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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL
Before Administrative Judges:
Ann Marshall Young, Chair
Dr. Richard F. Cole
Dr. Fred W. Oliver

In the Matter of CROW BUTTE RESOURCES, INC. (In Situ Leach Facility, Crawford, NE)	Docket No. 40-8943 ASLBP No. 07-859-03-MLA-BD01 February 22, 2008

MOTION FOR LEAVE TO FILE A BRIEF *AMICUS CURIAE*

COMES NOW, The Center for Water Advocacy (CWA),Rock the Earth (RtE) and Robert Lippman, through the undersigned as its duly authorized attorneys pursuant to the attached Notice of Appearance of even date herewith, moves pursuant to 10 C.F.R. Section 315(d) for leave to file a brief *amicus curiae*.

The movant is not a party to the above-referenced proceeding. The movant has reviewed the Hearing Transcript for the January 16, 2008 Hearing in Chadron, Nebraska in this matter. During the January 16, 2008 hearing, the Board took up the matter, *sua sponte*, of certain rights of Indigenous people under international law, US federal law and the 1851 and 1868 Ft. Laramie Treaties. *See,* Hearing Transcript re: Indigenous Issues at 187 and 190.

The movants' interest in this matter is: Movant CWA Is a non-profit public Interest law firm specializing In the water and other natural resource rights of Indian Tribes and Native Communities and environmental justice matters. Movant RtE is a nonprofit conservation organization, whose mission is to protect and defend America's natural resources through partnerships with the music industry and the world-wide environmental community. Movant Robert Lippman is a private citizen and an attorney living in Moab, Utah who specializes in natural resources and tribal legal issues and participating in the research and drafting of Movants' Amicus Curiae Brief.

The reasons why a brief is desirable are: the Atomic Safety and Licensing Board Panel has requested petitioners to obtain *Amicus Curiae* briefing from experts in Indian, water and other areas of the law to provide briefing in relation to treaty water rights,

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TEMPLATE = SECY-041

SECY-02

international indigenous rights, environmental justice matters that are relevant to petitioner's motion to intervene in these proceedings. *See,* Hearing Transcript re: Indigenous Issues at 187 and 190.

Respectfully submitted this 22nd Day of February,

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February 22, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC.	)	Docket No. 40-8943-MLA
	)	
(License Amendment for the North Trend Expansion Project)	)	ASLBP #07-859-03-MLA-BD01
	)	

AMICUS CURIAE BRIEF OF CENTER FOR WATER ADVOCACY, ROCK THE EARTH AND ROBERT LIBBMAN IN SUPPORT OF PETITIONERS' REQUESTS FOR DISCRETIONARY INTERVENTION AND PETITIONS FOR HEARING AND/OR TO INTERVENE OF DEBRA WHITE PLUME, THOMAS COOK, OWE AKU/BRING BACK THE WAY, SLIM BUTTES AGRICULTURAL DEVELOPMENT CORPORATION, AND WESTERN NEBRASKA RESOURCES COUNCIL (PETITIONERS)

INTRODUCTION

Pursuant to 10 C.F.R. §2.315(d) and by request of the Atomic Safety and Licensing Board (Board), *See,* Hearing Transcript re: Indigenous Issues at 187 and 190. the Center for Water Advocacy NRC staff (the "Center"), Rock the Earth ("RtE") and Robert Lippman, hereby, file this *Amicus Curiae* Brief in support of the above-listed petitions for hearing/intervention and discretionary intervention filed on November 12, 2007. For the reasons explained in this response, the Center and RtE submit that the petitions should be granted based on the following:

(a) The Expansion Impacts Petitioners' and the Oglala Sioux's Treaty rights under the Ft. Laramie Treaties of 1851 and 1868.

(b) Petitioners Have Standing to Prevent Violation of the Clean Water Act by the Expansion.

(c) The Expansion will Impact Petitioner's Indigenous rights under the United Nations Declaration of Rights of Indigenous People.

(d) Petitioners have standing to assert that NRC must Consider the Impacts of

Climate Change.

(e) The Expansion Involves Multiple Environmental Justice Issues.

(f) Petitioners have Standing to Argue for Limits on the Expansion Due to the Mixing Of Underlying Aquifers.

CORPORATE DISCLOSURE STATEMENT

Pursuant to Fed. R. App. P. 26.1(a), Petitioner Center for Water Advocacy states that it has no parent companies, subsidiaries, or affiliates that have issued shares to the public.

Pursuant to Fed. R. App. P. 26.1(a), Petitioner Rock the Earth states that it has no parent companies, subsidiaries or affiliates that have issued shares to the public.

IDENTITY OF the Center AND RtE AND SOURCE OF AUTHORITY TO FILE

A. Identity of the Center.

The Center is a non-profit public interest organization dedicated to protecting water resources of the Western United States for the benefit of its members and the general public. The Center conducts legal and scientific research, analysis, policy and litigation in its efforts to protect and restore water quantity, water quality and water rights for the health of the watershed ecosystem, preservation of cultural identity and the benefit of its members. The Center's membership consists of a Board of practicing attorneys, scientists and members of Northwest Indian Tribes along with local citizens interested in the shared goal of protecting the environment through scientific and legal means.

B. Identity of RtE

RtE is a nonprofit conservation organization, whose mission is to protect and defend America's natural resources through partnerships with the music industry and the world-wide environmental community. RtE acts as an advocate to ensure the existence of

a sustainable and healthy environment for all. RtE has approximately 2,000 members, some of which live in or near reside in this district and a substantial part of the events or Commissions giving rise to the claim occurred in this district. RtE files this Amicus Brief on behalf of itself and its adversely affected members. None of the members of RtE have been compelled to participate in this action in any way.

C. Identity of Robert Lippman.

Robert Lippman is a private citizen and an attorney living in Moab, Utah who specializes in natural resources and tribal legal issues.

D. Movants' Interests in the Issue

Movant the Center is a non-profit public interest law firm specializing in the water and other natural resource rights of Indian Tribes and Native Communities and environmental justice matters. RtE is a nonprofit conservation organization, whose mission is to protect and defend America's natural resources through partnerships with the music industry and the world-wide environmental community. Movant Robert Lippman is a private citizen and an attorney living in Moab, Utah who specializes in natural resources and tribal legal issues and participating in the research and drafting of this Brief.

D. Jurisdiction

Jurisdiction over this section is conferred by to 10 C.F.R. §2.315 and by order of the Atomic Safety and Licensing Board (Board).

DISCUSSION

A. The Expansion Impacts Petitioner's and the Oglala Sioux's Treaty rights under the Ft. Laramie Treaties of 1851 and 1868.

Water is "consumed" when it has been handled so that, before it could be used for drinking and after it cannot be used for drinking. CBR Resources (CBR) consumes 9000 gpm, which is its current permit limit to pump. With this north trend expansion, CBR will be permitted to increase pumping rates up to 13,500 gpm with this north trend expansion. CBR maintains that its 'net consumptive use' is 113 gpm, which credits CBC for the volume of geo-chemically changed water they intend to reinject to the aquifer.

