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Sherri Thompson
Project Manager
Bureau of Land Management
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215
(303) 239–3758

Re: Programmatic Environmental Impact Statement and Possible Land Use Plan Amendments for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the Bureau of Land Management in Colorado, Utah, and Wyoming

Dear Ms. Thompson,

Thank you for this opportunity to provide scoping comments to the Bureau of Land Management (BLM) on the Programmatic Environmental Impact Statement (PEIS) for the development of oil shale and tar sands (OSTS) in Utah, Colorado and Wyoming (tri-state). This comment letter is submitted on behalf of the members of Living Rivers/ Colorado Riverkeeper, Center for Biological Diversity, Peaceful Uprising, and Grand Canyon Trust.

The Colorado Plateau and the surrounding Rocky Mountain region is not an energy colony, it is a vital watershed for seven states, tribes and the nation of Mexico. Indeed, it is probably the most sublime watershed that has ever existed on Earth. Unfortunately, energy corporations are poised to transform this landscape into a national sacrifice area where all non-renewable resources will be completely consumed by the end of the 21st century. To paraphrase Aldo Leopold, they fully intend to squeeze the last drop of utility out of this land, which has the same desperate finality as having to chop up the furniture to keep warm.

This watershed is also an ecosystem. It provides free ecological services for the benefit of millions of people and other living things. The upper Colorado River basin provides drinking water for 30 million people. It is also the last refuge of wildlife for the region and the only place that yet remains to recover threatened and endangered endemic species. It will not be a burden on society to ask Congress and the multiple-use federal agencies to spare, as Wallace Stegner once emphasized, this "geography of hope."

Overall, if the federal government allows OSTS development to occur in this watershed and ecosystem, it essentially means that exploiting non-renewable energy resources is more important than water security. It also means this nation will never take seriously the urgency of greatly reducing pollution and greenhouse gases into the atmosphere. Additionally, the nation's energy portfolio will never include a dominant paradigm of cleaner and renewable energy development for a more resilient future.

1. CONGRESS MUST REPEAL THE ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005 states that the development of OSTS will reduce the growing dependence this nation has on foreign oil, and that this action will be done in an environmentally and sustainable manner. This is a tall order for an industry that yet remains in the formative stages of research and development to prove the extraction of this resource is even viable (Headwater Economics, 2010[1] & Western Resource Advocates, 2010[2]), or that it can be accomplished without huge diminishing returns; an industry that already has a reputation of boom and bust cycles that has generated cultural despair and angst (Colorado University, 2009[3]). What Congress should have enacted, instead, was a energy policy that greatly reduces internally this nation's dependence, consumption and reliance on fossil fuels. Where the fossil fuels come from is completely irrelevant, especially in the existing and encouraged economic framework of free world trade.

The citizens of the USA have been promised clean energy for decades by presidents and Congress, and we ask where are the deliverables? The Energy Policy Act of 2005 is the biggest step in the wrong direction this country has ever taken to achieve a truly resilient and brighter future. Therefore, we respectfully ask that Congress and the Department of Interior withdraw the Energy Policy Act of 2005 and this Programmatic Environmental Impact Statement (PEIS). In its place, we ask Congress to provide legislation that better fits the urgent times we now live in; legislation that does not perpetuate the broken promises of achieving a sustainable national energy policy that future generations can actually rely on. We also recommend that a PEIS be initiated immediately to restore and enhance the compromised water and air sheds of the Colorado River basin.

2. SECRETARIAL ORDERS & FEDERAL CLIMATE CHANGE SCIENCE

OSTS development will seriously load the atmosphere with carbon dioxide and intensify the dust on snow (Painter et al, 2010[4]) problem in the Rocky Mountains. Department of

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[1] http://www.riversimulator.org/Resources/farcountry/OilGas/14Questions2010HeadwaterEconomics.pdf

[2] http://www.riversimulator.org/Resources/NGO/FossilFoolishnessWRA2010.pdf

[3] http://www.riversimulator.org/Resources/University/ReportOilShale2009CU.pdf

[4] http://www.riversimulator.org/Resources/ClimateDocs/ColoradoRiverRunoffDustRadiativeForcingPainter2010.pdf

Interior (DOI) Secretary Salazar has informed (DOI video, 2009[5]) the water users of the Colorado River that one of his top priorities is to assure dependable water supplies for the basin and to reduce carbon emissions, since the impacts of climate change are expected to reduce Colorado River flows between 10 and 20 percent in the next 40 to 50 years (Reclamation Report, 2011[6]).

We also remind BLM that this process must consider the following Secretarial Orders: *Addressing the Impacts of Climate Change on America's Water, Land and other Natural and Cultural Resources* (#3289[7] & Plan[8]); and *Ensuring Scientific Integrity Within the Department of Interior* (#3305[9]). See also 2008 OSTS PEIS comments by California's Attorney General here.[10]

Life cycle assessments of greenhouse gas emissions have found that tar sands generate approximately three times the emissions as conventional oil, while oil shale generates approximately twice the emissions. The extraction and consumption of OSTS will only increase the climatic stress on the Colorado River Basin and BLM must take the climate impacts on water into account.

On the matter of DOI's climate change science plan, BLM must consult with the US Geologic Survey's National Climate Change and Wildlife Science Center,[11] the Regional Climate Science Centers,[12] and Western Water Assessment,[13] which is a program of the National Atmospheric and Oceanic Administration and located in Boulder, CO. BLM must also consult with the leadership of the Bureau of Reclamation (Reclamation) that is involved in a Basin Study[14] to determine the impacts of climate change on the supply and demand side of Colorado River management.

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[5] http://www.youtube.com/watch?v=vEPiHMMIYI4

[6] http://www.riversimulator.org/Resources/USBR/SECUREWaterReport.pdf

[7] http://www.riversimulator.org/Resources/USBR/SecOrder3289.pdf

[8] http://www.doi.gov/whatwedo/climate/strategy/loader.cfm?csModule=security/getfile&PageID=23288

[9] http://www.riversimulator.org/Resources/GCDAMP/GCDAMPchronicle/SectarialOrder3305ScienceIntregrity.pdf

[10] http://www.riversimulator.com/Resources/farcountry/OilGas/OSTScommentsCADOJ2008.pdf

[11] http://nccwsc.usgs.gov/

[12] http://www.doi.gov/news/pressreleases/Secretary-Salazar-Launches-New-Regional-Climate-Science-Center-and-Water-Census-at-Meeting-of-Colorado-River-Basin-Water-Leaders.cfm

[13] http://wwa.colorado.edu/

[14] http://www.usbr.gov/lc/region/programs/crbstudy.html

3. WATER SCARCITY

According to a report by the Government Accountability Office (GAO-11-35[15]) the water required to market one barrel of kerogen ranges from 1 to 12 barrels. The average of this water range is 6 barrels. The volume of kerogen in the Green River Formation is estimated to be 800 billion barrels. Therefore, the average amount of water to develop this kerogen is 4,800,000,000,000 barrels. The annual yield of the Colorado River basin (not adjusted to climate change) is 15 million acre-feet, or 116,375,500,000 barrels. Therefore, the average amount of water required to develop the kerogen of the Green River Formation will amount to 41 years of the entire flow of the Colorado River. If you add the water required to develop and process the estimated 12-19 billion barrels of tar sands in Utah, the immensity of the water scarcity problem is further intensified.

Since the Colorado River is already over-appropriated (Reclamation graphic[16]) and Reclamation has made a determination (Reclamation, 2011[17]) that climate change will reduce the annual yield of the Colorado River by 1 to 2 million acre-feet (maf) in 40 to 50 years, there clearly is not enough water in the basin to fully develop heavy oil resources in the tri-state area. This one fact alone is sufficient grounds for the federal government to withdraw all OSTS leases from development by the oil corporations. This fact also shines a light on the speculative nature of the entire OSTS research and development program because it is reluctant to openly address the overwhelming reality of the water scarcity issue (CERES, 2010[18]).

4. SALINITY AND HEAVY METALS

The purpose of the Colorado River Salinity Control Act of 1974[19] is to incrementally reduce the salinity of the Colorado River basin, especially for end-of-the-pipe water users such as Tucson, San Diego, and Tijuana. The major cause of increased levels of salinity and associated heavy metals in the basin are trans-basin diversions and land use practices on the Colorado Plateau.

Trans-basin diversions are defined as water that is diverted from the native Colorado River watershed to communities that exist in adjacent river basins. For example, the Front Range communities of Colorado are in the Mississippi River basin; the Wasatch Front communities of Utah are in the Great Salt Lake basin; and Albuquerque is the Rio Grande River basin. The water is diverted in the headwater regions of the Rocky Mountains and high plateaus where the quality is quite excellent. However, once the Colorado River enters the Colorado Plateau, which includes the OSTS study area, the water quality diminishes because of the natural erosion of these marine and lucustrine

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15 http://www.gao.gov/products/GAO-11-35

16 http://www.riversimulator.org/Resources/Graphs/CoRiverBasinSupplyAndUseUSBR.jpg

17 http://www.riversimulator.org/Resources/USBR/SECUREWaterReport.pdf

18 http://www.riversimulator.org/Resources/NGO/OilShaleCoalToLiquidRisksCeres2010.pdf

19 http://www.usbr.gov/uc/progact/salinity/

sedimentary rock deposits. Since the purest of Colorado River water is diverted before it even gets to the Colorado Plateau, the concentration of salts and heavy metals is exasperated. Reductions in flow from proposed diversion projects, such as the Flaming Gorge Pipeline[20] and Lake Powell Pipeline,[21] could also seriously aggravate the water quality issues of the Colorado River basin in the future.

