



TRAC – Capturing Cleanup Progress at DOE Environmental Management Sites

December 4, 2024

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Senior Development Engineer



PNNL is operated by Battelle for the U.S. Department of Energy



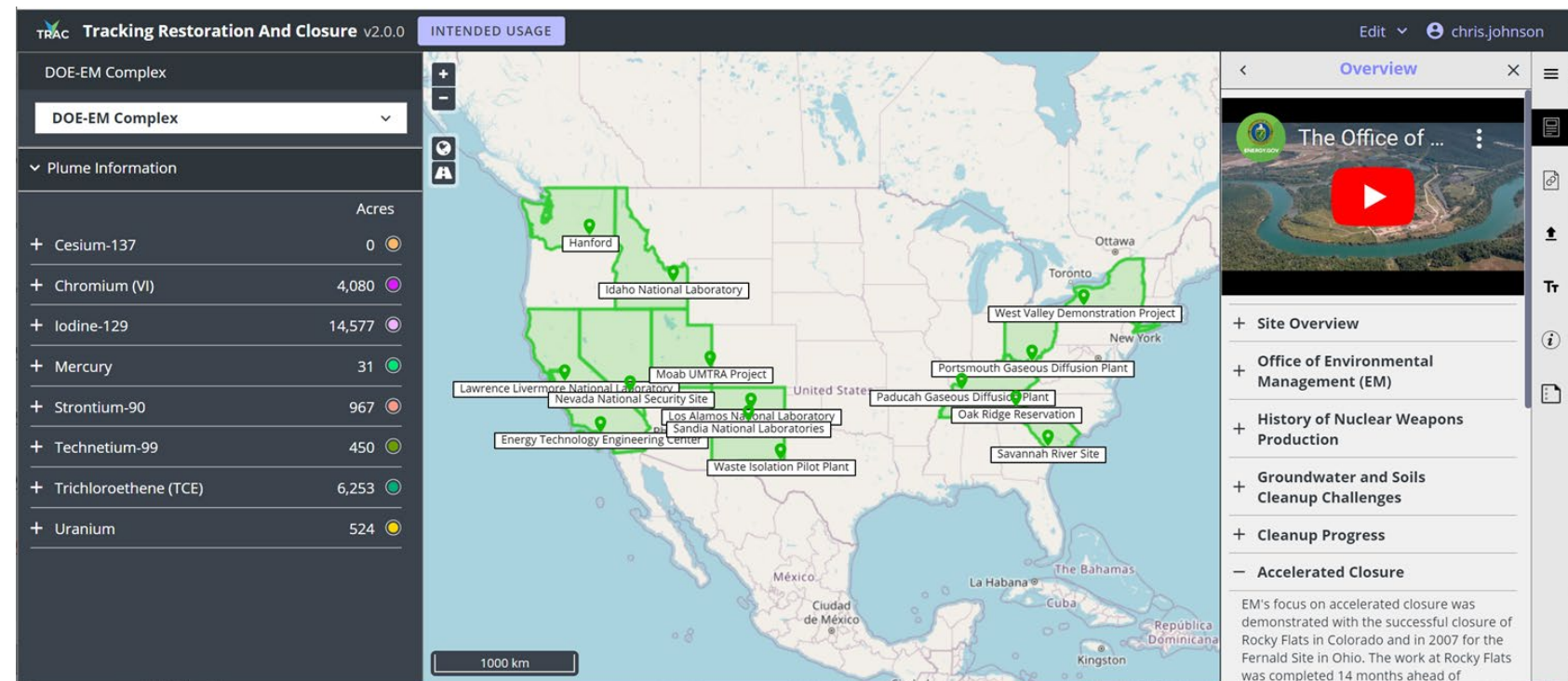
Outline

- What is TRAC? Why is it needed?
- What does TRAC show?
- How is information managed in TRAC
- Future work
- Summary



Tracking Restoration and Closure (TRAC)

- Web-based application to communicate about status of groundwater contaminant plumes and progress toward closure
 - For U.S. Department of Energy (DOE) Office of Environmental Management (EM) sites
 - Consolidates narratives, metrics, and geospatial data
 - Supports planning and decision-making about remaining plumes
- Hosted on Amazon Web Services (AWS) cloud computing
 - Robust, flexible, and cost-effective framework
- TRAC versions
 - Version 1.0 released Oct. 2022
 - Version 2.0 released Oct. 2023
 - ✓ Improved usability & features
 - ✓ Additional site data
- Part of DOE-EM groundwater closure strategy



Why is TRAC Needed?

- Provides dynamic online information resource for DOE-EM
 - Supports DOE-EM programs and mission
 - ✓ E.g., Groundwater closure strategy, Technology Development, etc.
- Provides a single endpoint for integrating and standardizing data between DOE-EM sites/organizations
 - Consistent framework for presenting progress towards site closure
- Facilitates effective communication
 - Between headquarters and DOE-EM sites
 - Between sites and stakeholders / regulators
 - Promotes sharing of technologies, successes, and lessons learned
- Mechanism for transparency and effective engagement with stakeholders
 - Complies with Programmatic Environmental Impact Statement Settlement Agreement

Technology Behind TRAC

- TRAC is a custom, single-page, web-based application
 - Modern, flexible framework
 - Web browser, dynamic content via AWS Lambda / AWS DynamoDB database
 - Database construction handles fusion of different data sets
- Hosted on Amazon Web Services (AWS)
 - Robust infrastructure – reliable, scalable, redundant
 - Lower maintenance costs associated with hosting
 - Server-side security updates by AWS
 - Compliant with FedRAMP security controls
- Leverages AWS Cognito user management for role-based access
 - Curated, EM site-specific access and roles



Amazon Lambda



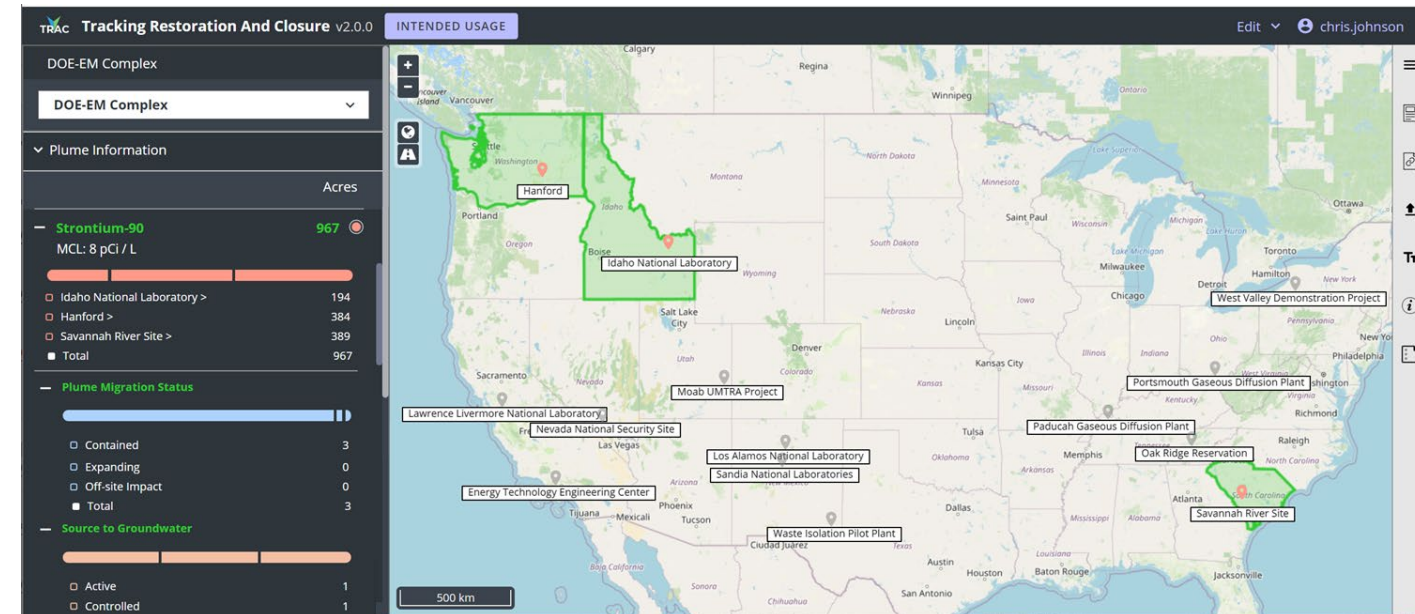
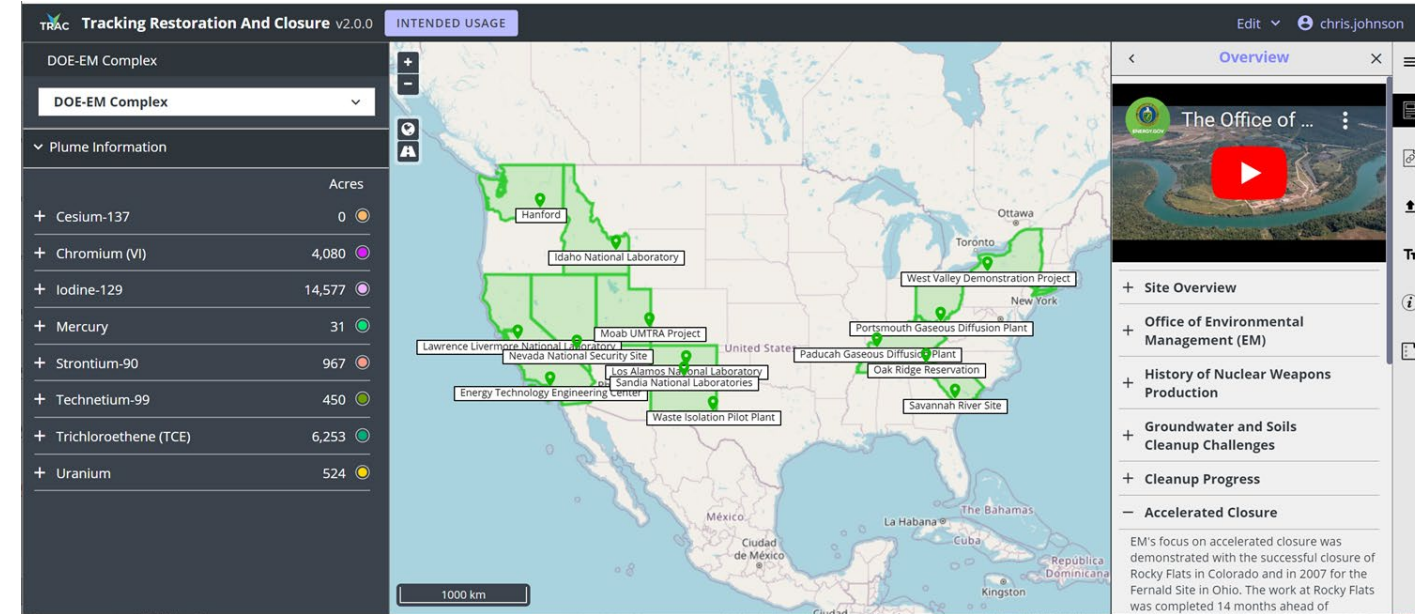
Amazon DynamoDB