Studies illustrate, however, that no uranium mining company has ever been able to clean up water affected by the mining process to "restoration standard" levels. *See,* study by Dr. William P. Stuab. (Attached as Exhibit A). The Stuab and other studies illustrate that, so far, restoration efforts have only been able to meet what are called "alternative concentration limits" which are nothing more than reduced amounts of radiation and heavy metals in water samples through expensive and complicated water purification processes.

Nevertheless, NRC has accepted CBR's restoration standards (in License Condition 10.3(C)) knowing that the Mine will never meet them. In fact, neither CBR nor NRC has provided any comprehensive data illustrating that restorative standards are a practical or, even economic, possibility that such a goal is largely impossible with today's technology. Based on the fact, therefore, that the Expansion will consume much more water than CBR is suggesting, they will be impacting water rights held by the Petitioners as listed in the Treaties of the Oglala Sioux Indian Tribe. Article III of the Fort Laramie Treaty of 1868, for example, provides that the Pine Ridge Reservation "shall be...set apart for the absolute and undisturbed use and occupation of the Indians...." In addition, Articles III and VI of the Fort Laramie Treaty, specifically, set

aside land both within and outside of the original reservation for the purpose of agricultural uses should members of the Tribe desire to take up such practices.

Such language implicitly reserved water needed for the "absolute and undisturbed occupation" by Petitioners and other Oglala Sioux members, as provided in *Winters v. United States,* 207 U.S. 564 (1908). In *Winters*, the United States brought suit on behalf of the Gros Ventre and Assiniboine tribes of the Fort Belknap Reservation in Montana to halt upstream diversions by non-Indians who had been using the water running through the Tribe's land since 1900. The Fort Belknap Reservation was established under the terms of an 1888 treaty that, as in the case of the Fort Laramie Treaty, generally described the purpose of the reservation as the provision of a permanent home for the tribes and to encourage the Indians to engage in agricultural pursuits, but did not mention water rights.*Id.* at 656.

The non-Indian diverters, in *Winters*, contended that their diversions, which were prior in time to those by the Indians, gave them a superior right. Mark A. McGinnis & Jason P. Alberts, "Southwest Water Decisions: The Law of Federal Reserved Water Rights," The Water Report: p. 2 (October 15, 2005). That argument was rejected by the Supreme Court, which stated,

> The case, as we view it turns on the agreement of May, 1888, resulting in the creation of the Fort Belknap Reservation.... The reservation was part of a very much larger tract which the Indians had the right to occupy and use and which was adequate for the habit and wants of a nomadic and uncivilized people. It was the policy of the Government, it was the desire of the Indians, to change those habits and to become a pastoral and civilized people. If they should become such the original tract was too extensive, but a smaller tract would be inadequate without a change in conditions. The lands were arid and without irrigation, were practically valueless. And yet, it is contended, the means of irrigation were deliberately given up by the Indians and deliberately accepted by the Government ... The power of the Government to reserve the waters and exempt them from appropriation under the state laws is not denied and could not be.

207 U.S. at 575–76 (1908), citing, *United States v. Rio Grande Dam and*

Irrigation. Company, 174 U.S. 690, 702 (1899).

After *Winters* the federal courts refined the definition of tribal sovereignty in relation to water rights, beginning with the U.S. Supreme Court's decision in *Arizona v. California,* 373 U.S. 546 (1963). In that case, the special master appointed to resolve certain preliminary questions settled on the notion of quantifying reserved water rights based upon practicably irrigable acreage (PIA). Under this test, an Indian tribe is legally entitled to as much water as is needed to irrigate all the PIA within its reservation. The water so reserved "was intended to satisfy the future as well as the present needs of the Indian Reservation." 373 U.S., at 600. In other words, the water was reserved "to make the Reservation viable." *Id.*, 599, *cited with approval in Montana v. United States*, 450 U.S. 544, 566 n. 15 (1981).

Ultimately, this approach developed into the 'permanent homeland' concept, which originated in *In Re General Adjudications of All Rights to use Water in the Gila River System and Source*. 201 Ariz. 307, 315, 35 P.3d 68, 76 (2001) (Gila V). In that case, the Arizona Supreme Court, in keeping with the standard established in *Arizona*, reviewed the decision of Judge Goodfarb of the Maricopa County Superior Court holding that all federal reserved rights for Indian reservations were to be measured based upon the PIA standard. *Id.* This standard provided that the tribes should get enough water to irrigate all land on the reservation that is: 1) arable; 2) physically irrigable; and 3) economically irrigable.

On review of Judge Goodfarb's decision, the Arizona Supreme Court rejected the PIA as the sole standard for determining the "essential purpose" of the tribal reservation and instead found that such purpose "is to provide Native American people with a 'permanent home and abiding place, that is 'a livable' environment." *Id.* The court held that the general purpose of providing a home for Indians must be broadly construed to provide tribes with the ability to

achieve self-determination and economic self-sufficiency and that limiting tribes to a PIA standard denies them the opportunity to evolve. *Id.* This, in turn, limits tribes to an agrarian standard in a largely non-agrarian modern world. The *Gila V* court mandated that proposed uses be "reasonably feasible." *Id.*, at 80. To determine if a use is reasonably feasible, a project must be: 1) achievable from a practical standpoint; and 2) economically sound. *Id.*. at 81.

As in this case, the Courts have found that if the suit is challenging the impact of a particular action on natural resources rights which are held for the benefit of tribal members, then individual members can file suit to protect such rights. *See Sohappy v. Smith*, 302 F. Supp. 899, 904 (D. Or. 1969). In other words, under *Sohappy*, the Expansion violates Petitioners' reserved water rights to the extent it threatens the amount of water they need to irrigate their 1) arable; 2) physically irrigable; and 3) economically irrigable lands or otherwise, their "reasonably feasible" uses of such water.

In addition, it is a basic principle of Indian law that tribal treaty water rights are owned communally by the Tribe itself. The courts have determined, therefore,that the Tribe, itself, has the right to assert these rights on behalf of its members. *See United States v. Nebraska*, 520 F.2d 676, 688 (9th Cir. 1975). This is important because the Oglala Sioux Tribal Council (OSTC) has supported this appeal and intends to file its own *Amicus Curiea* Brief in this matter.