Mitigation of salinity and heavy metal concentrations in the Colorado RIver basin is already an ongoing project that requires the spending of millions of dollars annually. It is not speculative to say that OSTS operations and mine waste will increase salinity and heavy metal concentrations in the Colorado River basin. Therefore BLM should consult with the Colorado River Salinity Control Forum,[22] Reclamation, and to the major water purveyors in the lower basin such as the Metropolitan Water District of Southern California,[23] Central Arizona Project,[24] and the Southern Nevada Water Authority.[25] BLM should also consult with Western Area Power Administration, since their hydropower revenues pay (WAPA MOU, 2011[26]) for the programs of the Salinity Control Act.

5. OIL SHALE EXTRACTION

To extract the kerogen in shale, the rock must be heated to very high temperatures that range from 650 to 1,000 degrees Fahrenheit. This cooking process is known as retorting and can be accomplished by two methods. One method involves traditional mining operations, either strip mining or underground mining, which brings the crushed rock to the surface for retorting and eventual processing at a refinery.

The other method is called in-situ, which means the retorting process is done in place (underground) and accomplished by drilling a series of strategic wells to heat the rock and another series of wells to pump the liberated kerogen to the surface. This method also requires a series of wells that will inject water into the host rock, which is then frozen with refrigerants in order to create a curtain that traps the kerogen so that it does not migrate away from the extraction wells. These frozen walls also prevents kerogen from migrating toward ground-water aquifers, which would become polluted.

Obviously in-situ and surface retorting requires huge amounts of energy for both the heating and/or freezing of the host rock. Electrical energy is not currently available regionally for OSTS development, unless more generating stations are built.

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[20] http://www.nwo.usace.army.mil/html/od-tl/eis/RWSP-EIS.html

[21] http://www.water.utah.gov/lakepowellpipeline/

[22] http://www.coloradoriversalinity.org/

[23] http://www.mwdh2o.com/

[24] http://www.cap-az.com/

[25] http://www.snwa.com/html/

[26] http://www.wapa.gov/CRSP/ratescrsp/documents/MOABasinFund.pdf

Additionally, the amount of native natural gas or kerosene energy that could be used for processing will be exorbitant. Building power plants and using vast amounts of energy to produce energy at the cost of vital water, air and wildlife resources is not a good management practice. The intensity of this energy demand begs the question about the need to address the economic principle of diminishing returns. It also begs the question why these kinds of investments are not diverted instead to clean energy technologies and applications for the nation.

Regardless of the huge resources of energy required to produce a useable fuel, the impacts of increased carbon emissions from this development will wreck havoc on an already impaired atmosphere that will further stress the increasing dryness of the Colorado River watershed.

6. TAR SANDS EXTRACTION

The proposed tar sand mining in Utah will significantly and adversely affect the ecosystem on many levels and by many means. The process of extracting and mining the tar sands requires large volumes of clean water and creates large volumes of polluted water. Impacts to groundwater and nearby riparian areas will be sustained as a result of the mine activity, with possible risk to species of concern such as sage grouse, the Mexican spotted owl, and sensitive soil and plant species.

The ecological destruction on the scale of tar sand mining is not worth the resource recovered: the estimated extent of Utah tar sand is 12 – 19 billion barrels,[27] and with US oil consumption at about 19 million barrels per day,[28] the total oil recovered would be about 2-3 years of the total US supply. The price of this extraction is irreparable damage to a unique American landscape and ecosystem that provides valuable habitat as well as supports sustainable human use.

The tar sand mining will create a landscape that does not ecologically function equivalent to the pre-mining condition. In addition to low reclamation success rates and inherent design flaws, mining creates a temporal loss of ecosystem functions that is not addressed even by successful reclamation.

7. REFINING TAR SANDS

The process of upgrading and refining tar sands exposes communities near mines and refineries to increased levels of highly toxic chemicals and heavy metals. The USGS has found in 2007 that "natural bitumen" contains 11 times more sulfur, six times more nitrogen, 11 times more nickel, and 5 times more lead than conventional oil. Both sulfur dioxide and nitrogen dioxide are criteria pollutants under the Clean Air Act and are

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[27] Argonne National Laboratory. *Potential Ground Water and Surface Water Impacts from Oil Shale and Tar Sands Energy-Production Operations*, US Dept. of Energy, October 2006.

[28] US Department of Energy web site, accessed on 5/13/2011. http://www.eia.doe.gov/energyexplained/index.cfm?page=oil_home#tab2

known hazards to human health and the environment.[29] Lead is considered an OSHA carcinogen, criteria pollutant and hazardous air pollutant by the EPA, while nickel is an OSHA carcinogen and hazardous air pollutant. A report by the Environmental Integrity Project explains that "the human health effects from SO2, H2S, NOX, lead and nickel include premature death; cancer; permanent lung damage; reproductive, neurological, developmental, respiratory, and immunological problems; cardiovascular and central nervous system problems; bio-mutations; respiratory illness (including bronchitis and pneumonia); and aggravation of heart conditions and asthma. Environmental damage caused by these pollutants includes acid rain; concentration of toxic chemicals up the food chain; the creation of ground-level ozone and smog; visible impairments that migrate to sensitive areas such as National Parks; and depletion of soil nutrients."[30]

Canadian imports of tar sands crude make up approximately 20–25 percent, or about 30,000 barrels per day, of the refinery crude runs in the Salt Lake City area.[31] In 2009, tar sands crude was known or likely to be processed at refineries in Sinclair, Guernsey, and Cheyenne, WY, Commerce City, CO and at two refineries each in Salt Lake City, and Woods Cross, UT.[32] The production of tar sands crude from Uinta Basin tar sands and oil shale will require the expansion of refining capacity.

During the winter, a weather inversion traps air in the Salt Lake valley, trapping exhaust from vehicles and industrial sources. This results in the some of the worst urban air pollution in the country. The Utah Department of Environmental Quality's Division of Air Quality routinely issues health advisories due to severe air pollution. It is expected that most of tar sands crude extracted from eastern Utah would be refined in either Salt Lake City or Woods Cross (also in the Salt Lake valley). This additional pollution will put Utah's largest population center at risk for increased health impairments due to air pollution. The BLM needs to take into account the impact that refining tar sands and oil shale crude would have on air quality and human health. The refining of dirty fuels must be addressed by Congress and DOI.

8. TAR SAND MINING PROCESS

It is uncertain how large the operations may be Utah, so we will discuss the techniques and applications that are currently being used in Alberta, Canada and proposed for eastern Utah.

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[29] Wakefield, Benjamin, and Matt Price. Tar Sands: Feeding U.S. Refinery Expansions with Dirty Fuel. Environmental Integrity Project, 2008. http://environmentalintegrity.org/pdf/publications/**Tar_Sand**_Report.pdf

[30] Wakefield, Benjamin, and Matt Price. *Tar Sands: Feeding U.S. Refinery Expansions with Dirty Fuel.* Environmental Integrity Project, 2008. http://environmentalintegrity.org/pdf/publications/**Tar_Sand**_Report.pdf

[31] Gwynn & Hanson, 2009

[32] Burnham, Morey. Tracking Tar Sands Crude. Earthworks, April 2010. http://www.earthworksaction.org/pubs/GulfCoastRefineries_ResearchNote1.pdf

Tar sands deposits near the surface can be recovered by open-pit mining techniques. These systems use large hydraulic and electrically powered shovels to dig up tar sands and load them into enormous trucks that can carry up to 320 tons of tar sands per load. For example, the Syncrude and Suncor oil sands operations near Fort McMurray, Alberta, use the world's largest trucks and shovels to recover bitumen. The trucks haul the tar sands to crushers that break up lumps and remove rocks. Photos of the operations there can be found here.[33]

The tar sand mining process is also summarized below, according to the US Department of Energy:

> The properties and composition of the tar sands and the bitumen significantly influence the selection of recovery and treatment processes and vary among deposits. In the so-called "wet sands" or "water-wet sands" of the Canadian Athabasca deposit, a layer of water surrounds the sand grain, with the bitumen partially filling the voids between the wet grains. The bitumen can be separated from the sand by using water. Utah tar sands lack the water layer; the bitumen is directly in contact with the sand grains without any intervening water and is sometimes referred to as "oil-wet sands." Processing beyond water washing is needed to recover the bitumen (Daniels et al. 1981. *Daniels, J.I., L.R. Anspaugh, and Y.E. Ricker, 1981, Technology Assessment: Environmental, Health, and Safety Impacts Associated with Oil Recovery from U. S. Tar-Sand Deposits, October 13*).
>
> *Processing*: After mining, the tar sands are transported to an extraction plant, where a hot water process separates the bitumen from sand, water, and minerals. The separation takes place in separation cells. Hot water is added to the sand, and the resulting slurry is piped to the extraction plant where it is agitated. The combination of hot water and agitation releases bitumen from the oil sand. The bitumen forms into a froth layer that floats to the top of the separation vessel where it is skimmed off. Further processing removes residual water and solids. The bitumen is then transported and eventually upgraded into synthetic crude oil. About two tons of tar sands are required to produce one barrel of oil. Roughly 75% of the bitumen can be recovered from sand. After oil extraction, the spent sand and other materials are then returned to the mine, which is eventually reclaimed.
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> *In-Situ Production*: In-situ recovery is used for bitumen deposits that are buried too deeply for mining to be practical. Most in-situ bitumen and heavy oil production comes from deposits buried more than 400 meters below the surface of the earth. Some of the production methods that have been used or proposed include:
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> - Cyclic steam stimulation (CSS), also called "huff and puff,"
> - Steam-assisted gravity drainage (SAGD),

[33] http://ostseis.anl.gov/guide/photos/index.cfm

- Vapor extraction process (VAPEX),
- Toe-to-heel air injection (THAI) or a variant known as CAPRI,
- Cold heavy oil production with sand (CHOPS), and
- Pressure pulsing technology (PPT).

