U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

DOE Inquiry into USGS E-mail Issues

Presented to:

Nuclear Waste Technical Review Board

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Outline

- *Evaluation of Technical Impact Report*
- **INFIL 2.0 Remediation Activities**
- **MASSIF Replacement Model Development**
- **Infiltration Technical Team Data Evaluation**
- **USGS Model Technical Re-evaluation**
- **DOE Inspector General's Investigation**
- **Conclusions and Path Forward**

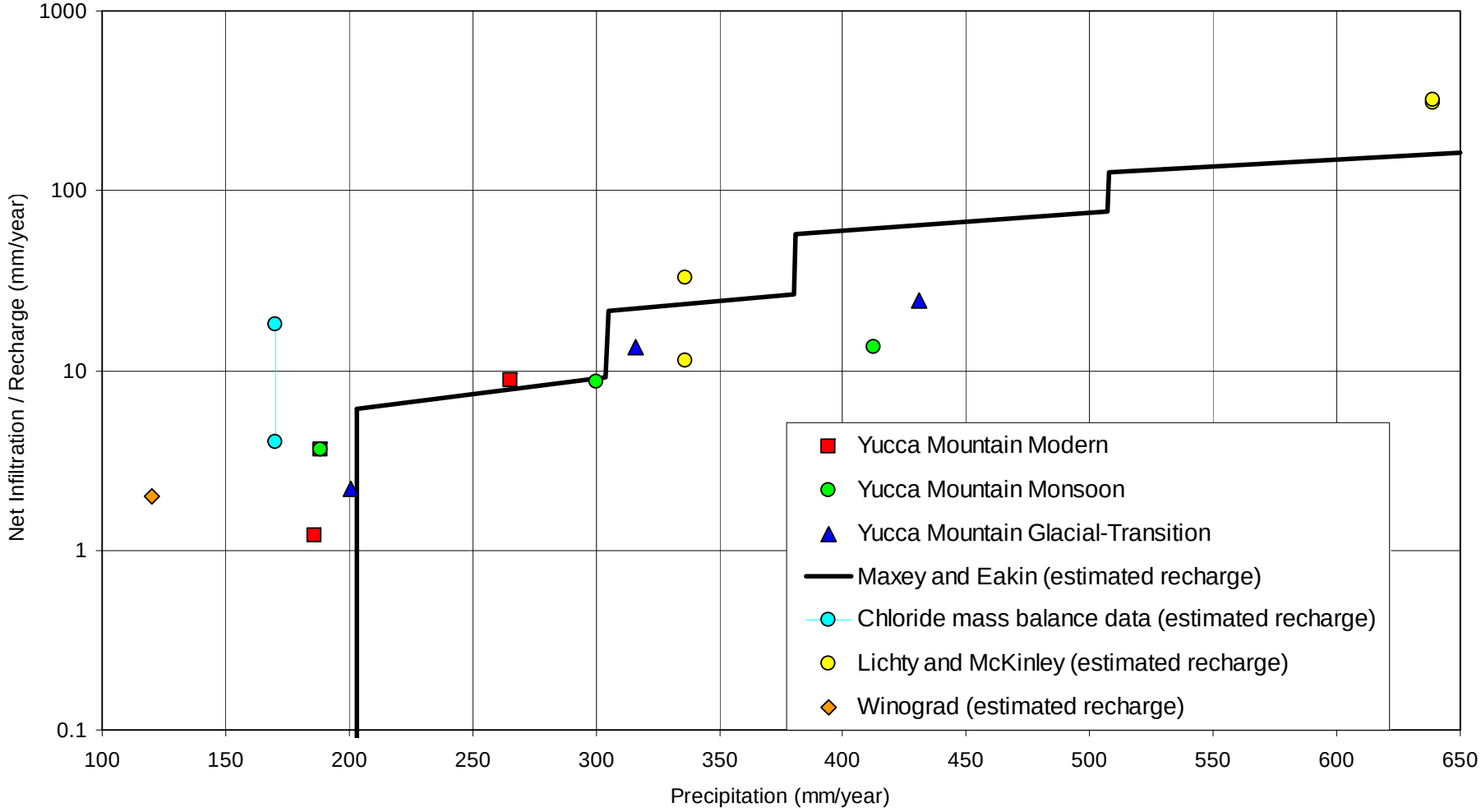
Evaluation of Technical Impact Report Focus and Purpose

- ***Evaluation of Technical Impact on the Yucca Mountain Project Technical Basis Resulting from Issues Raised by Emails of Former Project Participants*** **(DOE/RW-0583)**
- **Focused on the primary work products developed by the USGS employees who exchanged the e-mails**
  - **Infiltration Analysis and Model Report (AMR) –** ***Simulation of Net Infiltration for Modern and Potential Future Climates*** **(ANL-NBS-HS-000032, Rev. 00, June 2000)**
- **Evaluated whether net infiltration rate estimates are independently corroborated by published data**
- **Considered potential impacts on the technical basis supporting the 2002 Site Recommendation and Key Technical Issue agreements with the Nuclear Regulatory Commission**
- ***Evaluation of Technical Impact Report*** **will not be used as part of the technical basis for the license application**