The ability of Petitioners and the OSTC to protect treaty water rights provided in the Fort Laramie and other treaties in relation to the Expansion, is also supported by existing federal case law. While the courts have never directly settled on the question of whether treaty rights may be used to protect environmental resources, they have addressed the issue on numerous occasions. In a decision that was ultimately overturned by the 9th Circuit on procedural grounds, for example, after enumerating the list of human caused factors sponsored by governmental

entities that have resulted in the rapid decline of the Columbia River salmon, the U.S. District Court for the Western District of Washington held that "implicity incorporated in the treaties' fishing clause is the right to have the fishery habitat protected from man-made despoliation." *United States v. State of Washington*, 506 F.Supp. 187, 203 (Dist. WA 1980). In reaching this conclusion, the court made the logical assumption that the "most fundamental prerequisite to exercising the right to take fish is the existence of fish to be taken." *Id.* Similarly, other courts have recognized the tribal interests in protecting environmental resources. In *United States v. Washington*, Phase II, the initial lower court decision applied the "moderate living needs" standard. *See also, United States v. Adair*, 723 F.2d 1394 (9th Cir. 1983), *cert. Denied*, 467 U.S. 1252 (1984), requiring a revival of wetlands that had been decimated by non-Indian stream withdrawals. In *United States v. Anderson*, 736 F.2d 1358 (9th Cir. 1984), the court upheld a lower court ruling requiring non-Indians to maintain a minimum stream flow necessary for the survival of a tribal fishery.

Some experts have urged courts to recognize the existence of the dormant conservation mandate in tribal treaties in the form of "native sovereign property right to the 'natural capital asset.'" *See*, Mary Christina Wood, *The Tribal Property Right to Wildlife Capital (Part 1: Applying Principles of Sovereignty to Protect Imperiled Wildlife Populations*, Idaho L. Rev., vol. 37, (2000). Professor Wood characterizes natural resources inherent in treatise (in this case wildlife) "as a full asset having two fundamental components: yield and capital," with yield consisting of "actual harvestable returns of wildlife on an annual basis. *Id.* at 6. Capital, on the other hand is the key to prohibiting harm to the resource because it consists of "a set of conditions that sustains a particular yield over time." *Id.* Moreover, Prof. Wood suggests that unless courts consider capital in defining treaty rights, such rights are reduced "to paper rights

having meager currency in actual harvest because the depleted wildlife capital produces only scant yields." *Id.*

Finally, following the procedures of the Dawes Allotment Act of 1887, U. S. Statutes at Large, Vol. XXIV, p. 388 ff., much of the Pine Ridge Reservation was subject to allocation of 320 acre (1.3 km^2) parcels to heads of families. As a result,particularly because the Fort Laramie Treaty encouraged tribal members such as Petitioners, to take up individual parcels within the reservation for the purpose of engaging in agricultural practices the individual land owner's treaty water right that is appertunate to alloted lands, under the Dawes Act, is analogous to the treaty water rights of individual tribal members. *See e.g.*, article IV. In relation to such rights the courts conclude that when a governmental entity:

> ...is regulating the federal right of Indians to take fish at their usual and accustomed places it does not have the same latitude in prescribing the management objectives and the regulatory means of achieving them. The state may not qualify the federal right by subordinating it to some other state objective or policy. It may use its police power only to the extent necessary to prevent the exercise of that right in a manner that will imperil the continued existence of the fish resource.

Sohappy v. Smith, 302 F.Supp. 899, 908 (D.Or.1969). Similarly, in this case, Petitioners who are the beneficiaries of treaty water rights through individually allotted lands, have standing to protect rights from the Expansion and to prevent NRC from authorizing the Expansion unless the Petitioners are taking action that would imperil the resource at issue.

B. Petitioners Have Standing to Prevent Violation of the Clean Water Act by the Expansion

Petitioners have standing to insure that NRC does not violate water quality protection standards by requiring CBR to conduct "Bench Scale" followed by "Pilot Scale" tests to prove they can meet restorative standards prior to conducting any mining activity. Without such enforcement, NRC would be in violation of section 313 of the Clean Water Act which requires federal agencies to comply with water quality standards when they are "engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants" 33 U.S.C. § 1323(a).

In addition, Section 303 of the CWA requires states to develop water quality standards, which specify the appropriate uses of water bodies and set standards to protect those uses and to place those waters not meeting water quality standards on the 303(d) list. 33 U.S.C. § 1313(d)(1)(A)–(B). States must then calculate total maximum daily loads (TMDLs) for those waters not meeting water quality standards. *Id.* § 1313(d)(1)(C); 40 C.F.R. § 130.7. The NRC must insure that its preferred alternative in relation to the Expansion and listed water bodies without approved TMDLs does not lead to continuous violations of the CWA.

The potential impacts to Petitioners' interests is illustrated by testing of the geochemistry of relevance to groundwater quality restoration at in-situ uranium leach mining facilities with focusing on radio-active and heavy metals has been used to model groundwater restoration and stabilization efforts. Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities Draft Report for Comment U.S. Geological Survey, U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research Nebraska, DC 20555-0001 (USGS Study). (Excepts Attached as Exhibit B).

As in the case of CBR, this study found that it is difficult to predict the restoration of ground water even with intensive intervention and likely depends on types of minerals present, the rate of groundwater flow into the mined area, and the dissolved oxygen concentration of the groundwater. *Id.* In addition, whether long-term stabilization of the mined zone is likely is dependent upon the addition of large quantities of hydrogen sulfide to the purification process and the right natural gradient conditions. If not, "concentrations of U, As, and Se will likely rebound significantly above the baseline for a long period of time ...before decreasing back to baseline conditions." *Id.* Finally, the fact that CBR Resources does not conduct any ecological monitoring at the Crawford, Nebraska mine, makes it all the more likely that they are un-prepared or, otherwise, do not intend to conduct testing or otherwise incorporate expensive and resource intensive water cleaning methods necessary to achieve restorative standards in relation to the Expansion.

C. TheExpansion will Impact Petitioner's Indigenous rights under the United Nations Declaration of Rights of Indigenous People.

In September 2007, after more than two decades of debate, the United Nations General Assembly, during its 61st session, adopted the United Nations Declaration on the Rights of Indigenous Peoples (Declaration) which outlines the rights of the estimated 370 million indigenous people world wide and outlaws discrimination against them. United Nations General Assembly Sixty-first session, Agenda item 68 (October 2, 2007). A non-binding text, the Declaration sets out the individual and collective rights of indigenous peoples, as well as their rights to culture, identity, language, employment, health, education and other issues. The document emphasizes the rights of indigenous peoples to maintain and strengthen their own institutions, cultures and traditions and to pursue their development in keeping with their own

needs and aspirations. It also prohibits discrimination against indigenous peoples and promotes their full and effective participation in all matters that concern them, and their right to remain distinct and to pursue their own visions of economic and social development.

The Declaration, therefore, potentially applies to Petitioners' standing to intervene in this matter due to its focus on preventing disproportionate impacts to the environmental and cultural interests of the Petitioners (which are implemented at NRC through the Department of Energy Environmental Justice Strategy, discussed in Section E.4 below). Although non-binding, the Declaration illustrates that the United Nations (U.N.) and other authorities on international law and the rights of aboriginal people have taken a step closer to concurrence with such peoples who argue that water and similar resources upon which they depend is a "fundamental right."

Similarly, Indian Tribes and/or their members have often appeared before international tribunals after they are unable to obtain satisfaction in the protection of indigenous and treaty rights in U.S. courts. Such tribunals often rule on violations of traditional rights to land and water resources and the harm to tribal communities from government actions.