> These involve different combinations of injecting steam or solvents through horizontal or vertical wells. Some description of these technologies can be found in NEB (2006), Alberta COR (2004), and Dusseault (2002). (*NEB, 2006, Canada's Oil Sands − Opportunities and Challenges to 2015: An Update, National Energy Board of Canada, June. Alberta COR, 2004, Oil Sands Technology Roadmap – Unlocking the Potential, Alberta Chamber of Resources, January. Dusseault, M.B., 2002, CHOPS, Cold Heavy Oil Production with Sand in the Canadian Heavy Oil Industry, prepared for the Alberta Department of Energy, March.*)
>
> Bitumen requires additional upgrading before it can be refined. Alberta COR (2004) notes that essentially all of the bitumen mined in Alberta is upgraded. The process involves two steps. The first step uses coking and catalytic conversion processes. The second step uses hydroprocessing to increase the hydrogen content of the synthetic crude oil.
>
> After upgrading, the synthetic crude oil is piped to a refinery. Because it is so viscous, bitumen normally requires dilution with lighter hydrocarbons to make it transportable by pipelines.[34]

More specifically, the process is known to create toxic aquatic by-products whether chemically treated or not:

> The alkaline pH of the hot water extraction process used to separate bitumen from the oil sands dissolves the naphthenic acids and concentrates them in an aqueous slurry. The slurry, containing water, sand, clay, naphthenic acids, residual bitumen and inorganic and organic constituents, is known as oil sands tailings, and these tailings are stored on site in large settling ponds. As the solids separate from the tailings, water is released forming a surface water layer with low solids. The so-called ''process-affected water'' is recycled back to the extraction plant. Process-affected waters can contain 20–120 mg naphthenic acids l^{-1} ['l^{-1}' means 'per liter'] (Holowenko et al., 2002) and these acids are the most toxic components to aquatic organisms (MacKinnon and Boeger, 1986; Verbeek et al., 1994). Because of their toxicity, process-affected waters are not intentionally released to any receiving waters, and the oil sands companies are accumulating and storing vast volumes of these waters. Although some of the process-affected waters are not acutely toxic to fish, there are sublethal effects for fish exposed to oil sands waters containing naphthenic acids (Nero et al., 2006). Oil sands process-affected waters contain countless different compounds,

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[34] Argonne National Laboratory. *Potential Ground Water and Surface Water Impacts from Oil Shale and Tar Sands Energy-Production Operations*, US Dept. of Energy, October 2006.

> residual bitumen, heavy metals, polycyclic aromatic hydrocarbons [PAHs], benzothiophenes, dibenzothiophenes, and naphthenic acids (MacKinnon, 1989; Madill et al., 2001), which may contribute to fish toxicity (MacKinnon and Boeger, 1986; Nix and Martin, 1992) or fish tainting (Koning and Hrudey, 1992).

Additionally, the BLM's 2008 Programmatic Environmental Impact Statement concluded that upgrading tar sands for transport to a refinery, would require another 20 barrels of water per barrel of oil. Because upgrading is necessary for transport, this water use will necessarily take place on-site in Utah.

The United States Geological Society (USGS) conducted a 1984 study that identifies 21.6 billion barrels of measured tar sands and 32.1 billion speculative barrels of tar sands in the United States. Of the recoverable deposits, only 15 percent were deemed recovered by surface mining techniques and the remaining 85 percent would require in-situ extraction.[35]

The majority of tar sands deposits in the country are found in Utah, primarily in the Uintah Basin in the northeastern part of the state and in central southeastern Utah. It is estimated that Utah has between 19 and 29 billion barrels of oil contained in tar sands deposits, but only 11 billion barrels would be recoverable.[36] Ninety-six percent of Utah's total tar sand resource is found in the P.R. Spring, Sunnyside, Hill Creek, Asphalt Ridge, Tar Sand Triangle, and Circle Cliffs deposits.[37] These deposits are located in the Colorado River basin, which includes such major tributaries as the Green, White and Duchesne Rivers. Not only are tar sands found in one of the most important watersheds in the country, they are in close proximity to several national monuments and parks (Dinosaur NM, Colorado NM, Arches NP, and Canyonlands NP) and some of the most stunning landscapes in the country. Utah's $7.3 billion recreation industry provides 113,000 jobs around the state and brings more than 19 million visitors to the state. Tar sands and oil shale mining threaten the pristine landscape that brings tourists from around the world to Utah.

According to the Utah Mining Association (UMA), "the diverse nature and physical orientation of the tar sands deposits will necessitate differing extraction methods, ranging from surface mining to site-specific in-situ technologies." This means that different processes would be used, requiring different oversight and permitting procedures. Additionally, this means that tar sands extraction will not achieve the economies of scale of the Canadian tar sands industry (though in that case economies

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[35] Humphries, M. *North American Oil Sands: History of Development, Prospects for the Future.* Congressional Research Service, 2008.

[36] Task Force on Strategic Unconventional Fuels. *Development of America's Strategic Unconventional Fuels,* Vol. III - Resource and Technology Profiles, September 2007, pg. III-54, http://www.unconventionalfuels.org/publications.html

[37] Gwynn, J. and Hanson, F. *Annotated bibliography for Utah Tar Sand Deposits.* Utah Geological Society, 2009. http://geology.utah.gov/online/ofr/ofr-503.pdf

of scale means the destruction of an area the size of Florida in the boreal forest of Alberta).

There are significant difference between the tar sands deposits in Utah and those in Canada. First, the Canadian deposits are much larger and the oil saturations of the Canadian deposits are frequently twice those of the Utah deposits. This means that significantly more ore from Utah must be processed than in Canada to produce a single barrel of tar. Additionally, the tar sands of Utah are “oil wet,” which means that the bitumen adheres directly to the sand grains. Canadian tar sands are “water wet,” meaning that there is a film of water separating the bitumen from the sand. This distinction means that the water intensive extraction processes used in Canada are not viable options for Utah. Instead, companies plan to use extremely potent chemical solvents to essentially melt the tar away from the sand.

The Utah Mining Association has found that “Utah tar sands (typically quartz sandstones) exhibit compressive strengths 3 to 4 times that of Athabasca ores and consequently cannot be mined by truck and shovel methods. Tar sands from highly consolidated beds must be mined using hard rock techniques and equipment prior to processing in extraction plants, adding a significant premium to the overall costs of production.”[38]

Extraction of tar sands will also require substantial consumption of natural gas. Natural gas is used for operating the upgrading equipment and producing heat and steam for separating the bitumen from the sand. A Congressional Research Service report found that “natural gas accounts for 15% of the operating costs in mining operations.”[39] Because of the energy intensive process involved in extracting, upgrading and refining tar sands, the energy return on investment (EROI) for tar sands has been estimated between 1:1 and 7:1, meaning that 1 unit of energy put in to extracting tar sands only produces between 1 and 7 units of energy from the fuel.[40] Conventional crude oil has an EROI of about 20:1, indicating that tar sands are far less energy efficient than conventional oil.

Further, the UMA found that transportation of tar sands crude from the mines to refineries would require additional road, rail and pipeline infrastructure, and would represent approximately 25 percent of total production costs. Additional infrastructure such as transmission lines for electricity and pipelines to sources of water and natural gas would also be necessary. This level of physical infrastructure would increase the cost of extraction, much of which would be borne by the counties and local governments, and increase the environmental impact of mining operations.

9. TOXIC POLLUTANTS FROM TAR SAND MINING PROCESS

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[38] Utah Mining Association. *Development of Utah Oil Shale and Tar Sand Resources*. 2008.

[39] Humphries, 2008.

[40] Glick, D. *Fossil Foolishness: Utah’s Pursuit of Tar Sands and Oil Shale*. Western Resource Advocates, 2001. http://www.westernresourceadvocates.org/land/utosts/fossilfoolishness.pdf

The BLM's 2008 Final Programmatic Environmental Impact Statement on oil shale and tar sands states that, "support[ing] immediate leasing decisions would require making many speculative assumptions regarding potential, unproven technologies." Although there is no current mining of tar sands on public land, early tar sands mining operations on state-owned land in Utah suggests the kind of development that would occur on BLM land. There is currently one company in Utah with a permit to mine tar sands, Temple Mountain Energy, but the company primarily mines tar sands for asphalt, rather than for crude oil. A second company, Earth Energy Resources (EER), is in the permit application process to mine tar sands for crude oil. The application is currently tied up in litigation due to EER's failure to document the full environmental impacts of its operations.