Amazon Cognito

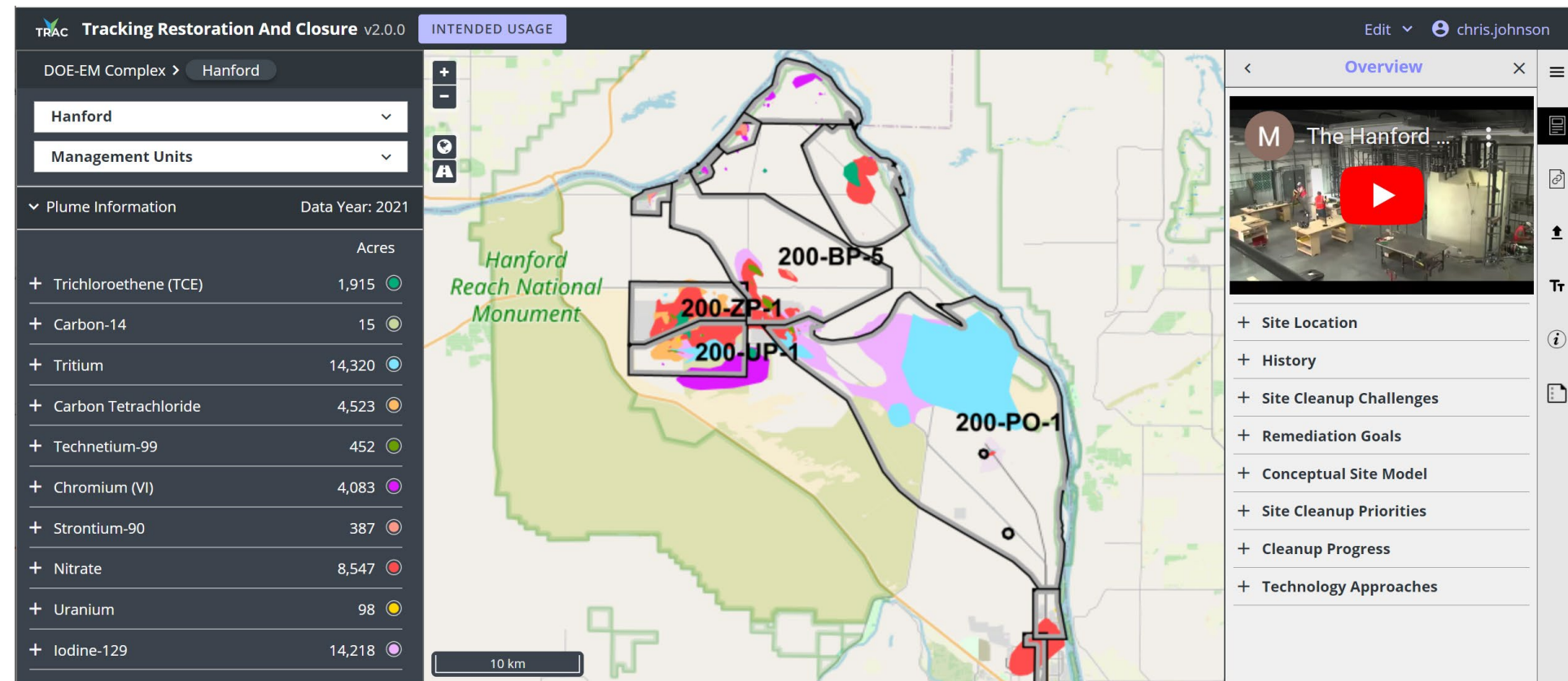
DOE-EM Complex Level Information

- Map overview of DOE-EM sites
- Focus on high-priority contaminants of concern
 - Which sites have the contaminant?
 - Total plume area and area by site
- Summary information on number of management units and status for:
 - Plume migration status
 - Source status
 - Regulatory status
 - Remediation technologies applied
 - Remedy implementation status



DOE-EM Site Level Information

- Summary / rollup of metrics for all management units at the site
 - Plume area/status, regulatory status, and technology applied/implementation status
- Map view of geospatial footprints for all groundwater plumes
- Explanatory narratives
 - Site location & history
 - Remediation goals / priorities
 - Conceptual site model
 - Cleanup progress
 - Technology approaches
- Video and photographs



