U.S. DEPARTMENT OF ENERGY | Legacy Management

Tuba City, Arizona, Disposal Site Overview

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On behalf of

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Office of Legacy Management (LM)

RemPlex Summit

Global Summit on Environmental Remediation

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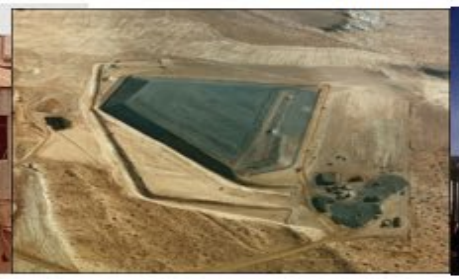
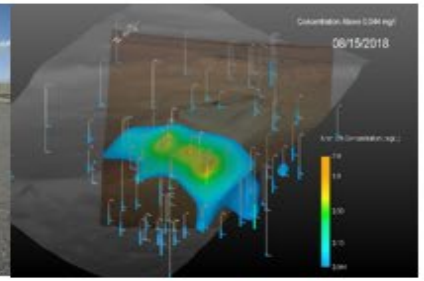
Site History

	UMTRCA 1978	RAP 1989	SOWP 1998	GCAP 1999			LM Risk Index NLN Collaboration 2020	
1956 - 1966	1966 - 1988	1988 - 1990	1990 - 1998		2000 - 2002	2002 - 2014	2015 - present	2020 - 2025
Mill operation	Site abandoned	Surface remediation	Site characterization, groundwater conceptual model		Remediation system design and construction	Groundwater remediation system operation	Interim treatment operation (pump and evaporate)	GCAP revision