The process of both mining and processing the tar sand will create toxic materials that will pollute the nearby terrestrial and aquatic ecosystems. Some of the toxic materials are discussed in this section. They include naphthenic acids, polycyclic aromatic hydrocarbons (PAH or PAC) such as pyrene and naphthalene, and terpenes. Earth Energy Resources plans to separate bitumen from the sand using chemicals called orange terpenes (mostly d-Limonene).[41] Terpenes like limonene are found in air fresheners and cleaning supplies, and are volatile organic compounds (VOCs) that evaporate readily.[42] Limonene is a very toxic substance and can harm humans: it causes irritation of airways when evaporated, and the harmful effects are increased when it reacts with ozone, a common air pollutant.[43]

Other toxic chemicals found in tar sand mine process water include naphthenic acids, which are corrosives found in detergents, lubricants, corrosion inhibitors, fuel and lubricating oil additives, wood preservations, insecticides, and fungicides:

> The principal cause of toxicity associated with MFT [mature fine tailings] and CT [consolidated, chemical treated] tailings is thought to be naphthenic acids, which are present as sodium naphthenates in dissolved form [1,6,8]. Naphthenic acids are a group of relatively low-molecular-weight (< 500 m/e) carboxylic acids, with varying numbers (zero to five) of polycyclic aliphatic ring structures and aliphatic side chains of various sizes [1,2,6]. There are no surface water quality guidelines for naphthenates in Canada or the United States. However, a maximum permissible limit of 0.15 mg/L of sodium naphthenates in seawater was established in the former Soviet Union [1], which is below the concentrations reported in lakes and rivers of the Athabasca oil sands region… Naphthenates also occur in concentrations >1 mg/L in many undisturbed aquatic systems throughout the Athabasca oil sands region through erosion of sedimentary

[41] Technical Testimony of Charles H. Norris Before the Board of Oil, Gas, and Mining, Dept. of Natural Resources, State of Utah. Docket No. 2010-027 Cause No. M/047/0900 A, Filed 02/16/11.

[42] Wolkoff, Peder, Per A. Clausen, *et al*. Acute airway effects of ozone-initiated d-limonene chemistry: Importance of gaseous products. *Toxicology Letters* 181 (2008) 171–176.

[43] Wolkoff, Peder, Per A. Clausen, *et al*. Acute airway effects of ozone-initiated d-limonene chemistry: Importance of gaseous products. *Toxicology Letters* 181 (2008) 171–176.

> organic material in exposed oil sands [6,20].[44] (*1. Fine Tailings Fundamentals Consortium. 1995. Advances in Oil Sands Tailings Research Volume II: Fine Tails and Process Water Reclamation. Alberta Department of Energy, Edmonton, AB, Canada. 2. Nelson RL, Gulley JR, MacKinnon M. 1995. Environmental issues on reclamation of oil sands fine tails. In Meyer RF, ed, 6th UNITAR International Conference on Heavy Oil and Tar Sands. Houston, TX, USA, February 12–17, pp 705–718. 6. Schramm LL, Stasiuk EN, MacKinnon M. 2000. Surfactants in Athabasca oil sands slurry conditioning, flotation recovery, and tailings processes. In Schramm LL, ed, Surfactants, Fundamentals and Applications in the Petroleum Industry. Cambridge University Press, Cambridge, UK, pp 365–430. 8. MacKay WC, Verbeek AG. 1993. The characterization of acutely toxic compounds in fine tails pore water and tailings pond water. AOSTRA 8878 (Sludge 681). Technical Report. Alberta Department of Energy, Edmonton, AB, Canada. 20. Alberta Environmental Protection. 1996. Naphthenic acids background information discussion report. Technical Report 08.96. Environmental Regulatory Service, Edmonton, AB, Canada.*)

Adverse effects can therefore be expected in the nearby streams similar to what occurred in the recent past, since the mining method is the same. In Canadian tar sand mines, naphthenic acid concentrations of >1 mg/L were found in nearby pristine streams; pollution occurred from erosion created simply mining (cutting into) the tar sands.

These low background levels can still harm fish. The calculated deformity threshold for yellow perch exposed to naphthenic acid is 1.67 mg/L to 7.52 mg/L, and higher levels more significantly affect fish embryo development.[45] When fish eggs were exposed to water with 20 mg/L naphthenic acid, they died after fertilization.[46] One lake near a tar sand mine was tested to contain 84 mg/L of naphthenic acid; fish eggs in this water did not fertilize.[47] It was described as "a 200 ha reservoir … created from an existing lake to supply water to the extraction plant. The lake's water source is the Athabasca River and contains no process-affected waters."[48]

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[44] SHERWIN SIK-CHEUNG LEUNG, MIKE D. MACKINNON, and RALPH E.H. SMITH. AQUATIC RECLAMATION IN THE ATHABASCA, CANADA, OIL SANDS: NAPHTHENATE AND SALT EFFECTS ON PHYTOPLANKTON COMMUNITIES. *Environmental Toxicology and Chemistry*, Vol. 20, No. 7, pp. 1532–1543, 2001.

[45] Lisa E. Peters, M. MacKinnon, et al. Effects of oil sands process-affected waters and naphthenic acids on yellow perch (*Perca flavescens*) and Japanese medaka (*Orizias latipes*) embryonic development. *Chemosphere* 67 (2007) 2177–2183.

[46] Lisa E. Peters, M. MacKinnon, et al. Effects of oil sands process-affected waters and naphthenic acids on yellow perch (*Perca flavescens*) and Japanese medaka (*Orizias latipes*) embryonic development. *Chemosphere* 67 (2007) 2177–2183.

[47] Lisa E. Peters, M. MacKinnon, et al. Effects of oil sands process-affected waters and naphthenic acids on yellow perch (*Perca flavescens*) and Japanese medaka (*Orizias latipes*) embryonic development. *Chemosphere* 67 (2007) 2177–2183.

[48] Lisa E. Peters, M. MacKinnon, et al. Effects of oil sands process-affected waters and naphthenic acids on yellow perch (*Perca flavescens*) and Japanese medaka (*Orizias latipes*) embryonic development. *Chemosphere* 67 (2007) 2177–2183.

Polycyclic aromatic hydrocarbons (PAHs) will also contaminate the land and waters surrounding the mine. In addition to naphthenic acid damage, PAH damage was detected in yellow perch exposed to fractions of oil sand process water: "there was also evidence of exposure to PAHs in these perch, indicated by elevated hepatic 7-ethoxy-resorufin-*O*-deethylase activity and bile fluorescence at the wavelengths of phenanthrene and benzo[a]pyrene."[49]

One study examined the sediments in tar sand mine tailings pond and found a variety of chemicals. "In WWP [waste water pond] sediments, the highest concentrations of PAH were the alkylated PAH and included benzo[a]anthracene/chrysene compounds (BAC1 through BAC4, 80–290 mg/g), C1- and C2-benzofluoranthene/pyrene (BFLPY1, 150 mg/g; BFLPY2, 110); C1- through C4-fluoranthene/pyrene (FLPY1 through FLPY4, 21–31 mg/g), and C1-through C4-phenanthrene/anthracene (P1 through P4, 7.3–34 mg/g)."[50]

These PAH chemicals are produced by tar sand mining at concentrations that are lethal to fish, developing embryos and eggs. "Eggs exposed to oil sands from all three sites demonstrated exposure-related increases in mortality (Fig. 2A). All bitumen exposed groups at and above the threshold of 1.5 g/L (i.e., LOEC) had significantly increased mortality compared to controls (Table 2). Eggs exposed to WWP sediments showed exposure- related increases in mortality at and above a threshold of 3.1 g/L (Fig. 2A and Table 2)."[51]

It is common knowledge that open pit mines are generally dusty places and that the wind blows often in Utah. Despite industry dust control measures, according to the *Proceedings of the National Academy of Sciences*, airborne tar sand dust from actual mining operations does contaminate nearby ecosystems. "Due to substantial loadings of airborne PAC [= PAH], the oil sands industry is a far greater source of regional PAC contamination than previously realized."[52]

A large number of studies focus on the effects of polycyclic aromatic hydrocarbons (PAHs), chemicals that are found in petroleum, and are often found in areas where

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[49] M. R. van den Heuvel, M. Power, J. Richards, M. MacKinnon, A and D. G. Dixon. Disease and Gill Lesions in Yellow Perch (*Perca flavescens*) Exposed to Oil Sands Mining-Associated Waters. *Ecotoxicology and Environmental Safety* 46, 334-341 (2000).

[50] Colavecchia, Maria V., Sean M. Backus. Oil sand toxicity to early life stages of fathead minnows (*Pimephales Promelas*). *Environmental Toxicology and Chemistry*, Vol. 23, No. 7, pp. 1709–1718, 2004.

[51] Colavecchia, Maria V., Sean M. Backus. Oil sand toxicity to early life stages of fathead minnows (*Pimephales Promelas*). *Environmental Toxicology and Chemistry*, Vol. 23, No. 7, pp. 1709–1718, 2004.

