COMMENT



Devastating wildfires ravaged California last month.

Global warming will happen faster than we think

Three trends will combine to hasten it, warn **Yangyang Xu**, **Veerabhadran Ramanathan** and **David G. Victor**.

Prepare for the "new abnormal". That was what California Governor Jerry Brown told reporters last month, commenting on the deadly wildfires that have plagued the state this year. He's right. California's latest crisis builds on years of record-breaking droughts and heatwaves. The rest of the world, too, has had more than its fair share of extreme weather in 2018. The *Lancet* Countdown on health and climate change announced last week that 157 million more people were exposed to heatwave events in 2017, compared with 2000.

Such environmental disasters will only intensify. Governments, rightly, want to know what to do. Yet the climate-science community is struggling to offer useful answers.

In October, the Intergovernmental Panel on Climate Change (IPCC) released a report setting out why we must stop global warming at 1.5 °C above pre-industrial levels, and how to do so[1]. It is grim reading. If the planet warms by 2 °C — the widely touted temperature limit in the 2015 Paris climate agreement — twice as many people will face water scarcity than if warming is limited to 1.5 °C. That extra warming will also expose more than 1.5 billion people to deadly heat extremes, and hundreds of millions of individuals to vector-borne diseases such as malaria, among other harms.

But the latest IPCC special report underplays another alarming fact: global warming is accelerating. Three trends — rising emissions, declining air pollution and natural climate cycles — will combine over the next 20 years to make climate change faster and more furious than anticipated. In our view, there's a good chance that we could breach the 1.5 °C level by 2030, not by 2040 as projected



GENE BLEVINS/REUTERS

in the special report (see 'Accelerated warming'). The climate-modelling community has not grappled enough with the rapid changes that policymakers care most about, preferring to focus on longer-term trends and equilibria.

Policymakers have less time to respond than they thought. Governments need to invest even more urgently in schemes that protect homes from floods and fires and help people to manage heat stress (especially older individuals and those living in poverty). Nations need to make their forests and farms more resilient to droughts, and prepare coasts for inundation. Rapid warming will create a greater need for emissions policies that yield the quickest changes in climate, such as controls on soot, methane and hydrofluorocarbon (HFC) gases. There might even be a case for solar geoengineering — cooling the planet by, for instance, seeding reflective particles in the stratosphere to act as a sunshade.

Climate scientists must supply the evidence policymakers will need and provide assessments for the next 25 years. They should advise policymakers on which climate-warming pollutants to limit first to gain the most climate benefit. They should assess which policies can be enacted most swiftly and successfully in the real world, where political, administrative and economic constraints often make abstract, 'ideal' policies impractical.

SPEEDING FREIGHT TRAIN

Three lines of evidence suggest that global warming will be faster than projected in the recent IPCC special report.

First, greenhouse-gas emissions are still rising. In 2017, industrial carbon dioxide emissions are estimated to have reached about 37 gigatonnes[2]. This puts them on track with the highest emissions trajectory the IPCC has modelled so far. This dark news means that the next 25 years are poised to warm at a rate of 0.25–0.32 °C per decade[3]. That is faster than the 0.2 °C per decade that we have experienced since the 2000s, and which the IPCC used in its special report.

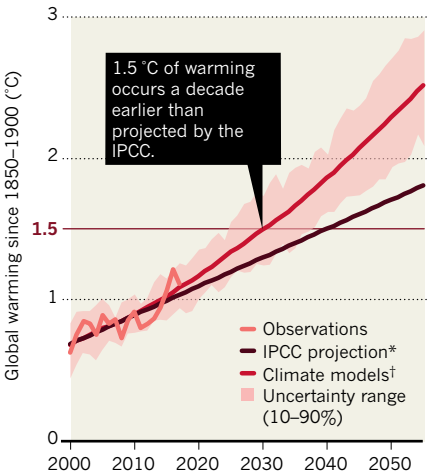
Second, governments are cleaning up air pollution faster than the IPCC and most climate modellers have assumed. For example, China reduced sulfur dioxide emissions from its power plants by 7–14% between 2014 and 2016 (ref. 4). Mainstream climate models had expected them to rise. Lower pollution is better for crops and public health[5]. But aerosols, including sulfates, nitrates and organic compounds, reflect sunlight. This shield of aerosols has kept the planet cooler, possibly by as much as 0.7 °C globally[6].

Third, there are signs that the planet might be entering a natural warm phase that could last for a couple of decades. The Pacific Ocean seems to be warming up, in accord with a slow climate cycle known as the Interdecadal Pacific Oscillation[7]. This cycle modulates temperatures over the equatorial Pacific and over North America. Similarly, the mixing of deep and surface waters in the Atlantic Ocean (the Atlantic meridional overturning circulation) looks to have weakened since 2004, on the basis of data from drifting floats that probe the deep ocean[8]. Without this mixing, more heat will stay in the atmosphere rather than going into the deep oceans, as it has in the past.

These three forces reinforce each other. We estimate that rising greenhouse-gas emissions, along with declines in air pollution, bring forward the estimated date of 1.5 °C of warming to around 2030, with the 2 °C boundary reached by 2045. These could happen sooner with quicker shedding of air pollutants. Adding in natural decadal fluctuations raises the odds of blasting through 1.5 °C by 2025 to at least 10% (ref. 9). By comparison, the IPCC assigned probabilities of 17% and 83% for crossing the 1.5 °C mark by 2030 and 2052, respectively.

ACCELERATED WARMING

Climate simulations predict that global warming will rise exponentially if emissions go unchecked.



*Trend for 2001–15 extended with a constant rate of 0.2 °C per decade, as per IPCC special report. †Ten-year average, 37 climate models for the RCP8.5 scenario (IPCC Fifth Assessment, 2014).

SOURCES: REF. 1/GISTEMP/IPCC FIFTH ASSESSMENT REPORT (2014)

FOUR FRONTS

Scientists and policymakers must rethink their roles, objectives and approaches on four fronts.

Assess science in the near term. Policymakers should ask the IPCC for another special report, this time on the rates of climate change over the next 25 years. The panel should also look beyond the physical science itself and assess the speed at which political systems can respond, taking into account pressures to maintain the status quo from interest groups and bureaucrats. Researchers should improve climate models to describe the next 25 years in more detail, including the latest data on the state of the oceans and atmosphere, as well as natural cycles. They should do more to quantify the odds and impacts of extreme events. The evidence will be hard to muster, but it will be more useful in assessing real climate dangers and responses.

Rethink policy goals. Warming limits, such as the 1.5 °C goal, should be recognized as broad planning tools. Too often they are misconstrued as physical thresholds around which to design policies. The excessive reliance on 'negative emissions technologies' (that take up CO_2) in the IPCC special report shows that it becomes harder to envision realistic policies the closer the world gets to such limits. It's easy to bend models on paper, but much harder to implement real policies that work.

Realistic goals should be set based on political and social trade-offs, not just on geophysical parameters. They should come out of analyses of costs, benefits and feasibility. Assessments of these trade-offs must be embedded in the Paris climate process, which needs a stronger compass to guide its evaluations of how realistic policies affect emissions. Better assessment can motivate action but will also be politically controversial: it will highlight gaps between what countries say they will do to control emissions, and what needs to be achieved collectively to limit warming. Information about trade-offs must therefore come from outside the formal intergovernmental process — from national academies of sciences, subnational partnerships and non-governmental organizations.

Design strategies for adaptation. The time for rapid adaptation has arrived. Policymakers need two types of information from scientists to guide their responses.

COMMENT

First, they need to know what the potential local impacts will be at the scales of counties to cities. Some of this information could be gleaned by combining fine-resolution climate impact assessments with artificial intelligence for 'big data' analyses of weather extremes, health, property damage and other variables. Second, policymakers need to understand uncertainties in the ranges of probable climate impacts and responses. Even regions that are proactive in setting adaptation policies, such as California, lack information about the ever-changing risks of extreme warming, fires and rising seas. Research must be integrated across fields and stakeholders — urban planners, public-health management, agriculture and ecosystem services. Adaptation strategies should be adjustable if impacts unfold differently. More planning and costing is needed around the worst-case outcomes.

Understand options for rapid response. Climate assessments must evaluate quick ways of lessening climate impacts, such as through reducing emissions of methane, soot (or black carbon) and HFCs. Per tonne, these three 'super pollutants' have 25 to thousands of times the impact of CO_2. Their atmospheric lifetimes are short — in the range of weeks (for soot) to about a decade (for methane and HFCs). Slashing these pollutants would potentially halve the warming trend over the next 25 years[10].

There has been progress on this front. At the Global Climate Action summit held in September in San Francisco, California, the United States Climate Alliance — a coalition of state governors representing 40% of the US population — issued a road map to reduce emissions of methane, HFCs and soot by 40–50% by 2030 (see go.nature.com/2ozhojc). The 2016 Kigali amendment to the Montreal Protocol, which will go into force by January 2019, is set to slash HFC emissions by 80% over the next 30 years.

"More planning and costing is needed around the worst-case outcomes."

Various climate engineering options should be on the table as an emergency response. If global conditions really deteriorate, we might be forced to extract large volumes of excess CO_2 directly from the atmosphere. An even faster emergency response could be to inject aerosols into the atmosphere to lower the amount of solar radiation heating the planet, as air pollution does. This option is hugely controversial, and might have unintended consequences, such as altering rainfall patterns that lead to drying of the tropics. So research and planning are crucial, in case this option is needed. Until there is investment in testing and technical preparedness — today, there is almost none — the chances are high that the wrong kinds of climate-engineering scheme will be deployed by irresponsible parties who are uninformed by research[11].

For decades, scientists and policymakers have framed the climate-policy debate in a simple way: scientists analyse long-term goals, and policymakers pretend to honour them. Those days are over. Serious climate policy must focus more on the near-term and on feasibility. It must consider the full range of options, even though some are uncomfortable and freighted with risk. ■

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e-mail: david.victor@ucsd.edu

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RE: Question about SONGS "incidental contact"

Morris, Scott [redacted]

Monday 10-18-21

To: Charles Langley

CC: Nina Babiarz

Dear Mr. Langley:

Thank you for your question. "Incidental contact" is a term that we (NRC Region IV staff) used in the referenced inspection report to refer to the mechanism by which canister scratching or gouging could occur; it is not a replacement term for the outcome of the contact between canisters and the internals of the storage vault. The Certificate of Compliance for the HOLTEC UMAX system was updated by the licensee via the 10 CFR 72.48 process to acknowledge that canister scratching and gouging can occur during canister insertion into and withdrawal from the storage vault. The previous version of the Certificate of Compliance stated that no scratching would occur.

I hope this information answers your question!

Best Regards,

Scott A. Morris

Regional Administrator

U.S. Nuclear Regulatory Commission / Region IV

[redacted]


MPC 72 INSPECTION
3/23/2019 10:01 AM
BETWEEN SEISMIC RESTRAINTS 1 & 2


MPC 72 QUADRANT 2
3/23/2019 11:07 AM
BETWEEN SEISMIC RESTRAINTS 3 & 4


MPC 64 QUADRANT 3
3/22/2019 1:17 PM
BETWEEN SEISMIC RESTRAINTS 6 & 7 Q3-4

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PRAIRIE ISLAND INDIAN COMMUNITY TRANSPORTATION DOSE ASSESSMENT – CONDUCTING THE ASSESSMENT

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ABSTRACT

The U.S. Department of Energy Office of Integrated Waste Management (DOE-IWM)[1] and the Prairie Island Indian Community conducted a transportation dose assessment to estimate the site-specific incident-free radiation doses from shipping spent nuclear fuel (SNF) by rail from the Prairie Island Nuclear Generating Plant (PINGP) through the Prairie Island Indian Community Reservation and Trust Land.

The transportation dose was based on SNF stored in TN-40 and TN-40HT metal casks at the PINGP Independent Spent Fuel Storage Installation (ISFSI). Exposure scenarios were focused on estimating potential doses to individuals at specific locations; no worker (i.e. individuals onsite at the PINGP) exposure scenarios were evaluated. The types of scenarios evaluated included:

- Exposures at grade crossings
- Exposures along frontage roads
- Exposures at residences, churches, schools, Tribal buildings, etc.
- Radiation doses to bison that live in paddocks along the rail line

Background radiation dose rate measurements and distances to key points of interest were made along the rail line. Background radiation dose rates were measured using a Ludlum Model 19 MicroR meter, which contains a 2.54-cm x 2.54-cm sodium iodide detector. Distances from the rail line to potential exposure locations were measured using a Bushnell Bone Collector 850 Rangefinder.

The measured background exposure rates were generally low, characteristically 5-10 µR/h. These exposure rates are at the very low end of the detection capability of the instruments that were used to measure the exposure rates and are consistent with natural background external exposure rates.

Individual TN-40 and TN-40HT dose rates were estimated using SNF characteristics from DOE's GC-859 Nuclear Fuel Data Survey, loading maps, and DOE's Used Nuclear Fuel–Storage,

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Transportation, & Disposal Analysis Resource and Data System (UNF-ST&DARDS). Radiation doses to individuals and bison along the rail line were estimated using the RISKIND computer code.