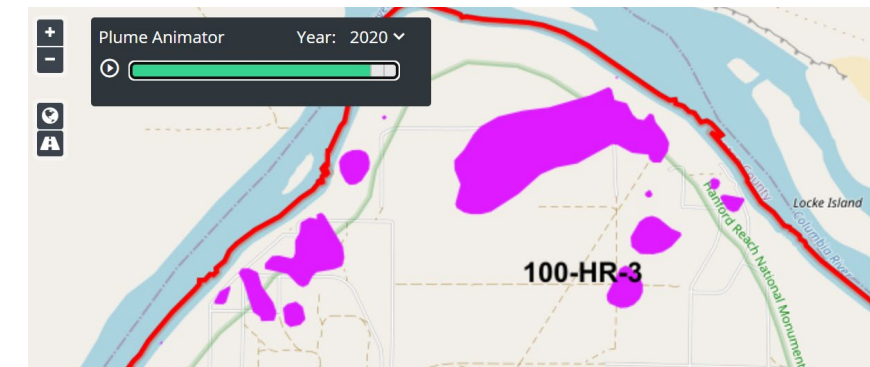
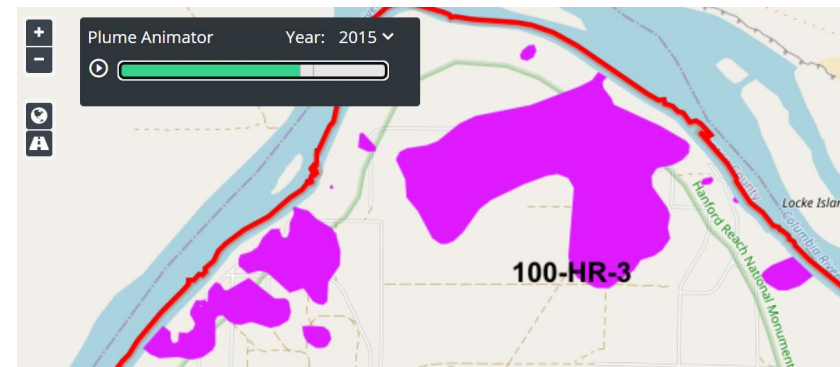
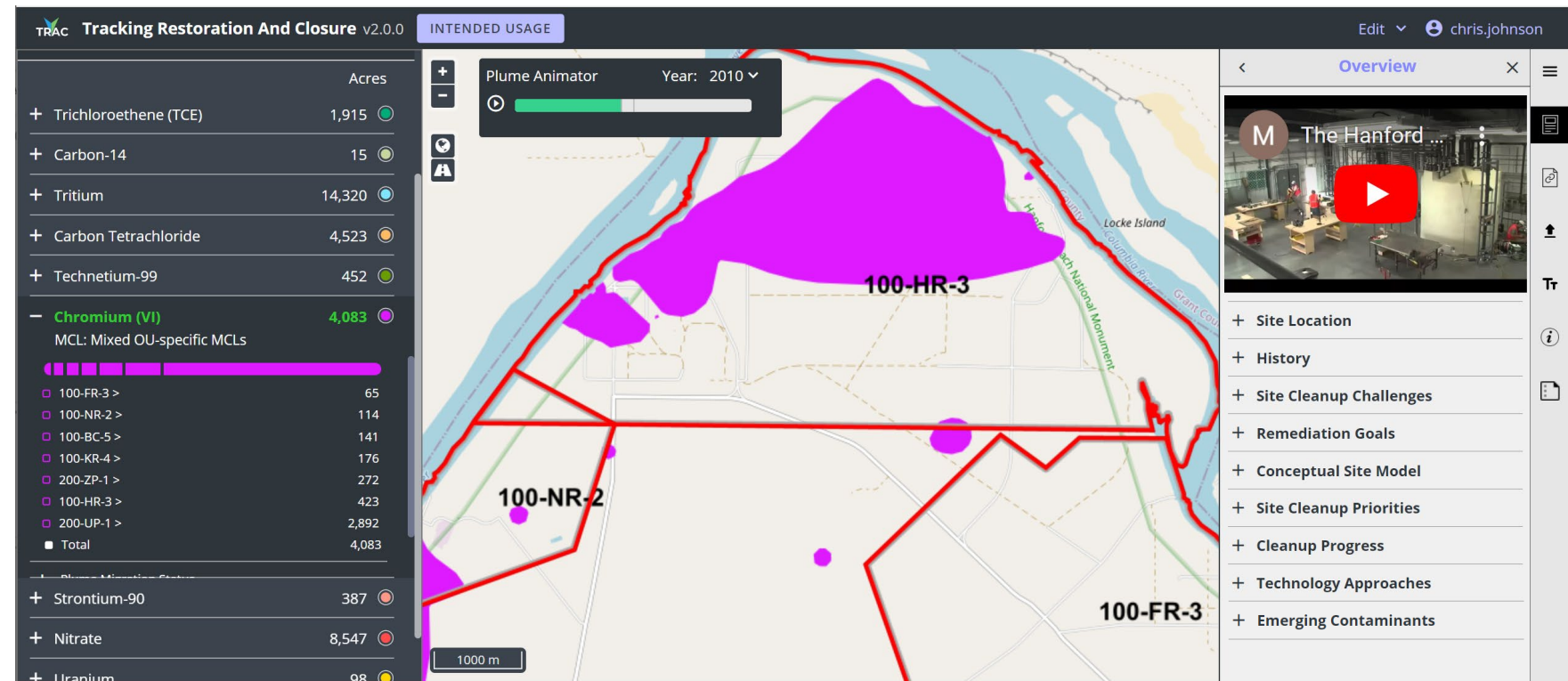
Site Plume Information and Plume Animator

- Plume footprint

- Total acres
- Acres for plume footprint by management unit
- Highlight management units with contaminant
- Different symbology for plumes at different depths

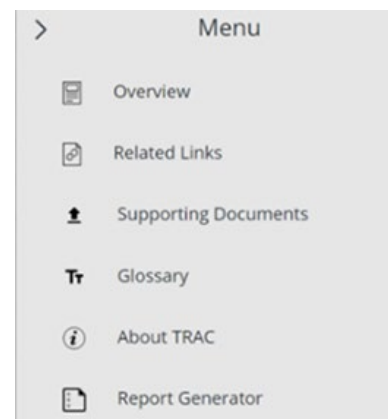
- Plume animator

- Changes over time
- May reflect changes in monitoring from year to year
- Can show remedy impacts



One-Page Factsheet

- Downloadable PDF file
 - Righthand side menu
- For EM site
 - Summary metrics for management units
 - Partial narrative content
 - ✓ Limited by space
- Useful for sharing, inclusion in a report, etc.



Moab UMTRA Project Site Data

DataYear: 2021

Plume Information

Contaminant	Area	Contaminant	Area
Ammonia	318.0	Uranium	427.0

Regulatory Information

Regulatory Cleanup Status	Cleanup Regulations
ROD	Other
ROD Amendment	

Technology Information

Regulatory Cleanup Status	Cleanup Regulations
Other	Treatment Plan Implemented

Contextual Information

Cleanup Progress

Interim groundwater action systems were installed starting in 2003 with a groundwater extraction system located along the Colorado Riverbank. This system was installed to remove contaminant mass from the groundwater and provide a source of water for dust control inside the Contamination Area. This system was updated over the past 20 years to currently extract groundwater from the base of the tailings pile. In addition, a freshwater injection system was installed along the riverbank to establish ...

Conceptual Site Model

Groundwater in the Moab region occurs in the unconsolidated Quaternary material deposited on the floor of Moab/Spanish Valley and in consolidated bedrock formations. Unconsolidated alluvial deposits overlie mostly the Paradox Formation at the site and comprise two distinct depositional facies: the Moab Wash alluvium and the basin-fill alluvium. The Moab Wash alluvium includes fine-grained sand, gravelly sand. The basin-fill alluvium is subdivided into two units; an upper unit (mostly Colorado Ri ...

History

Milling Operations. The Moab site began uranium milling operations in October 1956, and based on historical photographs the tailings pile was established once the mill operations were initiated. The mill was originally owned by the Uranium Reduction Company but was acquired by Atlas Corporation in 1962. In 1974, Atlas made several modifications to its ore processing operations. The major modifications were construction of an acid-leach processing circuit to replace the one destroyed in a 1968 fire, ...

Remediation Goals

As directed by UMTRCA, EPA published 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." The standards in 40 CFR 192, Subparts A, B, and C, apply to the remediation and final disposition of contaminated materials, including groundwater, for Title I sites. Remediation of the Moab site must be in compliance with these standards. The Subpart A standards for control of residual radioactive materials apply to disposal of these materials at processing or ...

Site Cleanup Challenges

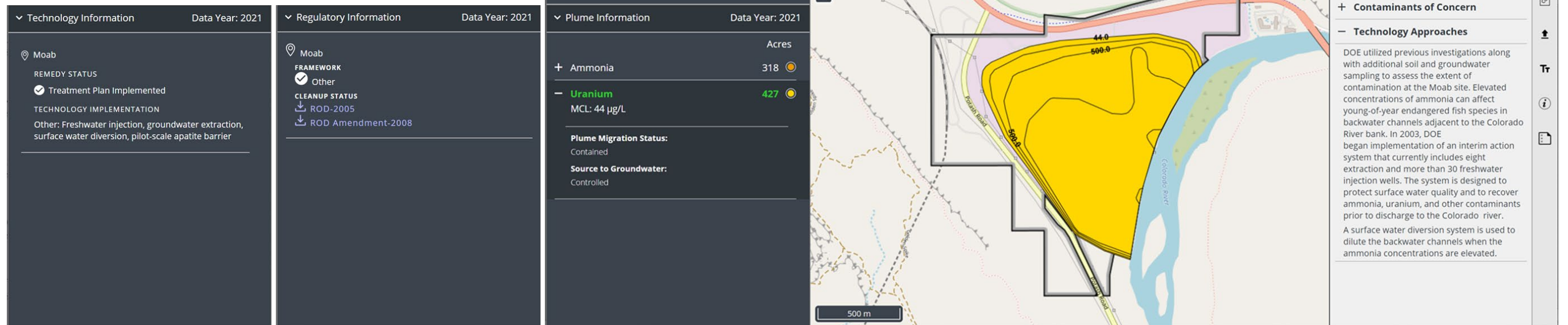
NRC has not approved a GCAP in many years, so the process and expectations currently have some uncertainty. DOE's objective is a final, approved GCAP by the completion of surface remediation activities, which may be as early as 2027.

Site Cleanup Priorities

The surface remediation of the tailings was initiated in April 2009. As of October 2023, 14 mil tons of the estimated 16 mil tons have been relocated to the Crescent Junction Disposal Cell. In conjunction with the surface remediation is groundwater remediation. Currently groundwater Interim Action has been removing contaminant mass and being protective of the Colorado River critical habitats. A final remediation strategy will be included in the site GCAP, which will be submitted to NRC in 2027. Am ...