The United Nations Working Group on Indigenous Populations, for example, is an organ of the U.N. Sub-Commission on Prevention of Discrimination and Protection of Minorities with a mandate to review developments concerning indigenous peoples' rights and to work toward the evolution of corresponding international standards. Getches, Wilkinson and Williams, Federal Indian Law, Third Addition, p. 1024 (1993). Through its activities, the Working Group has engaged states, indigenous peoples and others in an extended multilateral dialogue on indigenous rights. The Working Group has provided a forum for indigenous representatives along with

government representatives to articulate concerns and debate rights, which indigenous people have done, in part, by promoting their own written declarations of rights. *Id.*

In a case that is similar to Petitioners, in fact, at its sixty-seventh session, held from August 2 to August 19, 2005, the Committee for the Elimination of Racial Discrimination in Geneva heard a preliminary basis request submitted by the Western Shoshone National Council, the Timbisha Shoshone Tribe, the Winnemucca Indian Colony, and the Yomba Shoshone Tribe, asking the Committee to act under its early warning and urgent action procedure on the situation of the Western Shoshone indigenous peoples in the United States of America. Committee for the Elimination of Racial Discrimination, sixty-eighth session, Geneva, February 20–March 10, 2006, Early Warning and Urgent Action Procedure Decision (68), United States of America.

The Committee's decision was initiated by a petition filed by Mary and Carrie Dann (the Dann sisters), who are members of the Western Shoshone tribe and who live on a ranch in the rural community of Crescent Valley, Nevada. In a similar process to the present case, the Danns had asked the Commission to provide recommendations to the Bureau of Land Management (BLM) which was imposing grazing fees, trespass and collection notices; horse and livestock impoundments; restrictions on hunting, fishing and gathering; as well as making arrests related to the Dann's attempts to graze livestock on federal land in Nevada.

As a result of the request, the Committee ultimately filed a "Early Warning and Urgent Action Procedure" to the United States government based on its conclusion that it "has received credible information alleging that the Western Shoshone indigenous peoples are being denied their traditional right to land, and that measures taken and even accelerated lately by the State party in relation to the status, use and occupation of these lands may cumulatively lead to irreparable harm to these communities." *Id.*

As in the case of granting the Expansion which will impact Petitioners' individual interest in this case, the petitioners in Dann contended that the 'state' (in this case, the U.S. Bureau of Land Management) interfered with their use and occupation of their ancestral lands by purporting to have appropriated the lands as federal property through unfair procedures before the Indian Claims Commission (ICC), by physically removing and threatening to remove their livestock from the lands, and by permitting or acquiescing in gold prospecting activities within Western Shoshone traditional territory. Based upon these circumstances, the petitioners alleged that the state was responsible for violations of the American Declaration of Rights and Duties of Man (the American Declaration). *Id.*

Among the recommendations the Committee gave to the United States was to stop the citations and arrests of the Danns and "rescind all notices already made to that end, inflicted on Western Shoshone people using their ancestral lands." *Id.* The Committee further noted that the United States' position was based on processes before the ICC "which did not comply with contemporary international human rights norms, principles and standards that govern determination of indigenous property interests," as stressed by the Inter-American Commission on Human Rights in the case of *Mary and Carrie Dann v. United States*. Elimination of Racial Discrimination Committee, *citing* Case 11.140, (December 27, 2002). As in this case, the Committee stated that past and new actions taken by the State party on tribal ancestral lands lead to a situation where, today, the obligations of the State party under the Convention are not respected, in particular the obligation to guarantee the right of everyone to equality under the law in the enjoyment of civil, political, economic, social and cultural rights, without discrimination based on race, color, or national or ethnic origin. *Id.*, p. 2, para. 7.

D. Petitioners have standing to Assert that NRC must Consider the Impacts of Climate Change

NEPA requires all federal agencies to discuss in an EIS a reasonable range of alternatives to the proposed action. 42 U.S.C. §4332(2)(C)(iii); (2)(E). NEPA also requires federal agencies to take a "hard look" at the environmental consequences of a proposed action. *See, Idaho Sporting Cong. v. Rittenhouse*, 305 F.3d 957, 973 (9th Cir. 2002) (*quoting Marsh v. Ore. Natural Res. Council*, 490 U.S. 360, 374 (1989)). In addition, NEPA requires an EIS to include an analysis of the likely cumulative environmental impacts of proposed actions. See 40 C.F.R. §1508.7; 1508.25(a)(2).

Petitioners participation in this matter, therefore, is necessary to insure that NRC's analysis of the Expansion contains discussions of the effects of climate change on the water and other resources impacted by the mine. This is based on the fact that climate change is a phenomenom now accepted by most experts and, therefore, falls within the guise of NRC's duty to assess the impact of its activities on the environment. In fact, a recent study suggests that human-caused global warming has been shrinking the snowpack across the mountain ranges of the West for five decades, suggesting that the region's long battle for water will only get worse, according to a computer analysis. *See*, Tim P. Barnett, David W. Pierce, et al, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093, USA; Lawrence Livermore National Laboratory, Livermore, CA 94550, USA; Land Surface Hydrology Research Group, Civil and Environmental Engineering, University of Washington, Seattle, WA 98195, USA; National Institute for Environmental Studies, 16-2, Onogawa, Tsukuba, Ibaraki 305-8506, Japan. (Climate Change Study) (Attached as Exhibit C).

In addition, "Cumulative impact" is defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. § 1508.7.

CBR must, therefore, provide useful analysis not only of the effects of the proposed action, but also of these effects in combination with past, present, and future actions. *City of Carmel-By-The-Sea v. U.S. Dept. of Transp.*, 123 F.3d 1142, 1160 (9th Cir. 1997). In addition, the D.C. Circuit Court has held that the fact that a project may result in even a small, incremental increase in the overall impacts to a resource is meaningless if "there is no way to determine . . . whether [this small increase] in addition to the other [impacts], will 'significantly affect' the quality of the human environment." *Grand Canyon Trust*, 290 F.3d at 346. The Court in *Grand Canyon Trust* further stated that: "While the factual settings differ in some respects from the instant case, the consistent position in the case law is that, depending on the environmental concern at issue, the agency's [NEPA analysis] must give a realistic evaluation of the total impacts and cannot isolate a proposed project, viewing it in a vacuum." *Id.*, at 342.

Further, a multivariable climate-change detection and attribution study lead by Scripps Institution of Oceanography at University of California, shows that the hydrological cycle of the western U.S. changed significantly over the last half of the twentieth century. *See*, Climate Change Study. Using a high-resolution hydrologic model and global climate models, the study focuses on the changes that have already affected primarily arid regions in the West with a large and growing population. *Id.* The results show up to 60% of the climate related trends of river flow, winter air temperature and snow pack between 1950-1999 are human-induced and that "[t]hese results are robust to perturbation of study variates and methods. They portend, in

conjunction with previous work, a coming crisis in water supply for the western United States." *Id.*, at Executive Summary.