[52] Proceedings of the National Academy of Sciences. Oil sands development contributes polycyclic aromatic compounds to the Athabasca River and its tributaries. December 6, 2009: vol. 106, no. 52, pp. 22346 – 22351.

petroleum is spilled, transported, and combusted.[53] Diesel contains PAHs, as does other forms of petroleum (p. 2657).[54] "The percentage of PAHs in crude oil, Bunker C oil, and No. 2 diesel oil are about 1%, 4%, and 9% by weight, respectively" (p. 104).[55]

Other sources of PAHs are "creosote wood preserving facilities, petroleum storage and refinery facilities, paint and chemical manufacturers, combined sewer overflows, and sewage treatment facilities" (p. 93).[56] The dominant PAHs found in diesel and oil are naphthalenes (p. 260).[57] In the past, mothballs have been made of naphthalenes, which are flammable and toxic. PAHs that are larger than naphthalenes are less soluble in water, and can move more rapidly into some aquatic organisms. These PAHs "partition directly from crude oil to lipid rich [fish] tissues coming into contact with oil droplets."[58]

The PAHs released by tar sand mining and processing are bioavailable and harmful to fish and other aquatic organisms.[59] PAHs have been shown to be bioavailable (absorbable) to fish at concentrations of 30.5 – 399.5 ng/L (p. 852).[60] (ng = nanograms, one billionth of a gram; µg = micrograms, one millionth of a gram; 1,000 ng = 1 µg = 0.000001 g). At ingestion levels of 18 – 22 µg/day for 58 days in the lab, comparable to field measurements, juvenile fish show signs of starvation and reduced body mass.[61]

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[53] Meador, J. P., Sommers, F. C., Ylitalo, G. M., & Sloan, C. A. (2006, October). Altered growth and related physiological responses in juvenile Chinook salmon. *Canadian Journal of Fisheries and Aquatic Sciences,* 63: 2364-2376.

[54] Mos, L., Cooper, G., et al. (2008). Effects of Diesel on Survival, Growth, and Gene Expression in Rainbow Trout (Oncorhynchus mykiss) Fry. *Environmental Science & Technology,* Vol. 42, No. 7.

[55] Huntley 1, S. L., Bonnevie, N. L., & Wenning, R. J. (1995). Polycyclic Aromatic Hydrocarbon and Petroleum Hydrocarbon Contamination in Sediment from the Newark Bay Estuary, New Jersey (pp. 93-107). *Arch. Environ. Contam. Toxicol.* 28.

[56] Huntley 1, S. L., Bonnevie, N. L., & Wenning, R. J. (1995). Polycyclic Aromatic Hydrocarbon and Petroleum Hydrocarbon Contamination in Sediment from the Newark Bay Estuary, New Jersey (pp. 93-107). *Arch. Environ. Contam. Toxicol*., 28.

[57] Davis, H. K., Moffat, C. F., et al. (2002). Experimental Tainting of Marine Fish by Three Chemically Dispersed Petroleum Products, with Comparisons to the Braer Oil Spill (pp. 257-278). *Spill Science & Technology Bulletin*, Vol. 7, Nos. 5-6.

[58] Shukla, P., M. Gopalani, et al. Influence of Salinity on PAH Uptake from Water Soluble Fraction of Crude Oil in Tilapia mossambica. Bulletin of Environmental Contamination & Toxicology (2007) 79: 601-605.

[59] Meador, J. P.; Sommers, F. C.; Ylitalo, G. M. & Sloan, C. A. (2006, October). Altered growth and related physiological responses in juvenile Chinook salmon. *Canadian Journal of Fisheries and Aquatic Sciences,* 63: 2364-2376.

[60] Blanc, A. M., et al. (2010). *Ecotoxicology and Environmental Safety*, 73:849–857.

[61] Meador, J. P.; Sommers, F. C.; Ylitalo, G. M. & Sloan, C. A. (2006, October). Altered growth and related physiological responses in juvenile Chinook salmon. *Canadian Journal of Fisheries and Aquatic Sciences,* 63: 2364-2376.

The daily dose that would starve a wild juvenile fish living in a polluted estuary is estimated at 3.8 µg PAH/ gram of fish/day.[62]

PAH absorption through direct contact with oil continues for the duration of exposure, depending on the circumstances. “This is of concern since these contaminants can bioconcentrate in tissues of organisms to factors 10–1000 times greater than in water. Fluorescing oil droplets were observed under microscope to adhere to the gills of rainbow trout (*Oncorhynchus mykiss*)… Rainbow trout was chosen [for the study] to enable comparisons with freshwater data from previous experiments across salinities within their zone of tolerance (0–15‰).”[63]

High-energy ultraviolet light (UVB) reacts with PAHs in water. Compounds such as naphthalene were found to become more toxic when exposed to UVB light (p. 983).[64] “PAHs and solar radiation can therefore interact to induce a broad range of effects in aquatic animals and plants. After co-exposure to adequate amounts of solar radiation and PAH the lethal effects are likely due to massive cellular and tissue damage that cannot be repaired at an adequate rate” (p. 984).[65]

A recent study of tar sands operations in Canada also found unsafe levels of 13 elements considered priority pollutants (PPE) under the Clean Water Act in the Athabasca River and its watershed. Those PPE’s are: Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn. Although extraction processes in Canada will differ from operations in Utah, it is a possibility that similar contamination could occur in the Colorado River basin.[66]

Pollution is known to migrate from process-water treatment ponds into the landscape through groundwater flow.[67] One study that examined movement of naphthenic acid in groundwater found concentrations of around 75 - 100 mg/L about 180 meters (591 feet) from the edge of a tailings pond, and 0 - 5 mg/L up to 950 meters away (3117 feet).[68]

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[62] Meador, J. P.; Sommers, F. C.; Ylitalo, G. M. & Sloan, C. A. (2006, October). Altered growth and related physiological responses in juvenile Chinook salmon. *Canadian Journal of Fisheries and Aquatic Sciences,* 63: 2364-2376.

[63] Ramachandran, Shahunthala D., Michael J. Sweezey, et al. Influence of salinity and fish species on PAH uptake from dispersed crude oil. *Marine Pollution Bulletin* 52 (2006) 1182–1189.

[64] Pelletier, É., Sargian, P., et al. (2006). Ecotoxicological Effects of Combined UVB and Organic Contaminants in Coastal Waters: A Review. *Photochemistry and Photobiology*, 82(4):981-993.

[65] Pelletier, É., Sargian, P., et al. (2006). Ecotoxicological Effects of Combined UVB and Organic Contaminants in Coastal Waters: A Review. *Photochemistry and Photobiology*, 82(4):981-993.

[66] Kelly, E.N et al. (Sept. 2010). *Oil Sands development contributes elements toxic at low concentrations to the Athabasca River and its Tributaries.* Procedings of the National Academies of Science for the United States of America. www.pnas.org/cgi/doi/10.1073/pnas.1008754107

[67] Oiffer, A.A.L., J.F. Barker, *et al*. A detailed field-based evaluation of naphthenic acid mobility in groundwater. *Journal of Contaminant Hydrology* 108 (2009) 89–106.

[68] Oiffer, A.A.L., J.F. Barker, *et al*. A detailed field-based evaluation of naphthenic acid mobility in groundwater. *Journal of Contaminant Hydrology* 108 (2009) 89–106.

The study was conducted in soils with shallow bedrock, similar to the soils of the proposed mine site, and it is reasonable to assume the same polluted groundwater movement will occur from the Utah tar sand mining operation. Any streams or water drainages within the plume will likely receive this polluted groundwater, and contribute to the ecological damage caused by these compounds.

In nature, tar sands do slowly erode into the environment, but do not approach concentrations of the tar sand mining tailings, and do not produce negative effects on the scale of mining. One recent study examined the natural background levels of PAH in waters flowing through tar sand geologic areas. The total PAH (TPAH) was sourced by examining the sediments upstream, and comparing them to unaffected reference sites. "The TPAH concentrations were highest in anthropogenic sediments (WWP [waste water pond], 1,300 mg/g), followed by high TPAH concentrations in natural bitumen deposits (220–360 mg/g), then intermediate TPAH concentrations in natural river sediments (22–54 mg/g). Sediment TPAH concentrations from both reference sites were comparatively very low (0.03–2.4 mg/g)."[69]

10. SENSITIVE WILDLIFE SPECIES AFFECTED BY MINING

The USFWS list of threatened (T) and endangered (E) animal species that occur in Utah includes Kanab ambersnail (*Oxyloma haydeni kanabensis*, E), bonytail chub (*Gila elegans*, E), humpback chub (*Gila cypha*, E), Virgin River chub (*Gila seminuda*, E), black-footed ferret (*Mustela nigripes*, E), southwestern willow flycatcher (*Empidonax trailii extimus*, E), Canada lynx (*Lynx canadensis*, T), Mexican spotted owl (*Strix occidentalis lucida,* T), Colorado squawfish (pikeminnow; *Ptychocheilus lucius*, E), Utah prairie dog (*Cynomys parvidens*, T), razorback sucker (*Xyrauchen texanus*, E), desert tortoise (*Gopherus agassizii*, T), Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*, T), gray wolf (*Canis lupus*, E), woundfin (*Plagopterus argentissimus*, E), and the brown (grizzly) bear (*Ursus arctos horribilis*, T).

The federally-listed threatened, endangered, and candidate (C) plant and animal species found in Grand and Uintah Counties are listed below (Table 1, 2).[70]

Table 1. Grand County Federally-Listed Species

Common Name	***Scientific Name***	***Type***	***Status***
Jones Cycladenia	*Cycladenia humilis var jonesii*	Plant	T
Humpback Chub	*Gila cypha*	Fish	E
Bonytail	*Gila elegans*	Fish	E
Colorado Pikeminnow	*Ptychocheilus lucius*	Fish	E

[69] Colavecchia, Maria V., Sean M. Backus. Oil sand toxicity to early life stages of fathead minnows (*Pimephales Promelas*). *Environmental Toxicology and Chemistry*, Vol. 23, No. 7, pp. 1709–1718, 2004.

[70] Messmer, T. A., R. Drake, and A. McElrone, editors. Utah endangered and threatened animals. Berryman Institute Publication No. 17, Utah State Univ., Logan. 60 pp. 1998.