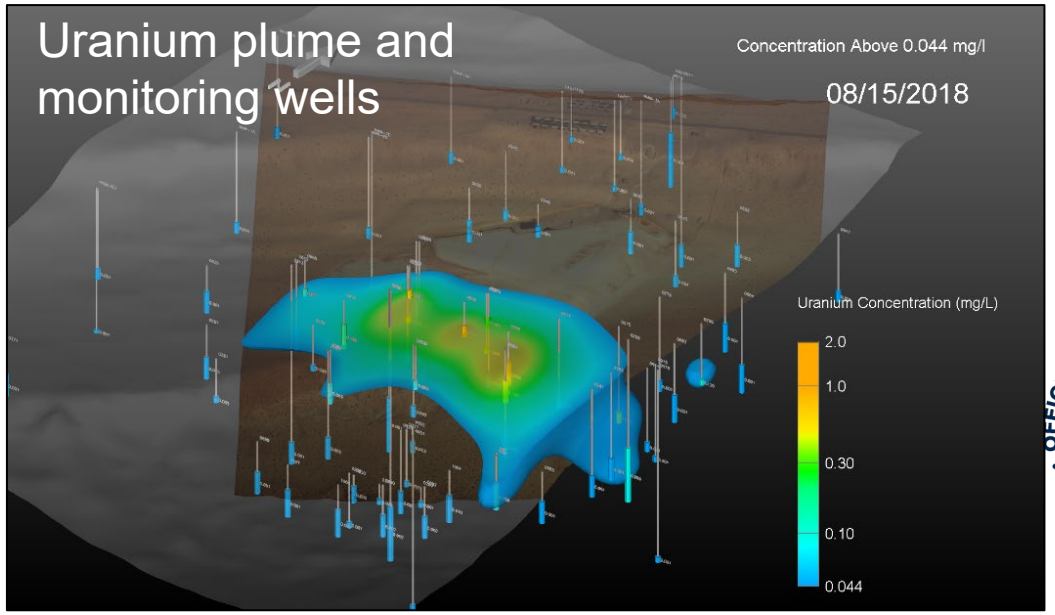


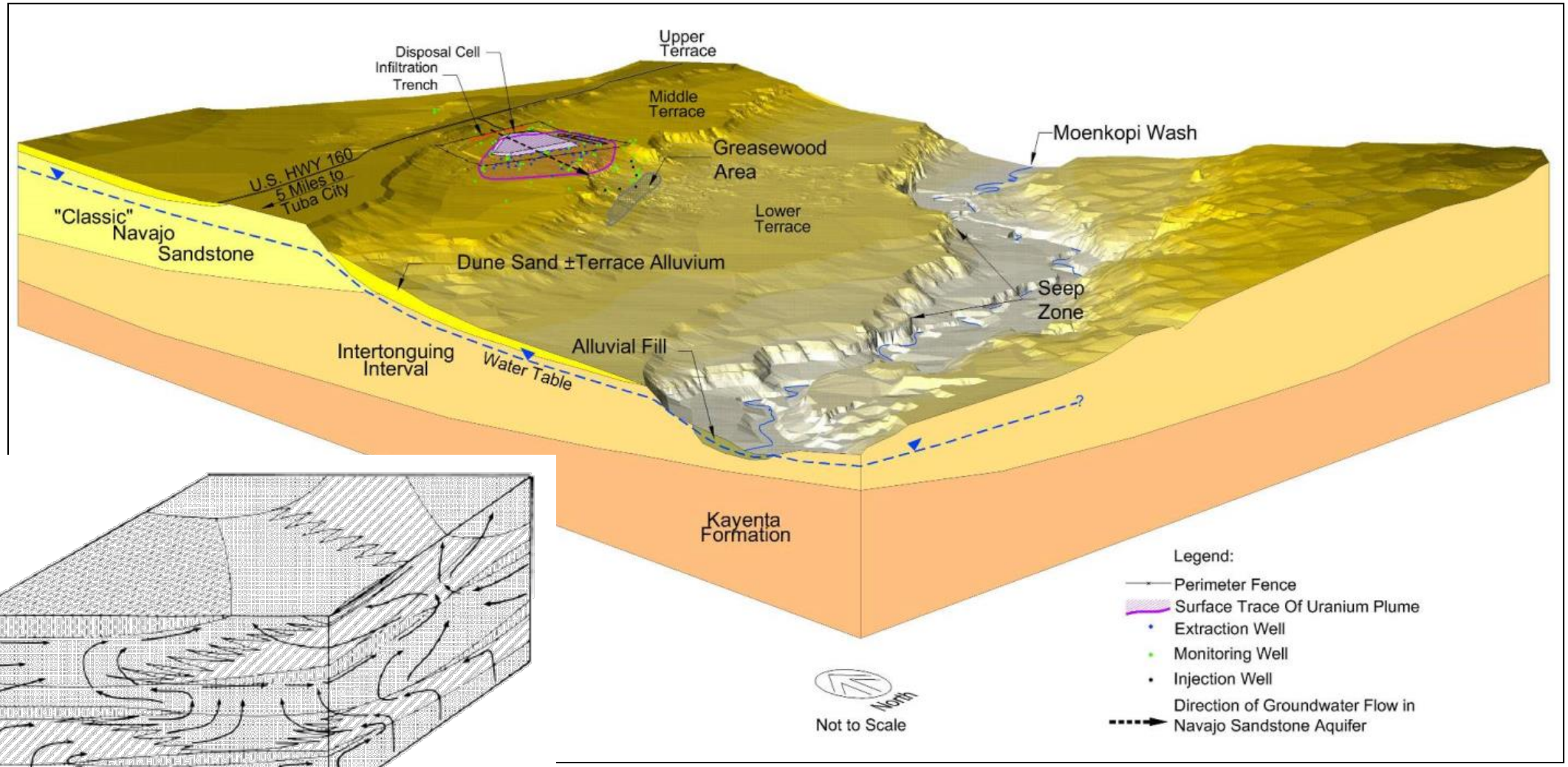
Abbreviations:
UMTRCA: Uranium Mill Tailings Radiation Control Act
RAP: Remedial Action Plan
SOWP: Site Observational Work Plan
LM: DOE Office of Legacy Management
NLN: National Lab Network
GCAP: Groundwater Compliance Action Plan

Groundwater Remediation, Past and Present

- 2002-2014 – Active remediation by extraction, softening and distillation, and return of treated water to the aquifer ~100 gallons per minute (gpm)
  - Annual evaluation indicated the system was underperforming
- 2015-Present – Interim treatment by extraction of contaminated groundwater and conveyance to the evaporation pond ~10 gpm
- Evaluation of plume metrics 2002-2018
  - Contaminant mass and plume volume:
    - Were shrinking during optimum operation of the active remediation system (2002-2009)
    - Are increasing under interim treatment (2015-present)
- Groundwater corrective action strategy is being revised



