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What Is “Restorative Justice” after the Church Rock Uranium Spill?

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Abstract

On July 16, 1979, the largest by volume radioactive spill in US history took place in Kinkitsosinil (Church Rock) in Diné Bikéyah (Navajo Nation) in northwestern New Mexico. This was both a mining disaster and nuclear disaster that happened when an earthen dam collapsed at the United Nuclear Corporation’s uranium mill tailings pond, releasing 94 million gallons of radioactive, toxic, and acidic slurry into the Puerco River Basin. Despite the acute disaster of the spill, a disaster declaration was never issued by any jurisdiction affected by the mine and mill releases, and there were no comprehensive disaster investigations or environmental health impact studies. This article addresses these patterns of “organized ignorance” that obscure geographies of environmental racism and injustice. These forms of ignorance cover up and downplay the uneven distribution and effects of the by-products from manufacturing the nuclear weapons arsenal and producing commercial nuclear energy. The downstream communities from the Church Rock mill spill were almost entirely Diné (Navajo) pastoralists who relied on the Puerco River as a source of water to sustain their lives, livestock, and livelihoods. Environmental health studies have

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Author contributions

Teracita Keyanna’s stories and intellectual contributions at previous meetings, conferences, and symposia are at the heart of this article and make up the core contributions to the field of disaster studies. Thomas De Pree served as the corresponding author, took notes from the meetings between co-authors, and integrated the notes into the initial drafts of the article. He also compiled the citations and rendered the conceptual framework provided in the footnotes. Chris Shuey provided the scientific and technical information regarding environmental health studies and regulatory history in the aftermath of the spill. He also provided stories of personal experiences, information from professional presentations, and key citations. Kirena Tsosie provided the framework for conceptualizing Diné restorative justice, as well as revisions and commentary. Mallery Quetawki contributed her artwork and description of extraction and remediation. Cheryl Jim offered revisions and commentary.

demonstrated that proximity to mine waste is a significant exposure variable, which is ignored by the current environmental cleanup regime. When faced with such forms of ignorance that cannot possibly grasp the realities of local communities affected by uranium mining, they respond by remembering, restorying, and restoring the land through their own particular visions of restorative justice.

Resumen:

El 16 de julio de 1979 se produjo el mayor vertido radiactivo por volumen de la historia de Estados Unidos en Kinkitsosinil (Church Rock), dentro de Diné Bikéyah (la Nación Navajo), en el noroeste de Nuevo México. Se trató de un desastre minero y un desastre nuclear a la vez, producido por el derrumbe de una presa de tierra en la balsa de residuos de la fábrica de uranio de la United Nuclear Corporation, liberando 94 millones de galones de lodo radiactivo, tóxico y ácido en la cuenca del río Puerco. A pesar del grave desastre que supuso el vertido, ninguna declaración de desastre fue emitida por las jurisdicciones afectadas por los vertidos de la mina y no se llevaron a cabo investigaciones exhaustivas del desastre ni estudios de impacto ambiental en la salud. Este ensayo aborda estas pautas de “ignorancia organizada” que ocultan las geografías del racismo y la injusticia ambiental. Estas formas de ignorancia encubren y minimizan la distribución desigual y los impactos de los subproductos de la fabricación del arsenal de armas nucleares de EE.UU. y la producción de energía nuclear comercial. Las comunidades situadas río abajo del vertido de la fábrica de Church Rock eran casi en su totalidad pastores Diné (Navajos) que dependían del río Puerco como fuente de agua para mantener sus vidas, su ganado y sus medios de subsistencia. Los estudios de salud ambiental han demostrado que la proximidad a los residuos mineros es una variable de exposición significativa, que es ignorada por el actual régimen de limpieza ambiental. Enfrentados a estas formas de ignorancia que no pueden comprender las realidades de las comunidades locales afectadas por la minería del uranio, responden recordando, recontando y recuperando la tierra a través de sus visiones particulares de la justicia restaurativa.

초록:

1979년 7월 16일, 미국 역사상 가장 큰 규모의 방사능 유출 사고가 뉴멕시코 북서부의 디네 비케야(나바호족)에 있는 킨위츠소시닐(교회 바위)에서 발생했다. 이 사고는 미국 원자력 공사의 우라늄 공장 광미 저수지에서 댐이 붕괴되어 9,400만 갤런의 방사성, 독성, 산성 슬러리가 푸에르코 강 유역으로 유출되면서 발생한 광산 재난이자 원자력 재난이었다. 공장 유출이라는 급박한 재난에도 불구하고 광산 및 공장 유출의 영향을 받은 관할 지역에서는 재난 선언이 이루어지지 않았고, 종합적인 재난 조사나 환경 건강 영향 연구도 이루어지지 않았다. 본 글은 환경 인종주의와 부정의의 지형을 가리는 이러한 ‘조직적 무지’의 양상을 다룬다. 이러한 형태의 무지는 미국의 핵무기 제조와 상업적 핵에너지 생산에서 발생하는 부산물의 불균등한 분포와 영향을 은폐하고 경시한다. 교회 바위 공장 유출 사고의 하류 지역 사회는 거의 전적으로 푸에르코 강을 그들과 가족의 생계 유지를 위한 물 공급원으로 의존하는 디네(나바호) 목축업자들이었다. 환경보건 연구에 따르면 광산 폐기물과의 근접성이 중요한 노출 변수이지만, 현재의 환경 정화 체계에서는 이를 무시하고 있다. 우라늄 채굴로 인해 영향을 받은 지역 사회의 현실을 파악할 수 없는 이러한 형태의 무지에 직면했을 때, 그들은 ‘회복적 정의’라는 그들만의 특별한 전망을 통해 땅을 기억하고, 새롭게 스토리텔링(restorying)하며, 회복함으로써 대응한다.

Keywords

environmental justice; disaster studies; restorative justice; environmental cleanup; settler colonial determinants of health; community-driven disaster research response; environmental health

Palabras clave:

Justicia ambiental; estudios de desastre; justicia restaurativa; limpieza ambiental; determinantes coloniales de la salud; respuesta comunitaria a la investigación sobre desastres; salud ambiental

키워드:

환경 정의; 재난 학; 회복적 정의; 환경 정화; 정착 식민주의적 건강 결정 요인; 지역사회 주도 재난연구 대응; 환경 건강

Introduction: The Church Rock Uranium Spill

On July 16, 1979, the largest (by volume) radioactive spill in US history took place in Kinkitsosinil (Church Rock) within Diné Bikéyah (the Navajo Nation) in northwestern New Mexico.¹ This was both a mining disaster and a nuclear disaster that occurred when an earthen dam collapsed at the United Nuclear Corporation's uranium mill tailings pond and released 94 million gallons of radioactive, toxic, and acidic uranium mill tailings into the Puerco River. The spill traveled eighty miles downstream, carrying elevated levels of radionuclides and toxic mixtures of heavy metals.² In addition to the spill, the Puerco River received 43.7 billion gallons of mine water with high levels of uranium, radium, sulfates, and other contaminants discharged from three underground mines over a roughly twenty-year period.³ During active mining, the Puerco was transformed from an ephemeral

¹Kinkitsosinil is also known as Kin Litso Sinili, Tsé Dadilidí, and Tsé'Íí'ahí. Kirena E. Y. Tsosie, "Climate Change Vulnerability Assessment of Navajo Nation Water Resources in the San Juan River Basin, NM: Utilizing Traditional Navajo Ecological Knowledge," 2020, https://digitalrepository.unm.edu/wr_sp/187. Church Rock is surrounded by 100–400-foot-high reddish-orange sandstone cliffs sparsely adorned by dark green juniper and piñon trees. Churchrock (spelled locally as one word) was named after an iconic rock formation on top of the cliffs that resembles a church steeple. The Diné word for this rock feature is Tsé'Íí'ahí, which translates to "standing rock." An older name for the Diné settlements at the foot of the sandstone cliffs is Tsé Dadilidí, translated to "Fire Rocks" or "Cooking Rocks," which refers to a layer of rocks in the cliffs with stones that did not crack under high heat and could be used for cooking. See Cindy Yurth (author), edited by Frank LaFrenda, *Exploring the Navajo Nation Chapter by Chapter: Nazlini—Wide Ruins* (Navajo Times, 2017). Teracita Keyanna referred to the place-name Łichíí' Deezahí (Red Point Mesa) in personal correspondence: "The reddish and pink Rocks comes from the exposure to heat. There are probably some coal seams that were ignited by lightning and burned for awhile. Heated rocks turned pink or red. There was a fire burning for awhile while I was a kid. I was afraid of it, I thought it was a volcano about to erupt!" *Kin-litsosinil* refers to a row of old yellow houses built for workers at Fort Wingate during World War II. Laurance D. Linford, *Navajo Places: History, Legend, Landscape: A Narrative of Important Places on and Near the Navajo Reservation* (Salt Lake City: University of Utah Press, 2000), 193. The following translations are imperfect and partial but in general *kin* refers to a house, trading post, or building; *litso* refers to the color yellow; and *sinil* means "they are in position (pl. separable objects)." Irvy W. Goossen, *Diné Bizaad: Speak, Read, and Write Navajo* (Flagstaff, AZ: Salina Bookshelf, 1995), xiv, 321, 323. Because Kinkitsosinil and its translation to "Church Rock" are the place names colloquially referred to in association with the spill, we use these terms to refer to a broader basin-wide bioregion running through other Navajo Nation chapters and non-Native communities in a geographical "checkerboard" of multiple land allotments under different federal, state, tribal, and private landholding.