Razorback Sucker	*Xyrauchen texanus*	Fish	E
Greater Sage-grouse	*Centrocercus urophasianus*	Bird	C
Gunnison Sage-grouse	*Centrocercus minimus*	Bird	C
Mexican Spotted Owl	*Strix occidentalis lucida*	Bird	T
Yellow-billed Cuckoo	*Coccyzus americanus*	Bird	C
Black-footed Ferret	*Mustela nigripes*	Mammal	E Extirpated

Table 2. Uintah County Federally-Listed Species

Common Name	***Scientific Name***	***Type***	***Status***
Ute Ladies'-tresses	*Spiranthes diluvialis*	Plant	T
Shrubby Reed-mustard	*Glaucocarpum suffrutescens*	Plant	E
Clay Reed-mustard	*Schoenocrambe argillacea*	Plant	T
Pariette Cactus	*Sclerocactus brevispinus*	Plant	T
Uinta Basin Hookless Cactus	*Sclerocactus wetlandicus*	Plant	T
White River Beardtongue	*Penstemon scariosus var albifluvis*	Plant	C
Humpback Chub	*Gila cypha*	Fish	E
Bonytail	*Gila elegans*	Fish	E
Colorado Pikeminnow	*Ptychocheilus lucius*	Fish	E
Razorback Sucker	*Xyrauchen texanus*	Fish	E
Greater Sage-grouse	*Centrocercus urophasianus*	Bird	C
Yellow-billed Cuckoo	*Coccyzus americanus*	Bird	C
Black-footed Ferret	*Mustela nigripes*	Mammal	E Experimental
Brown (Grizzly) Bear	*Ursus arctos*	Mammal	T Extirpated
Canada Lynx	*Lynx canadensis*	Mammal	T

The state of Utah has its own list of state sensitive species. The list includes threatened, endangered, and extirpated species, and "species of special concern." According to the list appendix, "By rule, wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. The additional species on the Utah Sensitive Species List, 'wildlife species of concern,' are those species for which there is credible scientific evidence to substantiate a threat to continued population viability."[71] These additional wildlife species of concern (SPC) and under conservation agreement (CS) are listed below for Grand and Uintah Counties (Table 3, 4). Plant species listed as rare are numerous, and are included in Appendix B.

[71] Utah Sensitive Species List – March 29, 2011.

Table 3. Grand County, Utah State-Listed Wildlife Species of Concern.

Common Name	***Scientific Name***	***Type***	***Status***
Allen's big-eared bat	*Idionycteris phyllotis*	Mammal	SPC
American white pelican	*Pelecanus erythrorhynchos*	Bird	SPC
Bald Eagle	*Haliaeetus leucocephalus*	Bird	SPC
Big Free-Tailed Bat	*Nyctinomops macrotis*	Mammal	SPC
Bluehead sucker	*Catostomus discobolus*	Fish	CS
Burrowing owl	*Athene cunicularia*	Bird	SPC
Corn snake	*Elaphe guttata*	Reptile	SPC
Eureka mountainsnail	*Oreohelix eurekensis*	Mollusk	SPC
Ferruginous hawk	*Buteo regalis*	Bird	SPC
Flannelmouth sucker	*Catostomus latipinnis*	Fish	CS
Fringed myotis	*Myotis thysanodes*	Mammal	SPC
Great Plains toad	*Bufo cognatus*	Amphibian	SPC
Gunnison's prairie dog	*Cynomys gunnisoni*	Mammal	SPC
Kit fox	*Vulpes macrotis*	Mammal	SPC
Lewis' woodpecker	*Melanerpes lewis*	Bird	SPC
Mountain plover	*Charadrius montanus*	Bird	SPC
Northern goshawk	*Accipiter gentiles*	Bird	CS
Roundtail chub	*Gila robusta*	Fish	CS
Smooth greensnake	*Opheodrys vernalis*	Reptile	SPC
Spotted bat	*Euderma maculatum*	Mammal	SPC
Three-toed woodpecker	*Picoides tridactylus*	Bird	SPC
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	SPC
White-tailed prairie dog	*Cynomys leucurus*	Mammal	SPC

Table 4. Uintah County, Utah State-Listed Wildlife Species of Concern.

Common Name	***Scientific Name***	***Type***	***Status***
American white pelican	*Pelecanus erythrorhynchos*	Bird	SPC
Bald Eagle	*Haliaeetus leucocephalus*	Bird	SPC
Big Free-Tailed Bat	*Nyctinomops macrotis*	Mammal	SPC
Bluehead sucker	*Catostomus discobolus*	Fish	CS

Bobolink	*Dolichonyx oryzivorus*	Bird	SPC
Burrowing owl	*Athene cunicularia*	Bird	SPC
CO River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	Fish	CS
Corn snake	*Elaphe guttata*	Reptile	SPC
Ferruginous hawk	*Buteo regalis*	Bird	SPC
Flannelmouth sucker	*Catostomus latipinnis*	Fish	CS
Fringed myotis	*Myotis thysanodes*	Mammal	SPC
Kit fox	*Vulpes macrotis*	Mammal	SPC
Lewis' woodpecker	*Melanerpes lewis*	Bird	SPC
Long-billed curlew	*Numenius americanus*	Bird	SPC
Mountain plover	*Charadrius montanus*	Bird	SPC
Northern goshawk	*Accipiter gentiles*	Bird	CS
Roundtail chub	*Gila robusta*	Fish	CS
Short-earred owl	*Asio flammeus*	Bird	SPC
Smooth greensnake	*Opheodrys vernalis*	Reptile	SPC
Spotted bat	*Euderma maculatum*	Mammal	SPC
Three-toed woodpecker	*Picoides tridactylus*	Bird	SPC
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	SPC
White-tailed prairie dog	*Cynomys leucurus*	Mammal	SPC

The proposed tar sand mining projects will likely affect the life history of several rare, threatened, and endangered species. A few are detailed below that may be of particular concern. These species all share a common trait: there aren't many of them around. Because of this, protection of habitat that may be colonized if numbers increase is very important. So even if a listed species does not occur on the site, it may be affected by the proposed mining's disruption of habitat, because it cannot grow into that area if conditions improve. Sensitive fish that live downstream will be affected by pollution as demonstrated by the studies presented elsewhere in this letter.

The greater sage grouse is a candidate species for listing under the Endangered Species Act (ESA) and is in rapid decline. The proposed action plan is located in current and historic greater sage grouse range, as shown in Figures 1 and 2.[72]

[72] Schroeder, Michael, A., Cameron L. Aldridge, et al. Distribution of Sage-Grouse in North America. *The Condor*, 106(2): 363-376. 2004.

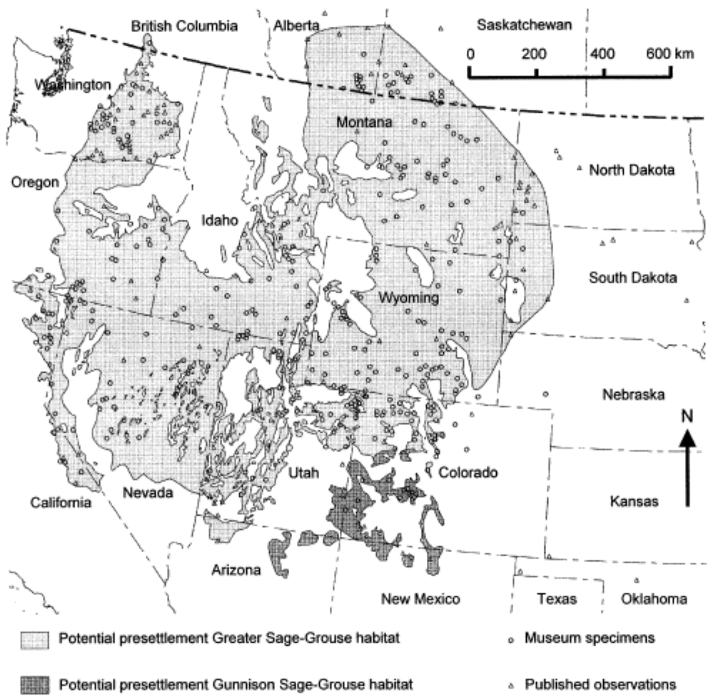

Figure 1. Historic Distribution of Greater and Gunnison Sage Grouse (Schroeder, M.A. *et al,* 2004).

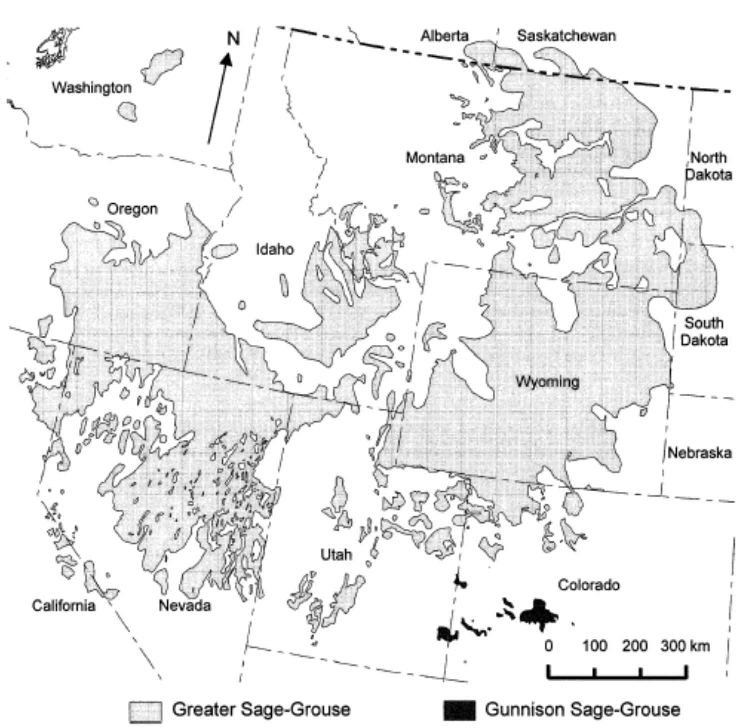

Figure 2. Current Distribution of Greater and Gunnison Sage Grouse (Schroeder, M.A. *et al,* 2004).

