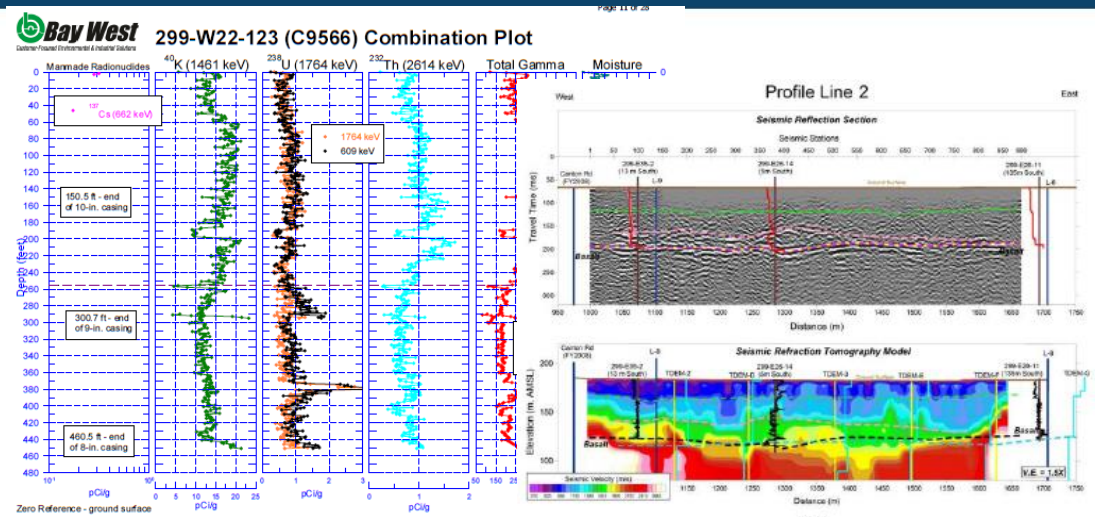
How to organize, analyze, interpret and integrate:

- 580 square miles total area
- 279 square miles cleanup area
- 12000+ boreholes
  - Geophysical Logs
  - Borehole geology logs
- Seismic Surveys
- ERT Surveys
- Field Observations
- 100's of geologic studies
- Generations of geologists
- Evolving geologic understanding



Geoframework Models

Field Observations



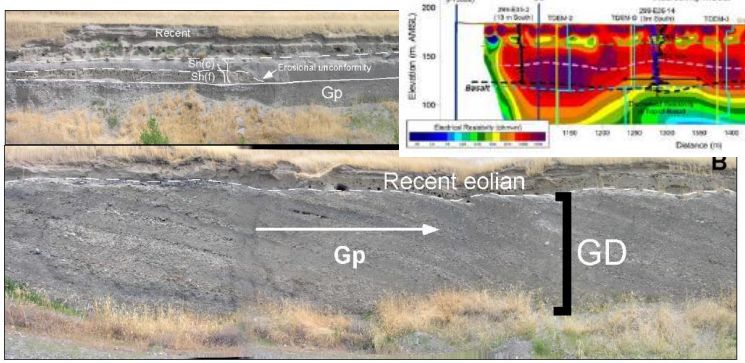
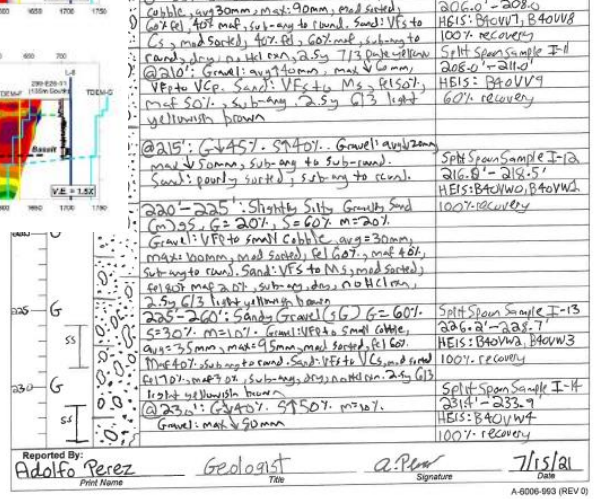


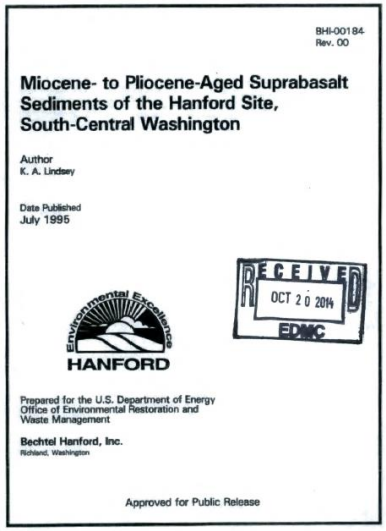
Figure B-5. Facies Associations GD and SD a

* (A) clastic sill runs along top of cataclysmic flood gravels, occasionally projecting upward into dikes. Fine-grained horizontally laminated sand (Sh[f]) locally scoured and filled with coarser-grained Sh(c). (B) planar-tabular (foreset-bedded) flood gravels (Gp) occur as single thick (4- to 5-m [13- to 16-ft]) unit that prograded downvalley (direction of arrow). Location identified by the letters "SC" on Figure A-19.



