

**Comparison of DiNEH Project Study Area on the Navajo Nation, USA
with Mining-Impacted town of Zakamensk, Buryatia, Russia**

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9/23/14

[Yellow-highlighted items require clarification and/or corrections]

Comparison Metric	Navajo Nation, Eastern Agency	Zakamensk, Buryatia
Geophysical Attributes		
Location	20 Chapters of Navajo Nation (a Native American reservation) in the state of New Mexico, USA	Town of Zakamensk, administrative seat of Zakamensky District, Republic of Buryatia, Russia
Latitude-Longitude	Lat: 35-36 degrees North Long: 107-109 degrees West	Lat: 50-51 degrees North Long: 103 degrees East
Elevation	5,000-7,500 feet above sea level (FASL); 1,524-2,286 meters above sea level	3,500-3,700 FASL (1,067-1,127 MASL)
Geography	Landscape characterized by sedimentary rock sequences with broad valleys, steep cliffs, buttes and mesas hosting arid-land grasses, shrubs, pinon and juniper trees	Alpine forests on the hills and mountains; grasslands in valleys
Climate; Annual Rainfall	<ul style="list-style-type: none"> • Arid to semi-arid • 10-15 inches (in) (254-381 mm (millimeters)) 	<ul style="list-style-type: none"> • Arid to semi-arid • 14.2-15.7 in. (360-400 mm)
Demographics		
Population of Study Area	Appx. 19,854 (2000 Census); 43% under age 21	Appx. 12,700 (2002 Census); Zakamensk town only
Race/ethnicity of study population	96% American Indian, 6% all other races (Caucasian, Hispanic-white, African-American, Asian)	xx% Buryat xx% Russian
Duration of residency	Median duration of residency at time of survey: 33 years, suggesting non-transient population	Generally, non-transient population
Mining and Mineral Development (Environmental Exposures)		
Contaminant sources	~100 abandoned uranium mines and mills and associated waste piles, left over from 1950s-1980s	Abandoned molybdenum-tungsten mine and mill and associated waste piles (~40 million tons), from operations in 1930s-1990s; gold mines in nearby drainage
Principal contaminants	Uranium, arsenic, iron, vanadium, lead, other metals; radium-226	Molybdenum, tungsten, copper, cadmium, aluminum, manganese, uranium, other heavy metals; volatile organic compounds
Reclamation/cleanup	<ul style="list-style-type: none"> • Mines and mills closed • Interim covering of mine wastes with clean soil at ~12-15 of 100 sites; final site closures, waste reclamation many years in future 	<ul style="list-style-type: none"> • Plan for waste reclamation, revegetation and dredging of tailings sands from river, 2011-2020 • 6 million tons tailings sands

	<ul style="list-style-type: none"> • Radium-contaminated soils removed from around homes at two mine sites out of ~100 	excavated, disposed in local landfill
Pathways of exposure	<ul style="list-style-type: none"> • Air – dust released from mine wastes • Soils – metals in dust deposited on lands, accumulate in soils • Groundwater – metals in regulated and unregulated drinking water sources • Surface water -- wastes released to ephemeral streams, deposited downstream 	<ul style="list-style-type: none"> • Air – dust released from mine wastes; acid vapors released during operations • Soils – metals in dust and sands deposited on lands, accumulated in soils around homes, gardens • Groundwater – drinking water wells in Zakamenska be • Surface water – wastes released to river that flows through Zakamensk
Cultural concerns	Navajo (<i>Diné</i>) residents are tied to land, do not want to move away despite contamination.	Zakamensk residents don't want to live in town during waste removals.
Health Studies to Determine Effects of Environmental Exposures		
Major research partners	<ul style="list-style-type: none"> • Univ. of New Mexico Community Environmental Health Program • Southwest Research and Information Center • Eastern Navajo Health Board (2001-2009) • 20 Chapters, Eastern Navajo Agency 	<ul style="list-style-type: none"> • Federal Scientific Center for Health Protection and Managing Risks to General Public Health • Federal Inspection Service for Protecting Consumer Rights and General Public Health in the Republic of Buryatia • Residents of Zakamensk
Principal health outcomes of interest	Kidney disease, autoimmunity, hypertension/cardiovascular disease, diabetes	Cancer; reproductive outcomes; birth defects; diseases of musculoskeletal system; diseases of circulatory system
Epidemiological/toxicological studies	Diné Network for Environmental Health (DINEH) Project, 2001-present	Preliminary investigations in 2003-2004
Study Design	Retrospective cross-sectional with biological confirmation of exposure	Retrospective analysis of medical reports ; case-control
Study Population	<ul style="list-style-type: none"> • Total: 1,304 • Subset of participants in blood & urine collections: 267 • All participants volunteered; about 58% were from communities affected by mine wastes (exposed), about 42% from communities not affected by mine wastes (non-exposed/controls) 	<ul style="list-style-type: none"> • Total: 1,310 • Children ≤15 years: 510 • Children divided into 2 groups: children of indigenous parts (exposed) and those of parents from other regions of Buryatia (not-exposed/controls)
Methods	<ul style="list-style-type: none"> • Survey covering demographics, water use, occupational history, health history and cultural practices, administered by trained, Navajo-speaking staff • Medical records review for confirmation of self-reported health • Environmental assessments: water quality sampling for 130 water sources; compilation of water 	<ul style="list-style-type: none"> • Questionnaire developed by Angarsk Institute of Occupational Medicine and Human Ecology • Geochemical survey of soils in Zakamensk in 2003-2004 • Geospatial representation of areas of metal contamination in ditches and streams • Analyzed infant mortality and child morbidities against geospatially

	<p>quality data for municipal water supplies, which serve ~63% of study population</p> <ul style="list-style-type: none"> • Geospatial data – locations of U waste sites, participants' homes; risk mapping • Targeted soil sampling; soil contamination surrogate for air (dust) and water (streams) pathways • Biological sampling (blood and urine) to confirm survey self-reports • Development of databases to manage survey, environmental and biological data • Statistical analyses: Bayesian modeling, conditionally specified logistic regression 	<p>represented contamination zones</p> <ul style="list-style-type: none"> • Soil contamination surrogate for air (dust) and water (streams) pathways • Water quality assessments for municipal water supply, based on 8 wells on Modonkul River providing water to 78.5% of town population; • “Decentralized” water supplies (i.e., private wells) serve 38% of population • Analyses of metals in food grown in local gardens •
<p>Plans for new or future health studies</p>	<ul style="list-style-type: none"> • Navajo Birth Cohort Study (ongoing) • UNM METALS Center – proposed Superfund research program with Native American communities 	<ul style="list-style-type: none"> • Pilot investigation to detect, enumerate and prove connection between deteriorating public health of local residents of Zakamenska and impacts of Dzhidinski Tungsten-Molybdenum Mill Site

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