Management Unit Level Information

- Contaminant plumes by management unit
 - Plume footprint area, concentration contours, plume status, source status
- Regulatory framework and regulatory status
 - Links to regulatory documents
- Remediation technology applied and implementation status
 - Target contaminants, volume/mass treated

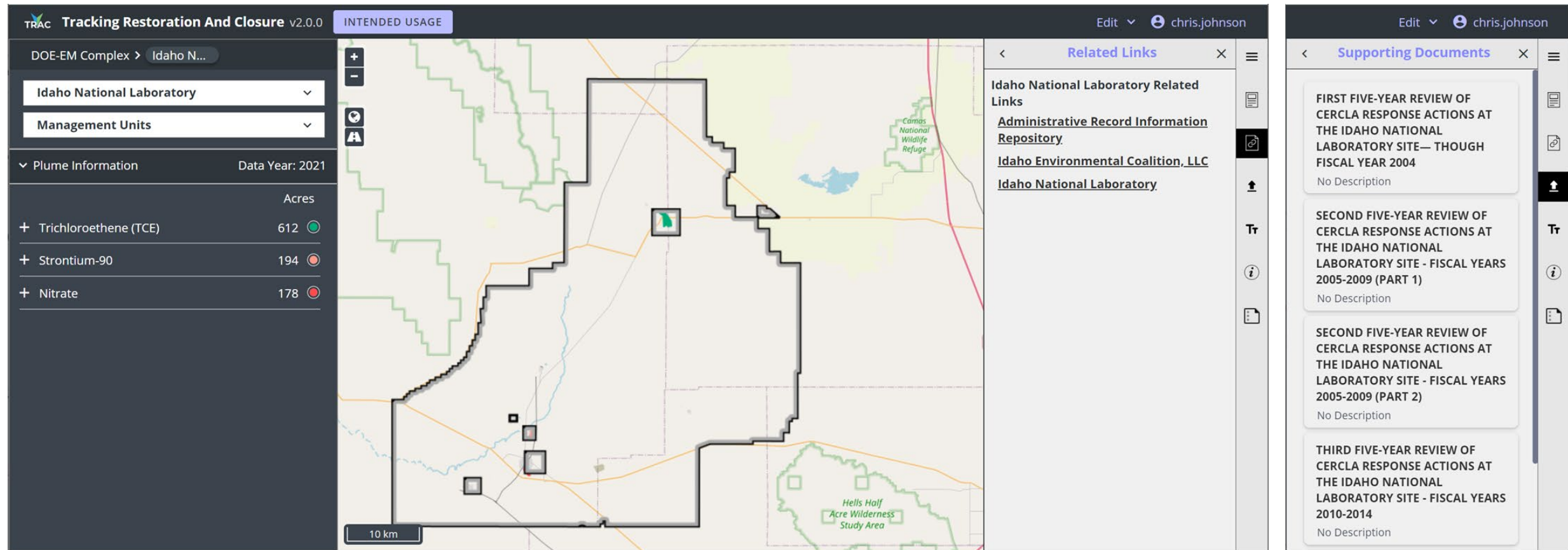


The screenshot displays the TRAC Tracking Restoration And Closure v2.0.0 interface for the Moab UMTRA Project. The interface is divided into several sections:

- Technology Information (Data Year: 2021):** Shows the Moab site with a "REMEDY STATUS" of "Treatment Plan Implemented" and "TECHNOLOGY IMPLEMENTATION" including "Other: Freshwater injection, groundwater extraction, surface water diversion, pilot-scale apatite barrier".
- Regulatory Information (Data Year: 2021):** Shows the Moab site with a "FRAMEWORK" of "Other" and "CLEANUP STATUS" including "ROD-2005" and "ROD Amendment-2008".
- Plume Information (Data Year: 2021):** Shows the Moab site with a "Plume Migration Status" of "Contained" and "Source to Groundwater" of "Controlled".
- Map:** A map of the Moab site showing the Colorado River, US 191, and various plume footprints and concentration contours. The map includes a 500m scale bar.
- Operational History:** A sidebar on the right provides an overview of the project, including "Operational History", "Conceptual Site Model", "Contaminants of Concern", and "Technology Approaches".

Related Links and Supporting Documents

- Related links feature to point at additional resources
 - Websites, documents, online databases/tools, videos, etc.
- Supporting documents
 - Easy access to relevant documents



The screenshot displays the TRAC Tracking Restoration And Closure v2.0.0 interface. The main map shows the Idaho National Laboratory site with various management units and plume information. The left sidebar includes filters for 'Idaho National Laboratory' and 'Management Units', and a table for 'Plume Information' with data for 2021. The right sidebar is split into two panels: 'Related Links' and 'Supporting Documents'.

Plume	Acres
Trichloroethene (TCE)	612
Strontium-90	194
Nitrate	178

Related Links

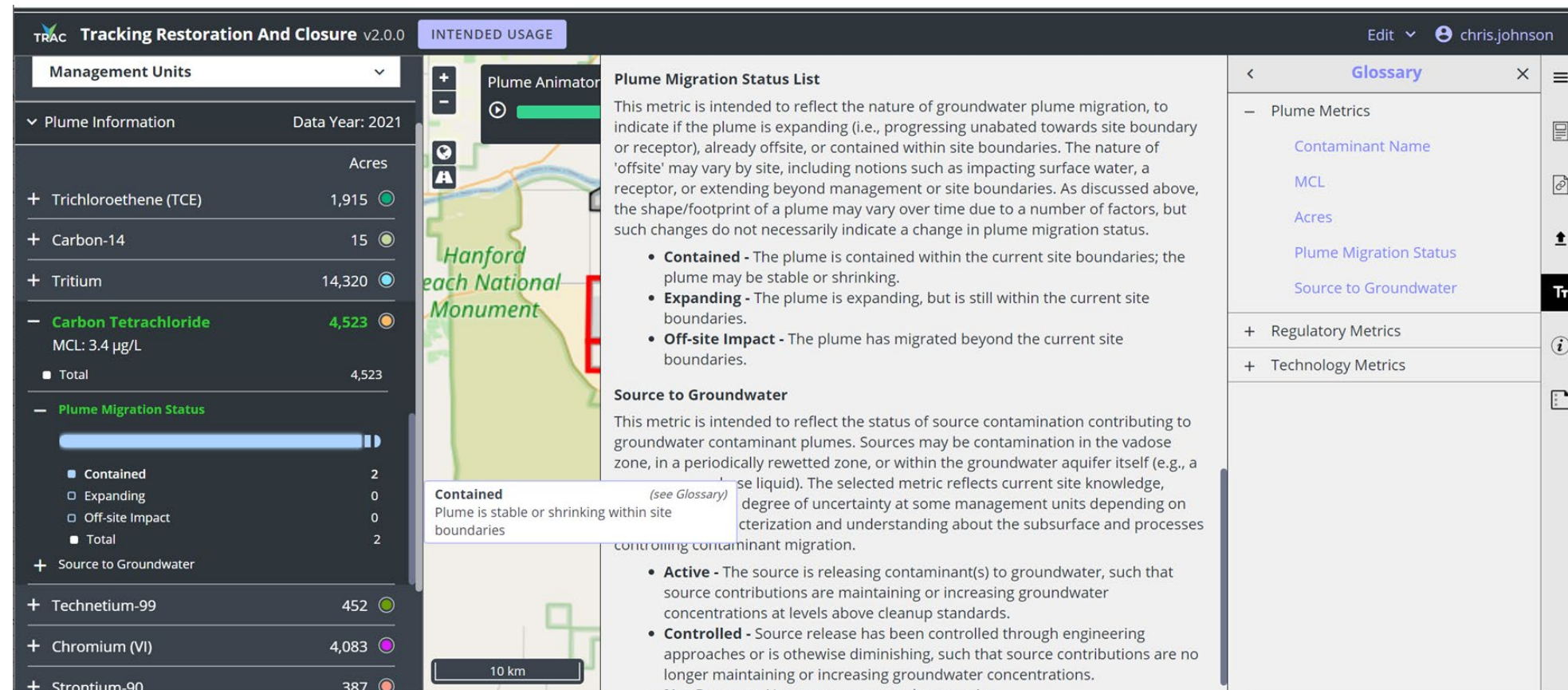
- Idaho National Laboratory Related Links
- [Administrative Record Information Repository](#)
- [Idaho Environmental Coalition, LLC](#)
- [Idaho National Laboratory](#)

Supporting Documents

- FIRST FIVE-YEAR REVIEW OF CERCLA RESPONSE ACTIONS AT THE IDAHO NATIONAL LABORATORY SITE— THOUGH FISCAL YEAR 2004
No Description
- SECOND FIVE-YEAR REVIEW OF CERCLA RESPONSE ACTIONS AT THE IDAHO NATIONAL LABORATORY SITE - FISCAL YEARS 2005-2009 (PART 1)
No Description
- SECOND FIVE-YEAR REVIEW OF CERCLA RESPONSE ACTIONS AT THE IDAHO NATIONAL LABORATORY SITE - FISCAL YEARS 2005-2009 (PART 2)
No Description
- THIRD FIVE-YEAR REVIEW OF CERCLA RESPONSE ACTIONS AT THE IDAHO NATIONAL LABORATORY SITE - FISCAL YEARS 2010-2014
No Description

Glossary for Terminology

- Definitions of terms helps interpret the metric information in the left pane
 - For both general users and DOE-EM site editors/reviewers
- Also – tooltips on mouse hover over metric name in left pane
 - Brief definition and points to Glossary for details



The screenshot displays the TRAC Tracking Restoration And Closure v2.0.0 interface. The top navigation bar includes the TRAC logo, the title "Tracking Restoration And Closure v2.0.0", a "INTENDED USAGE" tab, and user information "Edit" and "chris.johnson".