Studies

Single Author Comprehensive Studies



BHI-00184
Rev. 00

Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington

Author
K. A. Lindsey

Date Published
July 1995

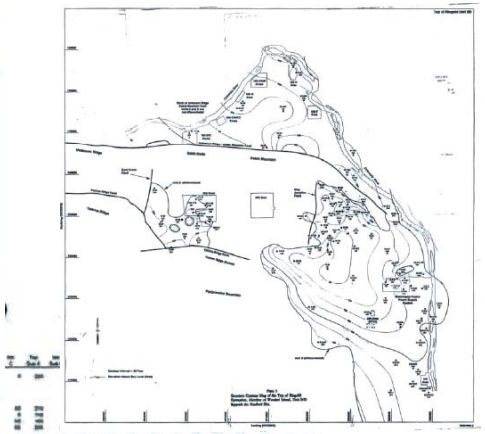
RECEIVED
OCT 20 2014
EDMC

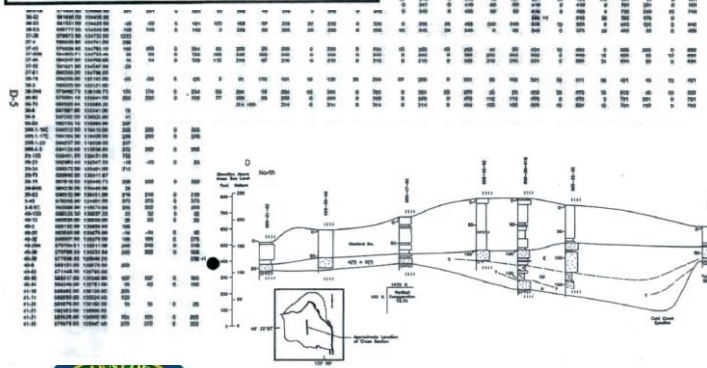
HANFORD

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

Approved for Public Release





Multi Author Focused Studies

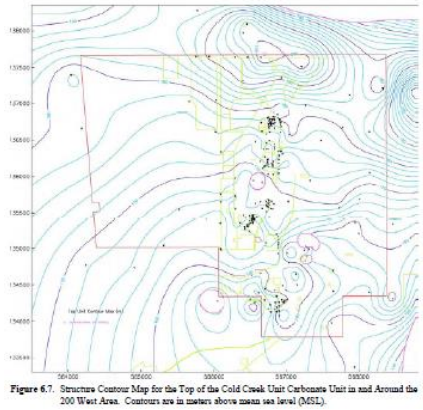
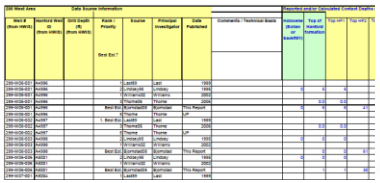
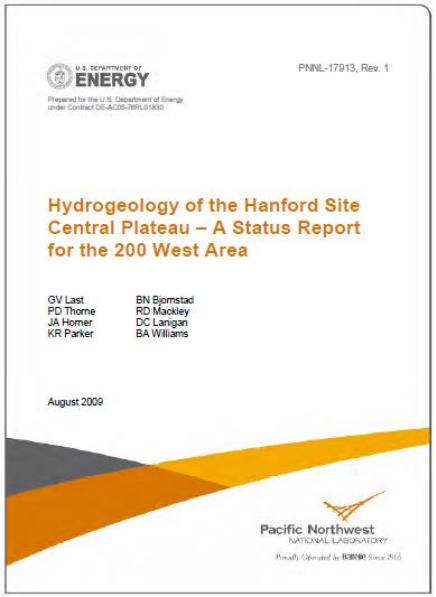


Figure 6.7. Structure Contour Map for the Top of the Cold Creek Unit Carbonate Unit in and Around the 200 West Area. Contours are in meters above mean sea level (MSL).





U.S. DEPARTMENT OF ENERGY

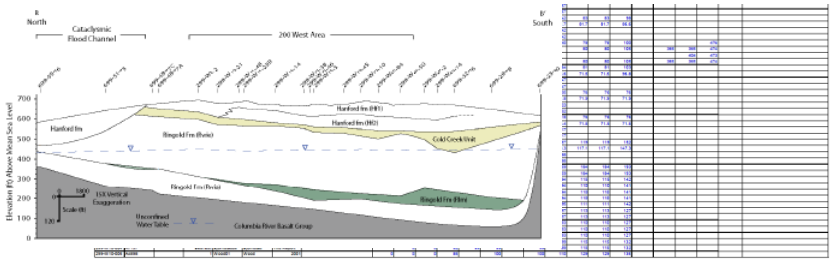
PNNL-17913, Rev. 1

Hydrogeology of the Hanford Site Central Plateau – A Status Report for the 200 West Area

GV Last
PD Thorne
JA Horner
KR Parker
BN Bjornstad
RD Mackley
DC Lanigan
BA Williams

August 2009

Pacific Northwest NATIONAL LABORATORY



Geoframework

"A Geological Framework (geoframework) is a set of 3D models used for integrating, interpreting, and analyzing geoscience data in 3D to help answer geological questions."