²Doug Brugge, J. L. deLemos, and C. Bui, "The Sequoyah Corporation Fuels Release and the Church Rock Spill: Unpublicized Nuclear Releases in American Indian Communities," *American Journal of Public Health* 97 (2007): 1595–1600; Doug Brugge, Timothy Benally, and Esther Yazzie-Lewis, *The Navajo People and Uranium Mining* (Albuquerque: University of New Mexico Press, 2006). Also see "Church Rock Spill: 30 Years Later," *Voices from the Earth* (2009), http://www.sric.org/voices/2009/v10n3/voices_10_3_churchrock_spill_30yrs.pdf. There are multiple Rio Puercos in New Mexico. Spanish settlers named these ephemeral streams "Rio Puerco," literally "pig river" or "filthy river," referring to the sediment-heavy water quality. Traci Brynn Voyles, *Wastelanding: Legacies of Uranium Mining in Navajo Country* (Minneapolis: University of Minnesota Press, 2015).

stream into a perennial river due to the continuous release of mine water into the regional watershed.⁴ Despite the acute disaster of the mill spill and the chronic effects from mine dewatering, a disaster declaration was never issued by any jurisdiction affected by the mine and mill releases, and there were no comprehensive disaster investigations or environmental health impact studies.⁵ More than forty years later, the combined fast and slow disasters of the tailings spill and mine dewatering have not yet received the same level of national or international scrutiny as other nuclear disasters (e.g., Three Mile Island) or mining disasters (e.g., the Gold King Mine release in the Animas River and San Juan River in Colorado, New Mexico, and the Navajo Nation).⁶

This article addresses these patterns of “organized ignorance” that obscure geographies of environmental racism and injustice.⁷ These forms of ignorance cover up and downplay the uneven distribution and impacts of the wastes from manufacturing the US nuclear weapons arsenal and producing commercial nuclear energy. The downstream communities from the Church Rock mill spill were almost entirely Diné (Navajo) pastoralists who relied on the Puerco River as a source of water to sustain their lives, livestock, and livelihoods. Although there were reports from members of downstream communities experiencing burns on their legs and feet from unknowingly wading through acidic mill effluent (pH 1.5) in the Puerco River, as well as toxic exposures to heavy metals from consuming contaminated livestock and native plants along the river, the broader environmental health effects from the spill have been poorly documented throughout the Puerco River Valley. The effects on livelihoods have not yet been comprehensively assessed, and neither have potential exposure pathways through particular forms of sociocultural and environmental interactions.⁸ The cumulative

³Dennis McQuillan, Chris Shuey, and Paul Robinson, “Let’s Not Wait for Catastrophic Spills to Happen: Holistic, Long-Term, Multi-Jurisdictional Monitoring in Legacy Mining Areas,” New Mexico Environment Department and Southwest Research and Information Center, June 20, 2017, https://animas.nmwri.nmsu.edu/wp-content/uploads/2017Presentations/D1_08_Dennis_McQuillan.pdf.

⁴Chris Shuey, “The Puerco River: Where Did the Water Go?,” 1986; excerpt at http://www.sric.org/workbook/features/V11_1.php.

⁵Jere Millard, Bruce Gallaher, David Baggett, and Steven Gary, “The Church Rock Uranium Mill Tailings Spill: A Health and Environmental Assessment,” New Mexico Environmental Improvement Division, 1983, <https://semspub.epa.gov/work/06/1000720.pdf>.

⁶The Church Rock disaster is only “the tip of the iceberg,” indicating a much bigger problem that must be addressed at expansive geographical scales and at massive geological depths. Johnnye Lewis and colleagues from the UNM METALS Superfund Research Center estimate that there are over 160,000 abandoned hard rock mines across fifteen states in the Western United States—5,000 to 10,000 are abandoned uranium mines. Lewis et al. highlight the associated environmental health disparities in their calculation of >600,000 Native Americans who live within ten kilometers of abandoned mine waste. The New Mexico Bureau of Geology and Mineral Resources estimates that there are >1,000 abandoned uranium mines in New Mexico; there are >500 in the Navajo Nation (Diné Bikéyah), which overlaps parts of New Mexico, Arizona, and Utah. The legacy of uranium mining and milling in the US Southwest is often ignored in national and international discourse about nuclear weapons and energy development. Johnnye Lewis, Joseph Hoover, and Debra MacKenzie, “Mining and Environmental Health Disparities in Native American Communities,” *Current Environmental Health Reports* 4, no. 2 (2017): 130–41, <https://doi.org/10.1007/s40572-017-0140-5>.

⁷We are thinking with the concept of organized ignorance and its applications in disaster studies. Drawing out several lessons in disaster studies, Scott Knowles applies Scott Frickel’s concept of organized ignorance to understand the limitations and data gaps of disaster investigation regimes, “each of which develops understandings of environmental contamination in ways that stand at some odds to ecological reality”; Scott Gabrielle Knowles, “Learning from Disaster? The History of Technology and the Future of Disaster Research,” *Technology and Culture* 55, no. 4 (2014): 773–84. Frickel and Vincent define organized ignorance as “a system of knowledge production that articulates risk in ways that do not, and perhaps cannot, answer some of our most basic questions concerning safety, health, and sustainability”; Scott Frickel and M. Bess Vincent, “Hurricane Katrina, Contamination, and the Unintended Organization of Ignorance,” *Technology in Society* 29, no. 2 (2007): 182. The concept of geographies of ignorance is also relevant here as a way to integrate geographical ideas of space, place, and scale in science and technology studies on the social production of ignorance; Scott Frickel and Abby Kinchy, “Lost in Space: Geographies of Ignorance in Science and Technology Studies,” in *Routledge International Handbook of Ignorance Studies*, edited by Matthias Gross and Linsey McGoe (London: Routledge, 2015).

⁸For example, in the aftermath of the Gold King Mine spill (2015), Karletta Chief and colleagues from the University of Arizona Superfund Research Program calculated the downstream impacts and identified forty-three different ways that Diné communities use the San Juan River to sustain their ways of life. Yoshira Ornelas Van Horne, Karletta Chief, Perry H. Charley, Mae-Gilene Begay, Nathan Lothrop, Melanie L. Bell, Robert A. Canales, Nicolette I. Teufel-Shone, and Paloma I. Beamer, “Impacts to Diné Activities

effects from the mine drainage and mill tailings spill pose chronic environmental health risks and disparities in Diné communities that are exceptionally vulnerable to environmental pollution through culturally specific forms of land-based “traditional pastoral economy,” ceremonial practices, and land subsistence activities in close proximity of extractive industries.⁹

We use the phrase *settler colonial determinants of health* to make sense of these specific patterns of environmental racism and injustice, the social production of intergenerational environmental health disparities, and the uneven distribution of risks and toxic exposures. “Settler colonialism” is an area of critical scholarship in and beyond Native American and Indigenous studies. The phrase refers to the successional forms of displacement and dispossession of Indigenous peoples by foreign settler populations. It is not just a historical event that happened in the past; it is an ideology and practice that is structural in nature—that is, the patterned and predictable taking of Indigenous land that persists to this day, always changing and sometimes very subtle in how it manifests.¹⁰ The concept of settler colonial determinants of health adds an epidemiological and toxicological focus to critical studies of settler colonialism. What are the health equity implications for Indigenous peoples and settler populations? What are the environmental and biomedical health results from the ideology and practice of settler colonialism?¹¹ These questions direct our gaze toward pollution as colonialism.¹² Among environmental health scientists, this concept can help shift researchers’ fixation on interventions in individual or group “behavior change” among affected community members, toward deeper interventions at broader scales of the social production of environmental health vulnerabilities.¹³ Mining and nuclear disasters—and other systematic failures of so-called development under ideologies of capitalism and

with the San Juan River after the Gold King Mine Spill,” *Journal of Exposure Science & Environmental Epidemiology* 31, no. 5 (2021): 1–15.

⁹Louise Lamphere, “Traditional Pastoral Economy,” in *Economic Development in American Indian Reservations*, edited by Roxanne Dunbar Ortiz (Albuquerque: University of New Mexico Press, 1979). Also see the US EPA Navajo Risk Assessment Calculator Tool, which assesses Navajo Nation-specific exposure scenarios to radionuclides and heavy metals: <https://www.epa.gov/navajo-nation-uranium-cleanup/navajo-risk-assessment-calculator-tool>.

¹⁰For an excellent example, see Glen Sean Coulthard, *Red Skin, White Masks: Rejecting the Colonial Politics of Recognition* (Minneapolis: University of Minnesota Press, 2014).

¹¹We are elaborating on Nicole Redvers and colleagues’ expression “colonial determinants of health,” which is used in passing without much qualification. Their term is an adaptation of the concept of “social determinants of health,” which is used broadly by the World Health Organization, Centers for Disease Control and Prevention, the National Institutes of Health, and others to identify “nonmedical,” “social” factors or conditions in which people are born, live, learn, grow, eat, drink, work, play, pray, travel, and so on that influence health outcomes. Nicole Redvers, Ann Marie Chischilly, Donald Warne, Manuel Pino, and Amber Lyon-Colbert, “Uranium Exposure in American Indian Communities: Health, Policy, and the Way Forward,” *Environmental Health Perspectives* 29, no. 3 (2022), <https://doi.org/10.1289/EHP7537>.