The transportation dose assessment was conducted in collaboration with the Prairie Island Indian Community, and a report is being prepared that documents the results of the transportation dose assessment. This report is a collaborative effort among the Prairie Island Indian Community, DOE-IWM, and Pacific Northwest National Laboratory and will serve as a demonstration of the data, methods, and communication of results that could be used for other site-specific transportation dose assessments.

INTRODUCTION

The Prairie Island Indian Community is a federally recognized Indian Tribe and is located approximately 48 km southeast of St. Paul, Minnesota, along the Mississippi River, near Red Wing, Minnesota. The Prairie Island Indian Community's land holdings total over 1200 hectares. The PINGP contains two 1650 megawatt thermal/575 megawatt electric pressurized water reactors and an associated independent spent fuel storage installation (ISFSI) and is located immediately southeast of the Prairie Island Indian Community (see Figures 1 and 2). A Canadian Pacific freight rail line runs through the Prairie Island Indian Community and serves the PINGP. The proximity of the PINGP site and ISFSI makes the Prairie Island Indian Community one of the closest communities in the U.S. to a nuclear power plant site and an ISFSI. Moreover, there is currently only one evacuation route from the Prairie Island Indian Community (Sturgeon Lake Road), and passing trains frequently block it.

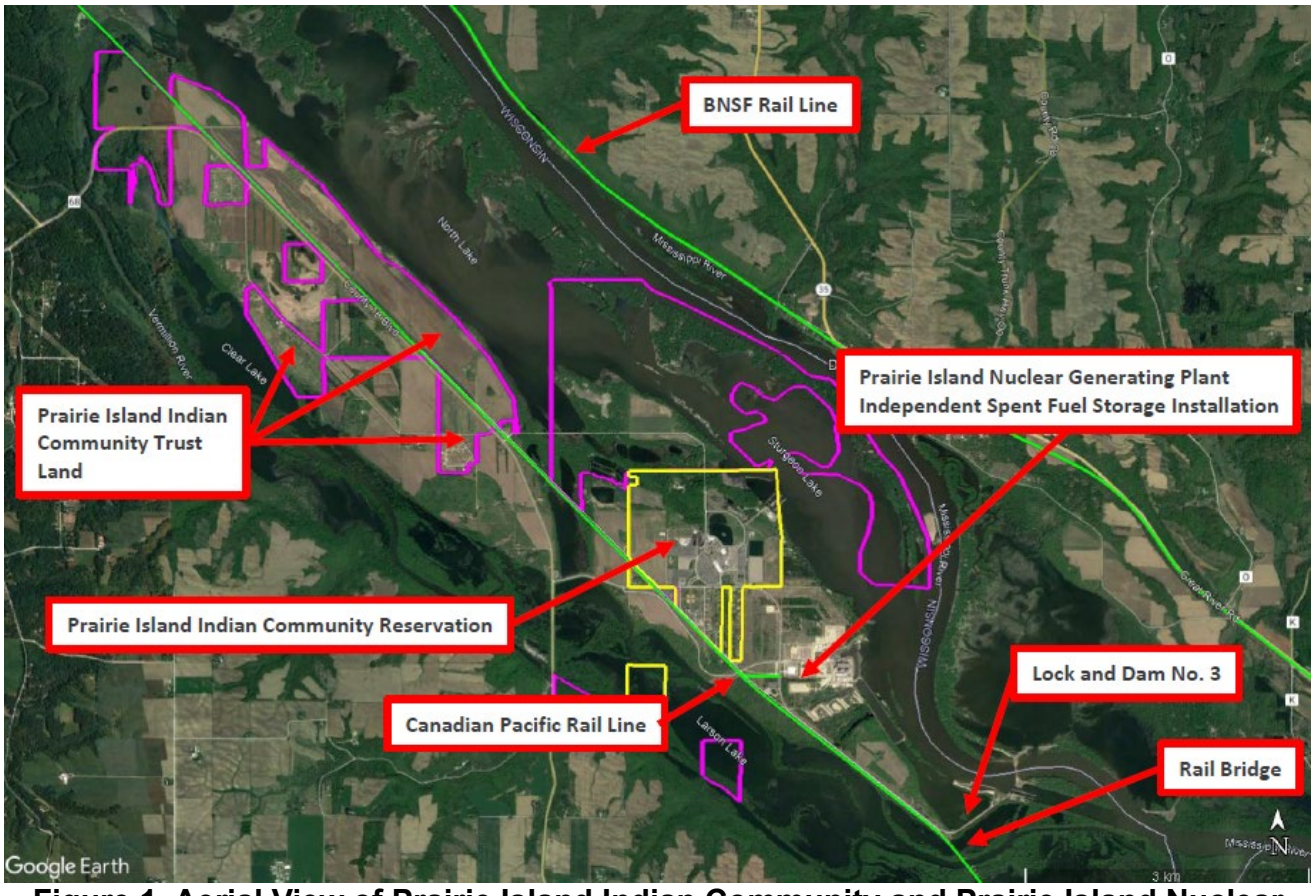


Figure 1. Aerial View of Prairie Island Indian Community and Prairie Island Nuclear Generating Plant

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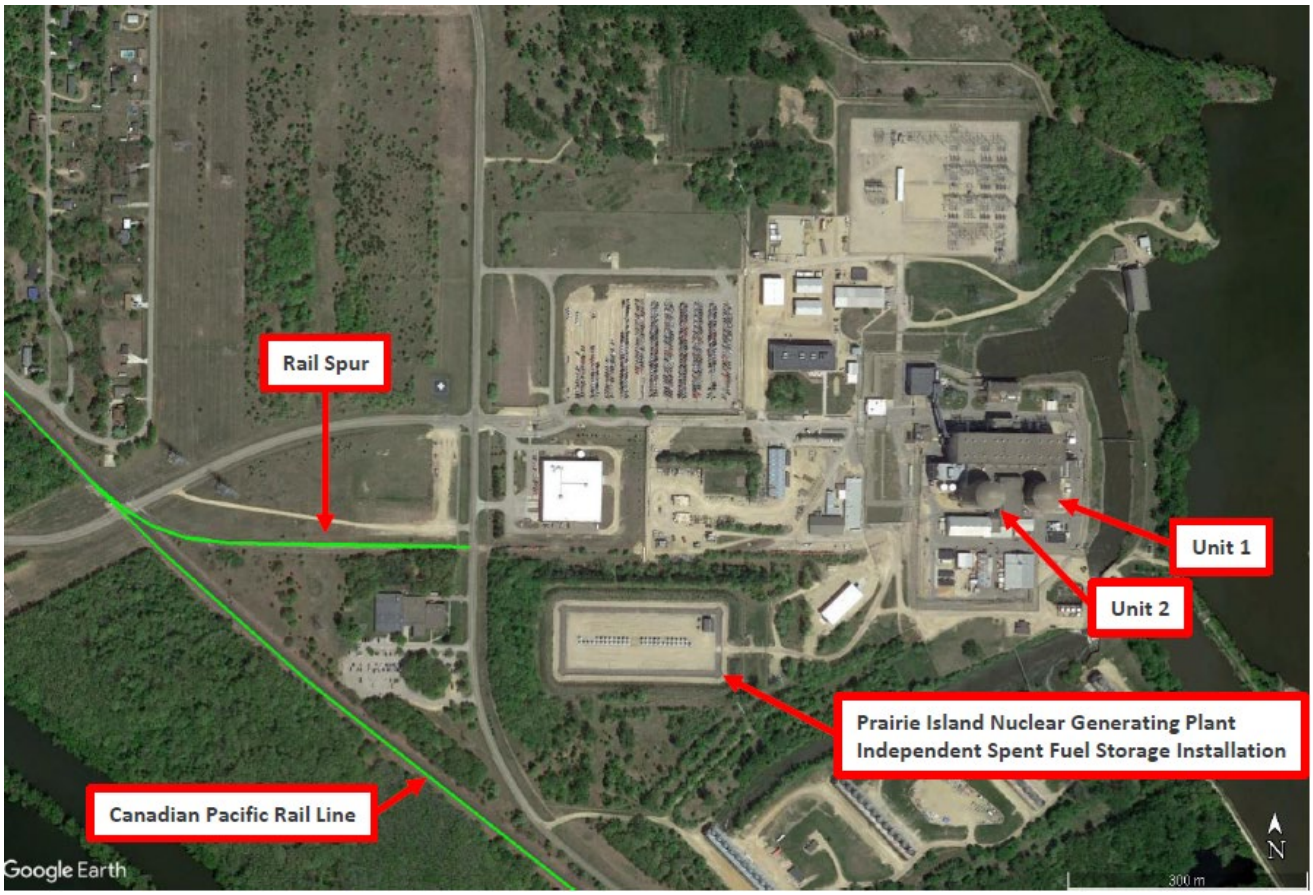


Figure 2. Aerial View of Prairie Island Nuclear Generating Plant

TN-40 AND TN-40HT RADIATION DOSE RATES

Dose rate calculations were performed for 50 TN-40 and TN-40HT metal casks located at PINGP to support estimating incident-free transportation radiation doses from shipping SNF by rail through the Prairie Island Indian Community. The calculations were performed with the shielding analysis sequence of the UNF-ST&DARDS (Banerjee et al. 2016; Radulescu et al. 2017). UNF-ST&DARDS was used to perform shielding calculations with the actual fuel and hardware inventory available. The source terms for the fuel and non-fuel hardware were generated using the ORIGAMI module of SCALE 6.2.4 (Rearden and Jessee 2016) and the radiation transport calculations were performed using the MAVRIC (Peplow 2011) sequence. All calculations were performed for 1 January 2030.

POTENTIAL EXPOSURE SCENARIOS

In this incident-free transportation radiation dose assessment, the following exposure scenarios were evaluated:

- Exposures at grade crossings. The radiation doses were estimated at a distance of 3 meters from the rail line for pedestrians and people in vehicles (Table 1). The 3-meter distance was based on measurements made at the Prairie Island Indian Community. Distances were measured using a Bushnell Bone Collector laser range finder.
- Exposures along frontage roads. The radiation doses were estimated at a distance of 18 meters from the rail line (Table 1).
- Exposures at residences, churches, and Tribal Buildings. Table 1 lists the distances at which radiation doses were estimated for these locations.

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- Radiation doses to bison raised by the Tribe that live in paddocks along the rail line. The distance to the front bison paddock was estimated to be 83 meters (Table 1).

Radiation doses were estimated for a shipment of five transportation casks for four cases: (1) the five transportation casks with the highest radiation dose rates, (2) the five transportation casks with the lowest radiation dose rates, (3) five transportation casks with the average radiation dose rate, and (4) five transportation casks with the median radiation dose rate.

Table 1. Exposure Location Distances

Location	Distance (m)
Grade Crossing	3
Frontage Road	18
Residences (minimum distance evaluated)	15
Residences (maximum distance evaluated)	60
Church	35
Public Safety Building	90
Front Bison Paddock	83

For exposures at residences, radiation doses were estimated for a case where people were assumed to be outside and therefore unshielded and for a case where people were assumed to be inside a structure and shielded. Three types of structures were evaluated, a wood frame structure, a manufactured home structure, and a concrete structure. Table 2 lists the shielding factors for the three types of structures. For exposures at churches and the Public Safety Building, radiation doses were estimated for a case where people were assumed to be inside a structure and shielded. For people in vehicles, shielding was also used to estimate the radiation doses.

Radiation doses were estimated for 4 train speeds, 16 kph, 40 kph, 64 kph, and 80 kph. Sixteen kph would be representative of the speed a train would be traveling when exiting PINGP, 40 kph corresponds to the Federal Railroad Administration (FRA) speed limit for Class 2 track, 64 kph corresponds to the FRA speed limit for Class 4 track, and 80 kph corresponds to the maximum speed allowed by Association of American Railroads (AAR) Publication OT-55 for a key train carrying hazardous materials, including spent nuclear fuel (AAR 2021).

Radiation doses were also estimated assuming that a train was stopped. Based on discussions with Prairie Island Indian Community staff, an exposure time of 15 minutes was used.

TRANSPORTATION DOSE ASSESSMENT METHODOLOGY

Radiation doses were estimated using the RISKIND computer code (Yuan et al. 1995) based on the dose rates at 1 meter. RISKIND has been verified and validated for estimating incident-free radiation doses during transportation of radioactive material (Maheras and Pippen 1995; Biwer et al. 1997). RISKIND was also used to estimate radiation doses in the Yucca Mountain Final Environmental Impact Statement (DOE 2002) and the Repository Supplemental Environmental Impact Statement (DOE 2008).