Hydrogeologic Setting and Site Conceptual Model



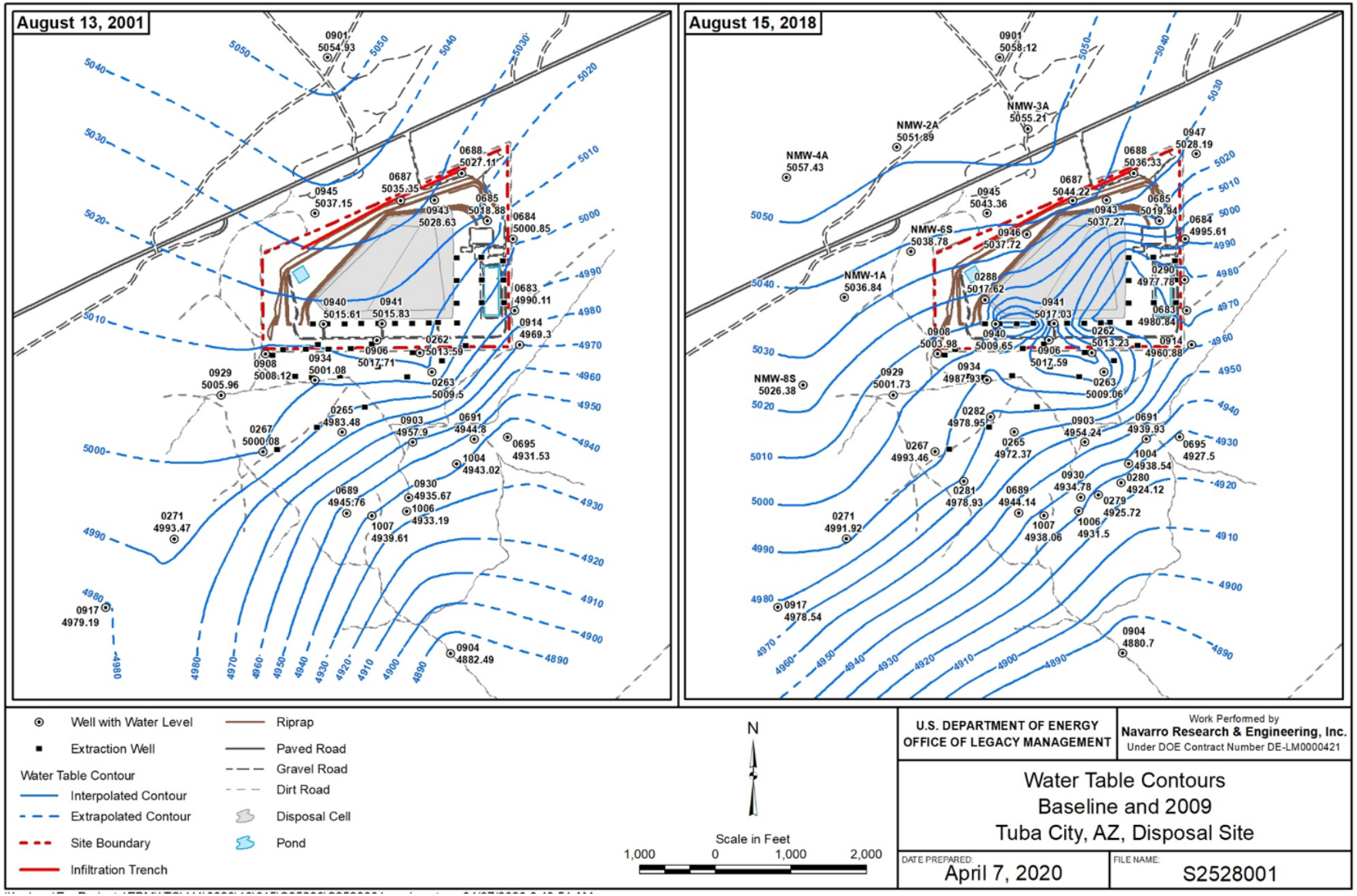
From: Chandler et al., 1989

Site Conceptual Model – Groundwater Flow

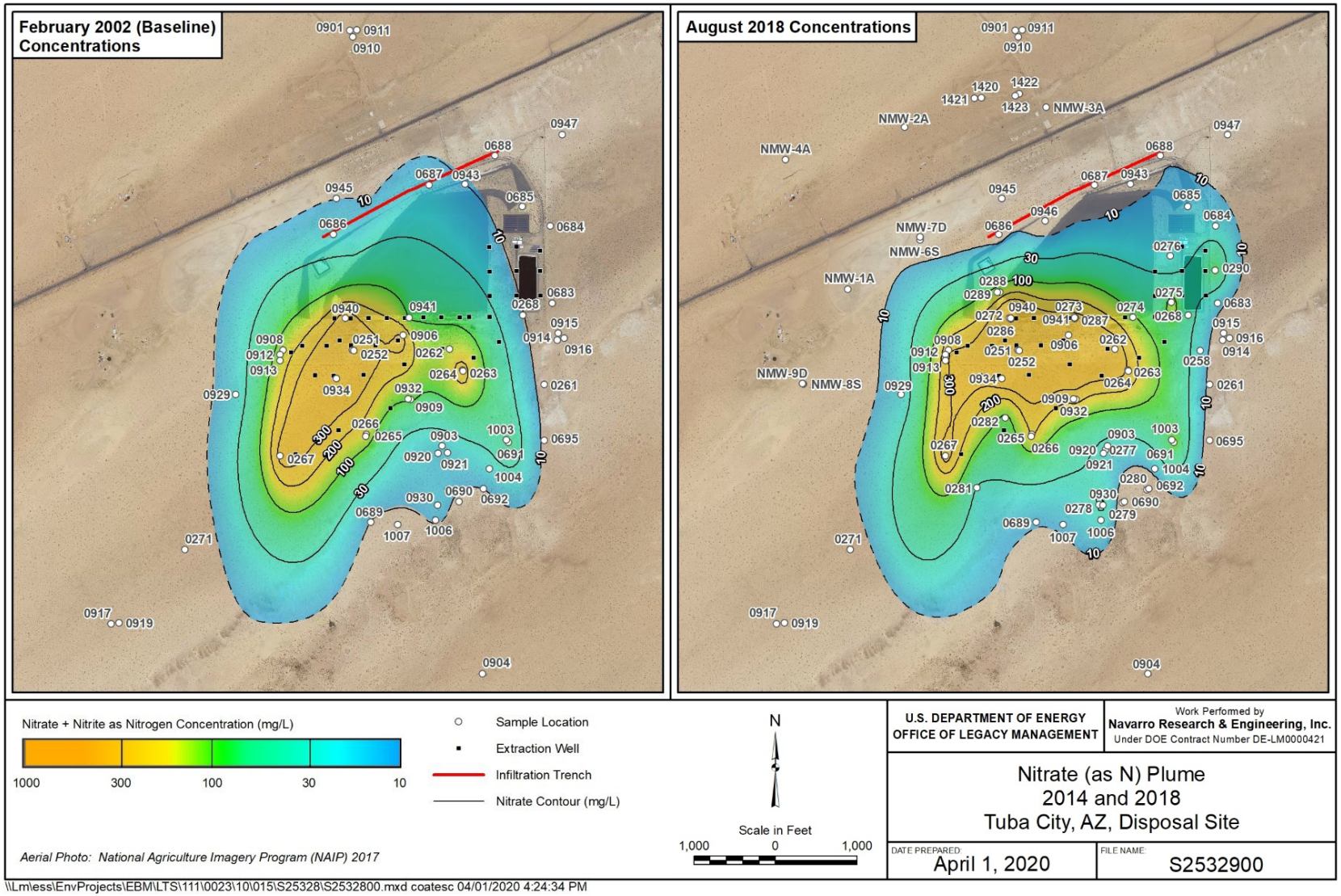
- The site's local flow system is delineated as follows:
  - Horizontally, surface features define the width of the local flow system and how the adjacent groundwater basins are separated
  - Vertically, the top of the flow system is about 50 feet below ground surface and the bottom is the top of the Kayenta Formation, about 500 feet below ground surface
- Groundwater recharge is primarily from rainfall infiltration
  - There is essentially no upgradient groundwater feeds into the local flow system
  - Groundwater discharge occurs as evapotranspiration (ET) in floodplain and riparian zones of Moenkopi Wash and to the Wash itself
- Distribution of horizontal hydraulic conductivity is known to vary by six orders of magnitude from field testing near the disposal cell. Little hydrogeologic or aquifer characterization data is available to inform model parameter assignments downgradient of the current nitrate plume delineation.