Adapted from the Alberta Geologic Survey

https://ags.aer.ca/research-initiatives/geological-framework

Geoframework Models

CP-67635
Revision 0

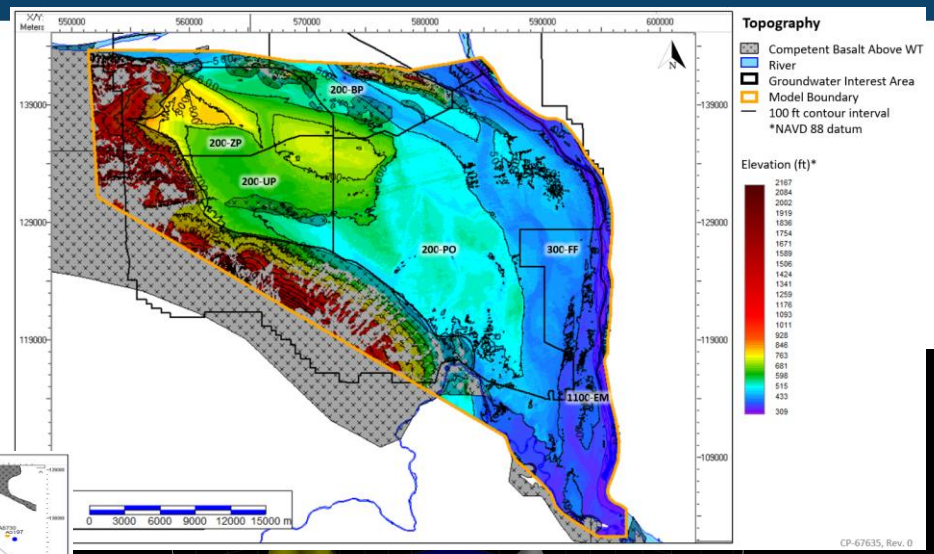
Development of Hanford South Geoframework Model

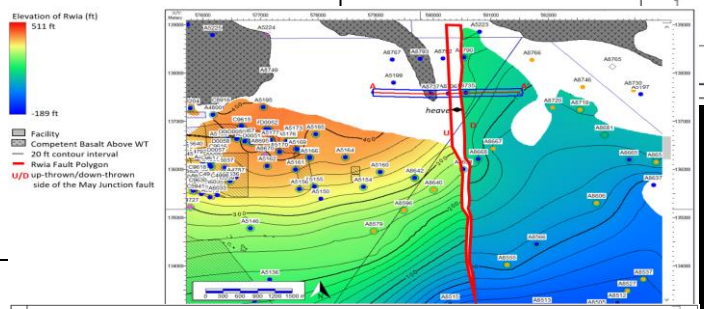
Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

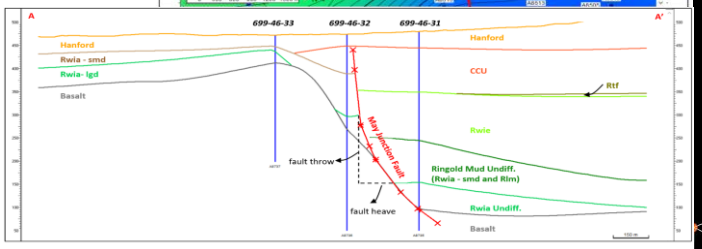
Contractor for the U.S. Department of Energy
under Contract 89303320DEM000020

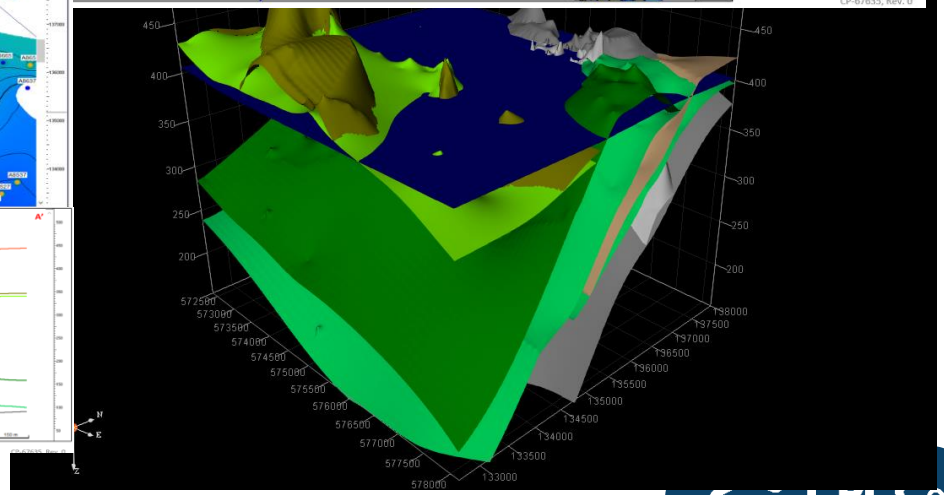
CPCCo
Central Plateau
Cleanup Company

P.O. Box 1464
Richland, Washington 99352









What's behind the Geoframework model?

NORTH AMERICAN STRATIGRAPHIC CODE

North American Commission on Stratigraphic Nomenclature
from The American Association of Petroleum Geologists Bulletin
Volume 89, Number 11 (November, 2005), pp. 1547–1591, 11 Figures, 2 Tables
with amendments published 2017, 2019, and 2020
*Stratigraphy, Volume 13, Number 3 (April, 2017), pp. 220–222***
Stratigraphy, Volume 16, Number 4 (December, 2019), pp. 279–281, 1 Table
Stratigraphy, Volume 17, Number 4 (December, 2020), pp. 315–316, 1 Table

FOREWORD TO THE 2021 EDITION

The 2021 version of the North American Stratigraphic Code is not a major revision. It simply states the changes mandated by the three approved amendments published in Easton et al. (2017), Brett et al. (2019), and Aubry et al. (2020), which contain modifications to Articles 13, 25, 26, 27, 37, 73, 81, 82, and Table 2. For completeness, the composition of the North American Commission on Stratigraphic Nomenclature has been updated in Appendix II, and citations to Notes and Reports of the Commission since 2005 have been added to Appendix III. These changes follow Code amendment procedures as outlined in Article 21.