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Table 2. Shielding Factors

Structure	Gamma Radiation Shielding Factor	Neutron Radiation Shielding Factor
Outside (Unshielded)	1.0	1.0
Vehicle	0.60[a]	1.0[b]
Wood Frame Structure[c]	0.74	0.48
Manufactured Home Structure	0.82[d]	1.0[e]
Concrete Structure[f]	0.38	0.18

a. Source: Dalak et al. (2022)
b. No neutron data available; shielding factor assumed to be 1.0.
c. Source: Ghita (2018) and Dant et al. (2018) average shielding factors for 1-story very light structures.
d. Source: Dickson and Hamby (2014).
e. No neutron data available; shielding factor assumed to be 1.0.
f. Source: Ghita (2018) and Dant et al. (2018) average shielding factors for 1-story heavy structures.

Two exposure scenarios were analyzed in RISKIND, the radiation dose associated with a passing rail transportation cask and the radiation dose associated with a stationary rail transportation cask. The shielding factors listed in Table 2 were applied to the calculated RISKIND results in an Excel spreadsheet. In order to provide flexibility for future analyses, the radiation doses were estimated at distances from 1 meter to 200 meters from the TN-40 and TN-40HT transportation casks. The dimensions of the radiation source contained in the TN-40 and TN-40HT transportation casks, i.e., the SNF, had dimensions of 1.83 m (diameter) and 4.14 m (length). This was based on the dimensions of the TN-40 and TN-40HT cask cavity (Greene et al. 2013).

To estimate the radiation dose to a bison in the bison paddock, an online biota dose calculator (BiotaDC) from the International Commission on Radiological Protection (ICRP 2017) was used to calculate the radiation dose to a large terrestrial animal like a bison (see http://biotadc.icrp.org/). This dose information was compared to ICRP dose coefficients for humans (ICRP 2020) and then used to develop a comparison of doses between a large animal (i.e., a bison at 1000 kg) and a person. The radiation dose to a bison would be about 20 to 25 percent less than the effective dose to a person at the same location for the high energy gamma photons of cesium-137 and cobalt-60, two important radionuclides in spent fuel shipments.

MEASURED RADIATION DOSE RATES

Handheld instruments were used to measure the exposure rate at the Prairie Island Indian Community on July 12 and 13 2022. A Ludlum Model 19 MicroR meter was the primary measurement. A backup Model 19 was also available, as was a Ludlum Model 14C survey meter with an energy-compensated Model 44-38 GM (Geiger-Mueller) probe. The Model 14C survey meter and 44-38 probe was included to make determinations on contributions from gamma and beta radiation as well to make dose rate measurements. The 44-38 probe provides effectively uniform response across all expected gamma energy levels. Instruments were rented from SEC Instrumentation Services in Knoxville, Tennessee.

Measurements were made with the instrument held at waist height, assumed to be approximately one meter from ground. The background exposure rate across the Prairie Island Indian Community was generally low, characteristically 0.05 μSv/h. An exception to this level was along the rail line right of way access road, where pink granite rock used as surface material for the road was characteristically about 0.10 μSv/h while the black rock (basalt) used as ballast was typically 0.05

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μSv/h (Figure 3). These exposure rates are at the very low end of the detection capability of the Model 14C/44-38. The Model 14C/44-38 showed general consistency with the Model 19 at these low levels, and no difference between open and closed window readings (beta and gamma radiation).

Exposure rates of 0.05-0.10 μSv/h would be considered at the low to intermediate end of background exposure rates that could be encountered across the United States. As a point of comparison, continuous exposure at 0.05 μSv/h for a full year, 8,760 hours, would result in an annual dose rate of 0.44 mSv.

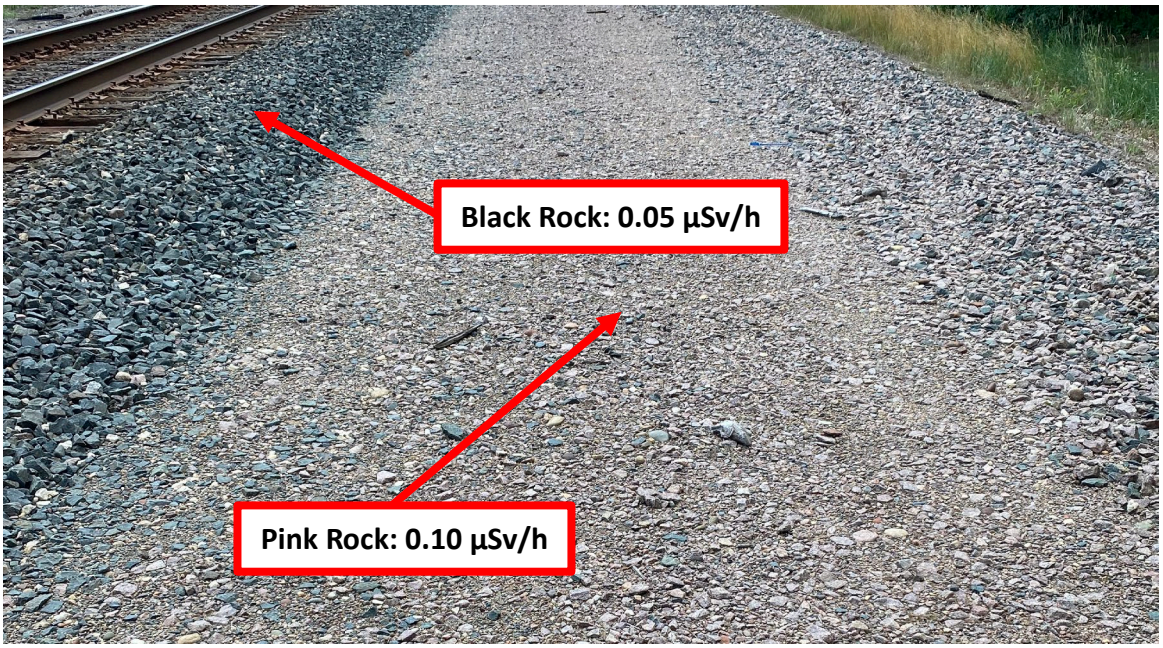


Figure 3. Pink and Black Rock Near Rail Line

RESULTS OF TRANSPORTATION DOSE ASSESSMENT

This section presents the radiation doses estimated for exposures at grade crossings, a frontage road, residences, at a church, at the Public Safety Building, and the bison paddock.

Exposures at Grade Crossings

The most likely location for grade crossing exposures is where the Canadian Pacific rail line crosses Sturgeon Lake Road, approximately 2.2 km west northwest of the PINGP. Figure 4 illustrates the radiation doses from exposures at grade crossing from five transportation casks. In Figure 4 (left), the train is assumed to be stopped on the rail line, obstructing the grade crossing and exposing people waiting for the train to pass. Radiation doses are illustrated for four cases: (1) the five transportation casks with the highest radiation dose rates, (2) the five transportation casks with the lowest radiation dose rates, (3) five transportation casks with the average radiation dose rate, and (4) five transportation casks with the median radiation dose rate. In Figure 4 (right), the train is assumed to pass through the grade crossing without stopping. Radiation doses are illustrated for five transportation casks passing the grade crossing at 16 kph, 40 kph, 64 kph, and 80 kph.

In the future, radiation doses from grade crossing exposures at Sturgeon Lake Road would be largely mitigated by the completion of the Sturgeon Lake Road Project (see http://www.red-wing.org/161/Sturgeon-Lake-Road-Project-Overview), which will include the elimination of the

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existing at-grade crossing and construction of an overpass for Sturgeon Lake Road over the Canadian Pacific rail line.

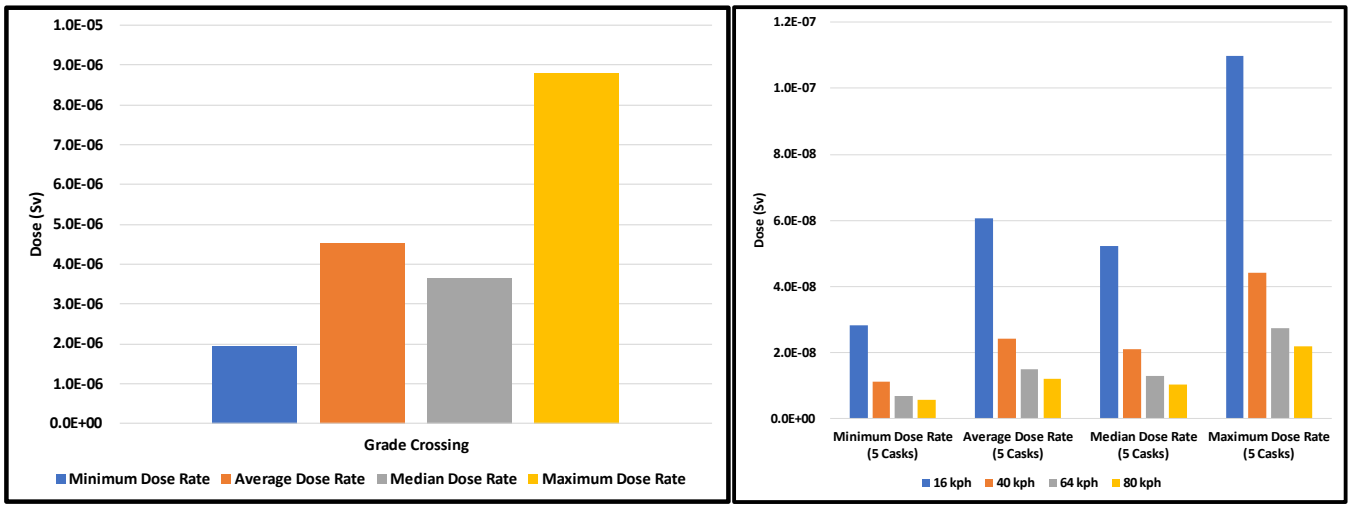


Figure 4. Exposures at Grade Crossing from Five Stopped Casks and Five Passing Casks

Exposures at Frontage Road

The frontage road along the Canadian Pacific rail line is located about 2.4 km west northwest of the PINGP. Figure 5 illustrates the radiation doses to an individual at the frontage road for five transportation casks passing at 16 kph, 40 kph, 64 kph, and 80 kph, for the five transportation casks with the highest radiation dose rates, the five transportation casks with the lowest radiation dose rates, five transportation casks with the average radiation dose rate, and five transportation casks with the median radiation dose rate.

Exposures at Residences

Figures 6 and 7 illustrate the radiation doses to an individual in a residence along the rail line. The radiation doses are illustrated for two cases: (1) outside, i.e., unshielded, and (2) inside a manufactured home. Radiation doses were estimated at two distances, 15 meters and 60 meters. Radiation doses were estimated for five transportation casks passing at 16 kph, 40 kph, 64 kph, and 80 kph, for the five transportation casks with the highest radiation dose rates, the five transportation casks with the lowest radiation dose rates, five transportation casks with the average radiation dose rate, and five transportation casks with the median radiation dose rate.

Exposures at Church

The church along the Canadian Pacific rail line is located about 1.25 km west of the PINGP. Figure 8 illustrates the radiation doses to an individual inside the church (i.e., shielded) along the rail line for five transportation casks passing at 16 kph, 40 kph, 64 kph, and 80 kph, for the five transportation casks with the highest radiation dose rates, the five transportation casks with the lowest radiation dose rates, five transportation casks with the average radiation dose rate, and five transportation casks with the median radiation dose rate.

Exposures at Public Safety Building

The Public Safety Building is located about 2 km west northwest of PINGP. Figure 9 illustrates the radiation doses to an individual inside the Public Safety Building (i.e., shielded) along the rail line for five transportation casks passing at 16 kph, 40 kph, 64 kph, and 80 kph, for the five transportation casks with the highest radiation dose rates, the five transportation casks with the lowest radiation

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dose rates, five transportation casks with the average radiation dose rate, and five transportation casks with the median radiation dose rate.