¹²Settler colonial determinants of health are kinds of social determinants of health that fix our attention on pollution as colonialism. Max Liboiron effectively argues that “pollution is not a manifestation or side effect of colonialism but is rather an enactment of ongoing colonial relations to Land”; Max Liboiron, *Pollution Is Colonialism* (Durham, NC: Duke University Press, 2021), 6. During the copy-edit process of this article, a colleague from Taipei Medical University, Dana Powell, and a colleague from National Taiwan University, Eric Karchmer, brought the following article to our attention: Bram Wispelap, Osama Tanous, Yara Asi, Weeam Hammoudeh, and David Mills, “Because its Power Remains Naturalized: Introducing the Settler Colonial Determinants of Health”, in *Frontiers of Public Health*, 11(2023): 1137428, doi: [10.3389/fpubh.2023.1137428](https://doi.org/10.3389/fpubh.2023.1137428).

¹³With the concept of settler colonial determinants of health, we can apply Audra Simpson’s method of “ethnographic refusal” and Roxanne Dunbar-Ortiz’s discursive strategy of unsettling common “cultural pathologies” of local communities—and a blame-the-victim narrative—by shifting to a broader political-economic analysis of the ideology of industrialization and proletarianization associated with exploiting mineral resources by transnational energy corporations in so-called underdeveloped reservations. Roxanne Dunbar-Ortiz, “Choices and Directions,” in *Economic Development in American Indian Reservations*, edited by Roxanne Dunbar Ortiz (Albuquerque: University of New Mexico, 1979), 153; Audra Simpson, *Mohawk Interruptus: Political Life across the Borders of Settler States* (Durham, NC: Duke University Press, 2014).

colonialism—undermine and destabilize Diné livelihoods in ways that continue to affect future generations.¹⁴

In and around Church Rock, local communities have fought for more than four decades to rid their lands of uranium mine waste and mill tailings that have degraded their homelands, threatened their cultural practices, and damaged their communities' health. Red Water Pond Road Community Association (RWPRCA) and their colleagues among the Eastern Navajo Diné Against Uranium Mining (ENDAUM) organized in response to the disastrous aftermath of uranium mining by advocating for better standards for cleaning up abandoned mine lands, forming “multicultural alliances,” and bringing environmental health expertise from all over the world to contaminated lands to bear witness.¹⁵ In pursuit of restorative justice, the RWPRCA annually memorializes the spill and remembers the land prior to mining. They testified to Congress and regularly engage with federal, state, and tribal environmental regulators. They continue to collaborate with university environmental health researchers for advancing community-driven disaster research response, working with environmental engineers on bioremediation projects in the emerging transdisciplinary fields of biogeochemistry and geomicrobiology, and collaborating with Indigenous artists and scientists in creative methods of art–science communication, research translation, and reporting of research results among community partners. These actions are rooted in their particular conceptions of restorative justice oriented toward diverse forms of Indigenous futurity.

Conceptualizing Diné Restorative Justice

What does restorative justice mean from the perspectives of Indigenous communities dealing with legacies of extraction? The RWPRCA was founded by local community members around Church Rock who have been affected by and are responding to the legacy of uranium mining. Their mission is: “to restore the land and water contaminated by uranium mining, improve the health of community members, and protect and preserve the natural and cultural environment in which we live.”¹⁶ There is a clear orientation toward restorative justice in their vision, which supports the theory that “Indigenous modes of justice typically reflect a restorative orientation,” and that “justice for Indigenous peoples is about restoring balance in relationships that are out of balance.”¹⁷ Commonly used in the field of criminal justice, “restorative justice” refers to a form of analysis, a way of thinking, an approach to justice, and a social movement to repair harm, heal, and hold perpetrators accountable by providing an opportunity for them to be responsible and work toward redemption.¹⁸

¹⁴On the lively resistance against the “death drive” of capitalism and colonialism, see Melanie Yazzie, “Decolonizing Development in Diné Bikeyah Resource Extraction, Anti-Capitalism, and Relational Futures,” *Environment and Society: Advances in Research* 9 (2018): 25–39. Also see Janene Yazzie in *Thirst for Justice*, dir. Leane Hosea, Bullfrog Films, 2020, <https://www.bullfrogcommunities.com/thirstforjustice>; Teresa Montoya, “Violence on the Ground, Violence below the Ground,” *Society for Cultural Anthropology*, December 22, 2016, <https://culanth.org/fieldsights/violence-on-the-ground-violence-below-the-ground>.

¹⁵According to Sarah Adeky, a Diné community liaison, translator, and language teacher at Southwest Research and Information Center, “The Red Water Pond Road is translated as Tólchí’ góó At’jín. That is the pond up about 3–4 miles from the community. What we refer to as RWPR community is called ‘Where the Meadows Meet’ translated as Ahidazdiigai” (personal communication, January 27, 2025).

¹⁶See “Red Water Pond Road Community Association,” December 11, 2015, <https://swuraniumimpacts.org/red-water-pond-road-community-association/>, emphasis added.

¹⁷Dina Gilio-Whitaker, *As Long as the Grass Grows: The Indigenous Fight for Environmental Justice, from Colonization to Standing Rock* (Boston: Beacon Press, 2019).

The words “restoration” and “justice” take on particular place-based and site-specific meanings and values and differ across diverse communities affected by disasters, but there are also continuities across communities through multicultural alliances and collective practices of remembering, which is an important place to begin the processes of restoration and “re-story-ation.”¹⁹ To achieve restoration of the land, we need to hear its stories. RWPRCA and ENDAUM are telling such stories by remembering the land before the spill. They amplified their voices in collaboration with the Multicultural Alliance for a Safe Environment (MASE), Laguna-Acoma Coalition for a Safe Environment, Bluewater Valley Downstream Alliance, Post-71 Uranium Workers Committee, the New Mexico Environmental Law Center (NMELC), the Southwest Research and Information Center (SRIC), and others. Conversely, practices of remembering are noticeably absent in what federal and state environmental regulators call “remediation” and what transnational mining companies tend to call “reclamation.” Despite the brief historical background sections of each mine and mill site in their reports, there appears to be no memory of the land, and no local knowledge or sense of place in their current designs for the future. These lapses in collective memory of disasters produce data gaps in recent risk assessments.²⁰

To address these data gaps, we highlight a collection of sources of environmental health research focused on toxic exposures from heavy metal mixtures at abandoned uranium mine sites through the METALS Superfund Research Program at the University of New Mexico.²¹ This emerging body of literature provides the background for understanding the decades of community-driven disaster response led by the RWPRCA, who foreground a model for a community-driven process of registering the spill as a disaster through diverse forms of engagement in environmental health research and governance. We trace the interconnections they have forged between place-based practices of remembering the spill, and extralocal actions to scale up Diné conceptions of restoration of the whole land into the dominant practices of environmental regulators and their remedial projects at abandoned uranium mine sites. The RWPRCA has defined their collective visions for restorative justice in critical responses to the remedial project management of state, tribal, and federal environmental regulators and policy makers.

The term “restoration” takes on particularly potent meanings and values in Diné. The Fundamental Law is based on concepts of *k'é* (relations) and *hózhó* (harmony, balance, peace), which are applied at every level of environmental health governance in the Navajo

¹⁸For example, see the University of Wisconsin-Madison Law School’s definition at <https://law.wisc.edu/fjr/rjp/justice.html>.

¹⁹On restorying, see Gary Paul Nabhan, “We are *restorying* our collective cultural memory, not just *restoring* the land, its waters, plant life, and microbial lives”; Gary Paul Nabhan, *Food from the Radical Center: Healing Our Land and Communities* (Washington, DC: Island Press, 2018), 30. On re-story-ation, see Robin Wall Kimmerer’s reference to Nabhan: “We can’t meaningfully proceed with healing, with restoration, without ‘re-story-ation.’ In other words, our relationship with the land cannot heal until we hear its stories. But who will tell them?”; Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* (Minneapolis: Milkweed Editions, 2013), 9.

²⁰Scott Knowles recently described “memorials as early warning signs” of imminent disaster in reviewing Beth Reddy’s book *¡Alerta!* (2023) via Zoom during the annual meeting of the Society for Social Studies of Science in Honolulu, Hawai’i (2023). Knowles pondered why decision makers are not seeing these as early warning signs, while emphasizing that “these are the best disaster early warning systems I can think of.”

²¹See UNM METALS Superfund Program Research website, including a list of publications: <https://hsc.unm.edu/pharmacy/research/areas/metals/> (accessed May 10, 2024).

²²We do not cite linguistic anthropologist Gary Witherspoon’s description of the ritual process of restoration in the Blessingway ceremonial, which we refuse as unethical in its disclosure of protected information that is revered as sacred. Doubts were raised about whether he asked for consent to publish that information about our ceremonies.