In part, as a result of such studies, the U.S. Supreme Court recently agreed with the State of Massachusetts and ordered the Environmental Protection Agency to consider greenhouse gases a pollutant. *Massachusetts v. EPA*, No. 05-1120 U.S. Supreme Court (2007). In reaching this conclusion, the court stated:

> The harms associated with climate change are serious and well recognized. The Government's own objective assessment of the relevant science and a strong consensus among qualified experts indicate that global warming threatens, *inter alia,* a precipitate rise in sea levels, severe and irreversible changes to natural ecosystems, a significant reduction in winter snowpack with direct and important economic consequences, and increases in the spread of disease and the ferocity of weather events. That these changes are widely shared does not minimize Massachusetts' interest in the outcome of this litigation.

Id., at 2, *citing Federal Election Comm'n* v. *Akins*, 524 U. S. 11, 24.

E. The Expansion Involves Multiple Environmental Justice Issues

The environmental and human health burdens of CBR's mine expansion will dis-proportionality impact Petitioners.

1). <u>Assessment of CBR's "Environmental Report"</u>

Crow Butt's "Environmental Report" (Report) submitted to the NRC, as it relates to soil, water, flooding and storms will form the basis for evaluating the environmental impacts for decisions on the various state and county permits and approvals for the Expansion. The Report, however, completely fails to analyze the disproportionate impact of the Expansion on the native community or even distinguish the specific cultural, traditional or subsistence interests of the community that may be affected by the mine. The only reference, in the Report to these interests includes that statement that "No adverse environmental impacts would occur to the population

within the PSA from proposed Project activities; therefore there would be no disproportionate adverse impact to populations living below the poverty level in these Block Groups." TR 2.3.3

2). **Executive Order on Environmental Justice**

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This Order requires federal authorities to consider the environmental and human health conditions of low-income populations and to develop an environmental justice strategy to counter any additional impacts of proposed activties. As a result, Region 7 has developed an environmental justice strategy that identifies and addresses unfair environmental impacts on programs, policies, and activities in minority and low-income populations. *See*, http://www.epa.gov/rgytgrnj/ej/pdf/english_ej_factsheet.pdf.

Federal agencies are required to consult with the Indian Tribes under the Presidential Directive that all activities relating to or affecting native tribal rights or trust resources should be implemented in a manner that recognizes tribal sovereignty. *See*, President Clinton's Directive (April 29, 1994). Specifically, the Directive requires that in all activities relating to or affecting tribal resources or treaty rights, the executive branch shall: 1) operate within a government-to-government relationship with federally recognized Indian tribes; 2) consult, to the greatest extent practicable and permitted by law, with Indian tribal governments *before* taking actions that affect them; and 3) assess the impact of agency activities on tribal trust resources and assure that tribal interests are considered *before* the activities are undertaken.

3). **Title 6 of Civil Rights Act of 1964**

Where a recipient of federal funding is involved and when part of action occurs on federal land and has been approved by the NRC, the state is required to comply with Title 6 in

issuing a water right permit. The Supreme Court has affirmed the right to bring a Civil Rights Act cause of action for violation of a federal statute by a state official under 42 U.S.C. A. § 1983. *See Maine v. Thiboutot*, 448 U.S. 1 (1980); *Middlesex County Sewerage Authority v. National Sea Clammers Ass'n*, 453 U.S. 1 (1981).

Native Hawaiian land-owners, in fact, have successfully used the Civil Rights Act to sue the state for violations of the federal Admission Act regarding handling of aboriginal lands and other assets held in trust by the state for native land owners. The Ninth Circuit Court of Appeals, for example, held that the rights being asserted under the Admission Act were protected by federal law, not state law. Therefore:

> While the management and disposition of the home lands were given over to the State of Hawaii with the incorporation of the Commission Act into the state constitution, the trust obligation is rooted in federal law, and power to enforce that obligation is contained in federal law.

Keaukah-Panaewa Community Ass'n v. Hawaiin Homes Comm'n, 739 F.2d 167, 1472 (9th Cir. 1984).

Further, the consumption and water toxins that will result from the Expansion, in this case, will violate the public interest due to the disproportionate impact that degraded water quality from decreased water flows and the releases from the mine itself will have on the interests of the Petitioners. The anti-degradation policy of the state of Nebraska, in fact, is generally guided by the Nebraska State Water Pollution Control Act, and Water Resources Act of 1971. 001. It is the public policy of the State of Nebraska to protect and improve the quality of surface water for human consumption, wildlife, fish and other aquatic life, industry, recreation, and other productive, beneficial uses. Beneficial uses are assigned to surface waters within or bordering upon the State of Nebraska (Chapters 5 and 6). Assigned and existing

beneficial uses are protected by the Antidegradation Clause (Chapter 3) and the narrative and numerical water quality criteria in this chapter. Beneficial uses are also protected by permits issued in accordance with the requirements of these standards, and through Department requirements for the applicable level of treatment or control for point and nonpoint sources of pollution. Some uses require higher quality water than others. When multiple uses are assigned to the same waters, all assigned uses will be protected. The beneficial uses defined by these standards are:

Primary Contact Recreation
Aquatic Life
Coldwater (Class A and B)
Warmwater (Class A and B)
Water Supply
Public Drinking Water
Agricultural
Industrial
Aesthetics
Title 117 - Nebraska Department of Environmental Quality, Chapter 4 - Standards For Water Quality

Finally, environmental justice is an important part of EPA Region 7's mission. An overall approach to identifying and addressing environmental justice concerns requires early involvement of the affected communities and other stakeholders. Region 7, the states, Indian tribes, and affected communities will work together to ensure fairer environmental and public health protection through effective use of policies and procedures.

See, http://www.epa.gov/rgytgrnj/ej/pdf/english_ej_factsheet.pdf.

4). Department of Energy Environmental Justice Strategy

In the context of the Expansion, neither CBR nor NRC has even mentioned the agency's own environmental justice strategy. This policy provides:

> a structured framework of the Department of Energy's efforts to integrate feasible environmental justice principles set forth in Executive Order 12898 into our operations. The strategy is structured in the spirit of the Administration's principles for reinventing government and is consistent with the principles set forth in the National Performance Review as it emphasizes a more responsive government and accountability by employees for achieving results. Individual strategies reflect a refocusing of policies and programs by Departmental elements, more meaningful dialogue with our stakeholders to address the impact of our operations on communities, and the continuation of on-going programmatic activities with the infusion of a heightened sensitivity to the principles of environmental justice. Implementation of the strategy will be carried out mainly within current programmatic and budgetary provisions of existing Departmental elements. As current budgetary situations change, the Department will work with stakeholders to prioritize strategies for implementation.
>
> Further, the Commission's strategy:
>
> reflects the commitment of the Department to participate in efforts to advance the human well-being of communities. It reflects an integrated approach by all our components to formulate strategies based on clear priorities and tangible benefits and actions that address programmatic, legislative, and regulatory responsibilities. It also emphasizes community participation and empowerment of our stakeholders and communities, refocused research agendas to reflect a new recognition of various health issues, encourages modified approaches for structuring models for occupational and environmental science research for high risk communities and workers, embraces interagency coordination to ensure environmental justice, and includes plans to heighten the sensitivity of our managers and staff to environmental justice options within our Department's infrastructure.

http://www.lm.doe.gov/env_justice/documents/envjus2.htm (emphasis added.)