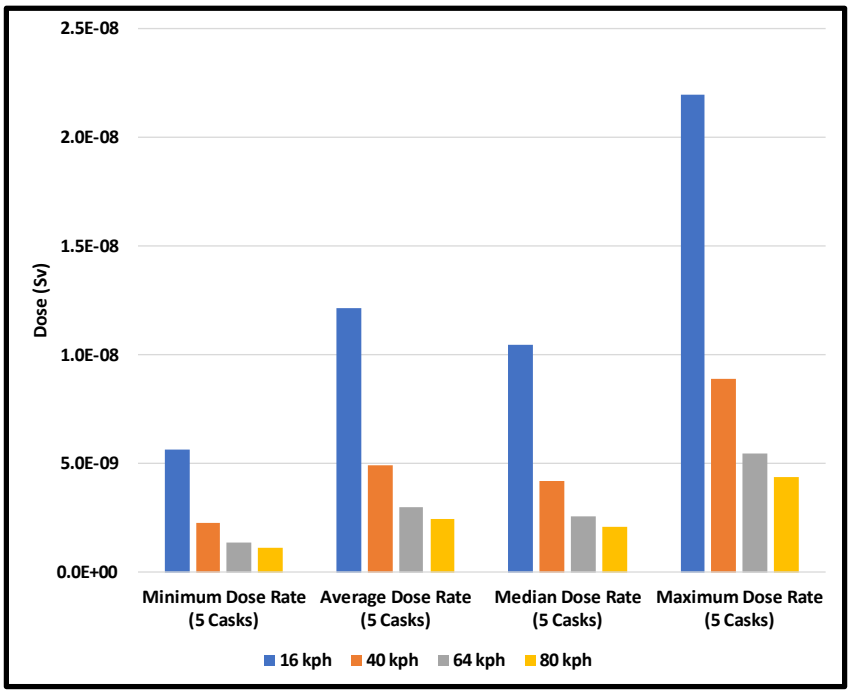


Figure 5. Exposures at Frontage Road from Five Passing Casks

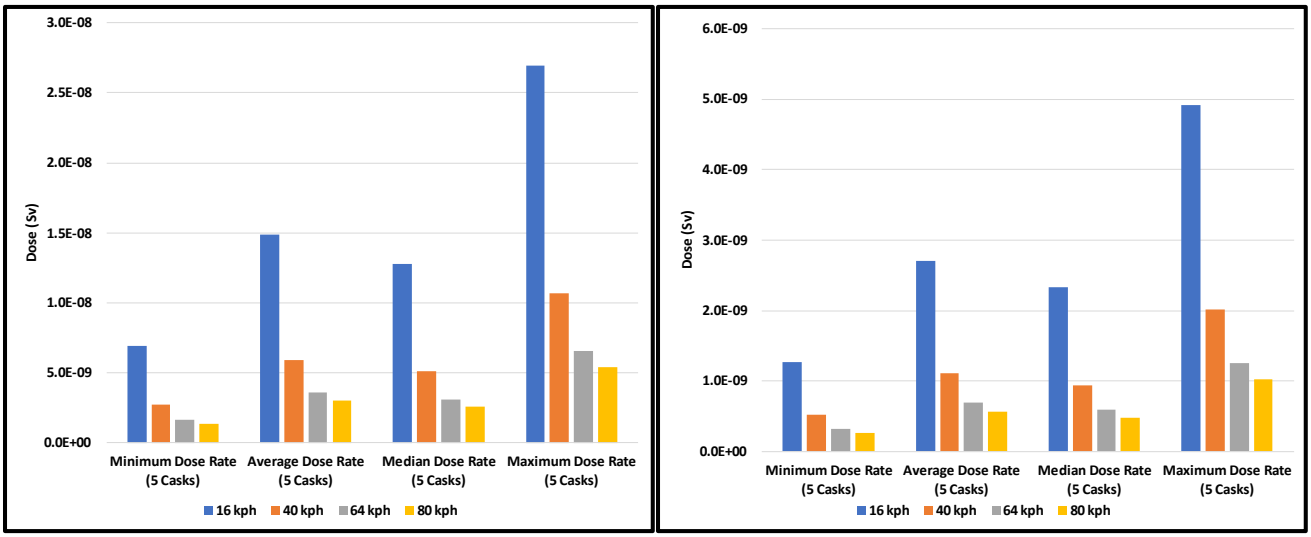


Figure 6. Exposures at Residence From Five Passing Casks (Minimum Distance, Outdoors and Maximum Distance Outdoors)

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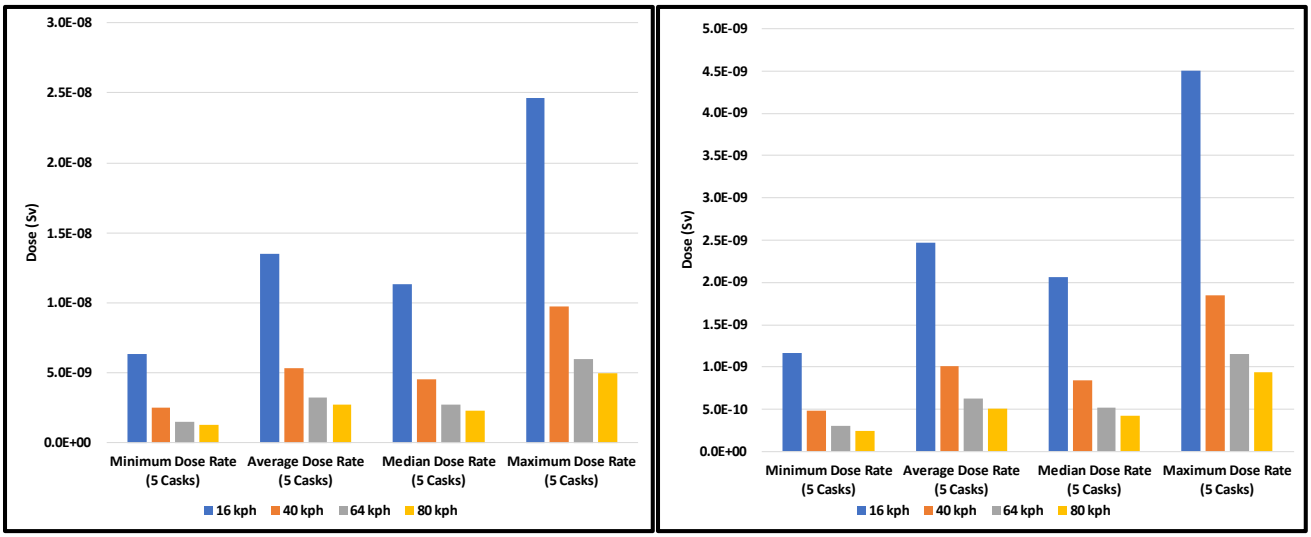


Figure 7. Exposures at Residence From Five Passing Casks (Minimum Distance, Inside Manufactured Home and Maximum Distance Inside Manufactured Home)

Exposures at Bison Paddock

The bison paddock is located about 6.4 km west northwest of PINGP. Figure 10 illustrates the radiation doses to a bison at the Bison Paddock along the rail line for five transportation casks passing at 16 kph, 40 kph, 64 kph, and 80 kph, for the five transportation casks with the highest radiation dose rates, the five transportation casks with the lowest radiation dose rates, five transportation casks with the average radiation dose rate, and five transportation casks with the median radiation dose rate.

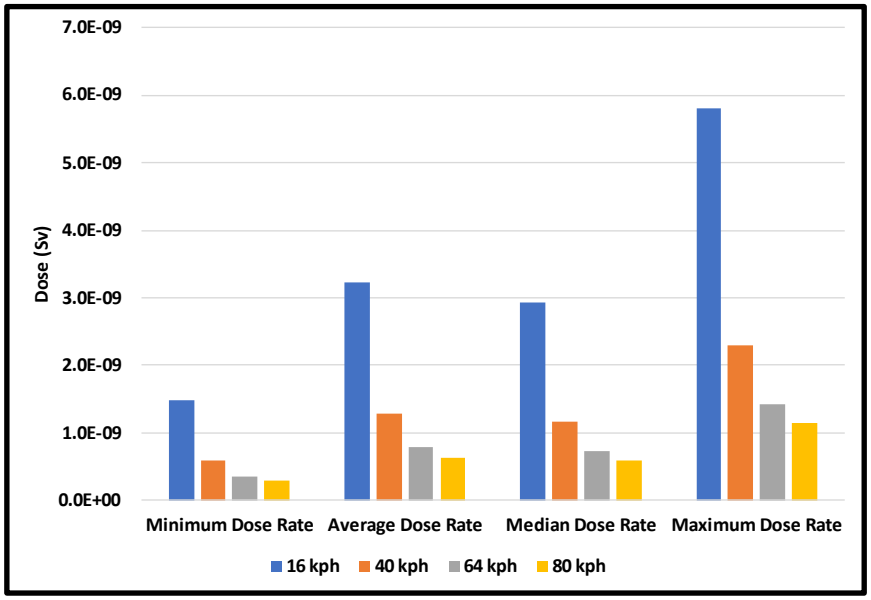


Figure 8. Exposures at Church From Five Passing Casks (Indoors)

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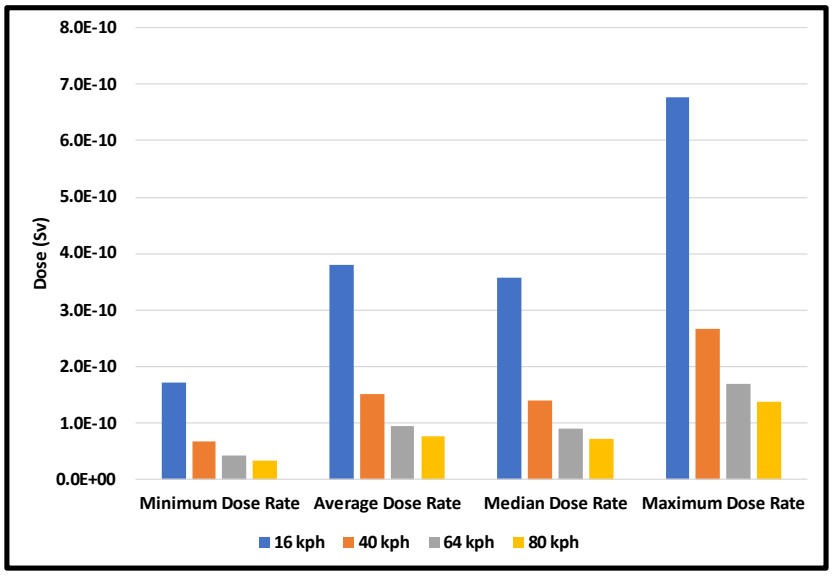


Figure 9. Exposures at Public Safety Building From Five Passing Casks (Indoors)

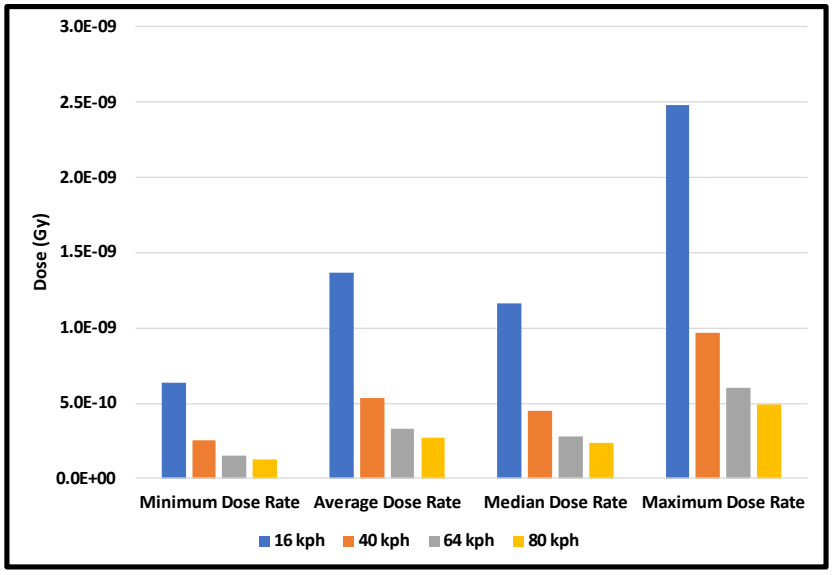


Figure 10. Exposures at Bison Paddock From Five Passing Casks

CONCLUSIONS

A transportation dose assessment was conducted in collaboration with the Prairie Island Indian Community to estimate the site-specific incident-free radiation doses from shipping SNF by rail from the PINGP through the Prairie Island Indian Community Reservation and Trust Land. Participation by the Prairie Island Indian Community was integral to conducting the dose assessment.

Exposures at grade crossings from a stopped train were found to yield the highest radiation doses to individuals, about 2-9 µSv per 5-cask shipment. This was due to the exposure distance (3 meters from the rail line) and exposure time (15 minutes). The most likely location for this to occur is at the Sturgeon Lake Road grade crossing; the potential for this exposure to occur would be largely mitigated by the construction of the Sturgeon Lake Road Project, which would eliminate this grade crossing.

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As expected, radiation doses from passing trains were higher for individuals closer to the rail line, with exposures at grade crossings being the highest and exposures at the Public Safety Building being the lowest. Manufactured homes were found to provide little shielding for gamma radiation; shielding factors for neutrons for manufactured homes were not available. In all cases, the radiation doses were very low. For the individuals closer to the rail line, radiation doses from a passing shipment were similar to 1 hour of exposure to background radiation measured along the Canadian Pacific rail line. For individuals further from the rail line, radiation doses from passing shipments were much less than background radiation measured along the Canadian Pacific rail line.

This paper is a collaborative effort among the Prairie Island Indian Community, DOE-IWM, and Pacific Northwest National Laboratory and will serve as a demonstration of the data, methods, and communication of results that could be used for other site-specific transportation dose assessments.

ACKNOWLEDGMENTS

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ENDNOTES

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PRAIRIE ISLAND INDIAN COMMUNITY TRANSPORTATION DOSE ASSESSMENT – BUILDING THE PROCESS

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ABSTRACT

American Indian Tribal governments are responsible for the health and safety of their members and enjoy a government-to-government relationship with the U.S. federal government. In addition, because Indian Tribes are potentially impacted by the future transport of spent nuclear fuel (SNF) and high-level radioactive waste (HLW), it is expected that federal agencies will work with Indian Tribes on issues associated with the transport of SNF and HLW.