2021 North American Commission on Stratigraphic Nomenclature

FOREWORD TO THE REVISED 2005 EDITION

By design, the North American Stratigraphic Code is meant to be an evolving document, one that requires change as the field of earth science evolves. The revisions to the Code that are included in this 2005 edition encompass a broad spectrum of changes, ranging from a complete revision of the section on *Biostratigraphic Units* (Articles 48 to 54), several wording changes to Article 58 and its remarks concerning *Allostratigraphic Units*, updating of Article 4 to incorporate changes in publishing methods over the last two decades, and a variety of minor wording changes to improve clarity and self-consistency between different sections of the Code. In addition, text-figures 1, 4, 5, and 6, as well as Tables 1 and 2 have been modified. Most of the changes adopted in this revision arose from Notes 60, 63 and 64 of the Commission, all of which were published in the *AAPG Bulletin*. These changes follow Code amendment procedures as outlined in Article 21.

We hope these changes make the Code a more usable document to professionals and students alike. Suggestions for future modifications or additions to the North American Stratigraphic Code are always welcome. Suggested and adopted modifications will be announced to the profession, as in the past, by serial Notes and Reports published in the *AAPG Bulletin*. Suggestions may be made to representatives of your association or agency who are current commissioners, or directly to the Commission itself. The Commission meets annually, during the national meetings of the Geological Society of America.

2004 North American Commission on Stratigraphic Nomenclature

FOREWORD TO THE 1983 CODE

The 1983 Code of recommended procedures for classifying and naming stratigraphic and related units was prepared during a four-year period, by and for North American earth scientists, under the auspices of the North American Commission on Stratigraphic Nomenclature. It represents the thought and work of scores of persons, and thousands of hours of writing and editing. Opportunities to participate in and review the work have been provided throughout its development, as cited in the Preamble, to a degree unprecedented during preparation of earlier codes.

Publication of the International Stratigraphic Guide in 1976 made evident some insufficiencies of the American Stratigraphic Codes of 1961 and 1970. The Commission considered whether to discard our codes, patch them over, or rewrite them fully, and chose the last. We believe it desirable to sponsor a code of stratigraphic practice for use in North America, for we can adapt to new methods and points of view more rapidly than a worldwide body. A timely example was the recognized need to develop modes of establishing formal nonstratiform (igneous and high-grade metamorphic) rock units, an objective that is met in this Code, but not yet in the Guide.

The ways in which the 1983 Code (revised 2005) differs from earlier American codes are evident from the Contents. Some categories have disappeared and others are new, but this Code has evolved from earlier codes and from the International Stratigraphic Guide. Some new units have not yet stood the test of long practice, and conceivably may not, but they are introduced toward meeting recognized and defined needs of the profession. Take this Code, use it, but do not condemn it because it contains something new or not of direct interest to you. Innovations that prove unacceptable to the profession will expire without damage to other concepts and procedures, just as did the geologic-climate units of the 1961 Code.

The 1983 Code was necessarily somewhat innovative because of (1) the decision to write a new code, rather than to revise the 1970 Code; (2) the open invitation to members of the geologic profession to offer suggestions and ideas, both in writing and orally; and (3) the progress in the earth sciences since completion of previous codes. This report strives to incorporate the strength and acceptance of established practice, with suggestions for meeting future needs perceived by our colleagues; its authors have attempted to bring together the good from the past, the lessons of the Guide, and carefully reasoned provisions for the immediate future.

State of Washington
ALBERT D. ROSELLINI, Governor
Department of Conservation
EARL COE, Director

DIVISION OF MINES AND G
MARSHALL T. HUNTTING, S

Reprint No. 1

RINGOLD FORM
OF PLEISTOCENE
IN TYPE LOCALITY, THE
WASHINGTO

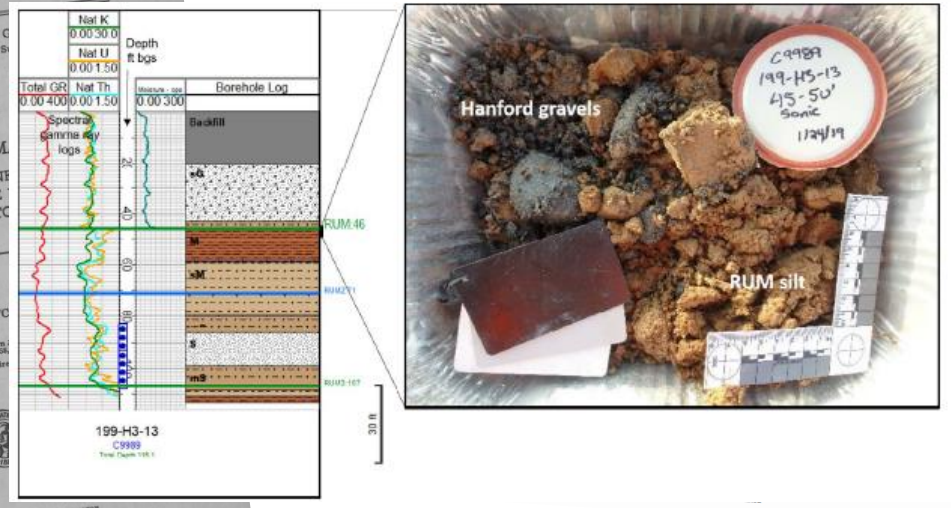
By
R. C. NEWC

Reprinted from American
Vol. 216, May 1928,
Published by permission of the Dire

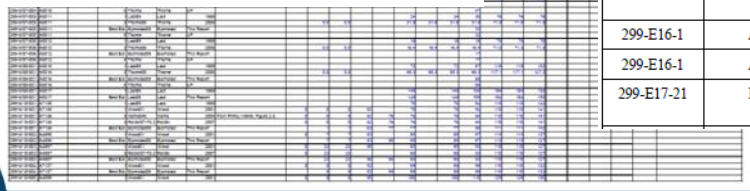
STATE PRINTING PLANT, OLYMPIA, WASHINGTON