The main content area is divided into several sections:

- Management Units:** A dropdown menu.
- Plume Information:** A table showing data for the year 2021.

Contaminant	Value	Unit
Trichloroethene (TCE)	1,915	Acres
Carbon-14	15	
Tritium	14,320	
Carbon Tetrachloride	4,523	MCL: 3.4 µg/L
Total	4,523	
- Plume Migration Status:** A section with a progress bar and a legend:
 - Contained: 2
 - Expanding: 0
 - Off-site Impact: 0
 - Total: 2
- Source to Groundwater:** A section with a progress bar and a legend:
 - Active: 452
 - Controlled: 4,083
 - Not Present: 387

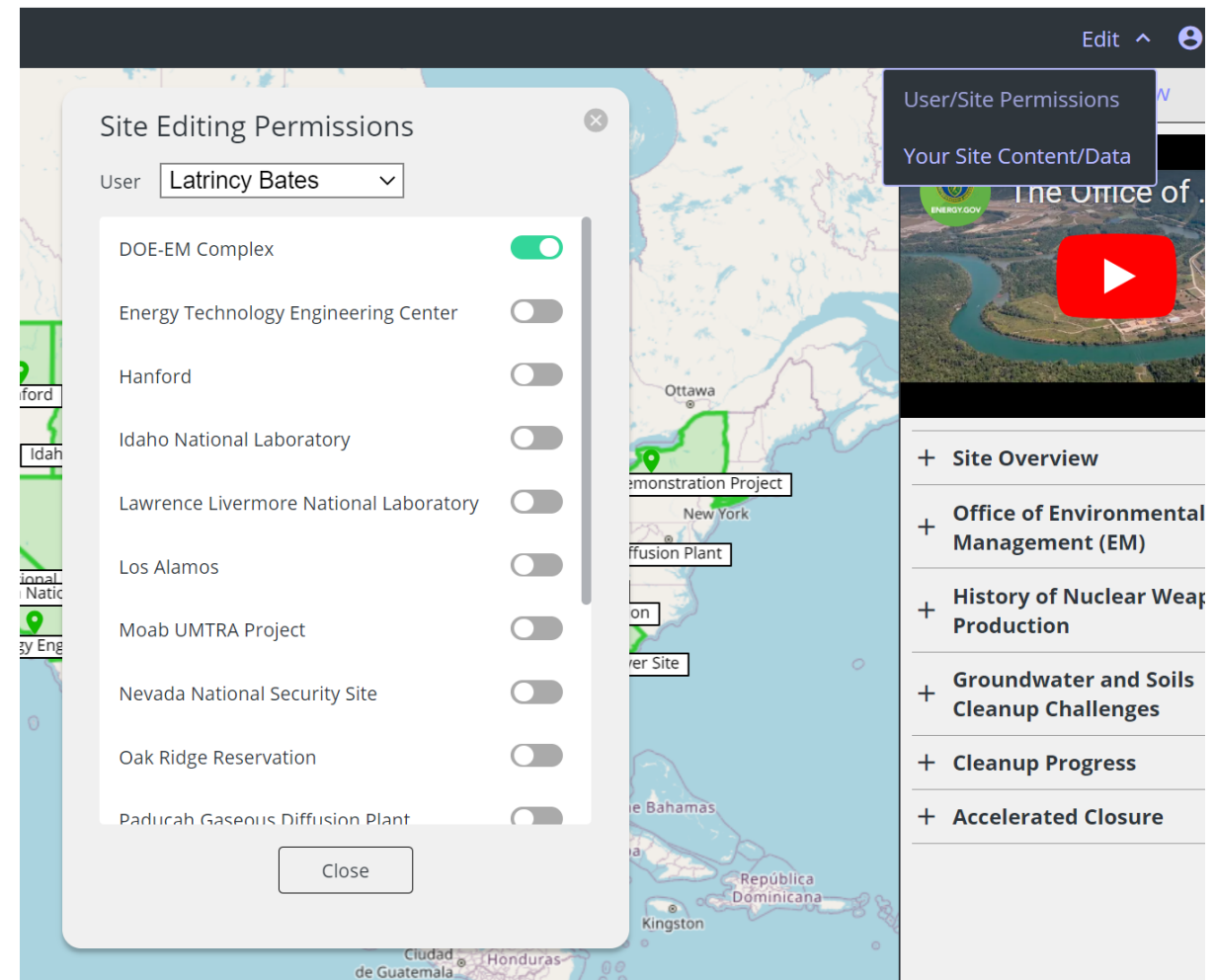
A map of the Hanford Reach National Monument is shown in the center, with a red box highlighting a specific area. A tooltip is visible over the map, providing a brief definition and a link to the glossary for the "Contained" status: "Plume is stable or shrinking within site boundaries".

The right-hand pane is titled "Glossary" and contains a list of metrics:

- Plume Metrics
 - Contaminant Name
 - MCL
 - Acres
 - Plume Migration Status
 - Source to Groundwater
- Regulatory Metrics
- Technology Metrics

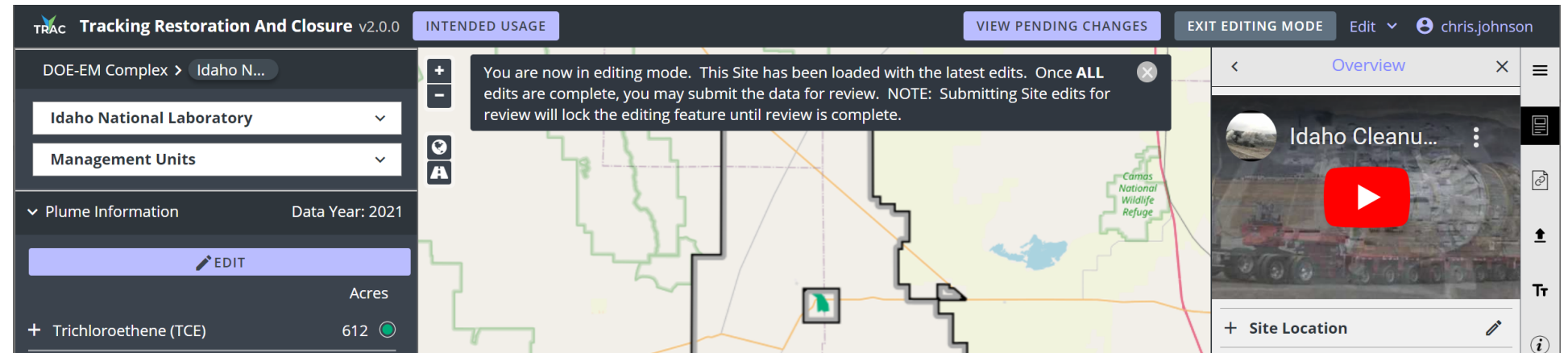
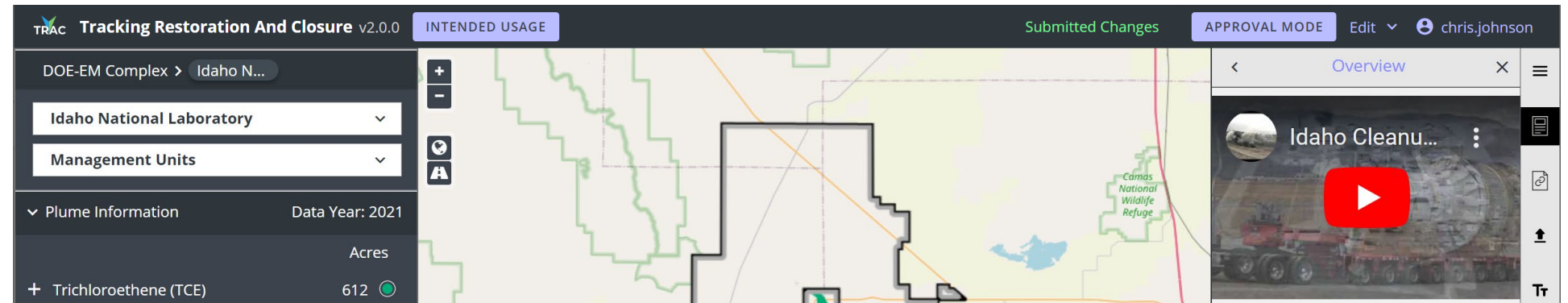
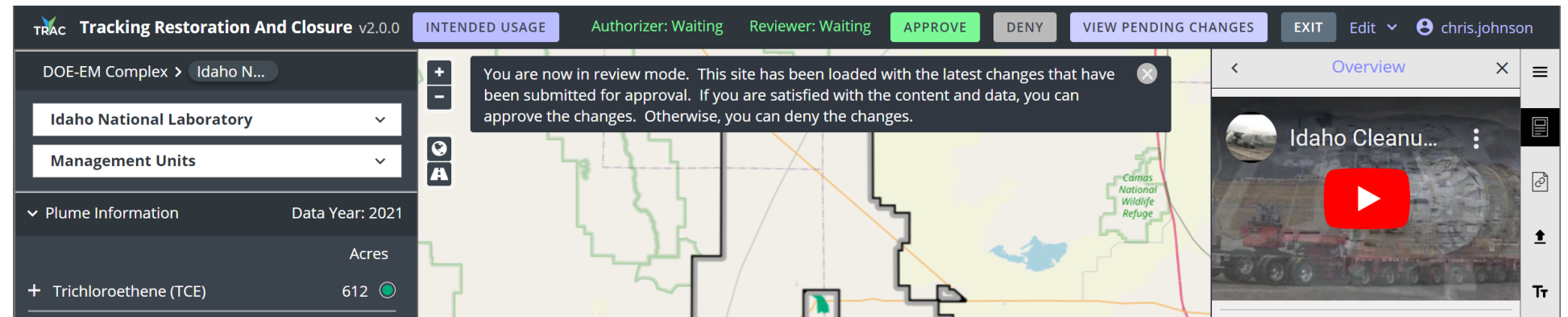
Collective Content Management