In a first-of-a-kind collaboration, the U.S. Department of Energy Office of Integrated Waste Management (DOE-IWM)[1] and the Prairie Island Indian Community conducted a transportation dose assessment to estimate the site-specific incident-free radiation doses from SNF that in the future is expected to be transported by rail from the Prairie Island Nuclear Generating Plant (PINGP) through the Prairie Island Indian Community Reservation and Trust Land.

This paper describes the process by which the transportation dose assessment was conducted and the associated roles and responsibilities of DOE-IWM and the Prairie Island Indian Community. Planning included conducting detailed research on the SNF inventory and TN-40 and TN-40HT dry storage systems/transportation casks stored at PINGP independent spent fuel storage installation (ISFSI), estimating the radiation dose rates associated with TN-40 and TN-40HT transportation casks, establishing the geographic context for the transportation dose assessment, and identifying potential exposure locations for both people and biota (e.g., bison that live in paddocks near the rail line that passes through the Prairie Island Indian Community Reservation and Trust Land). Prairie Island Indian Community Tribal members and staff provided detailed site-specific knowledge that enabled these exposure locations to be efficiently identified and also coordinated property access to enable distances to be measured from the exposure locations to the rail line. Prairie Island Indian Community staff also coordinated obtaining detailed SNF information from Xcel Energy, the owners of PINGP.

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Detailed field work conducted for the transportation dose assessment included measuring distances from the rail line to potential exposure locations and measuring radiation dose rates along the rail line. This paper is a collaborative effort among the Prairie Island Indian Community, DOE-IWM, and Pacific Northwest National Laboratory and will serve as a demonstration of the data, methods, and communication of results that could be used for other site-specific transportation dose assessments.

INTRODUCTION

The Prairie Island Indian Community is a federally recognized Indian Tribe and is located approximately 48 km southeast of St. Paul, Minnesota, along the Mississippi River, near Red Wing, Minnesota. The Prairie Island Indian Community's land holdings total over 1200 hectares. The PINGP contains two 1650 megawatt thermal/575 megawatt electric pressurized water reactors and an associated independent spent fuel storage installation (ISFSI) and is located immediately southeast of the Prairie Island Indian Community (see Figures 1 and 2). A Canadian Pacific freight rail line runs through the Prairie Island Indian Community and serves the PINGP. The proximity of the PINGP site and ISFSI makes the Prairie Island Indian Community one of the closest communities in the U.S. to a nuclear power plant site and an ISFSI. Moreover, there is currently only one evacuation route from the Prairie Island Indian Community (Sturgeon Lake Road), and passing trains frequently block it.

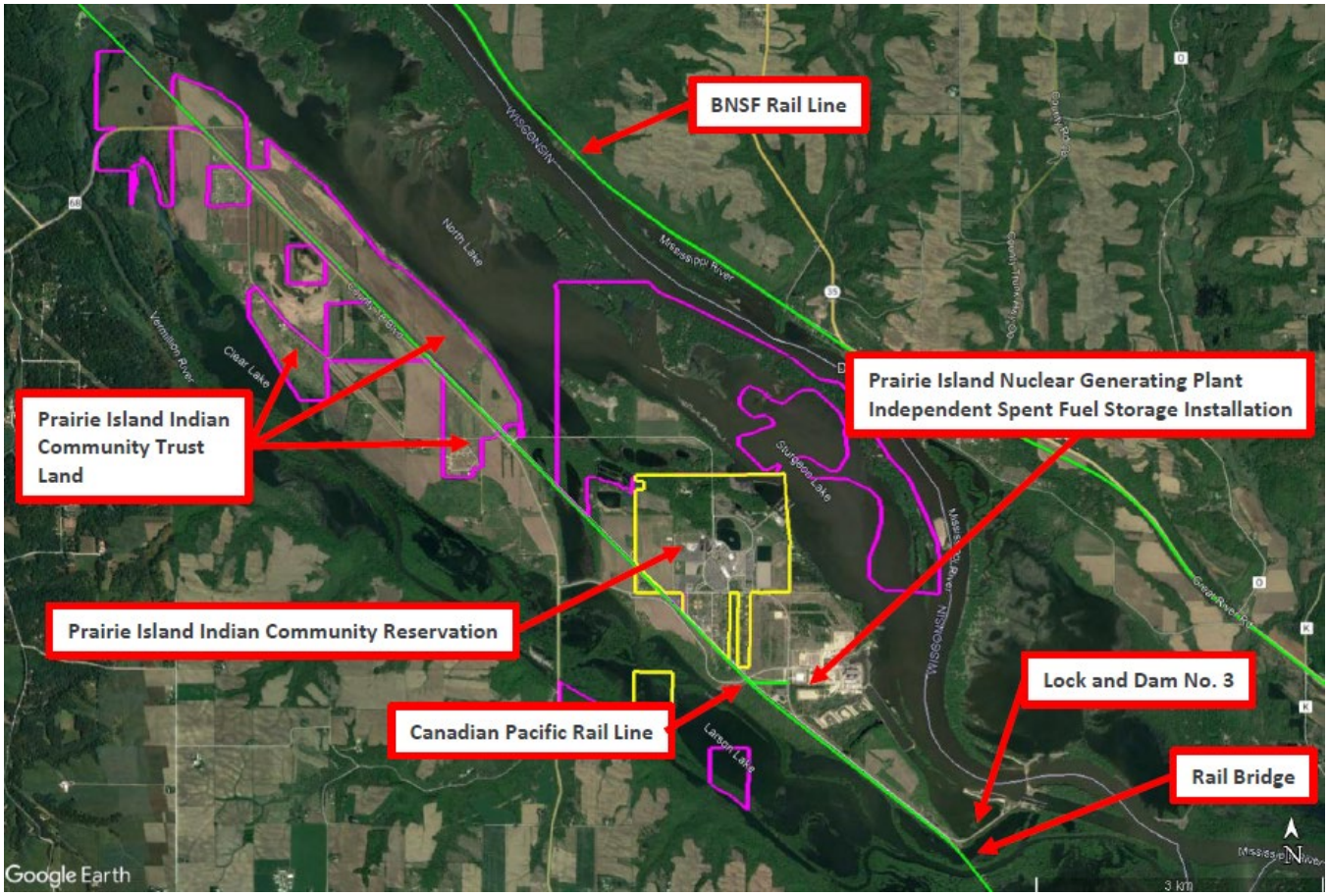


Figure 1. Aerial View of Prairie Island Indian Community and Prairie Island Nuclear Generating Plant

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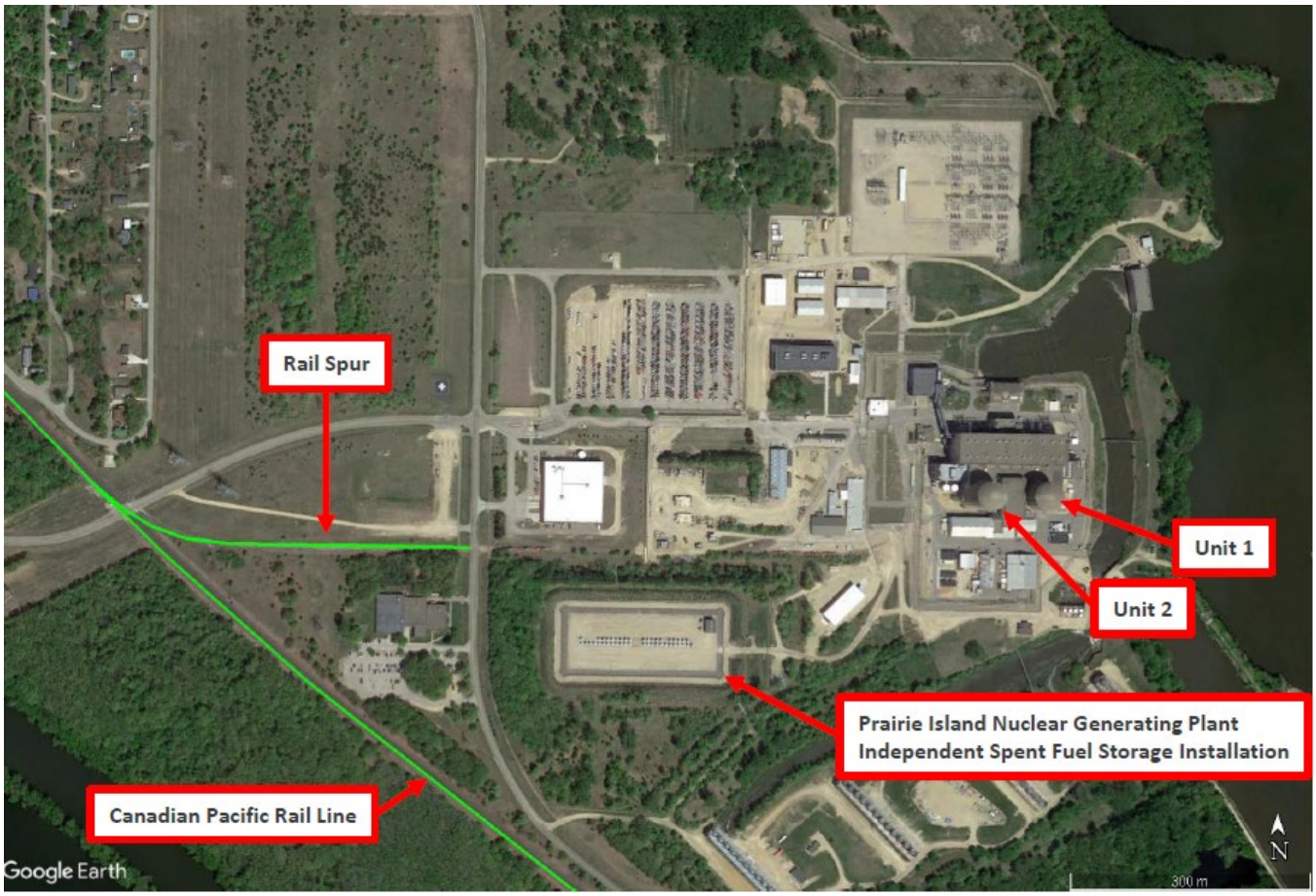


Figure 2. Aerial View of Prairie Island Nuclear Generating Plant

FIELD WORK

On July 11-14, 2022, the Prairie Island Field Team participated in field work at the Prairie Island Indian Community. The Prairie Island Field Team consisted of individuals from the Prairie Island Indian Community, DOE-IWM, and Pacific Northwest National Laboratory. Detailed field work conducted for the transportation dose assessment included measuring radiation dose rates along the rail line and measuring distances from the rail line to potential exposure locations.

Background dose rates were measured using a Ludlum Model 19 MicroR meter, which contains a 2.54-cm x 2.54-cm sodium iodide detector. Distances from the rail line to potential exposure locations measured using a Bushnell Bone Collector 850 Rangefinder.

EXPOSURE ASSESSMENT

Potential exposure scenarios were focused on estimating potential doses to individuals at specific locations; no worker (i.e., individuals onsite at the PINGP) exposure scenarios were evaluated. The following types of scenarios were evaluated in the transportation dose assessment:

- Exposures at grade crossings –vehicles and pedestrians
- Exposures along frontage roads
- Exposures at residences, churches, schools, Tribal Buildings, etc.
- Radiation doses to bison that live in paddocks along the rail line

The exposure assessment was based on SNF stored in TN-40 and TN-40HT metal casks stored at the PINGP ISFSI. Figure 3 shows the PINGP ISFSI and a TN-40HT on a railcar at PINGP. Prairie

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Island Indian Community staff coordinated obtaining detailed SNF information from Xcel Energy, the owners of PINGP. This data was used to estimate the radiation dose rates associated with the TN-40 and TN-40HT metal casks. The radiation dose rate calculations were performed with the shielding analysis sequence of the Used Nuclear Fuel–Storage, Transportation, & Disposal Analysis Resource and Data System (UNF-ST&DARDS) (Banerjee et al. 2016; Radulescu et al. 2017). UNF-ST&DARDS was used to perform shielding calculations with the actual fuel and hardware inventory available. All calculations were performed for 1 January 2030.

Radiation doses at exposure locations were estimated using the RISKIND computer code (Yuan et al. 1995) based on the gamma and neutron radiation dose rates at 1 meter estimated using UNF-ST&DARDS for the TN-40 and TN-40HT metal casks. Two exposure scenarios were analyzed in RISKIND, the radiation dose associated with passing rail transportation casks and the radiation dose associated with stationary rail transportation casks.

At the conclusion of the field work on July 13, 2022, the Prairie Island Field Team met with the President, Vice-President, Treasurer, and Secretary of the Prairie Island Indian Community Tribal Council and Federal Government Relations staff to discuss the exposure assessment.