CP-65222
Revision 0

Site-Specific Geoframework Model of the 100-HR-3 Intra-RUM Semi-Confined Aquifer System



Borehole Name	Borehole ID	Stratigraphic Unit	HSGFM Version 5 (ft MD)	HSGFM Version 6 (ft MD)	Explanation	Author
299-E13-18	A5863	Rlm	415.00	400.00	Driller's log says sandy silt and clay beginning at 400 ft which appears to grade into clay at 415 ft. Previously picked by author "Last" at 400 ft as well.	Wigginton
299-E13-62	C5923	Rwie	None	312.00	Borehole log shows an increase in felsic content to 70% at 312 ft.	Wigginton
299-E16-1	A4727	Rwia-smd	None	428.57	PNNL-12261	Williams
299-E16-1	A4727	Rwia-lgd	None	452.57	PNNL-12261	Williams
299-E17-21	B8500	Rwie	335.00	323.00	Borehole log clearly indicated Rwie contact at 323, also CPVZ Rev 1 pick.	Wigginton



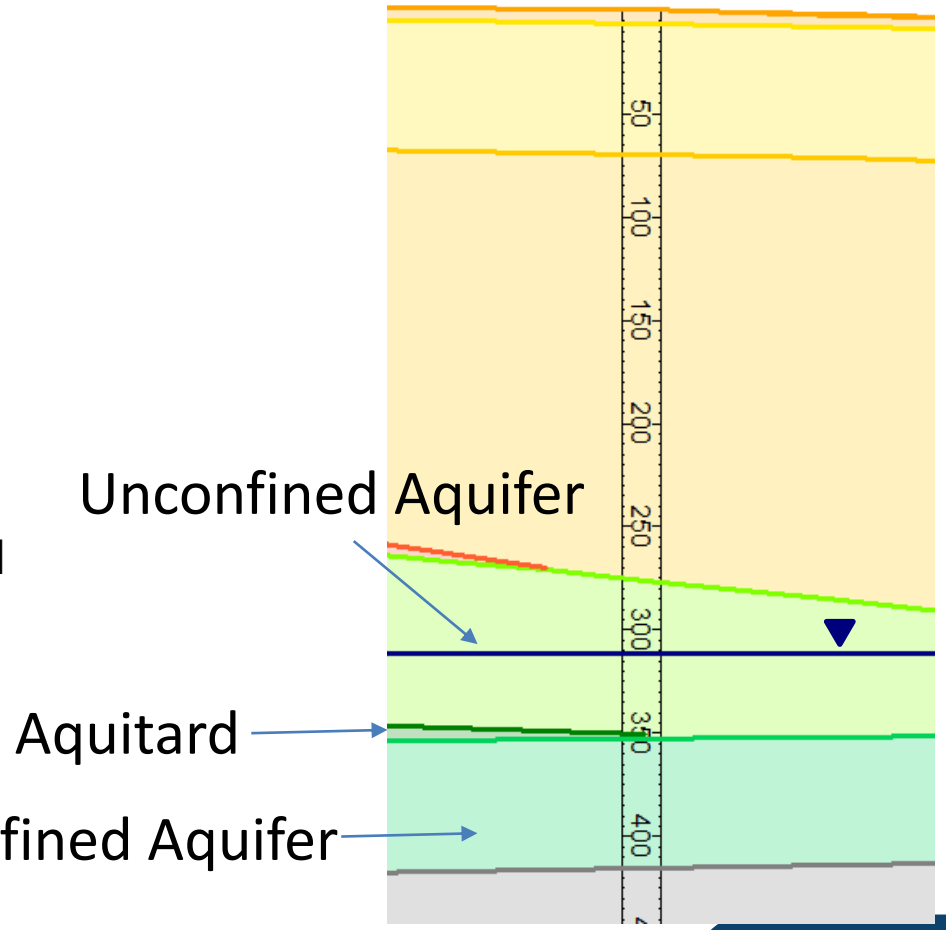
CP-65222, CP-67635

Case Study: To Case or Not to Case

Real Time Decision Making: To Case or Not to Case?

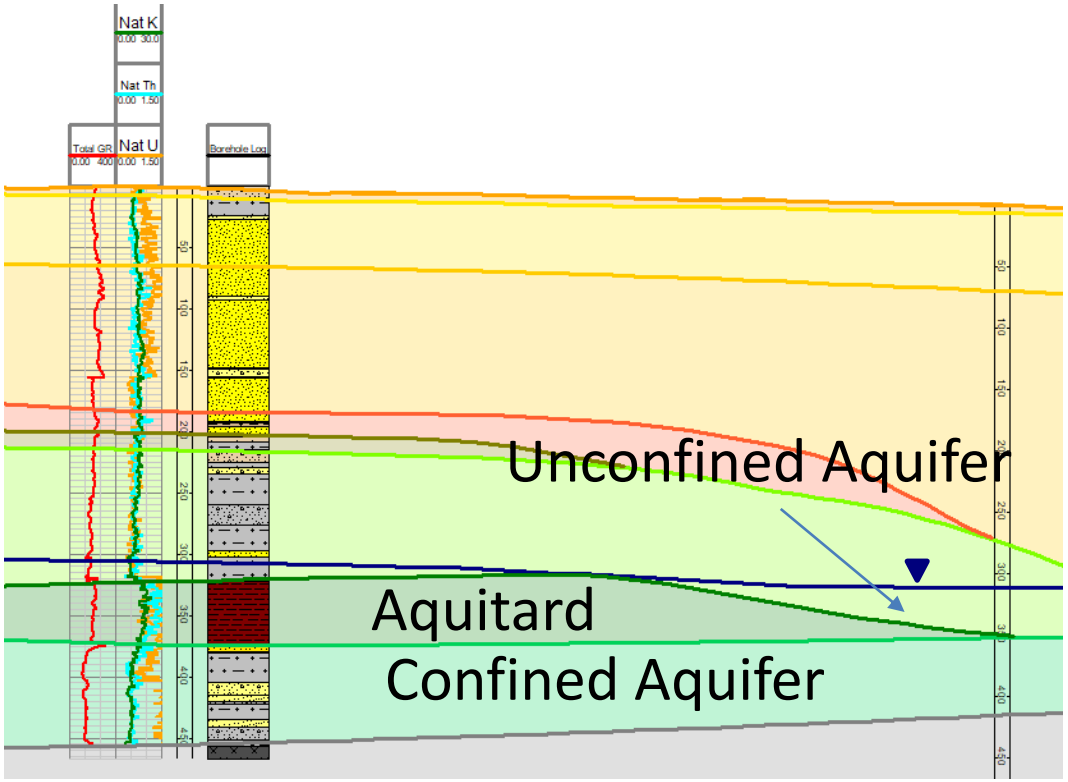
Problem: Silt layer (possible aquitard) drilled 20' higher than projected.