- Collaborative and effective workflow
- Site-specific and role-based editing
- Site-authorized users can:
 - Edit content (narrative, metrics, file uploads) in draft mode
 - Review submitted draft content
 - Approve and publish content for public consumption
- Updates require minimal interaction for the TRAC website owner
 - Currently need to manually add GIS data files (updated plume maps)



Editing / Submitting / Review / Approval

- **Editor role** – can make changes in edit/draft mode
- **Submitter role** – submit changes for review
- **Reviewer role** – review and approve/deny changes
- **Authorizer role** – final approval and publishing content

Editing Metrics at the Management Unit Level

- Plume

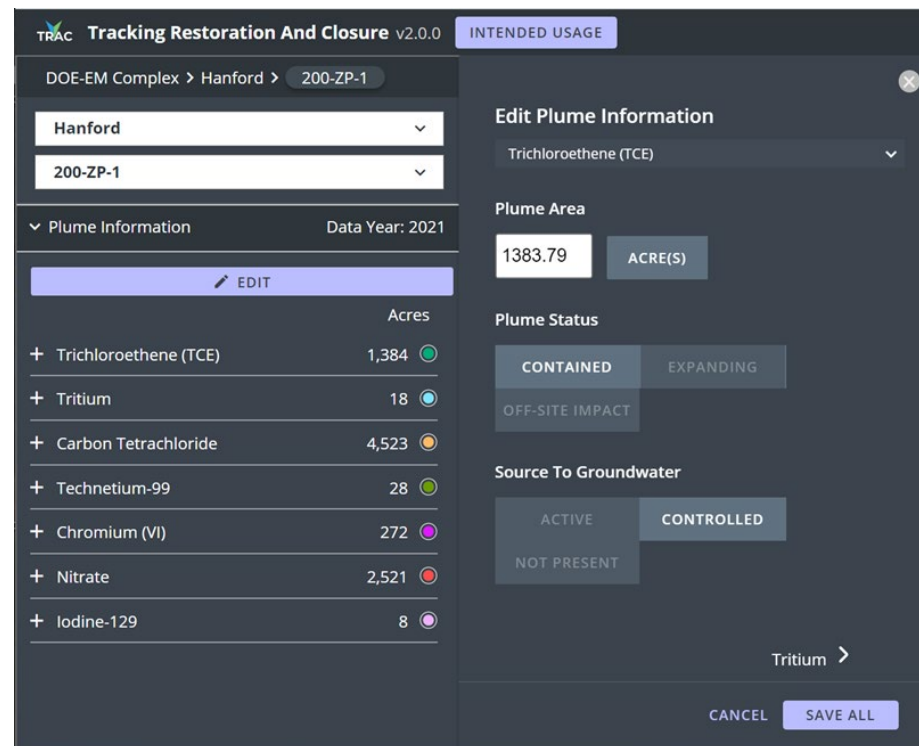
- Enter an area value
- Select appropriate status options
 - ✓ Plume migration and source status option

- Regulatory

- Select regulatory framework
- Add documents reflecting regulatory status

- Technology

- Select implementation status
- Select technology(ies) and targeted contaminants
- For P&T enter volume treated and mass removed



Tracking Restoration And Closure v2.0.0 INTENDED USAGE

DOE-EM Complex > Hanford > 200-ZP-1

Hanford

200-ZP-1

Trichloroethene (TCE)

Plume Information Data Year: 2021

EDIT

Contaminant	Value	Unit
Trichloroethene (TCE)	1,384	Acres
Tritium	18	
Carbon Tetrachloride	4,523	
Technetium-99	28	
Chromium (VI)	272	
Nitrate	2,521	
Iodine-129	8	

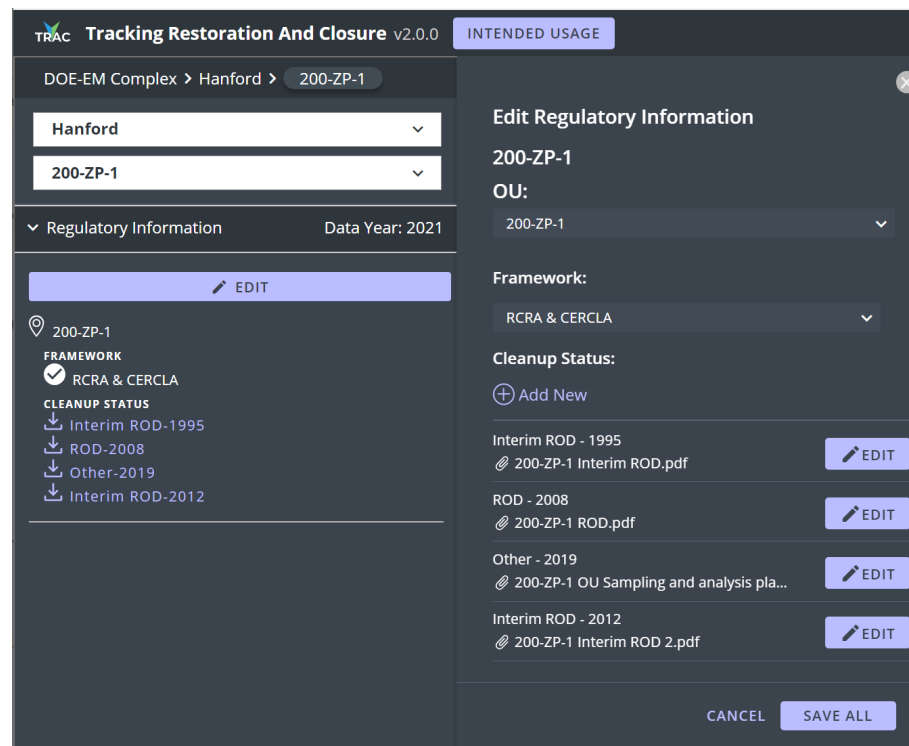
Plume Area: 1383.79 ACRE(S)