Figure 3. PINGP ISFSI (Left) and TN-40HT on Railcar at PINGP (Right)

SURVEY LOCATIONS

This section discusses the locations surveyed during the transportation dose assessment field work. These locations were identified by Prairie Island Indian Community Tribal members and staff who provided detailed site-specific knowledge that enabled these exposure locations to be efficiently identified and also coordinated property access to enable distances to be measured from the exposure locations to the rail line.

Lock and Dam No. 3 on Mississippi River

The first location surveyed was Lock and Dam No. 3 on the Mississippi. This location is about 2.2 km east southeast from PINGP. The purpose of surveying this location was to establish background radiation dose rates. Figure 4 shows an aerial view of Lock and Dam No. 3 and Figure 5 shows the Prairie Island Field Team at Lock and Dam No. 3.

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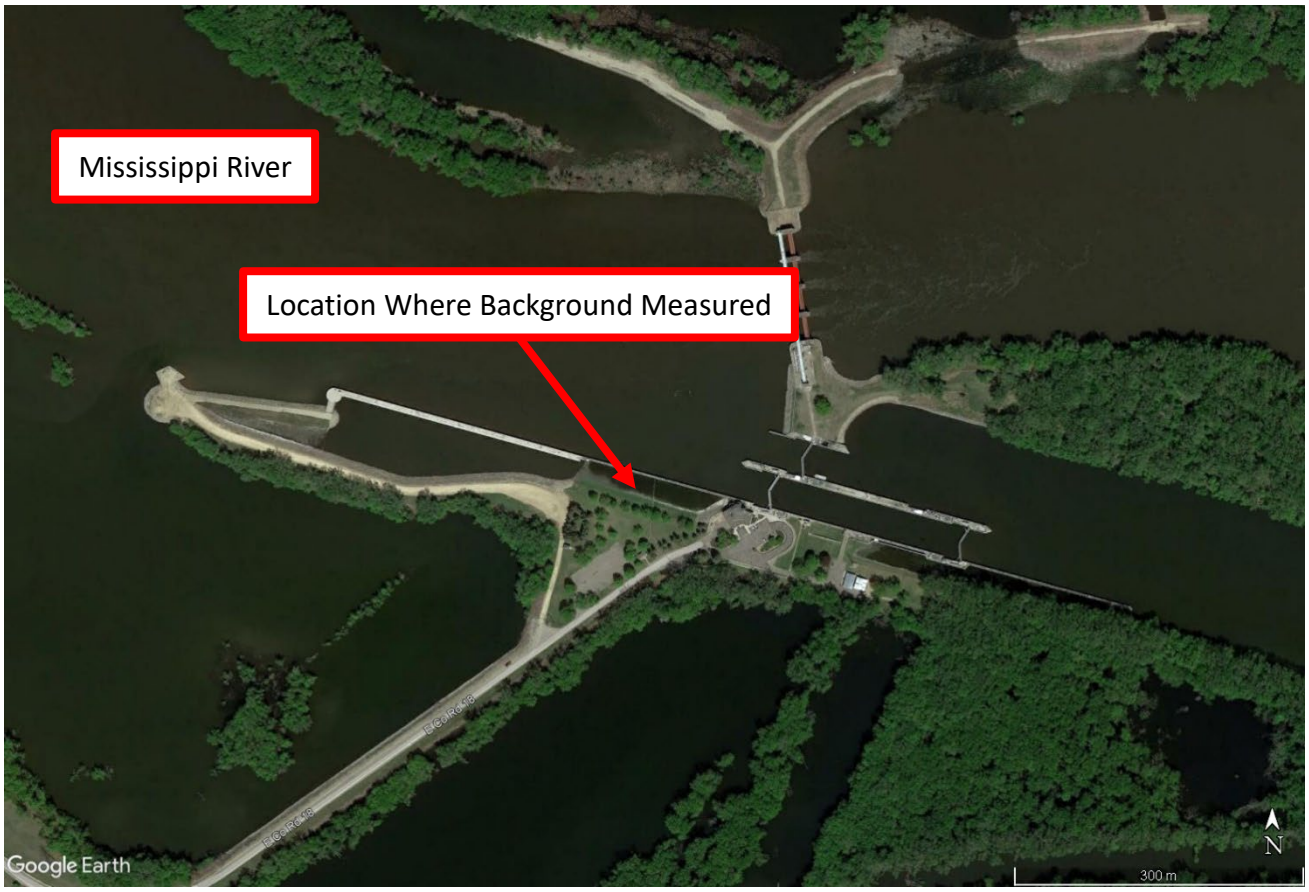


Figure 4. Aerial View of Lock and Dam No. 3



Figure 5. Prairie Island Field Team at Lock and Dam No. 3

Rail Bridge on the Canadian Pacific Rail Line

The second location surveyed was a rail bridge on the Canadian Pacific rail line. This was the southern-most location surveyed and was located about 2.4 km south southeast from PINGP. Figure 6 shows an aerial view of the rail bridge and Figure 7 shows the rail bridge looking south southeast and north northwest. At this location background radiation dose rates were measured close to the rail line.

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Figure 6. Aerial View of Rail Bridge on Canadian Pacific Rail Line



Figure 7. Rail Bridge on Canadian Pacific Rail Line Looking South Southeast and North Northwest

Grade Crossing at PINGP Entrance

The third location surveyed was a grade crossing at the PINGP entrance, located about 1.1 km west of PINGP. Figure 8 shows an aerial view of the grade crossing and Figure 9 shows the grade crossing looking southeast. This was the first potential offsite exposure location.

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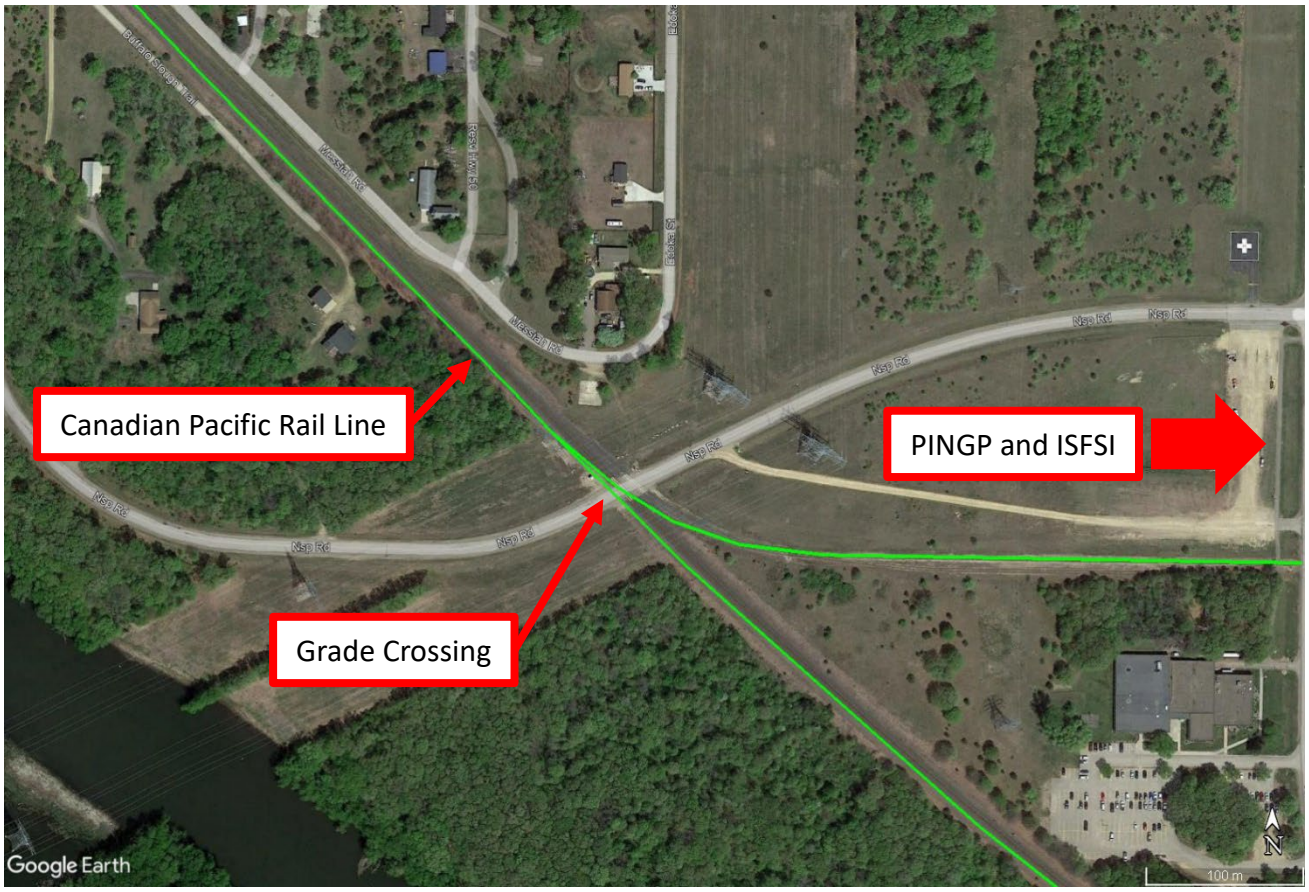


Figure 8. Aerial View of Grade Crossing at PINGP Entrance



Figure 9. Grade Crossing at PINGP Entrance Looking Southeast

During measuring background radiation dose rates at the grade crossing, it was observed that the radiation dose rate for the black rock (basalt) used as ballast on the rail line was typically about 0.05 µSv/h while the pink granite rock used as surface material for the road was characteristically about 0.10 µSv/h (see Figure 10).

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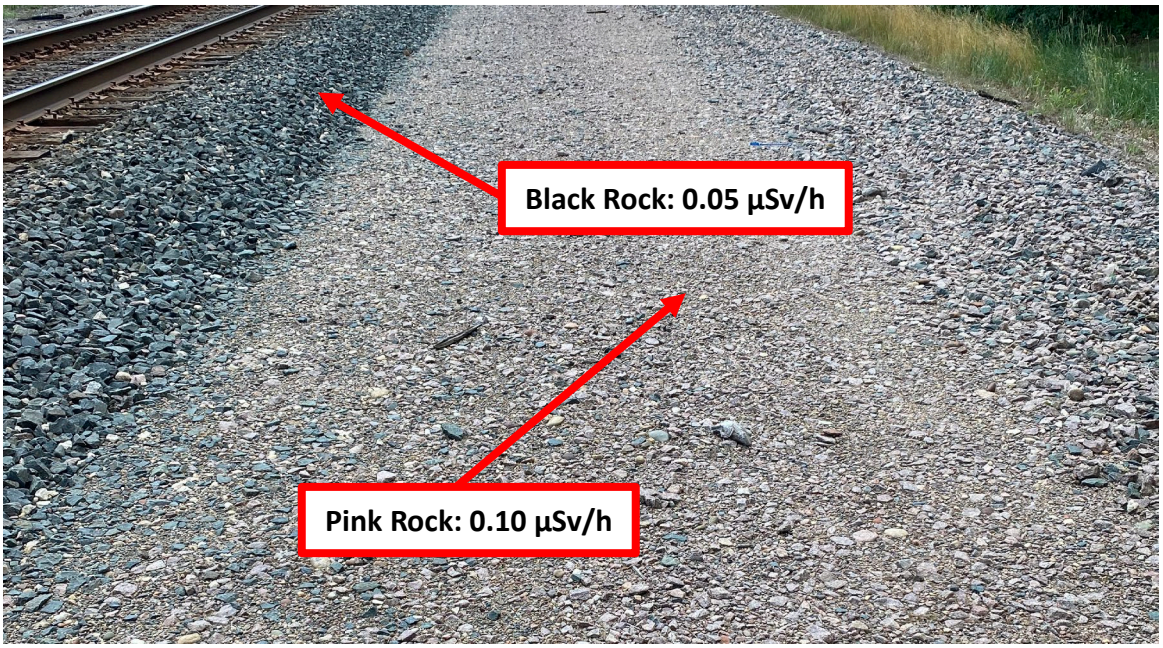


Figure 10. Pink and Black Rock Near Rail Line

Rail Line Near Church and Unguarded Crossing North of Church

The fourth location surveyed was the rail line near a church located about 1.25 km west of the PINGP and an unguarded crossing north of the church. Figure 11 shows these locations.



Figure 11. Rail Line Near Church Looking Southwest and Unguarded Rail Crossing North of Church Looking North

Sturgeon Lake Road Grade Crossing

The fifth location surveyed was the Sturgeon Lake Road grade crossing which is located 2.2 km west northwest from PINGP. This location is the most likely location for an exposure at a grade crossing from a stopped train. Figure 12 shows an aerial view of the Sturgeon Lake Road grade crossing and Figure 13 shows the grade crossing looking northwest and southeast.