- Is it an aquitard or a small silt lens?
- Must casing be set here or drill ahead?
- Regulations and best practices require:
  - "No resource protection well or soil boring excavation may interconnect aquifers.." (WAC 173-160-420(2))



Real Time Decision Making: To Case or Not to Case?

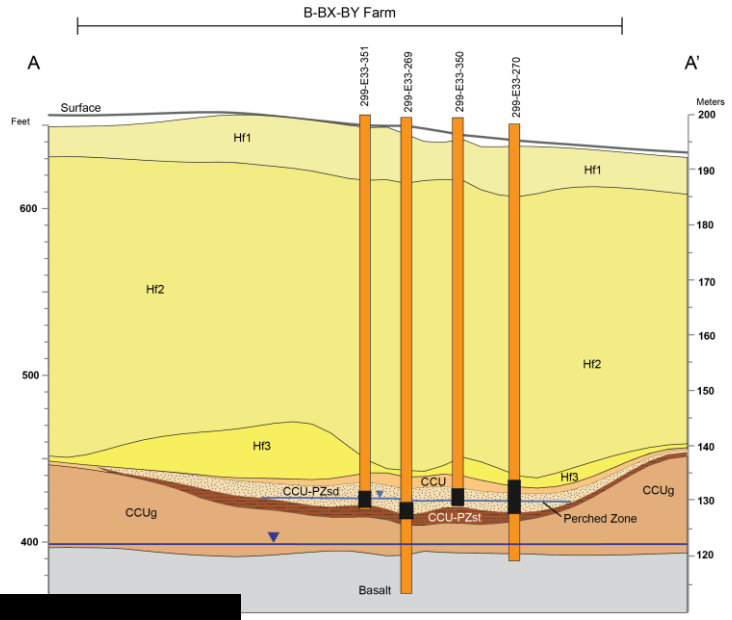
- Challenge:
  - Sparse Well Control
  - ~600 m to nearest well with aquitard and full data squite
- Solution:
  - Use geoframework models and recent well geophysical logs to provide interpretation within minutes
- Result: Formation identified with minimal disruption to operations flow and aquifer protected

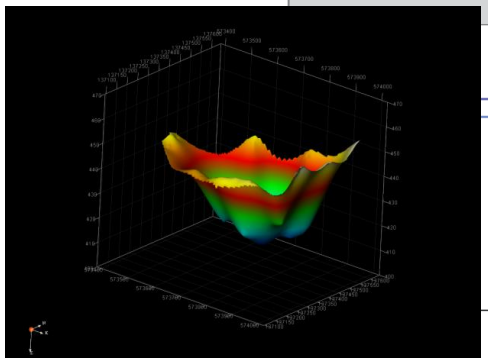


Case Study: Dry Well

Case Study: Dry Well

- Aquifer “suspended” or perched above the unconfined aquifer
- Identified in 1991
- Contaminant source:
  - Planned discharges
  - Unplanned releases
- Contaminants:
  - Uranium
  - Technetium-99
  - Nitrate
- Remedy: Pump and Treat Contaminated fluid
- Challenge: Extraction well drilled “dry”