Plume Status: CONTAINED EXPANDING OFF-SITE IMPACT

Source To Groundwater: ACTIVE CONTROLLED NOT PRESENT

Tritium >

CANCEL SAVE ALL



Tracking Restoration And Closure v2.0.0 INTENDED USAGE

DOE-EM Complex > Hanford > 200-ZP-1

Hanford

200-ZP-1

Regulatory Information Data Year: 2021

EDIT

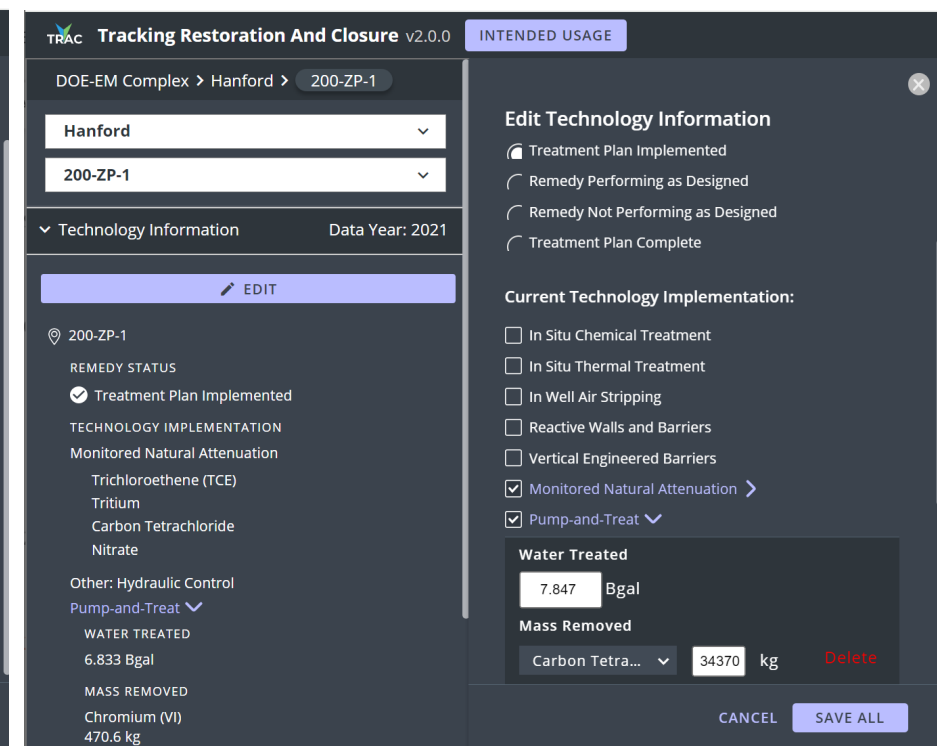
200-ZP-1

FRAMEWORK: RCRA & CERCLA

Cleanup Status: Add New

- Interim ROD - 1995: 200-ZP-1 Interim ROD.pdf EDIT
- ROD - 2008: 200-ZP-1 ROD.pdf EDIT
- Other - 2019: 200-ZP-1 OU Sampling and analysis pla... EDIT
- Interim ROD - 2012: 200-ZP-1 Interim ROD 2.pdf EDIT

CANCEL SAVE ALL



Tracking Restoration And Closure v2.0.0 INTENDED USAGE

DOE-EM Complex > Hanford > 200-ZP-1

Hanford

200-ZP-1

Technology Information Data Year: 2021

EDIT

200-ZP-1

REMEDY STATUS: Treatment Plan Implemented

TECHNOLOGY IMPLEMENTATION: Monitored Natural Attenuation

- Trichloroethene (TCE)
- Tritium
- Carbon Tetrachloride
- Nitrate
- Other: Hydraulic Control
- Pump-and-Treat

WATER TREATED: 7.847 Bgal

MASS REMOVED: 34370 kg

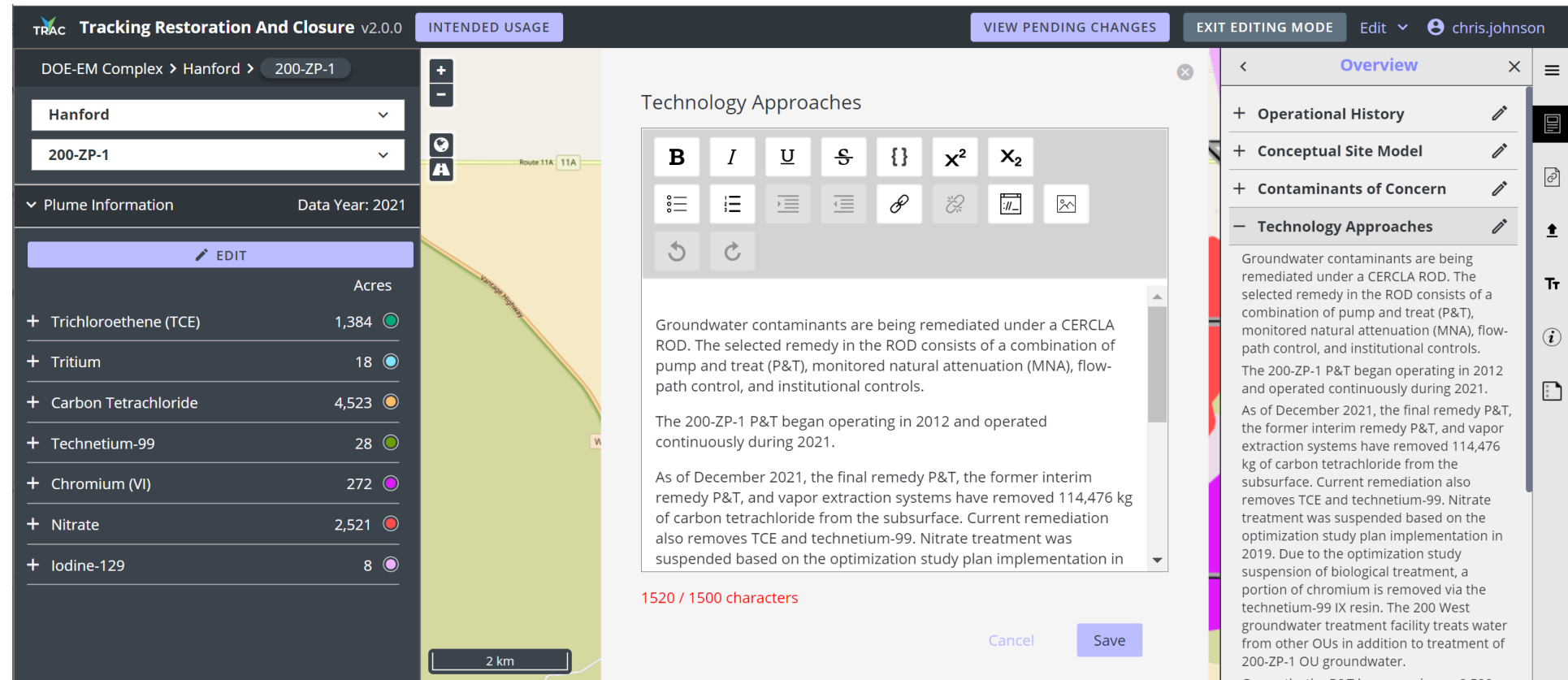
Water Treated: 7.847 Bgal

Mass Removed: Carbon Tetra... 34370 kg Delete

CANCEL SAVE ALL

Editing Narratives

- Can add text and format it as desired
 - Font formatting
 - Numbered/bullet lists
- Can add hyperlinks
- Can add photos/images



Tracking Restoration And Closure v2.0.0 INTENDED USAGE VIEW PENDING CHANGES EXIT EDITING MODE Edit chris.johnson

DOE-EM Complex > Hanford > 200-ZP-1

Hanford

200-ZP-1

Plume Information Data Year: 2021

EDIT

	Acres
+ Trichloroethene (TCE)	1,384
+ Tritium	18
+ Carbon Tetrachloride	4,523
+ Technetium-99	28
+ Chromium (VI)	272
+ Nitrate	2,521
+ Iodine-129	8

2 km

Technology Approaches

B *I* U ~~S~~ {} x² X₂

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↶ ↷

Groundwater contaminants are being remediated under a CERCLA ROD. The selected remedy in the ROD consists of a combination of pump and treat (P&T), monitored natural attenuation (MNA), flow-path control, and institutional controls.

The 200-ZP-1 P&T began operating in 2012 and operated continuously during 2021.

As of December 2021, the final remedy P&T, the former interim remedy P&T, and vapor extraction systems have removed 114,476 kg of carbon tetrachloride from the subsurface. Current remediation also removes TCE and technetium-99. Nitrate treatment was suspended based on the optimization study plan implementation in

1520 / 1500 characters

Cancel Save

Overview

- + Operational History
- + Conceptual Site Model
- + Contaminants of Concern
- Technology Approaches

Groundwater contaminants are being remediated under a CERCLA ROD. The selected remedy in the ROD consists of a combination of pump and treat (P&T), monitored natural attenuation (MNA), flow-path control, and institutional controls.

The 200-ZP-1 P&T began operating in 2012 and operated continuously during 2021.

As of December 2021, the final remedy P&T, the former interim remedy P&T, and vapor extraction systems have removed 114,476 kg of carbon tetrachloride from the subsurface. Current remediation also removes TCE and technetium-99. Nitrate treatment was suspended based on the optimization study plan implementation in 2019. Due to the optimization study suspension of biological treatment, a portion of chromium is removed via the technetium-99 IX resin. The 200 West groundwater treatment facility treats water from other OUs in addition to treatment of 200-ZP-1 OU groundwater.