Features in Navajo Sandstone on site that may affect permeability

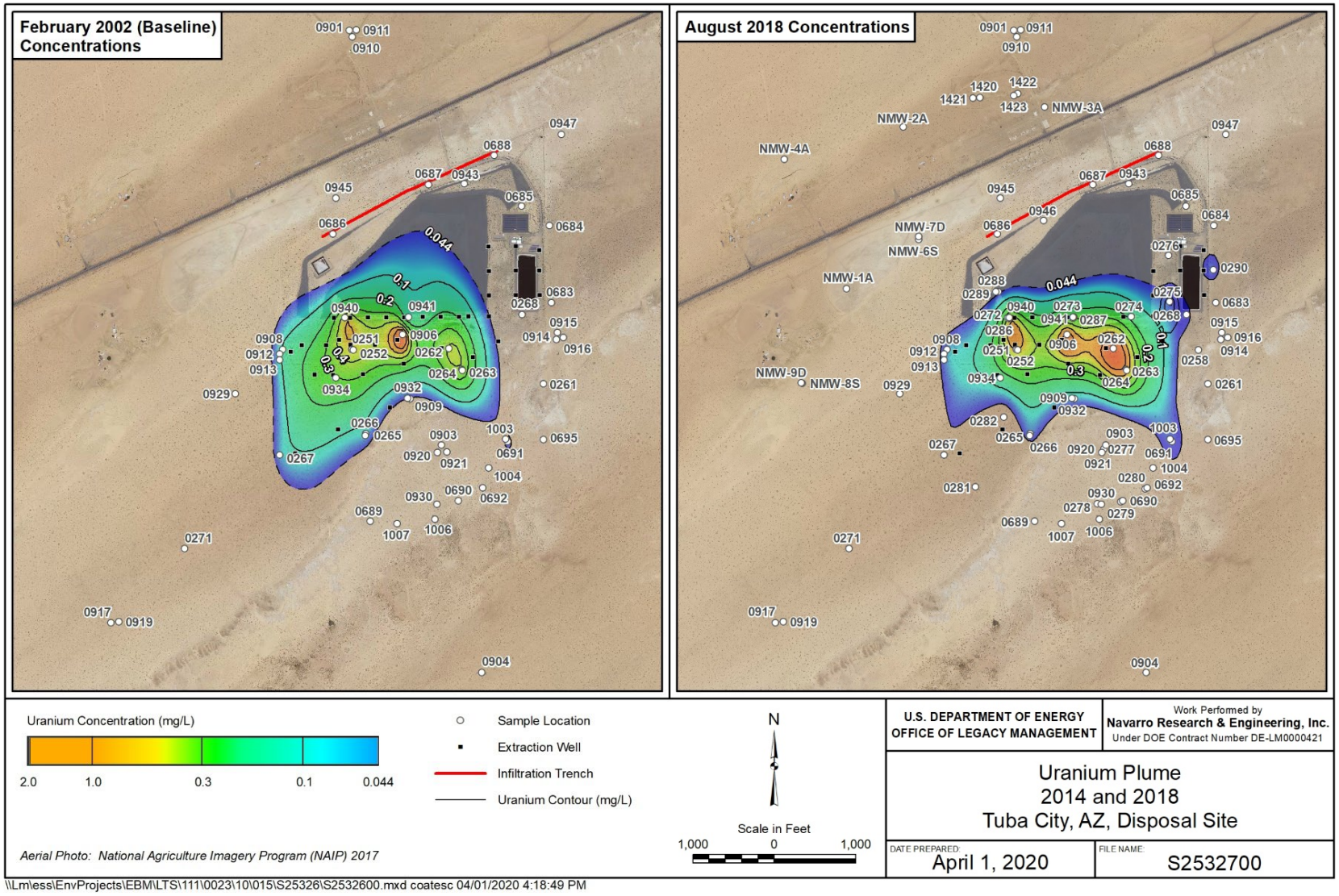
Site Conceptual Model – Groundwater Flow (continued)



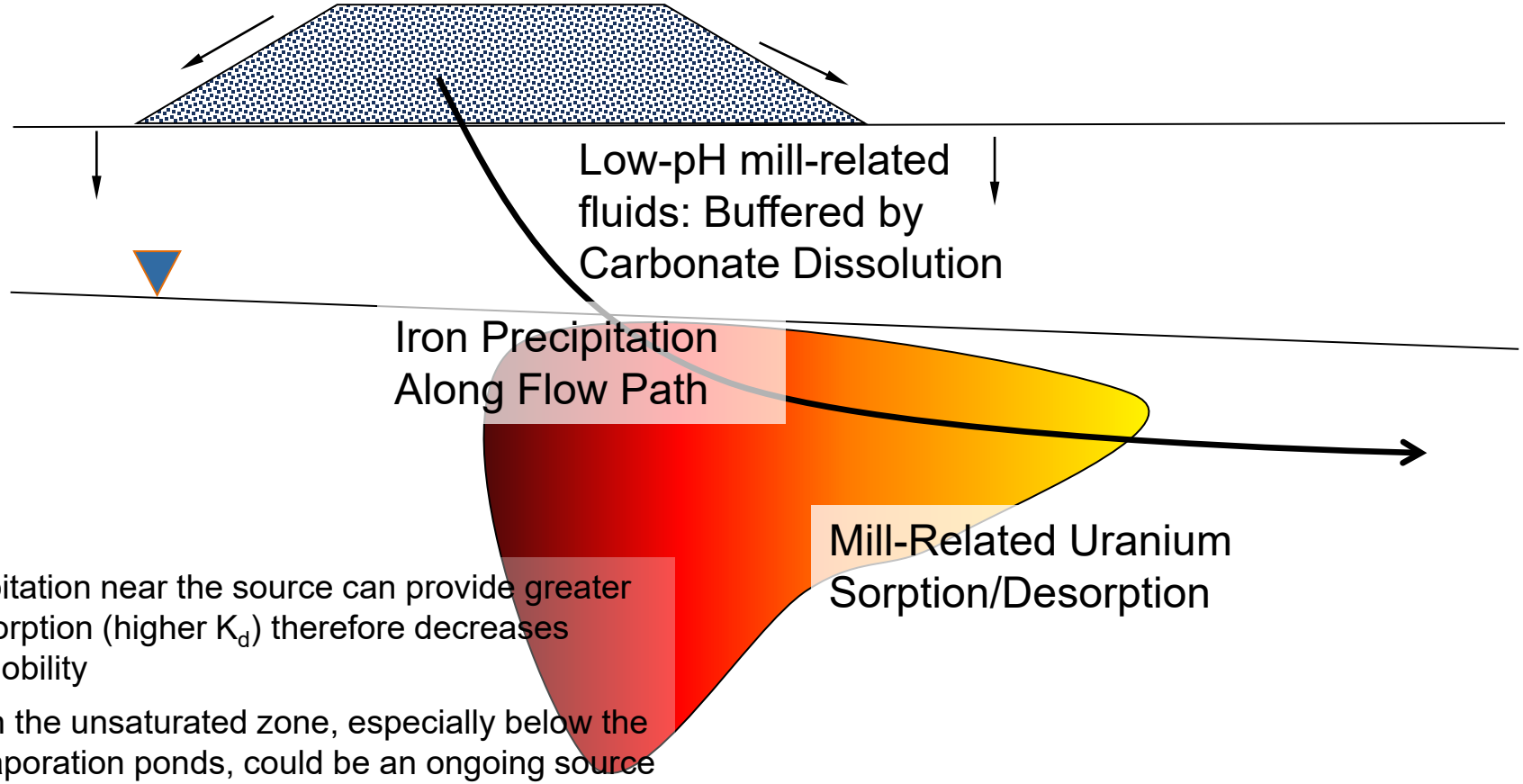
Site Conceptual Model – Nature and Extent of Groundwater Contamination