Evaluation of Technical Impact Report Independent Review

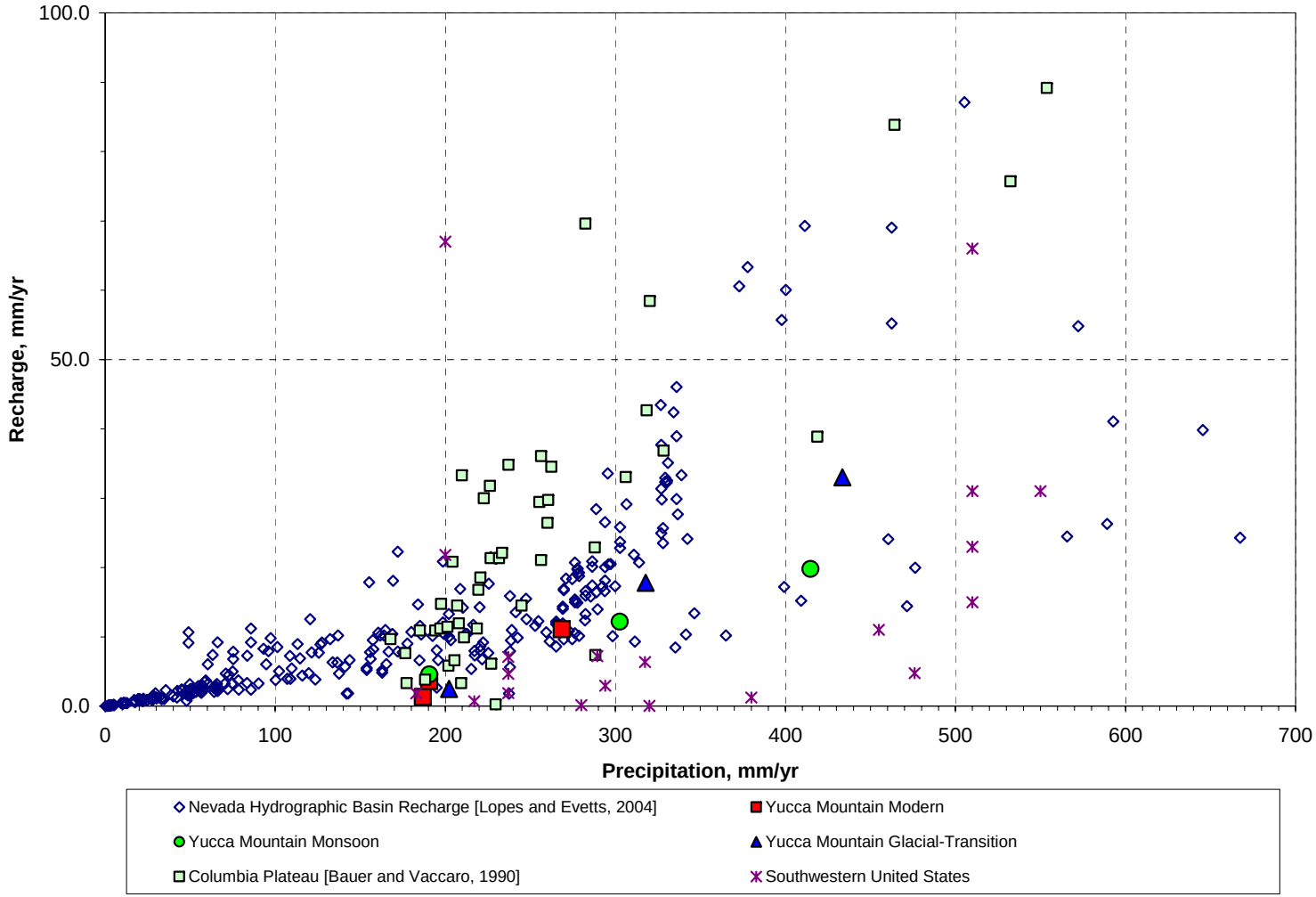
- **Draft report was reviewed twice by independent experts in hydrology and infiltration**
  - **Dr. Peter Wierenga, Director Emeritus, Water Resources Research Center, University of Arizona**
  - **Dr. John McCray, Professor, Colorado School of Mines**
  - **Dr. Timothy Green, U.S. Department of Agriculture, Agricultural Systems Research Unit, Ft. Collins, Colorado**
- **Independent review comments led to significant changes in report content and structure**
  - **Incorporated use of corroborating data from scientific literature and further consideration of technical bases for conceptual models**