Finally, the Commission's environmental justice strategy identifies a list of programs, policies, and planning processes for possible revision, in order to ensure improved environmental quality and health standards within Departmental operations. These include the use of policies and programmatic actions relating to:

- The National Environmental Policy Act of 1969 (NEPA) as it relates to "socio-economic impacts," "environmental consequences," and "affected environment;"

- DOE Order 5400.1 (General Environmental Protection);
- DOE Order 1600.6A (Prohibiting discrimination by recipients of Departmental financial assistance as it relates to Title VI of the Civil Rights Act;);
- DOE Order 4700.1 (Project Management System);
- Programmatic Environmental Impact Statements (PEIS);
- Environmental Impact Statements (EIS);
- Waste Minimization Pollution Prevention Awareness Plan;
- Risk Assessment Approaches;
- Future revisions of the Office of Civilian Radioactive Waste Management Strategic Plan; and
- Guidance and standards for worker and public health protection from unwarranted exposures.

http://www.lm.doe.gov/env_justice/documents/envjus2.htm.

Therefore, the NRC must consider its own environmental justice strategy and guidelines and apply them in the instant case. This is regardless of the fact that the impact on Petitioners is illustrated by the studies showing the impacts to water quality and quantity used by the Petitioners.

F. Petitioners have Standing to Argue for Limits on the Expansion Due to the Mixing Of Underlying Aquifers

The rule granting standing to people drinking water "adjacent" to a uranium mine should encompass at least a fifty mile radius, because the limitation in terms of distance increases when there is a mixing of underlying aquifers. The Applicant states that the Basal Chadron aquifer is not used for domestic supply in the North Trend area but omits to state that water the Basal Chafron mixes with the Brule aquifer which is used by people and animals in the areas

surrounding the North Trend area. Further, water transportation through both the primary aquifer water that permeates through rock within an aquifer and the secondary flow – that which flows through fissures and fractions in the rock , is increased by the insitue process due to the pressure caused by that process. In addition, this is further exacerbated by the nature of the geology of the Black Hills which are high above the Petitioners' homes and business sites. The water pressure in fact, is so great that it results in an artisian well at the site of the community.

In general, the "Basal Chadron" aquifer is part, but not all of, the Chamberlain Pass Formation, Evans, J. E. & Terry, D. O., Jr. 1994. The significance of incision and fluvial sedimentation in the basal White River Group (Eocene-Oligocene), badlands of South Dakota, USA. Sedimentary Geology 90:137-152 and studies, so far, have only delimited part of these rocks, the total distribution of which is currently unknown. This means that the ability to predict where water in the "Basal Chadron" is and where it is going is highly limited.

In addition, parts of the subsurface Chamberlain Pass Formation (some of the largest sandstone channels) trend from Crawford, Nebraska to the north generally southeastward to Bayard, Nebraska to the south. Swinehart, J. B. & others. 1985. Cenozoic paleogeography of western Nebraska, pp. 209-229 in (R. M. Flores & S. Kaplan, eds.) Cenozoic Paleogeography of West-central United States. Society of Economic Paleontologists and Minerologists (Rocky Mountain Section). The underground flow of water in western Nebraska follows this same trend, and also intersects the cone of depression produced by center-pivot irrigation in central Box Butte County. Pettijohn, R. A. & H. Chen. 1984. Hydrologic analysis of the High Plains Aquifer system in Box Butte County, Nebraska. United States Geological Survey Water Resources Investigations 84-4046, 53 p. This cone of depression is drawing water from the northwest to the southeast, towards Alliance and the North Platte River Valley.

Further, the High Plains Aquifer is highly fractured and faulted in some areas, including the Pine Ridge of northern Sioux, Dawes, and Sheridan counties in Nebraska. Diffendal, R. F. 1994. Geomorphic and structural features of the Alliance 1 x 2 Quadrangle, western Nebraska, are discernable from synthetic-aperture radar imagery and shaded relief maps. University of Wyoming Contributions to Geology, 30(2):137-147. These faulted zones contain groundwater, and are considered Areas of Critical Concern by the Upper Niobrara/White Natural Resource District (Upper Niobrara White Natural Resource District Groundwater Management Plan section 7). An exhaustive compilation of well data, shows that many of these fault zones connect the High Plains Aquifer and the uranium-bearing sandstones of the Chamberlain Pass Formation ("basal Chadron" of their terminology). Swinehart & Others (1985). The Upper Niobrara/White NRD recognizes the potential for contamination of both surface and subsurface water from uranium mining in Dawes County (Upper Niobrara White NRD Groundwater Management Plan section 7.5), and that their planned use of the fault zones for residential, municipal, and agricultural use increases the likelihood of drawing up contaminated water from below (Upper Niobrara White NRD Groundwater Management Plan section 7.5). Moreover, potential contaminants from surface spills north of the Pine Ridge would likely be contained by the Pierre Shale (although still a source of contamination of the White River's alluvium), surface spills south of the Pine Ridge would be transmitted through porous sandstones of the Ogallala and Arikaree groups directly into the High Plains Aquifer. Swinehart & others, 1985.

Finally, a study by Chadron State College based on detailed (1:24,000) geologic mapping and lithostratigraphic correlations found that the "local water supply" of the central Pine Ridge and along the South Dakota Border near Whiteclay, is found just below "high point beds" of fluvial sandstone. *See,* "Revised Lithostratigraphy of Late Paleogene and Neogene Strata of the

High Plains Aquifer in Western Nebraska, USA" by Hannan E. Lagarry et al., Department of Physical & Life Sciences, Chadron State College, Chadron, NE 69337, Executive Summary (Attached as Exhibit D). In addition, the base of strata of the High Plains Aquifer in western Nebraska, includes volcaniclastic and fluvial sandstones which "is narrowly incised into underlying strata...which is the source of many spring-fed creeks and rivers in northwestern Nebraska." *Id.* In addition, the base of the sandstones of the Ogallala Group is the "Running water Formation"and includes overbank sandstones, fluvial sandstones and conglomerates and is a source of municipal water including that of Petitioners. *Id.*

CONCLUSION

For the above reasons, the Center for Water Advocacy and Rock the Earth concur with the Petitioners' Motion and requests that the Board allow Petitioners' intervention and contentions as expressed in the Petition in the matter of the proposed Expansion of the CBR mine, and hold as a matter of law that the existence and operation of the Expansion would substantially burden Petitioners' rights to use of water and to exercise their traditional uses of the affected area and water resources under applicable law.

Dated: February 22, 2008.