Currently, the P&T has a maximum of 500

Pending Changes

- Pending changes screen lists edits compared to the prior version
- For submission of updates and for reviewing those updates

Tracking Restoration And Closure v2.0.0 INTENDED USAGE EXIT EDITING MODE Edit chris.johnson

← BACK ×

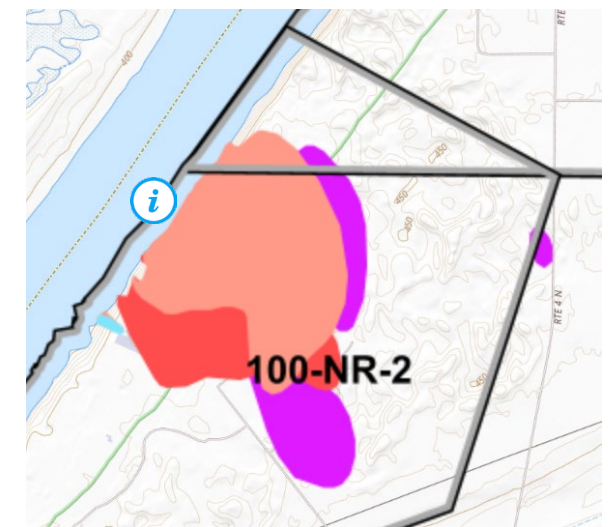
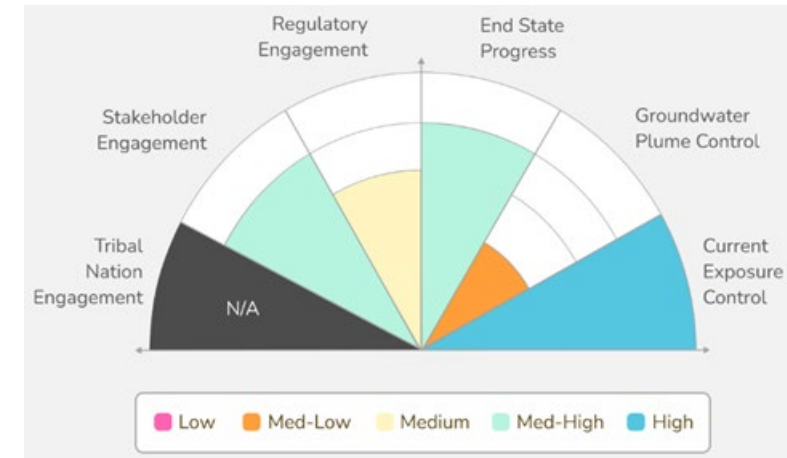
[CONFIRM & SUBMIT SUBMISSION](#)

↶ REVERT ALL CHANGES

Changed field	Old Value	New Value	Changed by	Timestamp
DOE-EM Complex > Savannah River Site > D Area > Overview > Operational History	<p>The D Area contains a coal-fired powerhouse and support facil	<p>The D Area contained a coal-fired powerhouse and support facil	karen.ladars	May 9, 2023 6:28
DOE-EM Complex > Savannah River Site > A/M Area > Technology Information > Technology Implementation > Pump-and-Treat > Water Treated		7.5 Bgal	scilla.s.gunn	Jan 31, 2023 11:02
DOE-EM Complex > Savannah River Site > A/M Area > Technology Information > Technology Implementation > Pump-and-Treat > Mass Removed >		259000	scilla.s.gunn	Jan 31, 2023 11:02
DOE-EM Complex > Savannah River Site > A/M Area > Technology Information > Technology Implementation > In Situ Bioremediation		Trichloroethene (TCE), Tetrachloroethylene (PCE)	scilla.s.gunn	Jan 31, 2023 11:02
DOE-EM Complex > Savannah River Site > A/M Area > Regulatory Information > Cleanup Status	Interim Rod-1992	Interim Rod-1992 , Other-2021	scilla.s.gunn	Jan 31, 2023 10:54

Ongoing and Future Work

- Content integration
 - Approval for LANL is imminent
 - Finish adding ETEC and ORO
 - Add new sites: LLNL, NNSS, SNL, & WIPP
- Standing Operating Policies and Procedure
 - EM HQ will issue guidance for annual updates
- Pending new features
 - Incorporate end state metrics
 - ✓ Developed as part of the groundwater closure strategy
 - Refinement of plume migration categories & info icons on map
 - Incorporate interactive, self-service GIS data file upload feature
 - Visualization of metrics over time
- Sister application for tanks closure strategy
- Soil & disposal cell metrics



ETEC = Energy Technology Engineering Center
 GIS = Geographic Information System
 LLNL = Lawrence Livermore National Laboratory
 NNSS = Nevada National Security Site

ORO = Oak Ridge Operations
 SNL = Sandia National Laboratories
 WIPP = Waste Isolation Pilot Plant
 WVDP = West Valley Demonstration Project

Summary

- TRAC provides summary information for sites across the DOE-EM complex
- Can quickly identify
 - Which sites have a particular contaminant
 - Magnitude of the groundwater plume areas (how extensive is the problem)
 - Plume, regulatory, and remedy technology status
- Consistent set of summary metrics and explanatory information for all sites
- Facilitates communication on multiple levels (sites/headquarters, public)
- Provides information for DOE-EM to help make strategic decisions
 - Where are the issues?
 - Where to allocate resources?
- Part of the overall strategy for groundwater cleanup across the EM complex
 - Technical Targets / Site Interviews / Recommendations for groundwater closure strategy
 - ALTEMIS – Advanced Long-Term Environmental Monitoring Systems

Acknowledgements

- Contributors & DOE-EM HQ Leadership
 - Jennifer Fanning, Marcus Perry, Eric Engel, Reem Osman, Chloe Sow, and Patrick Royer at the Pacific Northwest National Laboratory
 - Julie Karceski, Latrincy Bates, and Grover Chamberlain (retired) at the Department of Energy Office of Environmental Management
- This work was funded by the DOE-EM Headquarters, who are gratefully acknowledged in this important endeavor to better track the progress of groundwater cleanup.
- Pacific Northwest National Laboratory is operated by Battelle Memorial Institute for the Department of Energy under Contract DE-AC05-76RL01830.



Thank You

<https://trac.pnnl.gov>

<https://www.pnnl.gov/projects/trac>



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REMPLEX

CENTER FOR THE REMEDIATION
OF COMPLEX SITES

@PNNL

remplex@pnnl.gov

<https://www.pnnl.gov/projects/remplex>





**Pacific
Northwest**
NATIONAL LABORATORY

Left Pane

DOE-EM Complex > Hanford > 200-ZP-1

Hanford

200-ZP-1

Plume Information Data Year: 2020

Plume Information Acres

Regulatory Information 110

Technology Information

Carbon-14 17

Navigation back up to higher levels

Select EM Site or EM Complex

Select a management unit

Year(s) for site data

Menu for plume, regulatory, or technology metrics

Map

Top Right (header bar): Log in/out and feedback



Zoom controls (or use mouse wheel)

Satellite map

Street map

Plume animator (if multiple plume maps are available)

Plume Animator Year: 2020

Right Pane

Menu

- Overview
- Related Links
- Supporting Documents
- Glossary
- About TRAC

Expand pane

Close pane

EM Complex or EM Site levels show totals: plume acres and number of management units for a category

Management unit level shows plume acres and regulatory/technology summary information

EM Complex or EM Site levels show totals: plume acres and number of management units for a category

Category	Acres
Mercury	31
Strontium-90	978
Technetium-99	383

Management unit level shows plume acres and regulatory/technology summary information

Trichloroethene (TCE) 59%

Chromium (VI) 64

Strontium-90 27

100-FR.3 FRAMEWORK CERCLA CLEANUP STATUS ROD-2014 RUTS-2010

100-HR.3 REMEDY STATUS Remedy Performing as Designed

TECHNOLOGY IMPLEMENTATION Monitored Natural Attenuation

Strontium-90 Nitrate

Pump-and-Treat WATER TREATED 7.56 Bgal

MASS REMOVED Chromium (VI) 2658 kg

Bars show distribution across categories

Welcome to TRAC (Tracking Restoration And Closure)

TRAC is focused on communicating cleanup status, technical challenges, and needs for site closure of U.S. Department of Energy Office of Environmental Management (DOE-EM) sites. TRAC facilitates open communication, strategy development, and long-term protection of human health and the environment. TRAC provides video, summary narrative (1), geospatial visualization of groundwater plumes (in the Map), and metrics in the left pane (about plumes, regulatory status, and remediation technology implementation) for the DOE-EM complex, a particular DOE-EM site, or a management unit within a site.

- Tips for using TRAC:
- Take a few seconds to familiarize yourself with TRAC functionality via the description here of elements available in the Left, Right, and Map panes.
 - Make the **Glossary** (4) your first stop to understand terminology of TRAC.
 - TRAC provides summary information. The focus is not on specific numbers (which may be rounded values or sometimes have more significant digits than needed). Rather, the focus is on the magnitude/quantity, and, ultimately, how these numbers change over time as work progresses. For detailed information, numbers, and analysis, check out the **Related Links** (2) and **Supporting Documents** (3) for links to the annual report, 5-year report, online databases, or other resources.
 - Recognize that status information will change over time; some aspects may be uncertain and will be refined over time as characterization or remedy operations provide more information.
 - As more sites are included and DOE-EM prepares strategy for the coming decade, the metrics and categories used to describe status will evolve in TRAC to better track progress towards closure.

Expand to see narrative

Overview

The Hanford

- Site Location
- History
- Site Cleanup Challenges
- Remediation Goals
- Conceptual Site Model
- Site Cleanup Priorities
- Cleanup Progress
- Technology Approaches

Related Links

DOE-EM Complex Related Links

Department Of Energy

DOE Office of Environmental Management

Glossary

- Plume Metric
- Regulatory Metric
- Technology Metric