Energy exploration activity and mining are known to disturb sage grouse in several ways. In addition to destroying the sagebrush habitat directly, greater sage grouse tend to avoid areas where drilling is occurring, as seen in the Powder River Basin of Wyoming.[73] Changes to the ecosystem can affect the survival of the birds, and human-caused “ecological traps” may be attractive nesting areas but show high risk of mortality.[74] For example, birds might get hit by vehicles on back roads, or exposed to raptors perching on structures. “Chick mortalities tended to occur in proximity to oil and gas developments.”[75]

The Updated NOI for PR Springs tar sands mine, for example, states that the Monument lek is located in the study area, 3,000 feet (0.9 km) north of the initial mine development (p. 37). This lek is reported to exist near roads and gas exploration structures. These birds are likely experiencing higher chick mortality and increased survival pressure compared to birds in less disturbed areas. Because of the existing developments, the proposed tar sand mine will add to the harmful effects the Monument lek is already experiencing, and could cause increased mortality and nest failure.

Sage grouse management has centered on the leks as the focal point of efforts. Recent research shows that areas far beyond the lekking grounds are critical to the species. “However, our approach of modeling and mapping high-quality nesting and brood-rearing habitats suggests that such a heavy focus on habitat protection around lek sites may not be suitable to ensure the viability of Sage-Grouse populations… a threshold occurs at ~10 km from leks, within which the majority (~90%) of all source habitats occur.”[76]

“Thus, using a fixed buffer distance around leks of <10 km to protect Sage-Grouse habitat may not suitably protect important nesting and brood-rearing habitats. Wakkinen et al. (1992) suggested that the originally recommended 3.2-km buffer around leks (Braun et al. 1977) may not be large enough to protect nesting habitats, and Connelly et al. (2000) suggested that polygons of 5 km and 18 km may be required to protect breeding habitats for nonmigratory and migratory populations, respectively.”[77] Since the proposed mine site is within ten kilometers of the Monument lek, it is likely active habitat for greater sage grouse and should not be disturbed.

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[73] Dougherty, K.E., *et al*. Greater Sage-Grouse Winter Habitat Selection and Energy Development. *Journal of Wildlife Management,* 72(1): 187-195. 2008.

[74] Aldridge, Cameron L. and Mark S. Boyce. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. *Ecological Applications*, Vol. 17, No. 2 (Mar., 2007), pp. 508-526.

[75] Aldridge, Cameron L. and Mark S. Boyce. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. *Ecological Applications*, Vol. 17, No. 2 (Mar., 2007), pp. 508-526.

[76] Aldridge, Cameron L. and Mark S. Boyce. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. *Ecological Applications*, Vol. 17, No. 2 (Mar., 2007), pp. 508-526.

[77] Aldridge, Cameron L. and Mark S. Boyce. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. *Ecological Applications*, Vol. 17, No. 2 (Mar., 2007), pp. 508-526.

The Updated NOI for PR Springs states that disturbance to the Monument lek will be mitigated by shutting down mine operations if leks are seen nearby during the breeding season. In addition to being unenforceable, this "mitigation" will not protect the grouse from mining impacts. "Timing restrictions on construction and drilling during the breeding season do not prevent impacts of infrastructure (e.g., avoidance, collisions, raptor predation) at other times of the year, during the production phase (which may last a decade or more), or in other seasonal habitats that may be crucial for population persistence (e.g., winter). Previous research suggests that a more effective mitigation strategy would also include, at minimum, burying power lines (Connelly et al. 2000b); minimizing road and well pad construction, vehicle traffic, and industrial noise (Lyon and Anderson 2003, Holloran 2005); and managing water … to prevent the spread of mosquitoes that vector WNv [West Nile virus] in sage-grouse habitat (Zou et al. 2006, Walker et al. 2007)."[78]

Mine reclamation for sage grouse habitat is historically unsuccessful. In one long-term study, shrub cover was not established after more than ten years, and neither site was suitable sage grouse habitat.[79] "Less than optimal shrub canopy cover, density, plant community composition, and diversity on these study sites suggest that a long time period or improved cultural methods will be required for reclaimed shrub communities to achieve desired wildlife habitat characteristics similar to native sagebrush-grassland steppe ecosystems."[80]

11. UNIQUE SOIL PROPERTIES AND EROSION EFFECTS

Cryptobiotic crust is present in the proposed mining areas. This cryptobiotic crust is a unique assemblage of cyanobacteria, algae, lichens, and/or mosses that live together in a thin crust on the soil surface. It is biologically unique, and supports the entire ecosystem in arid regions by providing nutrients to the soil, fixing nitrogen in soil, preventing wind erosion, retaining moisture, aiding seed germination, and absorbing solar energy.[81] This crust is easily disturbed by walking, driving, and trampling, and can take up to 250 years to fully recover all functions in some cases.[82] The lack of crust affects plants growing in the area. The crust supports native plants and excludes exotic invasive grasses, which grow in the disturbed soil.[83] Plants growing in the encrusted

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[78] Walker, Brett L. et al. Greater Sage-Grouse Population Response to Energy Development and Habitat Loss. *Journal of Wildlife Management*, 71(8): 2644-2654. 2007.

[79] Olson, Richard A., J.K. Gores, et al. Suitability of shrub establishment on Wyoming mined lands reclaimed for wildlife habitat. Western North American Naturalist 60(1), pp. 77-92. 2000.

[80] Olson, Richard A., J.K. Gores, et al. Suitability of shrub establishment on Wyoming mined lands reclaimed for wildlife habitat. Western North American Naturalist 60(1), pp. 77-92. 2000.

[81] Belnap, Jayne, Kaltenecker, J.H., et al. *Biological Soil Crusts: Ecology and Management*. USDI Bureau of Land Management Technical Reference 1730-2. 2001.

[82] Belnap, Jayne. Surface Disturbances: Their Role in Accelerating Desertification. *Environmental Monitoring and Assessment*. 37: 39-57. 1995.

[83] Belnap, Jayne. Surface Disturbances: Their Role in Accelerating Desertification. *Environmental Monitoring and Assessment*. 37: 39-57. 1995.

undisturbed soil tested up to 31 percent higher in nitrogen content than those in disturbed soils.[84] This nutrient concentration has implications for wildlife browsing in the area that may experience a survival edge by consuming the higher-nutrient forage.

This nitrogen cycling is one of the most important aspects of the soil crust: the cyanobacteria are one of the few organisms on Earth that can take airborne N_2, atmospheric nitrogen, and convert it to a biologically usable form, like ammonia (NH_3) or nitrate (NO_3), that a plant can absorb.[85] The effect is the same as nitrogen-fixing bacteria in the roots of legumes like clover. The cryptobiotic crust literally feeds the ecosystem nitrogen from the air, which goes into plants, gets eaten by invertebrates and herbivores like deer, and then to predators like cougar, coyote, and humans.

Cryptobiotic crust is a crucial element of the ecosystem and should be preserved. Open pit mining will result in direct removal of the crust, and may impact crust nearby by chemical contamination or by dust effects from the proposed mine. If the crust is sensitive to the types of chemical pollution that tar sand mining will produce (and is documented to have produced in the past), then the off-site, indirect effects to the ecosystem could be sustained and the nitrogen cycle disrupted.

12. TEMPORAL LOSS OF ECOSYSTEM FUNCTION DURING MINING

Temporal loss (also called restoration lag) is the effect created by the time lag between the event of ecological destruction and the maturation of the reclamation site. In other words, when the mining begins, habitat is destroyed, and ecological functions are lost. This is the mining temporal loss. During the thirteen-year long proposed mining operation[86], those functions are not replaced. This effect is common knowledge among ecologists.

When the mining is over, the reclamation will be completed. From that time until the ecosystem matures, the ecological functions are still much lower than the pre-developed condition. The time between reclamation installation and maturity is the post-mining temporal loss. In this case, the minimum post-mining temporal loss can be estimated by the time it takes the cryptobiotic crust to re-grow and provide all ecological functions, which takes 250 years.[87] Therefore, the total temporal loss of ecological functions is the sum of the mining and post-mining temporal loss, which is 13 + 250 = 263 years until all ecological functions are restored.

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[84] Belnap, Jayne. Surface Disturbances: Their Role in Accelerating Desertification. *Environmental Monitoring and Assessment*. 37: 39-57. 1995.

[85] Belnap, Jayne. Surface Disturbances: Their Role in Accelerating Desertification. *Environmental Monitoring and Assessment*. 37: 39-57. 1995.

[86] JBR Environmental Consultants, Inc. letter to Susan M. White on May 8, 2008 with the Updated NOI dated May 9, 2008 from EER included.

[87] Belnap, Jayne. Surface Disturbances: Their Role in Accelerating Desertification. *Environmental Monitoring and Assessment*. 37: 39-57. 1995.