Respectfully submitted,

s/*Harold S. Shepherd*
Harold S. Shepherd
Of Attorneys for *Amicus Curiae*
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Marc A. Ross
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Rock the Earth

Exhibit A

URANIUM ISL GROUND-WATER DATA FROM WRITTEN TESTIMONY OF WILLIAM P. STAUB, PH.D., January 9, 1999

ENDAUM Home

SRIC's Uranium Impact Assessment Program

In support of ENDAUM-SRIC
Presentation on Groundwater Issues in the Matter of Hydro Resources, Inc.
USNRC ASLBP-95-706-01-ML
USNRC Docket No. 40-8968-ML

The following data tables were extracted from the written testimony of William P. Staub, Ph.D., a geophysicist and expert in uranium in situ leach mining technology. Dr. Staub is a consultant to Eastern Navajo Din, Against Uranium Mining (ENDAUM) and Southwest Research and Information Center (SRIC) in the groups' legal challenge of a source materials license issued by the U.S. Nuclear Regulatory Commission (NRC) to Hydro Resources, Inc. (HRI), in January 1998. HRI proposes to construct and operate the Crownpoint Uranium Project at three sites in northwestern New Mexico: Church Rock, Unit 1, and Crownpoint. All three sites are on or adjacent to Navajo lands or communities.

Dr. Staub was the principal author of a 1986 NRC consultant report that evaluated performance of the uranium ISL industry during its infancy in the mid-1970s to early-1980s. In his written testimony for ENDAUM and SRIC, he described how some of the industry's early problems with solution control are still evident at uranium ISL operations today. He described recent excursion experience at several ISL mines in Wyoming and Texas and how ground-water restoration remains difficult and has taken longer than expected at operating mines in Wyoming. He concluded that to this day, there is no example of a completely restored, commercial-scale uranium ISL operation in Wyoming. Tables 1 through 5 appeared in his testimony to illustrate these points.

Dr. Staub also noted there are important differences in "baseline," or "pre-mining," ground-water quality in Wyoming and Texas and at the proposed HRI sites in New Mexico. The Texas sites have significantly poorer baseline water quality, which in Dr. Staub's view, should make them easier to restore. The Wyoming sites have similar water quality to those in New Mexico, with the exception of much higher concentrations of dissolved radium-226 and uranium.

His view is that baseline water quality is exceptionally high at the New Mexico sites, making them potentially very difficult, if not impossible, to restore to baseline conditions. Table 6 provides a comparison of selected ground-water quality data for ISL mines in several states.

Further details on Dr. Staub's findings, and those of ENDAUM's and SRIC's other ground-water experts, Dr. Richard J. Abitz and Mr. Michael Wallace, are available from SRIC by calling 505-262-1862 or by writing SRIC at sricdon@earthlink.net. Contact people are Chris Shuey and Paul Robinson.

Table 1. Partial list of monitor wells recently or currently on excursion status at COGEMA Mining's Irigaray and Christensen Ranch ISL mines in Wyoming.

Site	Stage of Development	Well ID	Excursion Initiation	Excursion Termination
Irigaray Ranch	Restoration	SSM3 Unit 2	08/30/96	Ongoing
Irigaray	Restoration	SSM18 Unit 8	09/13/96	Ongoing
Irigaray	Restoration	SSM40 Unit 8	08/16/96	Ongoing
Irigaray	Restoration	SSM42 Unit 3	10/10/90	Ongoing
Irigaray	Restoration	SSM43 Unit 1	10/11/89	Ongoing
Irigaray	Restoration	DM10 Unit 6	02/02/94	Ongoing
Irigaray	Restoration	SSM41 Unit 4	09/12/97	03/04/98
Christensen R.	Production	MW89 Unit 2	08/07/98	Ongoing
Christensen	Production	MW46 Unit 6	03/02/98	04/01/98

Table 2. Partial list of monitor wells recently or currently on excursion status at Power Resources Inc. Highland Uranium Project, Wyoming.

Stage	Well	Initiation	Termination

URI	Kingsville Dome	D16	08/24/88	05/03/89
URI	Kingsville Dome	D39	07/18/96	08/31/96
URI	Kingsville Dome	D45	10/14/96	10/28/96
URI	Kingsville Dome	D47	01/14/98	01/28/98
URI	Kingsville Dome	MW7	02/17/92	03/02/92
URI	Kingsville Dome	MW8	11/13/98	Ongoing
URI	Kingsville Dome	MW49A	05/01/98	Ongoing
URI	Kingsville Dome	MW172	07/22/98	Ongoing

Table 4. List of monitoring wells currently (as of 12/10/98) or recently on excursion status at various ISL sites in Texas.

Company	Mine	# of wells	Earliest	Most recent
Cogema	El Mesquite	9 (3 current)	06/30/94	07/10/98
Cogema	Holiday	3 (3 current)	08/31/94	02/17/98
Cogema	O'Hern	6 (1 current)	10/06/94	02/20/97
Cogema	West Cole	4 (2	12/31/94	08/13/98

Restoration	M-8A	Before 10/96	??/98
Restoration	M-10A	01/25/95	Ongoing
Restoration	M-11	11/19/92	Ongoing
Restoration	B-56	11/22/96	Ongoing
Restoration	B-62	Before 10/96	Ongoing
Restoration	B-63	Before 10/96	??/98
Restoration	B-43	02/12/98	04/98
Production	CM-15	09/09/94	03/95

Table 3. List of monitoring wells currently (as of 12/10/98) or recently on excursion status at URI's Kingsville Dome mine, Kleberg County, Texas.

Company	Mine	Well	Initiation	Termination
URI	Kingsville Dome	A10	07/17/96	12/31/96
URI	Kingsville Dome	D2	07/12/96	08/31/96
URI	Kingsville Dome	D9	07/12/96	08/31/96
URI	Kingsville Dome	D15	08/24/88	09/08/88
URI	Kingsville Dome	D15	07/12/96	08/31/96

		current)		
Everest	Tex-1	1 (0 current)	07/16/93 (on)	11/10/93 (off)
Intercontinental	Lamprecht	2 (0 current)	04/30/93 (on)	11/30/93 (off)
Intercontinental	Zamzow	6 (? Current)	11/18/92	05/03/94
USX	Burns "A"	3 (0 current)	05/16/96 (on)	06/18/96 (off)
USX	Burns "B"	1 (0 current)	05/12/96 (on)	08/03/96 (off)
USX	Clay West	2 (0 current)	03/31/96 (on)	05/01/97 (off)
USX	Moser "A"	4 (0 current)	04/30/96 (on)	10/01/98 (off)
USX	Moser "C"	3 (0 current)	04/30/93 (on)	01/22/97 (off)
USX	Pawlik	1 (0 current)	04/30/95 (on)	05/31/95 (off)