Site Conceptual Model – Nature and Extent of Groundwater Contamination (continued)



Geochemical Reactions Along the Flow Path Conceptual Preview



- Iron precipitation near the source can provide greater uranium sorption (higher K_d) therefore decreases uranium mobility
- Uranium in the unsaturated zone, especially below the former evaporation ponds, could be an ongoing source
- Some uranium sorption (low K_d) at the plume front, thus uranium is not moving conservatively like chloride
- Longer pumping times than originally anticipated

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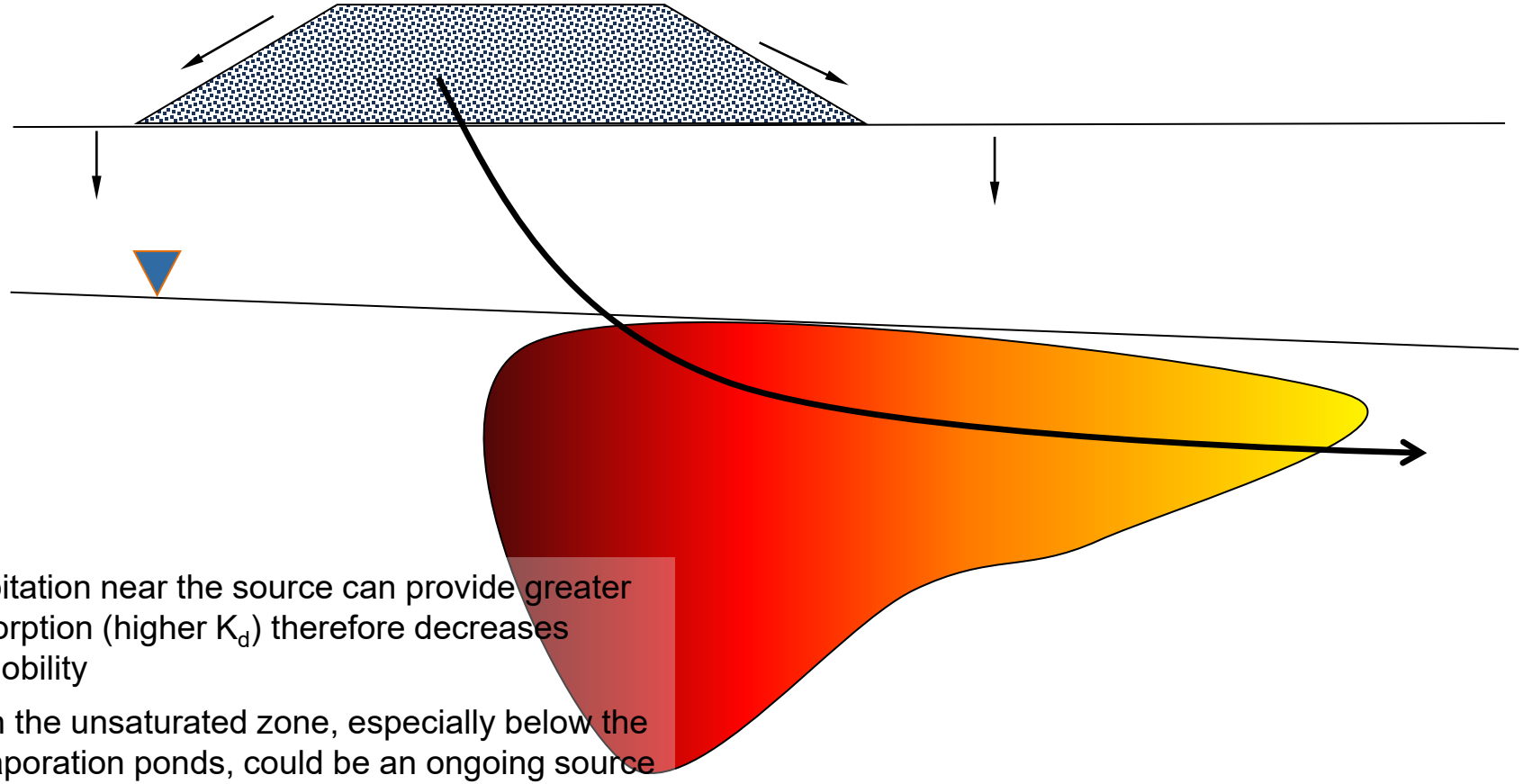