Nation—from the non-governmental political action of the RWPRCA and ENDAUM, to Navajo Nation Environmental Protection Agency, to the Navajo Nation Council.²³ According to Michelle Dineyahze, a Diné environmental engineer and remedial project manager with the US Environmental Protection Agency (EPA) Superfund Program in the Navajo Nation: “We also are mandating that cultural values like fundamental law coincide with the cleanup approach.”²⁴ As the Joe Biden administration amped up its rhetoric on environmental justice and traditional ecological knowledge on the webpages of government agencies, local experts with deep experience in these areas remained skeptical about whether and how social change will trickle down through these agencies. The track-records of the US EPA and other federal, state, and tribal environmental regulators have left the RWPRCA and colleagues with a number of critical adjectives like “willfully ignorant,” “negligent,” and “pre-decisional” when it comes to listening and responding to the public comments of local communities.²⁵

Restorative justice for Diné communities means abiding by Diné epistemology, in which everything begins in the east. The east is the direction from which the sun rises and brings blessings of light, warmth, and energy to Mother Earth. The east symbolizes the dawn and the beginning of many life cycles, including the cycle of planning, which is a traditional practice that aids in remediating uranium mines on Diné lands. The east symbolizes thoughts and is the background and introduction of Diné restorative justice. Moving forward in a clockwise motion, the south symbolizes the day and plans. Resilience against the exploitation of Diné lands are part of the plans, policies, and practices, which are both a burden and opportunity. Next is the west, symbolizing the dusk and life. The current lives of the Diné communities affected by the exploitation of uranium on Diné lands breathe life to social movements and emerging forms of advocacy for restorative justice by remembering, restoring, and remaining resilient against environmental injustices. Last, the north symbolizes the night and the future. The future for many Diné communities is cultivating and growing capacities for restorative justice that engage with local voices, needs, and concerns of the community members who create and curate their community-based cultural values and practices. We acknowledge that the lived experiences and traditional ecological knowledge and values expressed herein are the intellectual blessings of Diné (Navajo) peoples, including Kinkitsosinil (Church Rock) and the surrounding Diné communities responding to the mining and nuclear disasters (figure 1).

Restorative justice for Diné communities means restoring balance, health, and water back to the land and never disturbing “the uranium monster.” The Diné have recognized *naayéé*’ or monsters as carriers of imbalance, death, and chaos, which is how uranium is perceived. *Naayéé* is literally translated as “that which gets in the way of a successful life.” The

²³Navajo Nation Council Resolution No. CN-69-02 (November 1, 2002); Dana E. Powell and Andrew Curley, “K’e, Hozhó, and Non-governmental Politics on the Navajo Nation: Ontologies of Difference Manifest in Environmental Activism,” *World Anthropologies Network* 4 (2009): 109–38;

²⁴Quoted in Arlyssa Becenti, “Uranium Cleanup Report Falls on Few Ears,” *Navajo Times*, February 20, 2020, <https://navajotimes.com/rezpolitics/uranium-cleanup-report-falls-on-few-ears/>.

²⁵We seek to build on Tommy Rock and Jani Ingram’s work at scaling up traditional ecological knowledge into policy making and regulatory decisions regarding the legacy of abandoned uranium mines in Diné Bikéyah; Tommy Rock and Jani Ingram, “Traditional Ecological Knowledge Policy Considerations for Abandoned Uranium Mines on Navajo Nation,” *Human Biology* 92, no. 1 (2020):19–26, <https://doi.org/10.13110/humanbiology.92.1.01>.

common name for uranium is *léétsoh*, which is translated as “yellow dirt” but can also be interpreted as the big underground monster. Diné communities have always resisted monsters, and in response they have embraced traditional practices, teachings, and values that protect the balance of life cycles between the sky and Earth. *Yé’iitsoh* was an ancient destructor of life and considered the biggest and the worst of the monsters slayed in Diné origin stories. Farina King writes about how Diné have always faced the *naayéé* (monsters):

In Diné oral history, the Hero Twins defeated Yé’iitsoh and other terrible monsters. Generations of Diné heroes have risen and fallen, confronting the monsters of their eras. ... Our people are dying from COVID-19 because we are sicker than the general population, and we are sick because we are being poisoned and drained. One of the worst uranium mill spills in U.S. history took place down the road from my family’s home sites in Church Rock, N.M., in 1979.²⁶

In this way, *léétsoh* represents multiple forms of potential disaster, disorder, and chaos that present a challenge to living a good long life.

Esther Yazzie-Lewis describes how the rebirth of *léétsoh* as a uranium monster initially became associated with the Trinity Test and the detonation of the first ever nuclear bomb on July 16, 1945.²⁷ In the Church Rock area of northwestern New Mexico, the emergence of the uranium monster became associated with uranium mining and the mill tailings spill in 1979, which occurred coincidentally precisely thirty-four years after the world’s first nuclear explosion just a few hundred miles away in White Sands, New Mexico. Diné relational ontologies with uranium as a *naayéé*’ once disturbed and removed from Mother Earth have parallels in the geosciences and other forms of settler (*bilagáana*) science. In its place in the Earth, uranium is usually deposited in ancient streambeds near humate deposits (i.e., decaying plants) that rob the surrounding rocks of oxygen, thus reducing uranium to its tetravalent (Greek) or quadrivalent (Latin) form (+4), which is largely insoluble in groundwater. In other words, this form of naturally occurring uranium does not mobilize easily in water—it tends to stay where it has been deposited. But once extracted from the Earth by anthropogenic means, uranium rapidly oxidizes to its hexavalent form (+6). In this form, uranium is soluble, dissolving and mobilizing easily in water and even soils with low moisture content. We have seen this phenomenon throughout the uranium-producing areas of the Southwest, including the residential areas of RWPRCA next to the Northeast Church Rock Mine.²⁸

As a consequence of how its geochemistry has been altered by the anthropogenic processes of mining and milling, uranium is difficult to remediate, whether in soils, mine wastes, surface water, or groundwater. Elaborate methods are needed to chemically reduce uranium or to bury uranium-laden wastes in engineered disposal cells to contain it safely for hundreds of years. The RWPRCA have been collaborating with José Cerrato and colleagues at the

²⁶See Farina King, “Generations of Diné Healers Face Naayéé,” May 21, 2020, <https://farinaking.com/2020/05/21/generations-of-dine-healers-face-naayee/>.

²⁷Brugge, Benally, and Yazzie-Lewis, *The Navajo People and Uranium Mining*.

²⁸J. L. deLemos, D. Brugge, M. Cajero, M. Downs, J. L. Durant, C. M. George, S. Henio-Adeky, T. Nez, T. Manning, T. Rock, B. Seschillie, C. Shuey, and J. Lewis, “Development of Risk Maps to Minimize Uranium Exposures in the Navajo Churchrock Mining District,” *Environmental Health* 8, no. 29 (2009), <https://doi.org/10.1186/1476-069X-8-29>.

University of New Mexico in building the scientific foundations of the transdisciplinary fields of biogeochemistry and geomicrobiology, which are currently at the cutting edge of research in “bioremediation” of abandoned uranium mines in the US Southwest.²⁹

In tandem with these collaborative forms of bioremediation, the UNM METALS SRP Research Translation Core has been working with RWPRCA on creating and curating art–science communication projects. Mallery Quetawki’s diptych painting, titled “Extraction & Remediation,” displayed on exhibition for Exposure: Native Art and Political Ecology at the Institute of American Indian Arts Museum of Contemporary Native Art (see figure 2). Quetawki is an artist and biologist from Zuni Pueblo, co-lead of the UNM METALS Research Translation Core, and a coauthor of this article. The painting represents the decades of mining on Indigenous lands from the start of extraction to the current remedial efforts to clean up contaminated sacred sites. The petroglyphs represent the acknowledgment of ancient customs as they collide with the modern world, hence the circuit board pattern. This is also portrayed alongside the uranium vein in the soil. It has the likeness of the petroglyph design as it is meant to “stay in the ground,” but further along it escapes, signifying extraction and causing the upper environment to become contaminated as the flowers wilt into radioactive symbols. The recognition of modern technology melding with ancient customs is portrayed in the second part of the painting, titled “Remediation.” When these ideas work in tandem, we can begin to heal our lands and our people. Our Indigenous ways of life need to be heard and recognized to work with current clean-up efforts on our contaminated soils. Sacred sites will remain sacred, and so will our stewardship to the lands in which we were born. The DNA at the bottom addresses our kinship to land, animals, and other people and how it is broken when the uranium was allowed to leave the ground, representing the harmful health effects exposure has caused.

Resilience against the Exploitation of Diné Lands

In March 2021, Teracita “Terry” Keyanna, the lead author of this article, addressed an international audience of nuclear scientists and engineers, artists, community leaders, journalists, filmmakers, policy makers, health care providers, biologists, and environmental and social scientists in virtual attendance of the Next Generation Radiation Governance Symposium hosted by the University of California.³⁰ As a resident of the Red Water Pond Road community who has lived in close proximity to the Church Rock mill spill and multiple abandoned mine and mill tailings sites, Keyanna described the effects of uranium mining on her community: “We’ve been living with this contamination from the air, inside our land, in our water. In our community we no longer can plant crops. We can’t drink the water. We can’t even utilize our natural herbs that we use in our culture. These are things that were natural to us, and now because of the uranium, they’re not natural.”

Keyanna has presented to audiences from the Inter-American Commission on Human Rights in Washington, DC, Harvard’s Belfer Center for Science and International Affairs,

²⁹See their collaborative NSF research project: “The impact of the fungal microbiome in metal tolerance and soil biogeochemical transformations,” NSF no. 2125298, https://nsf.gov/awardsearch/showAward?AWD_ID=2125298 (accessed July 19, 2023).