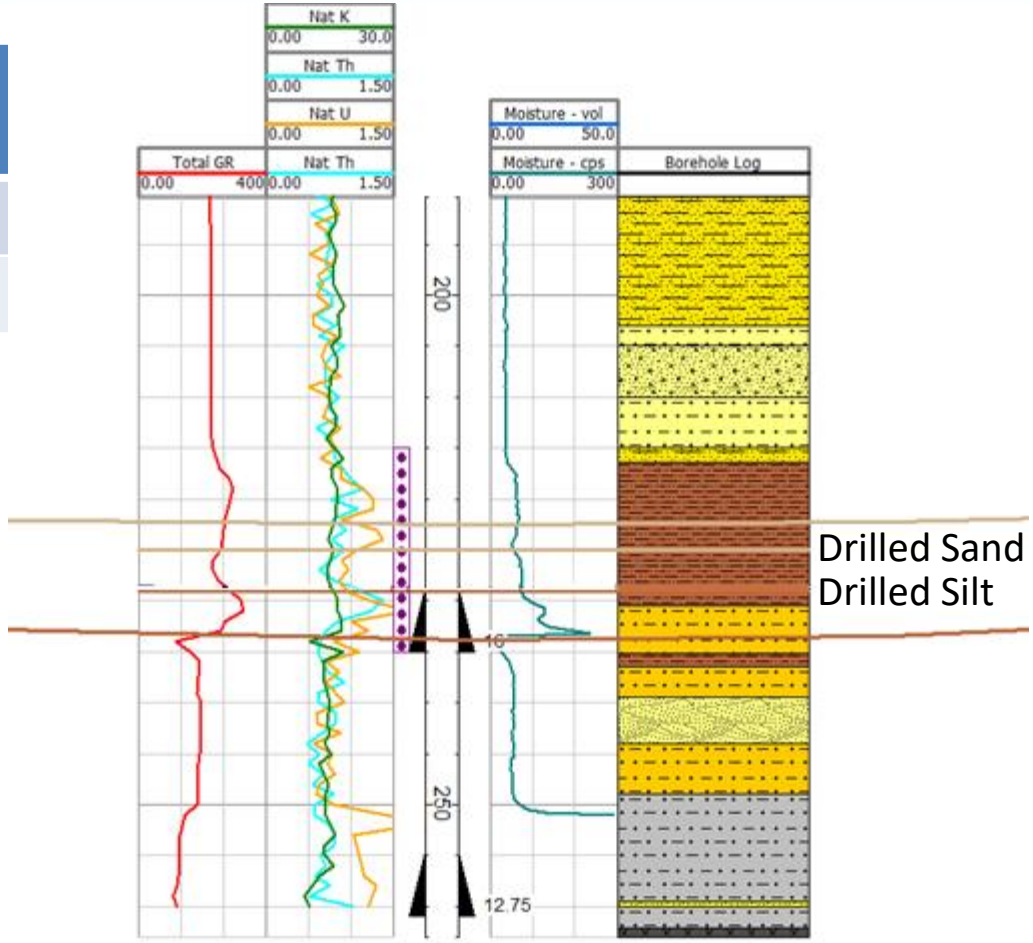


Case Study: Dry Well

Formation Top	Expected	Observed
Sand Aquifer	223’ MD	225’ MD
Silt Layer	234’ MD	229’ MD

Results:

- Sand aquifer deeper and thinner than modeled
- Well is dry
  - Inability to collect water sample
  - Neutron Moisture Log indicates lack of water

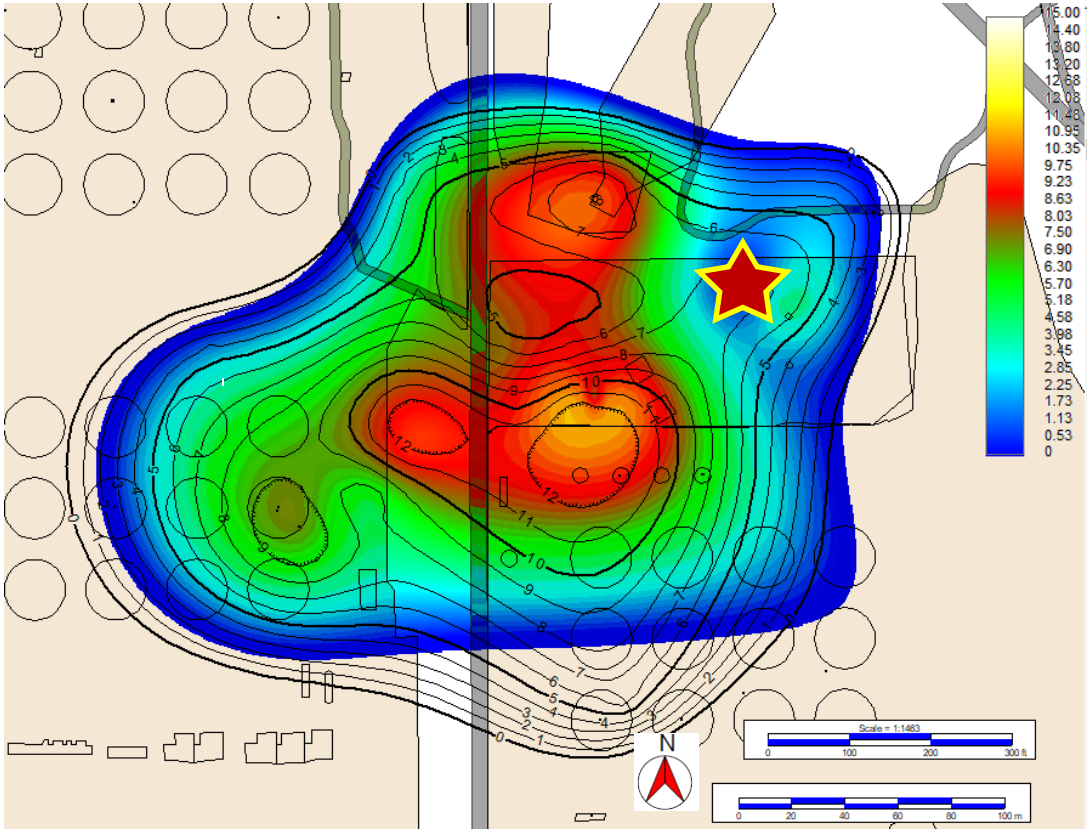


Data for visualization not for decision basis

Case Study: Dry Well

Result:

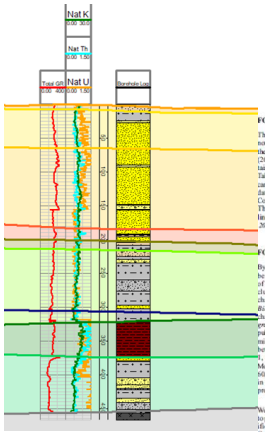
- "Quick look" with provisional data provides a new understanding clean up scope.
- Understanding in hours, not days.
- "Quick look" graphics modeled in hours, not days.