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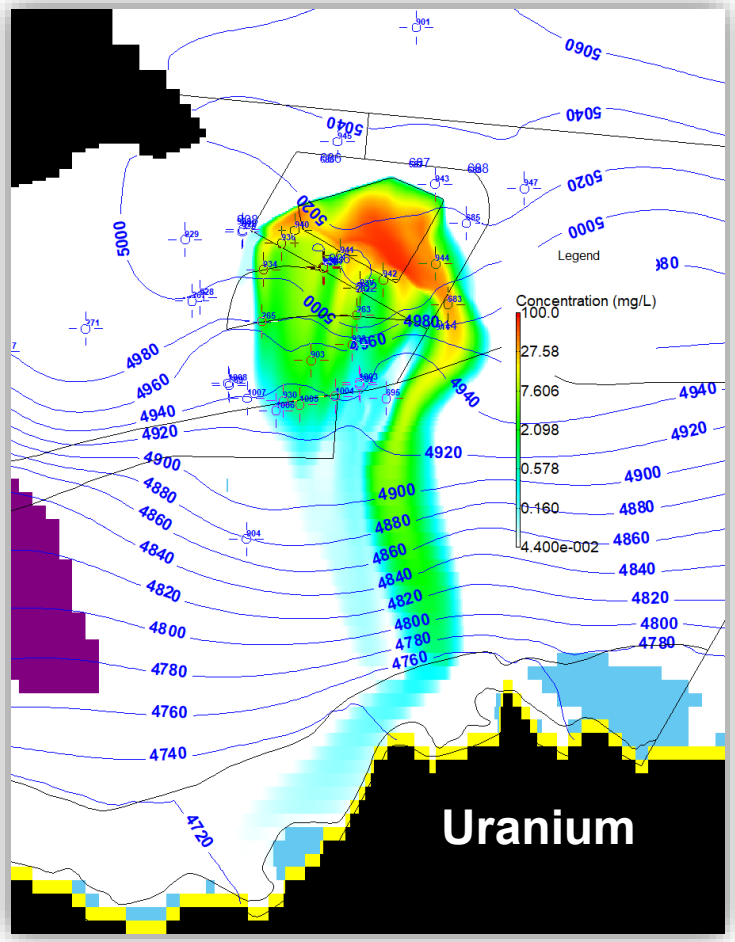
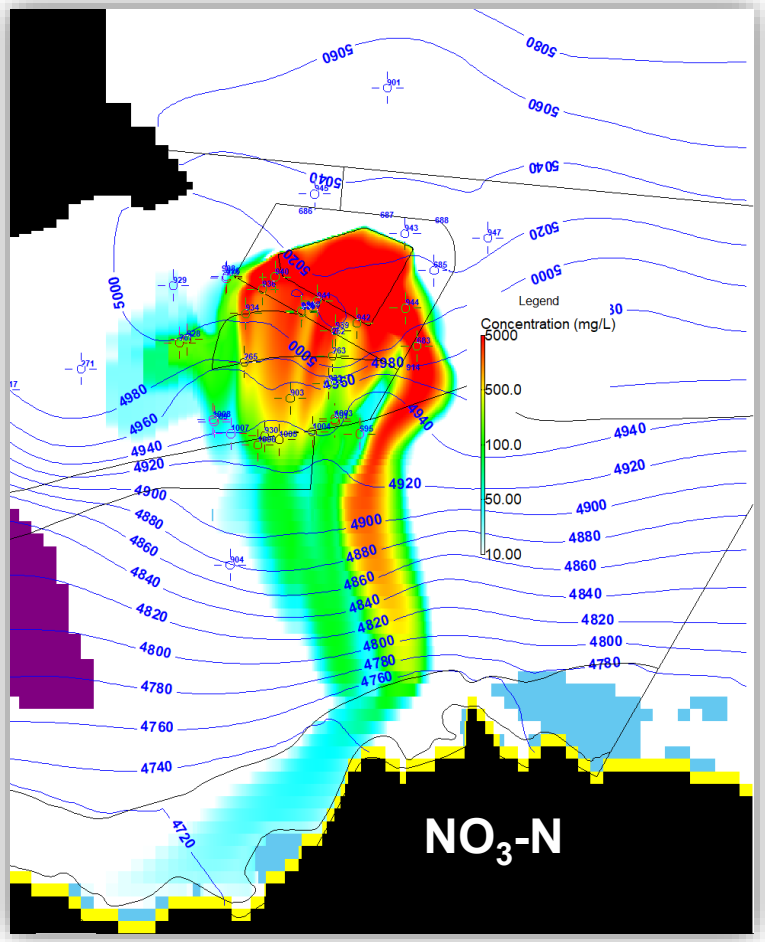
Preliminary Forward Transport Modeling

- Preliminary forward transport modeling indicates that the plumes will continue to expand and reach Moenkopi Wash under a range of assumed, reasonable transport parameter values in the absence of pumping