³⁰See Next Generation Radiation Governance Symposium: Remembering Fukushima, 2021, <https://disaster-sts-network.org/content/next-generation-radiation-governance/essay> (accessed September 26, 2023).

the Mailman School for Public Health at Columbia University, and University of New Mexico Health Sciences Center; she has submitted countless public comments to the EPA, Nuclear Regulatory Commission, and other federal, state, and tribal entities. Keyanna's recent comments have added to decades of what we refer to here as community-driven disaster research response—a phrase that combines the keywords of “community-driven research” and “disaster research response” as defined by National Institute of Environmental Health Sciences (NIEHS) to conceptualize and cultivate community-driven environmental health research and action in response to disasters. This term also provides common ground for exchange between the NIEHS Disaster Research Response Network and the Disaster STS Network and bridges the dichotomy between “social” and “technical” dimensions of disasters that elide such sociotechnical constructs, which can lead to forms of ignorance that fail to grasp the realities of communities affected by disasters.

Again in her comments at the virtual conference in 2021, Keyanna called out the environmental injustices and racism inherent in the disparities between the environmental cleanup actions in Indigenous communities as opposed to non-Indigenous communities:

When it comes to the cleanup, and things like that, and naturalizing what happened to our community, you can see a big difference between our community, which is mostly Indigenous, and the community of Moab in Utah. There, that was a predominantly Anglo community and their cleanup was fast. Everybody was moved out. They cleaned the whole thing, no questions asked. Everything was cleaned up. ... And so that's when we get that environmental racism. And that's something that, you know, a lot of our children need to be taught as well, about things like that, just because we have all of these different disparities.

There are remarkable differences in the ways US EPA Superfund remediation projects have been carried out in Indigenous communities versus primarily white settler communities.³¹ Of the four “inactive” uranium tailings piles on the Navajo Nation, three were left in place on top of important water sources in the arid high-desert Southwest region: (1) the Shiprock tailings on the south bank of the San Juan River in Shiprock, NM;³² (2) the Mexican Hat and Monument Valley tailings consolidated in a disposal cell on the banks on the San Juan River in Mexican Hat (Halchitta), UT;³³ and (3) the Rare Metals tailings east of Tuba City, AZ, that rest on a bluff above Moenkopi Wash, a significant farming area for the Hopi village of Moenkopi.³⁴ Meanwhile, the Department of Energy removed tailings piles from sites in Durango and Grand Junction, CO; South Salt Lake City; and Lakeview, OR, to remote disposal sites outside of those cities, which are predominately white. In 1989, Congress authorized nearly \$1 billion in funding for removing the Atlas Minerals Co. mill tailings pile on the banks of the Colorado River in Moab, UT, to a remote disposal site

³¹See geochemist Ann Maest's table “Disparity in Regional Mill Tailings Site Cleanup Efforts,” MASE fact sheet, with support from NMELC, <https://swuraniumimpacts.org/wp-content/uploads/2022/06/Fact-Sheet-Uranium-Mill-Disparity.png> (accessed May 19, 2025).

³²See US Department of Energy, Legacy Management, “Fact Sheet, Shiprock, New Mexico, Disposal Site,” <https://www.energy.gov/sites/default/files/2021-09/ShiprockFactSheet.pdf> (accessed September 30, 2023).

³³US Department of Energy, Legacy Management, “Fact Sheet, Mexican Hat, Utah, UMTRCA Disposal Site,” accessed September 30, 2023.

³⁴See US Department of Energy, Legacy Management, “Fact Sheet, Tuba City, Arizona, Disposal Site UMTRCA Title I Site,” <https://www.energy.gov/sites/default/files/2021-09/TubaCityFactSheet.pdf> (accessed September 30, 2023).

thirty miles away, linked by a newly constructed railway. Atlas had gone bankrupt before commencing closure of its 13-million-ton pile. The law that authorized the project specified that only Atlas tailings can be disposed of at the Crescent Junction disposal site.³⁵

A map from a US EPA Fact Sheet (March 2017) illustrates such geographies of ignorance that further perpetuate legacies of environmental injustice and racism through absences in a spatial risk assessment of mine wastes surrounding RWPRCA and other Diné communities.³⁶ This map ignores and misrepresents one of the most significant exposure variables identified in recent Superfund research—proximity to mine waste—by representing “structures” instead of the communities where people live (figure 3).

Red Water Pond Road Community is indicated by white squares scattered along Red Water Pond Road. The community has occupied their homeland for over a hundred years across more than four generations, and each generation continues to be exposed to hazardous materials that make them sick.³⁷ The loss of land, cultural practices, ecological knowledge, and loved ones is immeasurable and should not be experienced by any community.

Advocating and Advancing Restorative Justice

By the early 2000s, in the absence of any comprehensive disaster research response to the spill, community responses to the disaster prompted development of the Church Rock Uranium Monitoring Project (CRUMP), a nascent form of community-based participatory research, in partnership between the Churchrock Chapter of the Navajo Nation and SRIC.³⁸ CRUMP trained local residents in radiological assessment methods, water sampling, and air monitoring. Findings from CRUMP’s radiation surveys and soil sampling showed extensive contamination around some fifty homes in Red Water Pond Road Community, which is sandwiched between two of the largest abandoned uranium mines on the Navajo Nation: (1) the Northeast Church Rock Mine to the south, and (2) the Quivira Church Rock I Mine to the north, in addition to the United Nuclear Corporation (UNC) uranium mill tailings disposal facility about a mile to the southeast. Evidence of elevated concentrations of uranium, radium, selenium, and other contaminants prompted the US EPA to order three removal actions under the Superfund Law between 2007 and 2012.

Community members who participated in the CRUMP fieldwork testified about uranium contamination in their community in congressional hearings.³⁹ The CRUMP report provided the basis for community participation in public policy through the Waxman hearings in

³⁵See US Department of Energy, “Overview of the MOAB UMTRA Project,” <https://www.energy.gov/em/moab/overview-moab-umtra-project#:~:text=At%20the%20Crescent%20Junction%20site%2C%20the%20containers%20carrying%20tailings%20are,support%20area%2C%20and%20access%20road> (accessed September 30, 2023).

³⁶It is important to note that in their recently updated map, the EPA specifies that the white boxes represent the residential locations of communities: <https://www.epa.gov/system/files/documents/2023-03/epa-factsheet-northeast-church-rock-necr-site-update.pdf> (accessed May 19, 2025); On “geographies of ignorance,” see Frickel and Kinchy, “Lost in Space.”

³⁷See the Navajo Birth Cohort Study at the University of New Mexico, <https://hsc.unm.edu/pharmacy/research/areas/nbcs-echo/> (accessed August 18, 2024).

³⁸Chris Shuey and Melinda Ronca-Battista, Report of the Church Rock Uranium Monitoring Project (CRUMP) USA, 2007. Prepared and submitted to Resolve, Inc. SRIC.

³⁹US House of Representatives, Committee on Oversight and Government Reform, “The Health and Environmental Impacts of Uranium Contamination on the Navajo Nation,” 110th Congress, 1st session, October 23, 2007. Transcript available at <http://webharvest.gov/congress110th/20081217030819/http://oversight.house.gov/story.asp?ID1560>.

2007, which were named after the Chairman of the House Oversight Committee who arranged the hearings after reading Judy Pasternak's reportage in the *LA Times* on the legacy of uranium mining in the Navajo Nation.⁴⁰ Red Water Pond Road Community was among the affected communities that testified on the health and environmental impacts of uranium contamination in the Navajo Nation in front of the US House of Representatives' Committee on Oversight and Government Reform.⁴¹ During the hearing, it was determined that the Northeast Church Rock Mine would be "the highest priority cleanup on EPA's AUM ranking list."⁴² Despite the promise of the "highest priority cleanup," the mine and mill sites in Kinkitsosinil (Church Rock) remain far from cleaned up or restored from the perspectives of local communities. The Waxman hearings mandated that federal agencies with regulatory responsibilities over uranium development on the Navajo Nation prepare and act on a series of five-year plans to address effects of the Navajo Uranium Legacy.⁴³ While the three subsequent plans describe the effects and overall problem of remediating more than 500 abandoned uranium mines (AUMs) and more than 1,000 mine features in the Navajo Nation, as well as the actions taken by federal agencies to address the AUM burden, the EPA's 2020 Ten-Year Plan did not give federal agencies credit for remediating a single AUM. In the absence of any serious remedial action, the RWPRCA and colleagues have cultivated their own thoughts, plans, actions, and futurisms toward restorative justice.