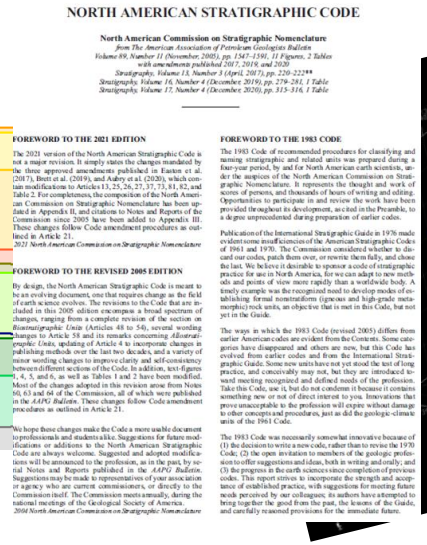


Conclusion

Conclusion

- Data management is crucial for the lifecycle of the project.
- Create a data management system that enhances integrating, interpreting, and analyzing geoscience data in 3D
- Data management is ultimately synergistic





NORTH AMERICAN STRATIGRAPHIC CODE

North American Commission on Stratigraphic Nomenclature

from The American Association of Petroleum Geologists Bulletin
Volume 89, Number 11 (November, 2005), pp. 1547–1591, 11 Figures, 2 Tables
with amendments published 2017, 2018, and 2020
*Stratigraphy, Volume 13, Number 3 (April, 2017), pp. 220–222***
Stratigraphy, Volume 16, Number 4 (December, 2019), pp. 279–281, 1 Table
Stratigraphy, Volume 17, Number 4 (December, 2020), pp. 315–316, 1 Table

FOREWORD TO THE 2021 EDITION

The 2021 version of the North American Stratigraphic Code is not a major revision. It simply states the changes mandated by the three approved amendments published in Easton et al. (2017), Brett et al. (2019), and Aubry et al. (2020), which contain modifications to Articles 13, 25, 26, 27, 37, 73, 81, 82, and Table 2. For completeness, the composition of the North American Commission on Stratigraphic Nomenclature has been updated in Appendix II, and citations to Notes and Reports of the Commission since 2005 have been added to Appendix III. These changes follow Code amendment procedures as outlined in Article 21.

2021 North American Commission on Stratigraphic Nomenclature

FOREWORD TO THE REVISED 2005 EDITION

By design, the North American Stratigraphic Code is meant to be an evolving document, one that requires change as the field of earth science evolves. The revisions to the Code that are included in this 2005 edition encompass a broad spectrum of changes, ranging from a complete revision of the section on *Biostratigraphic Units* (Articles 48 to 54), several wording changes to Article 58 and its remarks concerning *Allostratigraphic Units*, updating of Article 4 to incorporate changes in publishing methods over the last two decades, and a variety of minor wording changes to improve clarity and self-consistency between different sections of the Code. In addition, text-figures 1, 4, 5, and 6, as well as Tables 1 and 2 have been modified. Most of the changes adopted in this revision arose from Notes 50, 63 and 64 of the Commission, all of which were published in the *AAPG Bulletin*. These changes follow Code amendment procedures as outlined in Article 21.

We hope these changes make the Code a more usable document to professionals and students alike. Suggestions for future modifications or additions to the North American Stratigraphic Code are always welcome. Suggested and adopted modifications will be announced to the profession, as in the past, by serial Notes and Reports published in the *AAPG Bulletin*. Suggestions may be made to representatives of your association or agency who are current commissioners, or directly to the Commission itself. The Commission meets annually, during the national meetings of the Geological Society of America.

2004 North American Commission on Stratigraphic Nomenclature

FOREWORD TO THE 1983 CODE

The 1983 Code of recommended procedures for classifying and naming stratigraphic and related units was prepared during a four-year period, by and for North American earth scientists, under the auspices of the North American Commission on Stratigraphic Nomenclature. It represents the thought and work of scores of persons, and thousands of hours of writing and editing. Opportunities to participate in and review the work have been provided throughout its development, as cited in the Preamble, to a degree unprecedented during preparation of earlier codes.

Publication of the International Stratigraphic Guide in 1976 made evident some insufficiencies of the American Stratigraphic Codes of 1961 and 1970. The Commission considered whether to discard our codes, patch them over, or rewrite them fully, and chose the last. We believe it desirable to sponsor a code of stratigraphic practice for use in North America, for we can adapt to new methods and points of view more rapidly than a worldwide body. A timely example was the recognized need to develop modes of establishing formal nonstratiform (igneous and high-grade metamorphic) rock units, an objective that is met in this Code, but not yet in the Guide.

The ways in which the 1983 Code (revised 2005) differs from earlier American codes are evident from the Contents. Some categories have disappeared and others are new, but this Code has evolved from earlier codes and from the International Stratigraphic Guide. Some new units have not yet stood the test of long practice, and conceivably may not, but they are introduced toward meeting recognized and defined needs of the profession. Take this Code, use it, but do not condemn it because it contains something new or not of direct interest to you. Innovations that prove unacceptable to the profession will expire without damage to other concepts and procedures, just as did the geologic-climate units of the 1961 Code.

The 1983 Code was necessarily somewhat innovative because of (1) the decision to write a new code, rather than to revise the 1970 Code; (2) the open invitation to members of the geologic profession to offer suggestions and ideas, both in writing and orally; and (3) the progress in the earth sciences since completion of previous codes. This report strives to incorporate the strength and acceptance of established practice, with suggestions for meeting future needs perceived by our colleagues; its authors have attempted to bring together the good from the past, the lessons of the Guide, and carefully reasoned provisions for the immediate future.