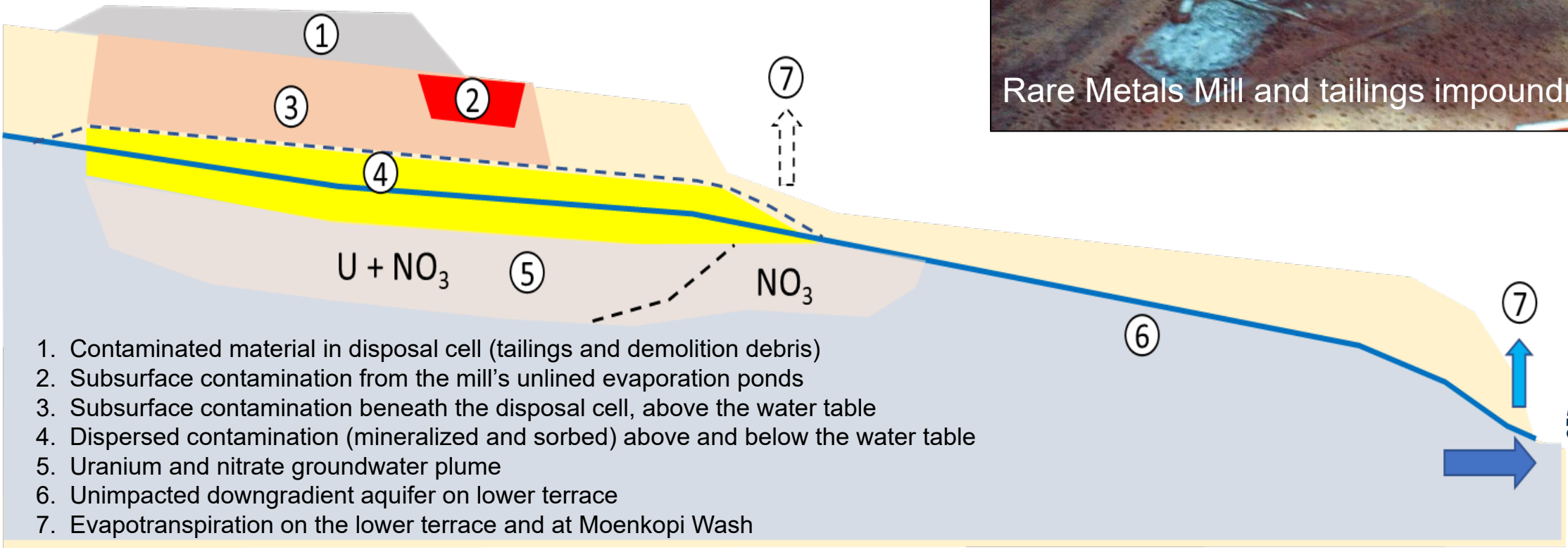




Issues

- Multiple contaminant source forms and zones
- Hydraulic conductivity varies widely and the most contaminated depths of the aquifer are difficult to pump from