In the future, radiation doses from grade crossing exposures at Sturgeon Lake Road would be largely mitigated by the completion of the Sturgeon Lake Road Project (see http://www.red-wing.org/161/Sturgeon-Lake-Road-Project-Overview), which will include the elimination of the

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existing at-grade crossing and construction of an overpass for Sturgeon Lake Road over the Canadian Pacific rail line.

Frontage Road Along Canadian Pacific Rail Line

The sixth location surveyed was the frontage road that runs along Canadian Pacific rail line. The frontage road is located about 2.4 km west northwest from PINGP. Figure 14 shows an aerial view of the frontage road location and Figure 15 shows views of the frontage road looking southeast and northwest.

Church Road Grade Crossing

The seventh location surveyed was the Church Road grade crossing, located about 4.3 km northwest from PINGP. Figure 16 shows an aerial view of the Church Road grade crossing and Figure 17 shows views of the Church Road grade crossing looking northwest and southeast.

190th Street Grade Crossing

The eighth location surveyed was the 190th Street grade crossing located about 8.8 km northwest from PINGP. Figure 18 shows an aerial view of the 190th Street grade crossing and Figure 19 shows views of the 190th Street grade crossing looking southeast and northwest.

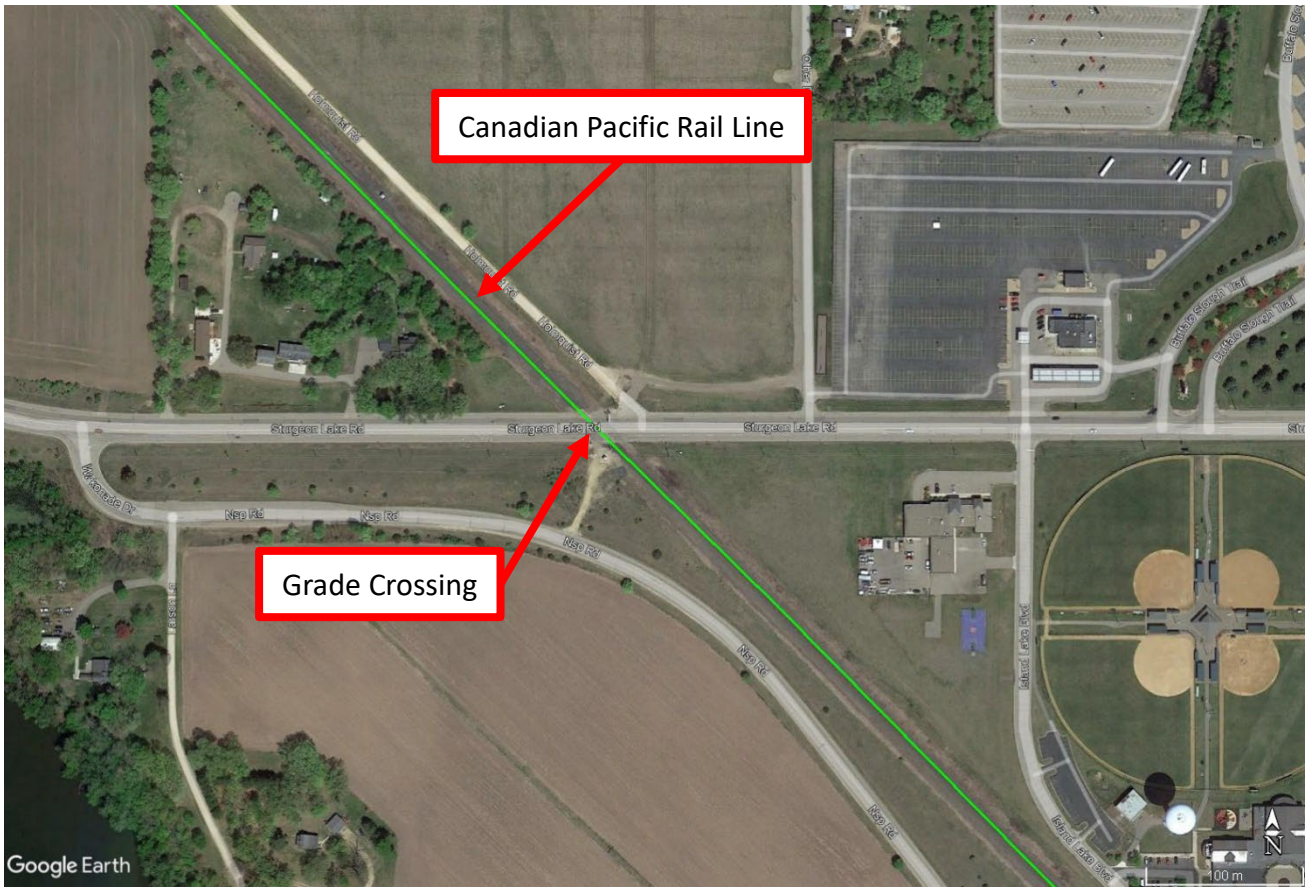


Figure 12. Aerial View of Sturgeon Lake Road Grade Crossing

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Figure 13. Sturgeon Lake Road Grade Crossing Looking Northwest and Southeast

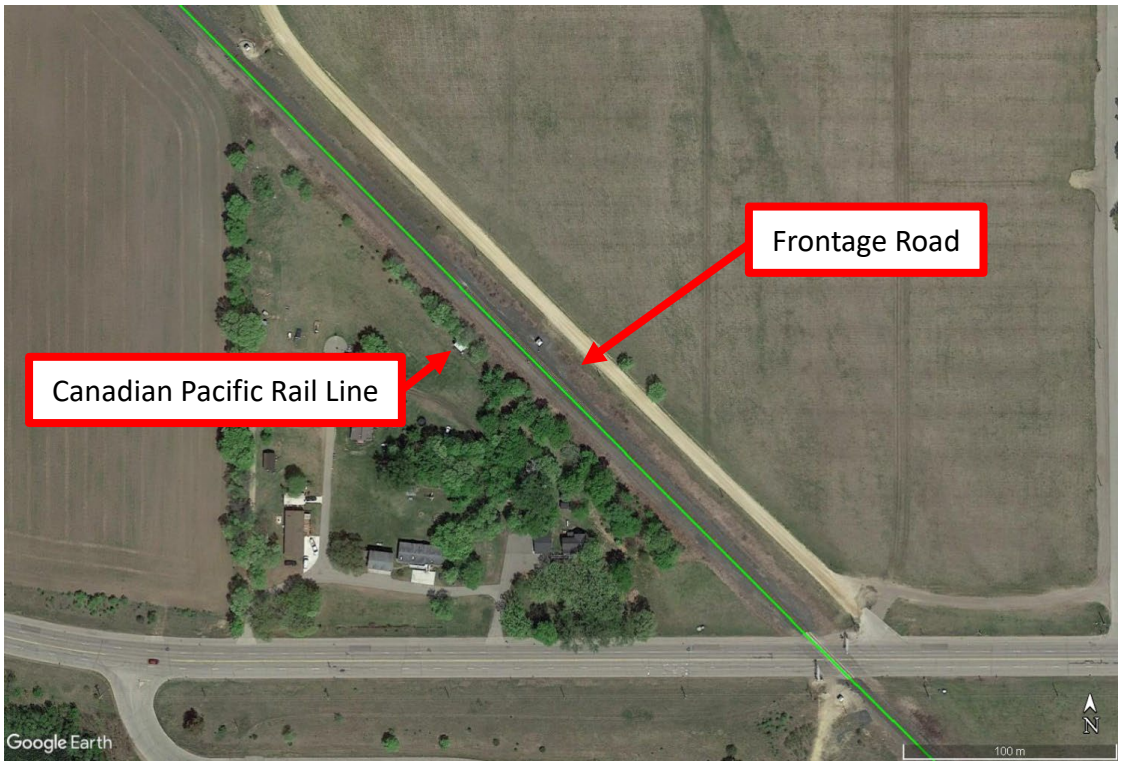


Figure 14. Aerial View of Frontage Road Along Canadian Pacific Rail Line



Figure 15. Frontage Road Along Canadian Pacific Rail Line Looking Southeast and Northwest

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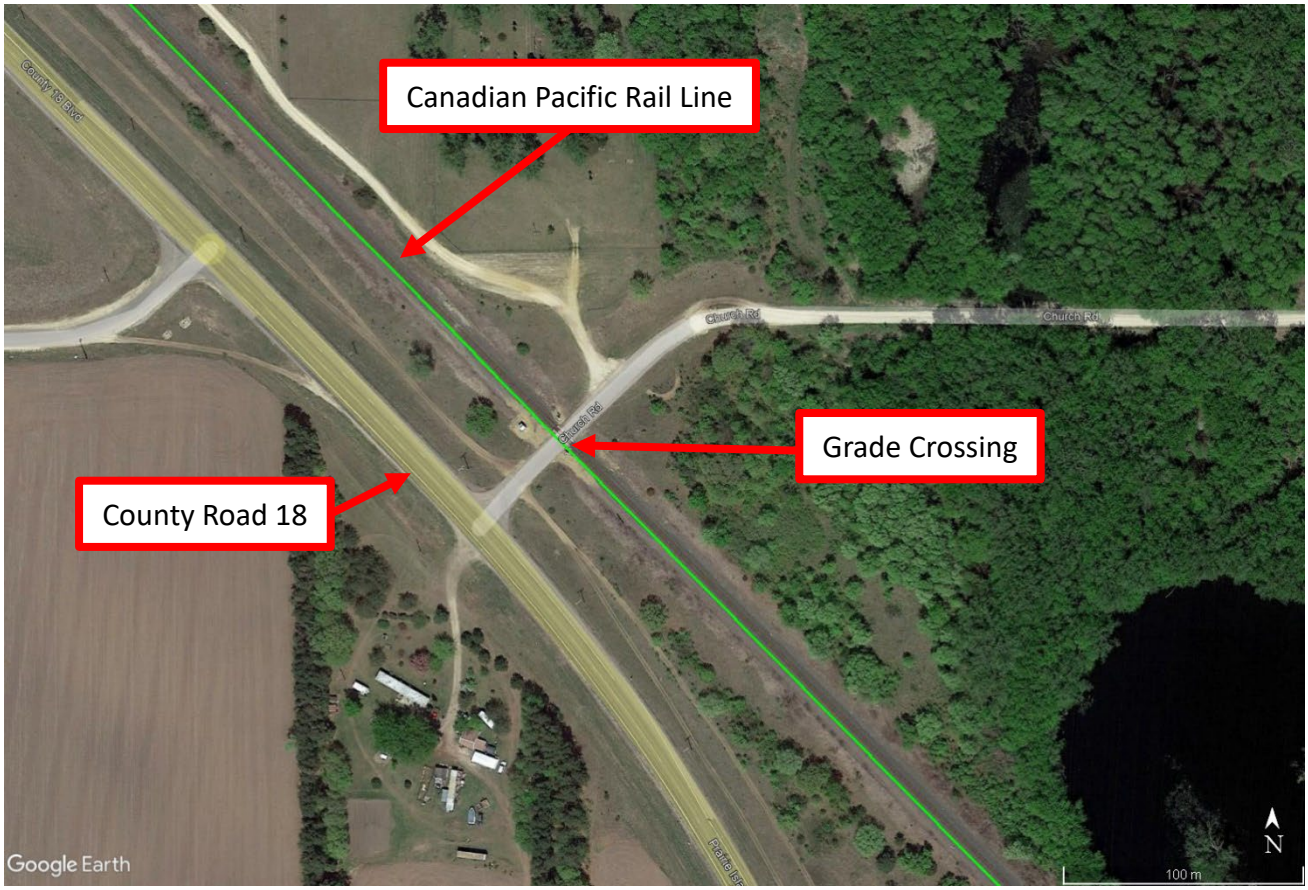