The RWPRCA frequently invite environmental regulators and policy makers to visit their communities, witness the scale and proximity of the mine wastes in situ, and experience the effects of wind and water erosion in action, which can expose toxic mine wastes to environmental conditions and communities. They are concerned that a chronic disaster continues to unfold undocumented, while another acute disaster will happen at the historic site of the Church Rock mill spill, particularly if the mining company and government agencies continue to disregard local knowledge and experiences and decide to move mine waste on top of the remaining tailings, which sit at the confluence of ephemeral arroyos that can swell to a flash flood during the summer monsoons, especially in July. Because the tailings are situated precariously in a floodplain, the RWPRCA is concerned Mother Nature will reclaim her path right through the uranium mill tailings and mine wastes. But these are not "natural" disasters from the purview of the RWPRCA. By calling out the unnatural effects of these nuclear and mining disasters, grassroots groups apply fundamental lessons in disaster studies to "document the naturalization process of natural disaster" and "locate those organizations and people for whom the apolitical rendering of disaster is a necessary act."⁴⁴ From a public health perspective, proximity to mine waste has proven to be a significant exposure variable often ignored by the current environmental cleanup regime. These recent insights in the environmental health literature are absent in the bibliographies

⁴⁰See Judy Pasternak, "Navajos' Desert Cleanup No More than a Mirage," *Los Angeles Times*, November 21, 2006, <https://www.latimes.com/la-na-blightedpt3-story.html>; also see Judith Pasternak, *Yellow Dirt: A Poisoned Land and the Betrayal of the Navajos* (New York: Free Press, 2010).

⁴¹"Hearing on the Health and Environmental Impacts of Uranium Contamination in the Navajo Nation," House of Representatives, Committee on Oversight and Government Reform, Washington, DC, October 23, 2007. Transcript available at <https://www.nrc.gov/docs/ML0835/ML083520178.pdf>.

⁴²Ibid.

⁴³These agencies are the EPA, Department of Energy, Nuclear Regulatory Commission, Bureau of Indian Affairs, and Indian Health Service.

⁴⁴Knowles, "Learning from Disaster?"

of US EPA's risk assessments. When faced with forms of ignorance that cannot possibly grasp the realities of local communities affected by uranium mining, communities responded by growing partnerships in environmental health research.

Partnerships in Public Health

This article is part of a long-term, ongoing collaborative partnership between the RWPRCA and the UNM METALS Superfund Research Program. Previous academic products from our community-partnered research includes a scientific poster made by residents of the Red Water Pond Road Community titled "Living with Uranium Wastes for 50 Years and Four Generations—A Navajo Community's Perspective."⁴⁵ Our collaborative partnership has resulted in a number of peer-reviewed scientific articles that illustrate the dangers of living in close proximity to abandoned uranium mines. Recent environmental health studies in the Navajo Nation document the increased risks of chronic diseases from proximity to toxic mine wastes. Building on previous studies that link metals exposure to certain health outcomes, Hund and colleagues examined the relationship between exposures to uranium mine waste and health effects of kidney disease, diabetes, and hypertension. Their work shows that chronic diseases of these kinds are highly prevalent in the study population and present major public health risks. Using a multivariate framework, Hund et al. found evidence of associations between these chronic diseases and exposures from the historic mining era and postmining. According to them, risk of chronic kidney disease doubled in participants in active mining areas (1950–86), noting that 10 percent of participants were former uranium miners.⁴⁶ Harmon et al. link proximity to mine waste with cardiovascular disease and observed a 62–81 percent increase in the risk of hypertension during the legacy period after active mining stopped in 1986.⁴⁷ Erdei et al. examine autoimmune disease and show how proximity predicts autoantibody responses.⁴⁸

Note that proximity to uranium mine waste is only one exposure variable among many others that the METALS Superfund Research Program studies. Leveraging methods of GIS-based multi-criteria decision analysis, geographer Yan Lin and colleagues have developed models for mapping multiple environmental risks from AUMs in the Navajo Nation.⁴⁹ In particular, for the wells along the Puerco River downstream from the Church Rock spill, according to Navajo Water GIS: "We recommend *avoiding* this water source."⁵⁰ Taken

⁴⁵Prepared and presented by Peterson Bell, Bertha Nez, Edith Hood, Teracita Keyanna, Jacquelyn Bell-Jefferson, Grace Henio, and Anna Benally (Red Water Pond Road Community Association, Coyote Canyon Chapter, Navajo Nation) at the 10th Conference on Metals Toxicity and Carcinogenesis and Center for Native Environmental Health Equity Research 2018 Annual Meeting, October 29, 2018, http://www.sric.org/uranium/docs/Bell_Nez_Hood_RWPRCA_poster_v6_102418.pdf.

⁴⁶L. Hund, E. J. Bedrick, C. Miller, G. Huerta, T. Nez, S. Ramone, C. Shuey, M. Cajero, and J. L. Lewis, "A Bayesian Framework for Estimating Disease Risk Due to Exposure to Uranium Mine and Mill Waste on the Navajo Nation," *Journal of the Royal Statistical Society Series A* 178, no. 4 (2015): 1069–91, <https://www.jstor.org/stable/43965784>.

⁴⁷M. E. Harmon, M. J. Campen, C. Miller, C. Shuey, M. Cajero, S. Lucas, K. Zychowski, B. Pacheco, E. Erdei, S. Ramone, T. Nez, M. Gonzales, and M. J. Campen, "Associations of Circulating Oxidized LDL and Conventional Biomarkers of Cardiovascular Disease in a Cross-Sectional Study of the Navajo Population," *PLOS One* 11, no. 3 (2016), <https://pubmed.ncbi.nlm.nih.gov/28120833/>.

⁴⁸E. Erdei, C. Shuey, C. Miller, J. Hoover, M. Cajero, and J. Lewis, "Metal Mixture Exposures and Multiplexed Autoantibody Screening in Navajo Communities Exposed to Uranium Mine Wastes," *Journal of Translational Autoimmunity* 6 (2023): 100201, <https://doi.org/10.1016/j.jtauto.2023.100201>; E. Erdei, C. Shuey, B. Pacheco, M. Cajero, J. Lewis, and R. L. Rubin, "Elevated Autoimmunity in Residents Living Near Abandoned Uranium Mine Sites on the Navajo Nation," *Journal of Autoimmunity* 99 (2019): 15–23, <https://doi.org/10.1016/j.jaut.2019.01.006>.

⁴⁹Y. Lin, J. Hoover, D. Beene, E. Erdei, Z. Liu, "Environmental risk mapping of potential abandoned uranium mine contamination on the Navajo Nation, USA, using a GIS-based multi-criteria decision analysis approach," *Environmental Science and Pollution Research International* (2020): Aug 27(24):30542–30557, <https://doi.org/10.1007/s11356-020-09257-3>.

together, these peer-reviewed publications in high-impact scholarly journals demonstrate considerable risks from living in close proximity to uranium mine wastes, which fill important data gaps in the various risk assessments of environmental regulators and provide the basis for improving environmental cleanup efforts at abandoned mine sites on Indigenous lands in the US Southwest. These public health studies set the background for place-based methods of restoring the land, which is rooted in remembering Church Rock.

Remembering Church Rock

The Church Rock mill spill is memorialized annually by the RWPRCA and ENDAUM (figure 5). The Indigenous-led grassroots event provides space and place for impacted communities to voice needs, concerns, and solutions while providing additional information for participants to learn more about the devastating effects of this combined nuclear and mining disaster and the broader legacy of uranium mining in the region.⁵¹ During the Church Rock mill spill commemoration in 2009, Navajo Nation President Joe Shirley declared July 16 as Uranium Legacy Remembrance and Action Day. Shirley wanted “the world to know that the Navajo Nation would not forget impacts of the tailings spill.”⁵² Since about 2015, the long-standing practice of remembering the spill has emerged as a well-documented Indigenous environmental justice case study, which has attracted interest from an international vanguard of Indigenous and non-Indigenous social justice scholars, environmental health scientists, artists, documentary filmmakers, journalists, politicians, lawyers, community organizers, activists, allies, and advocates. The commemoration of the spill has been reported in the *Guardian*, *Vice*, *Vox*, ABC News, and the *Washington Post*, among other national-scale news media outlets.⁵³

Such forms of remembering can be a way of “continuing liability” by engaging with and empowering local experiences, knowledge, and histories of the disaster in ways that will inspire Indigenous futures and protect community health. Remembering can be a way of holding corporations and governments accountable in the aftermath of their unnatural disasters. “Remembering” and “remembrance” are keywords in postcolonial and late industrial scholarship on disaster and advocacy, which are often framed in the future anterior. Reflecting on the demands of disaster victims in the aftermath of Bhopal,

⁵⁰See UNM Navajo WaterGIS, <https://unmcp.unm.edu/metals/platform.html> (accessed May 20, 2024). See map of Potential Exposure to Abandoned Uranium Mines in Navajo Nation, <https://theodros-woldeyohannes.github.io/MyWebApp.html> (accessed May 21, 2024); Grand Canyon Trust’s Navajo Nation Uranium Waste ArcGIS StoryMap, <https://storymaps.arcgis.com/stories/bcc266d0937e4e24adfb65c36b93884f> (accessed May 20, 2024); Dr. Tommy Rock’s research downstream of the spill in Sanders, AZ, <https://cenv.wvu.edu/toxicology-and-societies-speaker-series-tommy-rock> (accessed August 19, 2024).

⁵¹Fixating on the disastrous “event” would only add to the ignorance of settler colonial determinants of health. Teresa Montoya identifies “the pervasive tendencies by policy makers to treat contamination as discrete discharge ‘events’ while obscuring the enduring structures of toxicity itself”; Teresa Montoya, abstract for “*From Fire Water to Toxic Water: Navajo Politics of Permeability*,” <https://csw.ucla.edu/ce-abstracts> (accessed May 6, 2024).

⁵²Quoted in “Church Rock Spill: 30 Years Later.”