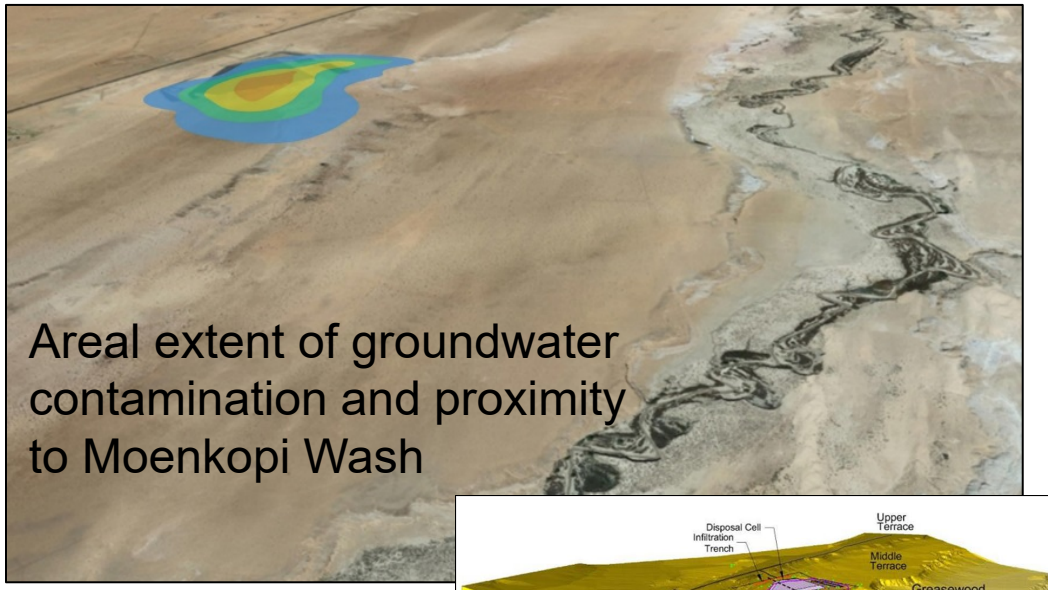

Rare Metals Mill and tailings impoundment, 1960s

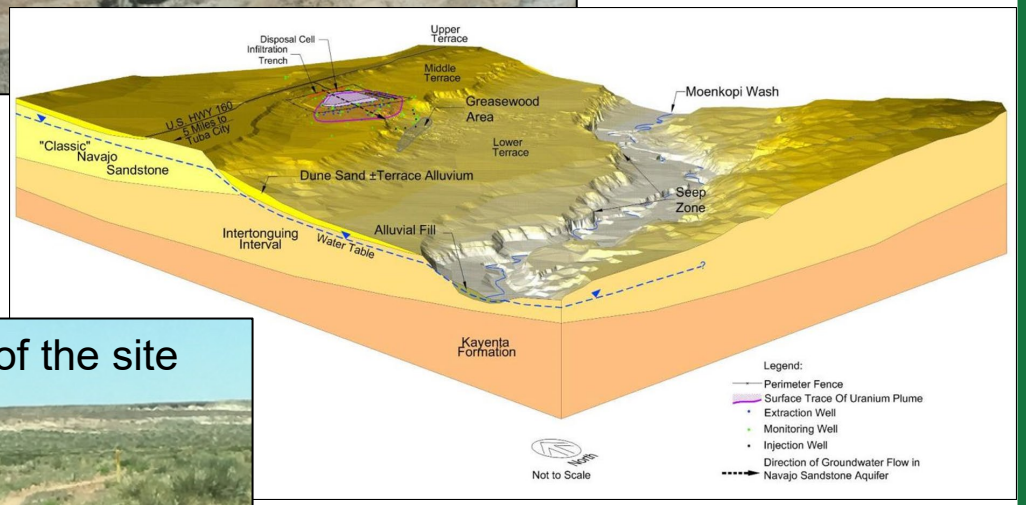


1. Contaminated material in disposal cell (tailings and demolition debris)
2. Subsurface contamination from the mill's unlined evaporation ponds
3. Subsurface contamination beneath the disposal cell, above the water table
4. Dispersed contamination (mineralized and sorbed) above and below the water table
5. Uranium and nitrate groundwater plume
6. Unimpacted downgradient aquifer on lower terrace
7. Evapotranspiration on the lower terrace and at Moenkopi Wash

Needs – Data Gaps and Data Quality Objectives

- DQO 1: Define the source mass term and update the extent and mobility of contaminants
- DQO 2: Evaluate hydrology and geochemistry on lower terrace
- DQO 3: Define feasible remediation strategies
- DQO 4: Define an appropriate range of institutional control





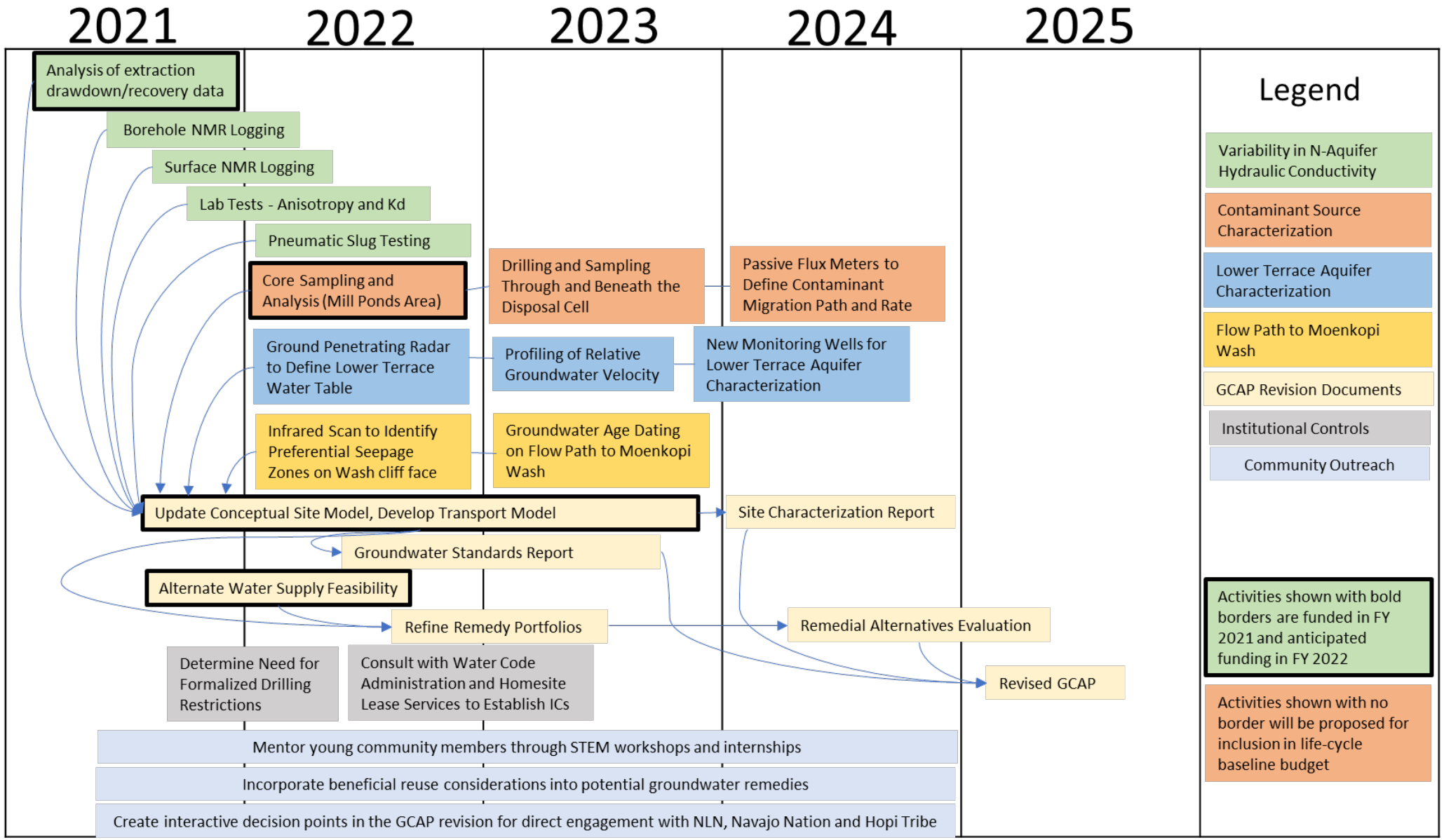
Plans

- Revise the corrective action strategy, based on:
  - LM/National Lab Network recommendations for site/source characterization
  - End-state vision, to protect quality and quantity of groundwater in the Navajo aquifer
- Revision process will follow U.S. Nuclear Regulatory Commission guidance, and will include timely consultation with tribal agencies and impacted communities
- Remedy portfolios, addressing multiple source zones with multiple technologies, will be refined as contaminant transport projections are developed


Moenkopi Wash, south of the site


Farming, near Moenkopi Villages

Tuba City LM/NLN Recommendations Implementation Timeline



Questions?