Figure 16. Aerial View of Church Road Grade Crossing



Figure 17. Church Road Grade Crossing Looking Northwest and Southeast

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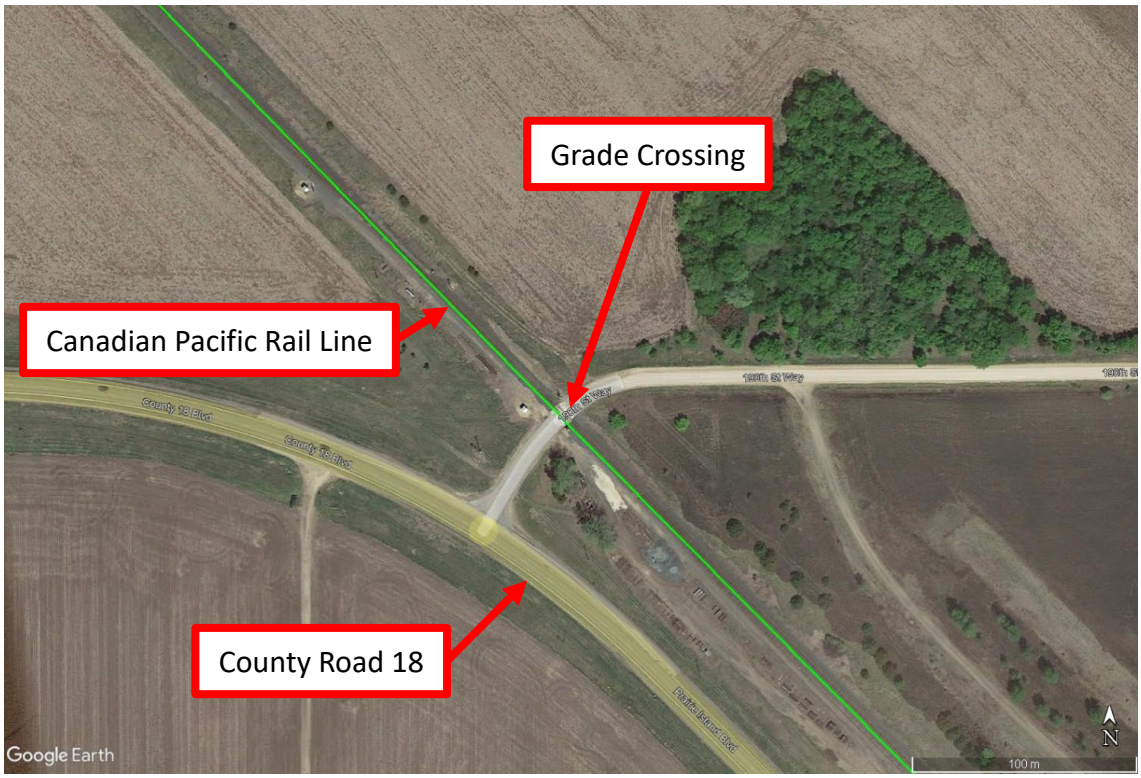


Figure 18. Aerial View of 190th Street Grade Crossing



Figure 19. 190th Street Grade Crossing Looking Southeast and Northwest

Bison Paddocks

The Prairie Island Indian Community maintains a bison herd at paddocks located about 6.4 km west northwest from PINGP. Figure 20 shows an aerial view of the bison paddocks. Figure 21 shows the bison herd and a warning sign posted at the bison paddocks.

To estimate the radiation dose to a bison in the bison paddock, an online biota dose calculator (BiotaDC) from the International Commission on Radiological Protection (ICRP 2017) was used to calculate the radiation dose to a large terrestrial animal like a bison (see http://biotadc.icrp.org/). This dose information was compared to ICRP dose coefficients for humans (ICRP 2020) and then used to develop a comparison of doses between a large animal (i.e., a bison at 1000 kg) and a person. The radiation dose to a bison would be about 20 to 25 percent less than the effective dose

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to a person at the same location for the high energy gamma photons of cesium-137 and cobalt-60, two important radionuclides in spent fuel shipments.

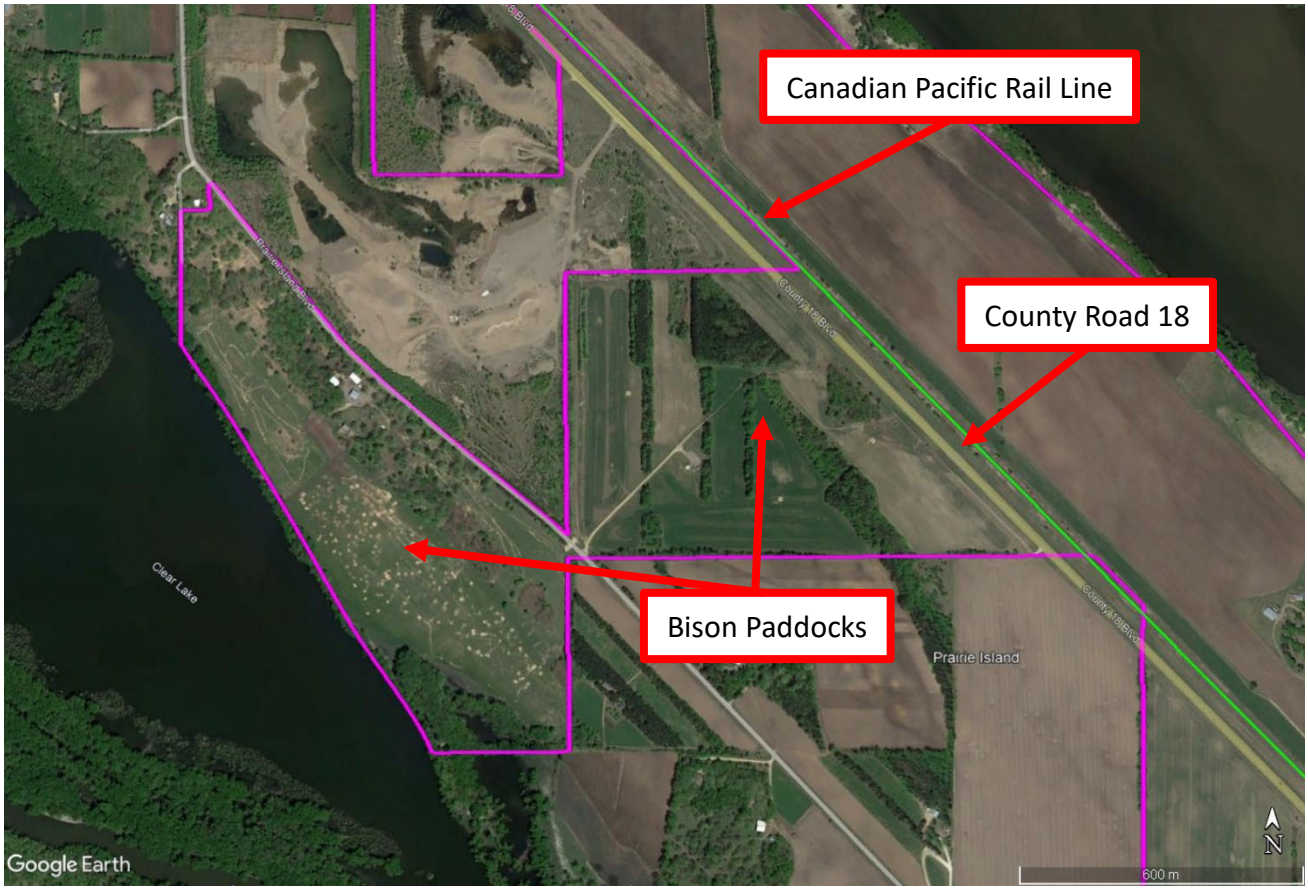


Figure 20. Aerial View of Bison Paddocks



Figure 21. Bison Herd and Warning Sign at Bison Paddock

CONCLUSIONS

This paper discusses the planning, field work, and data collection for a transportation dose assessment that was conducted by the Prairie Island Indian Community, DOE-IWM, and PNNL to estimate the site-specific incident-free radiation doses from shipping SNF by rail from the PINGP through the Prairie Island Indian Community Reservation and Trust Land. Participation by the Prairie Island Indian Community was integral to conducting the transportation dose assessment.

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Nine locations were surveyed along the Canadian Pacific rail line that runs through the Prairie Island Indian Community Reservation and Trust Land and distances were measured to potential locations where radiation exposures could occur. Background radiation dose rates were also measured along the Canadian Pacific rail line.

This paper was a collaborative effort among the Prairie Island Indian Community, DOE-IWM, and Pacific Northwest National Laboratory and will serve as a demonstration of the data, methods, and communication of results that could be used for other site-specific transportation dose assessments.

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Banerjee K., K.R. Robb, G. Radulescu, J.M. Scaglione, J.C. Wagner, J.B. Clarity, R.A. LeFebvre, and J.L. Peterson. 2016. “Estimation of Inherent Safety Margins in Loaded Commercial Spent Nuclear Fuel Casks.” Nuclear Technology, Vol. 195, No. 3, pp. 124-142.

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To: Dr. David Victor, Professor

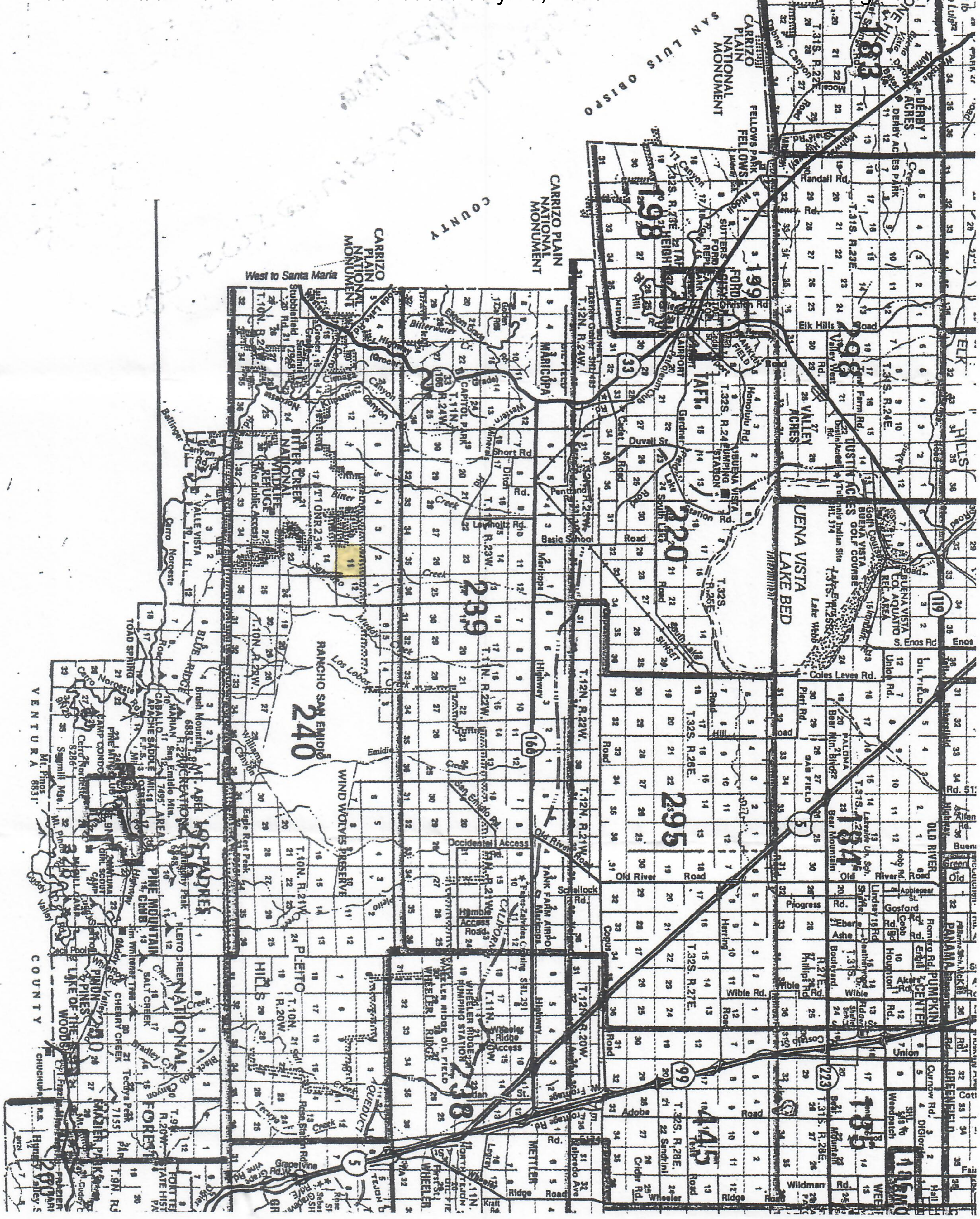
FROM: VITO FRANCESCO
2216 Coolcrest Way Upland, Calif. 91784
Phone # [redacted] (land line only – NO text – NO E-Mail)

We own 80 acres of land in Maricopa, Calif. in Kern County Calif. The Kern County APN is: 240-192-06. The legal is: S 1/2 of the NE 1/4 of Sec. 11, T 10N, R 23W, SBBM. Highway 166 is North of the 80 acres and Santiago Creek is East of the 80 acres. Please take a look at these 80 acres. Maybe they might be good for you and your group to use to store the Nuclear waste from your San Onofre Nuclear Generating Station. Let me know what you think. Maybe we can work together and do something good for everyone. Thank you for your time and consideration. Hope to hear from you.

Sincerely, Vito

Phone # [redacted]

Description: Kern,CA Assessor Map 240.19 Page: 1 of 1
Order: for Bill Mickelson Comment:


SAN LUIS OBISPO
COUNTY
CARRIZO PLAIN NATIONAL MONUMENT
West to Santa Maria
MARICOPA
TAFT
BUENA VISTA LAKE BED
BITTER CREEK NATIONAL WILDLIFE REFUGE
RANCHO SAN EMIDIO
240
239
220
295
WIND WOLVES PRESERVE
LOS PADRES
NATIONAL FOREST
PINE MOUNTAIN CLUB
VENTURA
COUNTY
WHEELER RIDGE
Old River Rd.
Elk Hills Road