Research shows that other reclaimed mine sites are still significantly ecological different from the original landcover. A study that investigated the mine-induced negative effects of nutrient cycling (carbon, nitrogen, and phosphorus) from land into a nearby stream found "major impacts on the adjoining stream ecosystem."[88] These impacts show the interconnectedness of the ecosystem, and further add to the temporal loss time estimate:

"Currently the goal of mine reclamation is simply the establishment of permanent vegetative cover. This approach is shortsighted and does not take into account the importance of ecosystem processes like nutrient cycling nor the potentially harmful conditions created... As a result, recovery of comparable ecosystem function will take decades to centuries."[89]

The final estimate for the temporal loss would then be 263 years or longer to build up soil crust, nutrients, and other ecological elements to the current levels. No designed landscape exists that can actually compensate for the temporal loss of that time span. Even established reclamation sites are still too young. So it is clear that reclamation produces something, but that something is not a fully ecologically restored landscape. No compensation for this temporal loss is included in the mining proposal. Therefore, the mining proposal will result in overall damage to the ecosystem.
Temporal loss is frequently addressed by federal agencies such as the US Army Corps of Engineers, and is accepted as a known phenomenon.[90] When industry fills wetlands and applies for mitigation, they must address and compensate for temporal losses of ecosystem function as well as permanent losses. Although temporal loss is commonly addressed in state and federal wetland regulation, it is not addressed in mining regulation. This regulatory oversight harms the environment and results in a net loss of ecosystem function in every case.

The result is economic harm to society, because the community loses a functional part of the landscape. That loss of function has a dollar value, as one Ohio study quantifies over a 50-year period:

> Findings of this study make a strong case that time lag costs to society of wetland function restoration should no longer be ignored in the mitigation decision-making process. Restoration lag costs for the low elevation sites range from $2,939 to $11,179 per acres with an average of $6,136 per acre for floristic functional restoration. Restoration lag costs to achieve equivalency under logarithmic growth for both floristic and soil indicators range from $3,460 to $49,811 per acre with an average of $16,640 per acre. For high elevation constructed inland marshes, time lag costs range from

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[88] Simmons, Jeffrey A, William S. Currie, Keith N Eshleman, et al. Forest to Reclaimed Mine Land Use Change Leads to Altered Ecosystem Structure and Function. *Ecological Applications*, 18(1), 2008, pp. 104-118.

[89] Simmons, Jeffrey A, William S. Currie, Keith N Eshleman, et al. Forest to Reclaimed Mine Land Use Change Leads to Altered Ecosystem Structure and Function. *Ecological Applications*, 18(1), 2008, pp. 104-118.

[90] US Army Corps of Engineers Regulatory Guidance Letter 02-2. December 24, 2002.

> $22,368 to $31,511 per acre when achieving floristic equivalency with an average cost of $27,392 per acre.[91]

The economic costs of temporal loss in the proposed tar sands mine site may be much greater because of the slow growth rates and time required to achieve full function of the cryptobiotic crust. The mining and reclamation temporal losses must, at a minimum, be addressed by the agencies, and preferably should be avoided by denial of the mining permit.

13. SHORTCOMINGS OF THE RECLAMATION PLAN AND DISCHARGE TO WATERS OF THE US

The reclamation process has been found to degrade the environment by not returning it to the original levels of ecological performance. There is no way for the mining company to install cryptobiotic crust during reclamation. Natural colonization must occur, and during that time ecological functions will be lower. A 46-year study found that the soil fauna, animals like worms that live in the soil, undergo community changes and cannot be replaced to the original condition:
"The goal is a self-sustaining rehabilitation… finally reaching the "original ecosystem," i.e. a full restoration approaching the "perturbation point." This is seldom achieved and the more frequent alternative approach is the replacement by another system..." [92]

Another study points out the similarity of mine land to urban land in terms of the negative ecological effects compared to forest:

"There are some parallels between a forest to mineland conversion and a forest to urban land-use conversion. In both cases soil permeability decreases; in one case due to soil compaction and in the other due to addition of buildings and pavement… Some of the reported symptoms include a flashier hydrograph, elevated concentrations of nutrients, … , reduced biotic richness, increased dominance of tolerant species, … , and a decrease in leaf breakdown."[93]

The mine areas are generally impervious, but to replicate the effects of the urban landscape, the land surface does not have to be 100% impervious. Urban landscapes include areas such as lawns, medians, and natural areas as well as pavement. It is common knowledge among civil planners that urban areas with greater than 12% impervious surface will produce negative effects from runoff. Some cities mandate that new developments limit impervious area to about this level in order to protect water quality.

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[91] Gutrich, John J, and Fred J. Hitzhusen. Assessing the substitutability of mitigation wetlands for natural sites: estimating restoration lag costs of wetland mitigation. *Ecological Economics* 48 (2004) 409– 424.

[92] Dunger, Wolfram, and Manfred Wanner, et al. "Development of soil fauna at mine sites during 46 years after afforestation" *Pedobiologia* 45, 243–271 (2001).

[93] Simmons, Jeffrey A, William S. Currie, Keith N Eshleman, et al. Forest to Reclaimed Mine Land Use Change Leads to Altered Ecosystem Structure and Function. *Ecological Applications*, 18(1), 2008, pp. 104-118.

If the ecological trajectory after mining progresses from completely barren toward the reclaimed attempt at the original condition, but does not reach the original condition, then the mine site has a net decrease of ecological and wetland function level. The degree of the decrease depends on the site condition at any given moment during the 263-year estimated temporal loss period identified elsewhere in this letter.

A Water of the US is proposed for fill in the Updated Notice of Intent at PR Springs. The stream fill can be seen by zooming in on the pdf version of the Updated NOI Figure 2. The stream appears on the USGS PR Springs 7.5' Quadrangle Map, and can be seen in Figure 2 under the brown polygon titled "Overburden/interburden Storage Area No. 2." As measured on Figure 2, over 1,000 linear feet of stream will be filled by the mining, with no ecological compensation planned.

"Both of the overburden/interburden storage areas will be constructed outside of the pit limits on the side-slopes of ephemeral draws above Main Canyon" (p.18). "The small headwater drainages that will be filled with overburden/interburden storage areas flow ephemerally, contain very small active-channel cross sections, and typically show no evidence of live water or riparian vegetation" (p. 32).

The fact that no water was observed in the drainages is immaterial. Many streams only flow for a part of the year. The presence of an observable "active channel" means that an ordinary high water mark is present, which qualifies this drainage as a Water of the US,[94] unless specifically determined non-jurisdictional by the Army Corps of Engineers, who reserves the right to determine it's own jurisdiction. Any discharges of fill material to these Waters of the US is prohibited under Section 404 of the Clean Water Act unless specifically authorized by the Corps of Engineers.

The applicant proposes to "mitigate" the effects of the stream fill by installing rip-rap at the base of the permanent fill. This is a misuse of the word "mitigate," and the action will not mitigate the ecological effects of filling the stream. The fill represents a permanent impact to a Water of the US and associated ecological losses.

Furthermore, the NOI says that drainage channels will be constructed to route water from the pile into the stream: "Outflows would be re-directed along the edge of the overburden/ interburden storage area fill to a point below the toe of its slope" (p. 33). Cross-section W1-E1 (NOI Figure 4a Rev. 2) shows that the overburden will slope down into the stream, which means toxic chemical pollution (discussed elsewhere in this letter) from the tar sands overburden can easily enter the stream. This polluted discharge, in addition to the fill material itself, is prohibited by the Clean Water Act.

14. CONCLUSION

The risks and dangers associated with OSTS development in the tri-state area is compelling enough to ask that this PEIS be completely withdrawn and to ask that Congress start over and give citizens a real energy policy that will take us safely and

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[94] 33 CFR 328.4: Definition of Waters of the United States, Limits of Jurisdiction.

securely into the future. The seven most compelling reasons are 1) surplus water simply does not exist in the Colorado River basin; 2) clean drinking water in the Colorado River basin is already at risk; 3) the increasing dryness of the Colorado River basin will be compounded; 4) species that are not listed as threatened and endangered, will soon be listed; 5) restoration is truly not possible and the native ecosystem will be rendered inviable; 6) the threat of shutting down operations for lack of energy and water, solvent shortages, habitat dysfunction, and exceedance of pollution standards, will create a situation of boom and bust that will unfairly displace workers and their families; 7) it will seriously impact national parks and the well-established tourist industry.

Sincerely Yours,

John Weisheit
Living Rivers Conservation Director
Colorado Riverkeeper
435-259-1063
john@livingrivers.org
Juliana Williams
Living Rivers Program Director
425-274-5877
julianawilliams@gmail.com

Ashley Anderson
Peaceful Uprising Co-Director
801-652-2971
ashley@peacefuluprising.org

Taylor McKinnon
Center of Biological Diversity
Public Lands Campaign Director
928-310-6713
tmckinnon@biologicaldiversity.org

Laura Kamala
Utah Program Director
Grand Canyon Trust
435-259-8702
laurakamala@gmail.com

Joseph D. Leyda, MA
Professional Wetland Scientist
Certified Ecologist
President, Leyda Consulting, Inc.
www.leydaconsulting.com

APPENDICES

Appendix A: Curricula Vitae of Joseph Leyda[95]
Appendix B: Inventory of Sensitive Species and Ecosystems in Utah[96]

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[95] http://www.livingrivers.org/pdfs/AppendixALeydaCVMay2011.pdf

[96] http://www.livingrivers.org/pdfs/UtahPlantDA1996.pdf