⁵³See Cody Nelson, “‘Ignored for 70 Years’: Human Rights Group to Investigate Uranium Contamination on Navajo Nation,” *The Guardian*, October 27, 2021, <https://www.theguardian.com/environment/2021/oct/27/human-rights-group-uranium-contamination-navajo-nation>; Samuel Gilbert, “Church Rock, America’s Forgotten Nuclear Disaster, Is Still Poisoning Navajo Lands 40 Years Later,” *Vice*, August 12, 2019, <https://www.vice.com/en/article/ne8w4x/church-rock-americas-forgotten-nuclear-disaster-is-still-poisoning-navajo-lands-40-years-later>; Vox, “How the US Poisoned Navajo Nation,” YouTube, October 12, 2020, <https://www.youtube.com/watch?v=ETPogv1zq08&t=23s>; “A Radioactive Legacy Haunts This Navajo Village Which Fears a Fractured Future,” *The Washington Post*, January 18, 2020, https://www.washingtonpost.com/national/a-radioactive-legacy-haunts-this-navajo-village-which-fears-a-fractured-future/2020/01/18/84c6066e-37e0-11ea-9541-9107303481a4_story.html; ABC News, “Fallout: Two Nations Under Uranium,” video, available at <http://www.sric.org/uranium/rirf.php> (accessed May 14, 2022).

Kim Fortun draws on her colleagues' concept of "continuing liability," which is a matter of simultaneous "remembrance and forgetting." Fortun uses the concept to explain how "Advocacy becomes a historical project. A project that contests the origins and order of things". "What once seemed settled can be unsettled. The past can be pulled into significance in different ways. History can become an altercation."⁵⁴ "Re-membling" is also a significant form of place-making and sense-making in anthropology-as-cultural-poetics. Kathleen Stewart explores "local cultural epistemology of re-membling impacts by re-tracing them in graphic images that stand at once as refuse and refuge."⁵⁵ Remembering also provides justification for a future based on Indigenous values and ways of knowing. Indigenous sciences put emphasis on "remembering to remember" one's responsibility to participate in caring for the life-giving and life-continuing forces of Mother Nature.⁵⁶ Remembering can also trigger trauma among local people who lived through the disaster. Despite these risks, and using humor to cope, the RWPRCA has crafted its own unique practices of remembering the land and formulating critical analyses that bring awareness to the disaster-as-disaster; they have proposed alternative possible futures toward restorative justice.⁵⁷

Upon its founding in 2006, the RWPRCA advocated for the complete removal of all uranium wastes in and around its community—a position enunciated by former Navajo Nation Council delegate George Arthur in testimony at the Waxman hearings in 2007 and echoed by former Navajo Nation President Jonathan Nez in 2022. On several occasions since then, grassroots groups described the health, environmental, and cultural impacts of living with uranium mine wastes since the late 1960s.⁵⁸ In May 2021, the RWPRCA and colleagues registered a series of public comments on a Draft Environmental Impact Statement to permit General Electric's plan to move the Northeast Church Rock 1 million cubic yards of mine waste less than a mile down the road (Highway 566) to be placed on top of the uranium mill tailings impoundment containing 3.5 million tons of tailings.⁵⁹ The RWPRCA's letter to the Nuclear Regulatory Commission (NRC) "restates our position and strongly recommends that the Navajo Nation lead a multi-stakeholder effort to find suitable sites for permanent disposal of uranium mines outside of the Navajo Nation" (May 18, 2021). In response to the community's concerns, Navajo Nation President Nez and Vice President Lizer submitted a letter of support for the RWPRCA: "the Navajo Nation remains steadfast in its position that all NECR radioactive mine waste registering above USEPA's action level should be removed from the community."⁶⁰ The RWPRCA and ENDAUM have advocated for place-based

⁵⁴See Kim Fortun, *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders* (Chicago: University of Chicago Press, 2001), 353–354.

⁵⁵Kathleen Stewart, *A Space on the Side of the Road: Cultural Poetics in an "Other" America* (Princeton, NJ: Princeton University Press, 1996), 91.

⁵⁶Gregory Cajete, *Native Science: Natural Laws of Interdependence* (Santa Fe, NM: Clear Light Publishers, 2000).

⁵⁷Kim Fortun and colleagues and others have noted, "categorizing environmental health impacts as disaster-related is itself a sociopolitical process." Michael Guggenheim, "Introduction: Disasters as Politics—Politics as Disasters," *Sociological Review* 62 (2014): 1–16, cited in Kim Fortun, Scott Gabriel Knowles, Vivian Choi, Paul Jobin, Miwao Matsumoto, Pedro de la Torre, Max Liboiron, and Luis Felipe Rosado Murillo, "Researching Disaster from an STS Perspective," in *The Handbook of Science and Technology Studies*, 4th ed., edited by Ulrike Felt, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr (Cambridge, MA: MIT Press, 2016).

⁵⁸Also see Teracita Keyanna and Edith Hood, "Opinion: EPA Finally Doing the Right Thing with Uranium Waste in Red Water Pond Road Community," *Albuquerque Journal*, June 2, 2024; https://www.abqjournal.com/opinion/opinion-epa-finally-doing-the-right-thing-with-uranium-waste-in-red-water-pond-road/article_59c65c90-1df3-11ef-9eac-7f7179beeb82.html.

⁵⁹General Electric acquired UNC and the Northeast Church Rock mine and mill sites in the 1990s.

community-driven research to be considered in the enforcement of the Comprehensive Environmental Response, Compensation, and Liability Act and the National Environmental Policy Act through environmental impact statements and the EPA Superfund Program.⁶¹

Conclusion: Realizing Restorative Justice through Indigenous Futurity

What does restorative justice mean after the Church Rock uranium mill tailings spill? In our initial response to this question, we foregrounded the restorative thoughts, plans, actions, and futurity of the RWPRCA and colleagues. We introduced the concepts of community-driven disaster research response as a viable response to the settler colonial determinants of health caused by the uranium mining and milling on Indigenous lands in the US Southwest. Proximity to mine waste is a significant exposure variable that is ignored by the current environmental cleanup regime. When faced with such forms of ignorance, communities affected by uranium mining respond by remembering, restorying, and restoring the land through their own visions of social and environmental justice. Although we have witnessed advancements in growing Indigenous-led multicultural social movements for restorative justice, and advancements in the environmental health sciences on toxic exposures from mixtures of heavy metals at abandoned mine sites, major limitations still exist among federal government agencies in their capacity to respond to the requests of local communities and a failure to integrate any current environmental health research and information in radiation decision making. Experts who are critical of the regulatory decisions of government agencies use the phrase “willful ignorance.” Those who are sympathetic to the constraints of government agents refer to a legal limit that prevents the adoption of any community-based decision making. Yet other legal and technical experts describe regulatory decision as predecisional, that is, all the important decisions have been made by the time local community stakeholders register their voices in public comment periods. Each term offers critical insight into the decision to relocate mine waste from an abandoned mine site near Red Water Pond Road Community to be placed on top of a tailings impoundment in a significant watershed area of the Puerco River Valley.⁶²

In 2011 and 2013, the US EPA approved a plan to place one million cubic yards of mine waste from the Northeast Church Rock mine on top of the UNC mill tailings. The NRC concurred with this decision in 2023. Despite local community and tribal government opposition, the EPA and NRC approved General Electric’s plan to move the mine waste less than a mile down the road to be placed on top of the mill tailings at the historic site of Church Rock mill spill.⁶³ The RWPRCA and ENDAUM have consistently voiced their opposition to such a plan on multiple occasions and in multiple contexts. Among their most prescient demands is for environmental regulators to “walk Pipeline Arroyo,” watch the late summer monsoons flood the Puerco River Valley, and watch the flash floods move

⁶⁰Navajo Nation Office of the President Johnathan Nez and Vice President Myron Lizer, “Statement on DEIS for Disposal of NECR Mine Waste at UNC Mill Site,” April 12, 2021.

⁶¹Kurt Dongoske, Theresa Pasqual, and Thomas F. King, “The National Environmental Policy Act (NEPA) and the Silencing of Native American Worldviews,” *Environmental Practice* 17 (2015): 36–45.

⁶²See NRC, “Environmental Impact Statement for the Disposal of Mine Waste at the United Nuclear Corporation Mill Site in McKinley County, New Mexico Final Report,” NUREG-2243, 2023, <https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2243/index.html>.