Comparison of Net Infiltration Rate Estimates with Other Estimates in the Vicinity of Yucca Mountain



Source: Figure 4-1 in the *Evaluation of Technical Impact* Report

Net Infiltration Rate Estimates at Yucca Mountain and Recharge Estimates at Other U.S. Locations



Source: Figure 4-5 in the *Evaluation of Technical Impact* Report

Evaluation of Technical Impact Report
Key Findings

- **USGS conceptual model of infiltration was built on earlier research**
  - **Physical processes that govern the water cycle are widely documented and applied by hydrologists**
- **USGS net infiltration rate estimates are consistent with estimates for arid and semi-arid climates across the western United States**
  - **Net infiltration is a small percentage of precipitation**
- **USGS net infiltration rate estimates and the conceptual models have been presented publicly and published in scientific journals**
- **Net infiltration rate estimates used in the total system performance assessment for the Site Recommendation are consistent with and corroborated by independent data**

INFIL 2.0 Remediation Activities

- **As a result of a detailed review of INFIL 2.0, Idaho National Laboratory is developing a new version of the software – INFIL 2.2**
- **Primary work activities include**
  - **Technical evaluation of INFIL 2.0 code**
  - **Evaluation and update of documentation against current procedural requirements**
  - **Consolidated codes into integrated package and updated operating system**
  - **Streamlined user interface**
- **There are currently no plans to use INFIL 2.2 in any future quality-affecting work**

MASSIF Replacement Model Development

- **Sandia National Laboratories (SNL) is developing a replacement infiltration model referred to as the Mass Accounting System for Soil Infiltration and Flow (MASSIF)**
  - **Implemented using a Mathcad® worksheet in conjunction with ArcGIS™ to provide new infiltration maps**
  - **Incorporates a revised evapotranspiration (ET) model (primary difference with USGS INFIL model)**
  - **Consulting expert (Daniel B. Stephens) retained to review new model concurrent with its development**

Infiltration Technical Team Data Evaluation

- **Infiltration Technical Team (ITT) evaluating data sets associated with original USGS modeling documented in June 2000 Infiltration AMR**
  - **Only a small number of these data sets will be used in the replacement modeling – where data are unique or irreplaceable and have been thoroughly checked**
- **Final evaluation will group data into 3 bins:**
  - **Use-As-Is: no additional effort to qualify**
  - **Remediate: some additional effort to provide full procedural compliance**
  - **Do-Not-Use-As-Is: traceability issues, not used in new infiltration model**

Re-qualification and Re-development of Key Inputs for Infiltration Modeling

- **ITT also re-qualifying and re-developing key inputs required for use in MASSIF**
  - **Includes neutron probe moisture data, soil maps, soil thickness determinations, soil hydraulic properties, bedrock permeability parameters, composite bedrock geologic map coverage, weather station data, and stream-flow data**
- **Data being re-qualified or re-developed using project procedures**
- **Consulting expert (Daniel B. Stephens) retained to conduct concurrent review**

USGS Model Technical Re-evaluation

- **In December 2005, USGS agreed to re-evaluate their infiltration model, including**
  - **Evaluation of transparency and traceability of the primary USGS infiltration model code (INFIL) and all supporting codes, data sets, and references**
  - **Emphasis on appropriateness, mathematical accuracy, and logic**
- **USGS is re-running model simulations and comparing output to that in USGS Infiltration AMR**
- **USGS will provide DOE with a technical report detailing results of the evaluation and a copy of the INFIL model and execution files**

DOE Inspector General's Investigation

- **On April 25, 2006, the DOE Inspector General (IG) issued a memorandum providing a summary of the results of the criminal investigation**
  - **Extensive factual record developed during investigation forwarded to U.S. Attorney's Office (District of Nevada)**
  - **U.S. Attorney's Office declined to pursue criminal prosecution**
- **DOE IG observed internal control deficiencies that warrant attention by DOE program managers**
  - **Delay in surfacing and dealing with e-mails inconsistent with sound quality assurance protocols**
  - **Scientific notebook requirements**
  - **Critical control files relating to the USGS Infiltration AMR were not maintained in accordance with data management system requirements**

Conclusions and Path Forward

- ***Evaluation of Technical Impact Report*** **found net infiltration rate estimates used in the total system performance assessment for the Site Recommendation and the KTI agreements are consistent with and corroborated by independent data**
- **INL model remediation produced INFIL 2.2 with updated documentation, consolidated code, and streamlined user interface**
- **SNL developing MASSIF to replace INFIL model**
- **ITT evaluating data inputs for applicability to future work**
- **USGS re-evaluating and re-running INFIL 2.0 code**
- **DOE IG reported U.S. Attorney's Office declined to pursue criminal prosecution, but observed internal control deficiencies**