⁶³Ibid.

the rip-rap boulders and barriers intended to prevent erosion of the stream banks by the mine sites and mill tailings. The RWPRCA and ENDAUM often point out that the mining company situated the uranium mill in a floodplain. They are concerned that Mother Nature will retake her path through the tailings disposal cell and mine wastes. They are concerned that conditions will get worse under duress of climate change, including the compounding effects from the increasing frequency and intensity of droughts, dust storms, wildfires, flash floods, and other erosional processes affecting mine and mill sites. Such ignorance of local Indigenous experiences, knowledges, methods, and histories by the federal government and mining companies has made possible recent policy decisions and regulatory practices at these abandoned mine and mill sites in the Navajo Nation. When these projects fail, seemingly by design, we begin to wonder what an environmental cleanup project would have looked like if it was designed to always prioritize local Indigenous community health, experiences, methods, histories, epistemologies, ontologies, arts, and sciences.⁶⁴ Indigenous futurity is akin to Diné visions to the north and toward the future (*náásgóó*) in ways that empower Diné communities to nurture and sustain their traditional values and ways of knowing.⁶⁵

Although the mine waste from Northeast Church Rock remains slated for disposal across the road from RWRPCA at the site of the uranium spill, a plan they have refused throughout the process, the US EPA has taken a different approach with the Kerr McGee/Quivira mine waste on the other side of the community. In January 2025, in the last few weeks before finalizing this article, the US EPA signed an action memo approving the removal of uranium mine waste from the Church Rock community to a “regional waste disposal facility.” According to Teracita Keyanna, “I feel as though our community finally has something of a win.” “Removing the mine waste from our community will protect our health and finally put us back on a positive track to *Hózhó* (balance) ... I think this decision empowers grassroots organizations like ours and our allies continue to advocate and educate to clean up hundreds of abandoned uranium mines that threaten our Diné communities every day.”⁶⁶

Biographies

Teracita Keyanna (Diné) is an Executive Board Member of the Red Water Pond Road Community Association, a core group of the Multicultural Alliance for a Safe Environment.

Thomas De Pree is a Research Assistant Professor in the Department of Civil, Construction and Environmental Engineering, and Affiliated Faculty in the Anthropology Department at the University of New Mexico. He is a co-lead of the Research Translation Core in the UNM METALS Superfund Research Program and an Instructor in Environmental Science at Southwestern Indian Polytechnic Institute.

⁶⁴Beth Rose Middleton Manning, *Upstream: Trust Lands and Power on the Feather River* (Tucson: University of Arizona Press, 2018).

⁶⁵We are following Laura Harjo’s definition of “futurity” as “the enactment of theories and practices that activate our ancestors’ unrealized possibilities, the act of living out the futures we wish for in a contemporary moment, and the creation of the conditions for these futures”; Laura Harjo. *Spiral to the Start: Mvskoke Tools of Futurity* (Tucson: University of Arizona Press, 2019).

⁶⁶See “MASE Supports EPA Decision that Will Protect Uranium Impacted Communities,” press release, January 7, 2025, <https://swuraniumimpacts.org/epa-decision-will-protect-uranium-impacted-communities/>.

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Kirena E. Y. Tsosie (Diné) is a Community Water Specialist at Southwest Research and Information Center. Her master's thesis in the Water Resources Program at the University of New Mexico provided a vulnerability assessment of water resources in the greater Chaco area, New Mexico, using traditional Navajo ecological knowledge.

Mallery Quetawki (Zuni) is the Lead of the Research Translation Core in the METALS Superfund Research Program and Artist-in-Residence with the Community Environmental Health Program in the College of Pharmacy at the University of New Mexico.

Cheryl Jim (Diné) is an undergraduate student in the Geospatial Information Technology Program of the Advanced Technical Education Department at Southwestern Indian Polytechnic Institute.

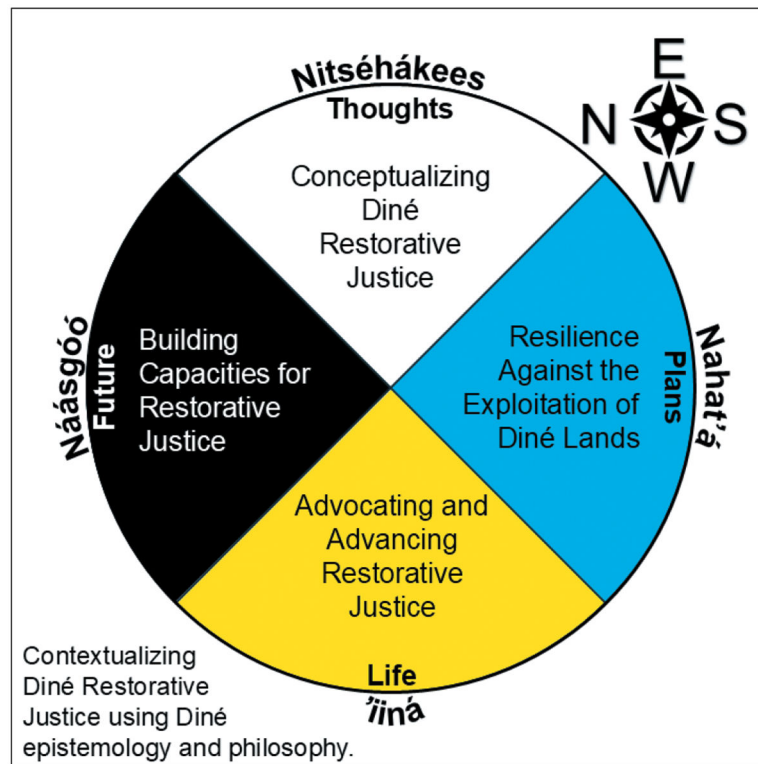


Figure 1.
Conceptualizing Diné Restorative Justice with Diné Epistemology (Credit: Kirena Tsosie 2025).

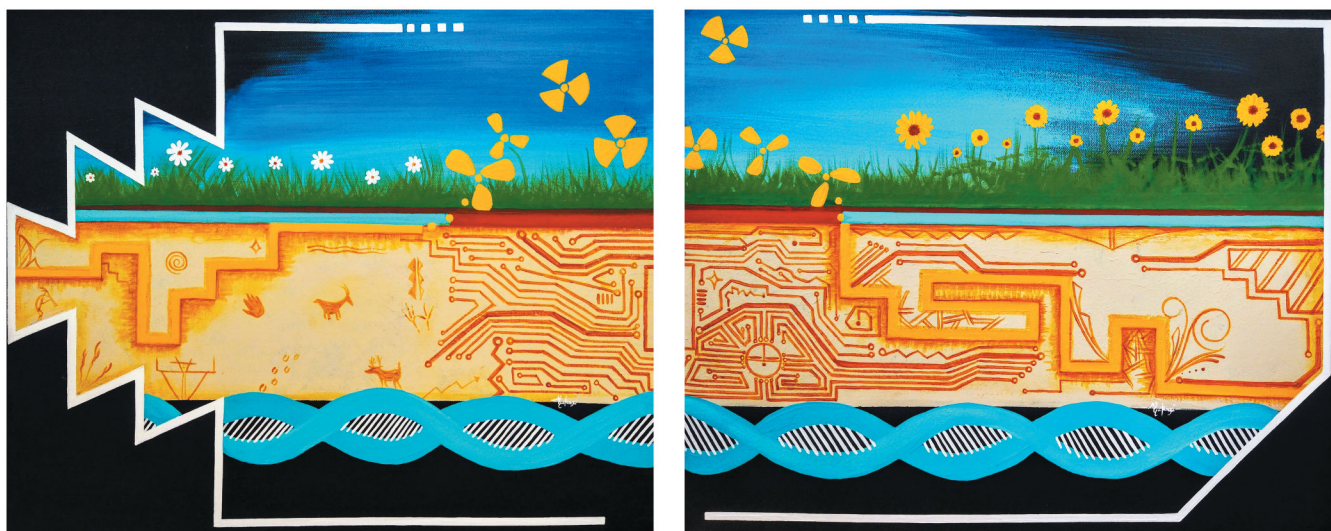


Figure 2.
Extraction & Remediation. 16 × 20 in. Diptych. Acrylic on Canvas. 2020. Mallery Quetawki
(Zuni Pueblo). Funded by grant: 1P42ES025589 METALS Superfund Center.
Same as the one above; they are two piece of the same artwork

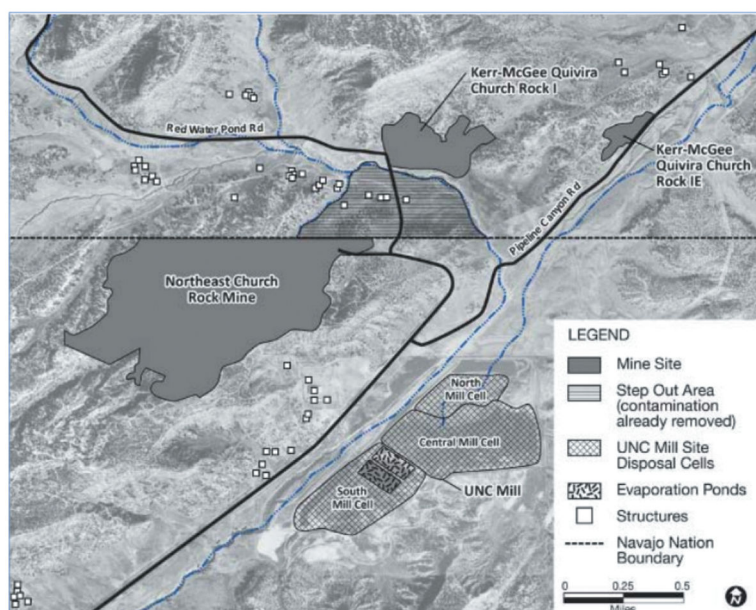


Figure 3. Screenshot of USEPA Region 9 Map of Northeast Church Rock Mine, Kerr-McGee Quivira and UNC Mill Superfund Sites (March 2017).



Figure 4.
An AUM site located adjacent to Red Water Pond Road Community. Photograph by Thomas De Pree, July 2022.



Figure 5.
Flyer for 44th annual Uranium Tailings Spill Commemoration on July 15th 2023.