Table 5. Restoration Performance at Selected Uranium ISL Mines in Wyoming

Project/ selected wellfields	Restoration period start-current status (yrs.)	Cum. pvs to date (method)	Conductivity (µ mhos/cm) restor. goals	Conductivity (µ mhos/cm) most recent sample
Christensen Ranch Mine	04/97-7/98*	1.8-gws	approx. 700	3686
Mine Unit 2	(1.3 yrs) 11/96-7/98*	1.84-gws 1.93-gws	approx. 600 approx. 600	4015 3401
Mine Unit 3	(1.8 yrs) 08/97-7/98*			

Table 6. Average baseline groundwater quality for selected ISL mine sites in Texas, New Mexico, and Wyoming. Data compiled from Staub, et. al., 1986, and USNRC, 1997 (all concentrations in mg/l, except as noted)

Para-meter	WMC-Bruni	URI-K'Dome	URI-Rosita	HRI-C'point	HRI-C'Rock	PRI Highland	WMC-Irigaray
	PA 1,2 1979	PAA2 2/13/90	PAA3 6/6/96	CP mws '90-'91	CR mws '88-'89	A-W.F. 7/91	WF-`E' 1980
Bicarb-onate	175.0	297.0	161.0	203.0	246.0	215.0	90.0
Chloride	1090.0	224.0	952.0	15.8	6.0	4.0	12.0
Conduct-ivity*		1662.0	4276.0	602.3	556.0	525.0	650.0
Sodium	413.0	323.0	751.0	127.7	130.0		120.0
Sulfate	142.0	224.0	496.0	62.2	37.0	91.0	
TDS	2312.0	1035.0	2524.0	394.0	370.0	330.0	
Radium*	129.0	92.0	87.3	58.7 (0.9**)	10.0	675.0	
Uranium	0.300	1.890	0.586	0.005	1.800	0.050	0.030
Arsenic	0.020	0.006	0.068	0.000	0.003		
Selenium	0.050	0.008	0.120	0.000	0.001	<0.001	

*Conductivity concentration in umhos/cm; radium concentration in pCi/l.
**This is the mean value of radium-226 concentrations in all HRI Crownpoint monitor wells, except CP-2, which Dr. Abitz has identified as having such anomalous water quality as to inappropriately skew the radium concentrations upward.

Table 7. Geometry of Orebodies, Number of Production and Injection Wells at Crownpoint Uranium Project, New Mexico.

Site	Orebody Thickness	Orebody Width	Orebody Length	No. Wells Production/Injection

Church Rock	11.5 ft.	158 ft.	33,100 ft.	868	834
Unit 1	9.2 ft.	139 ft.	25,629 ft.	305	302
Crownpoint	9.02 ft.	126 ft.	80,960 ft.	823	767

(This table, which was derived from information submitted by HRI to the NRC Staff, was used by Dr. Staub to show that the orebodies at the Crownpoint Project are elongated, channel-like geologic structures. Mr. Wallace testified that these channels typify the heterogeneous hydrogeologic systems at the HRI sites. They have the potential to make fluid control more difficult because ground water is transmitted faster through the rocks.)

Mine Unit 4	(1.0 yr)			
Irigaray Mine:				
Units 1-3	unk.-	unknown	unknown	unknown
Units 4-5	"complete"	9.22-RO	approx. 750	816
Units 6-9	1993	1.28-RO	approx. 750	1648
	04/95-ongoing, 7/98 (3.3 yrs)			
	04/95-ongoing, 7/98 (3.3 yrs)			
Highland:		thru		
A-Wellfield	07/91-	7/97:	525	471
	ongoing,	21.0-RO	574	1365
B-Wellfield	10/98 (7.3	3.6-RO	721	2343
	yr)	unknown		
C-Wellfield	07/91-ongoing, 10/98 (7.3 yr)			
	07/97-10/98 trial (1.3 yr)			

gws = groundwater sweep
pvs = pore volumes
RO = reverse osmosis treatment-reinjection

* COGEMA Mining, Inc., the Christensen Ranch-Irigaray operator, reported that all groundwater sweep operations at Christensen Ranch was "terminated" in July 1998 "when COGEMA ceased all surface discharge activities. COGEMA's NPDES [National Pollutant Discharge Elimination System] permit for the discharge of restoration wastewater was reissued on July 31, 1998 with a new selenium limit of 0.05 mg/l. As COGEMA is not able to meet this limit through conventional water treatment methods, the discharge of restoration solutions stopped on July 31. . . .[T]he other wastewater disposal systems such as the disposal well and evaporation ponds are not capable of handling the additional volumes of groundwater sweep solutions. . ." (COGEMA 1998, at 7.) My interpretation of this statement is that COGEMA has suspended restoration until new disposal capacity is permitted and installed.

Exhibit B

NUREG/CR-6870

Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities

Draft Report for Comment

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Consideration of Geochemical Issues in

Groundwater Restoration at Uranium In-Situ

Leach Mining Facilities

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ABSTRACT

The geochemistry of relevance to groundwater quality restoration at in-situ uranium leach

mining facilities is reviewed and discussed, with a particular focus on the elements uranium, selenium, arsenic, and vanadium. The computer code PHREEQC Interactive (Parkhurst and Appelo, 1999) is used to model the chemical evolution of groundwater in a typical groundwater restoration and stabilization effort, with one pore volume of groundwater sweep, followed by several pore volumes of reverse osmosis treatment with re-injection of the permeate water, and stabilization simulations out to 100 pore volumes with either oxic or reducing influent groundwater. The database for the pilot plant groundwater restoration project at the Ruth In-Situ Leach Uranium Mine facility (Wyoming) (Schmidt, 1989) was used to set initial post-mining conditions and to compare the model results for various geochemical/hydrologic scenarios with actual field observations of water quality evolution. The modeling and field data suggest that there was little pyrite or uraninite left in the mined ore zone that was in good hydrologic contact with flowing groundwater. These reduced minerals may be present in regions of low permeability that transfer solutes slowly to the high permeability regions, however, this is not likely to lead to chemically reducing conditions in the permeable regions during the active phases of groundwater restoration. The addition of a reductant (such as hydrogen sulfide gas) to the re-injected reverse osmosis permeate water is very effective at creating reducing conditions in the mined ore zone for a period of time. The ability of the model to simulate the conditions in the subsurface requires a knowledge of the mineral phases formed in the mined zone after hydrogen sulfide addition. The formation of metastable phases, such as elemental sulfur, rather than thermodynamically stable phases, such as pyrite, has a very significant effect on the modeling results if oxic water flows into the mined region during the stabilization phase of restoration. The stability of chemically reducing conditions in the subsurface after hydrogen sulfide addition is difficult to predict and likely depends on the actual reduced minerals formed, the rate of groundwater flow into the mined ore zone region, and the dissolved oxygen concentration of the groundwater under natural gradient conditions. Long-term stabilization of the mined zone is likely if sufficient hydrogen sulfide is added during a few pore volumes of RO treatment to achieve highly reducing conditions, and the influent groundwater under natural gradient conditions is anoxic. If the influent groundwater during stabilization is oxic, however, the reducing conditions caused by hydrogen sulfide addition will eventually be overcome, and increases in the concentrations of U, As, and Se will likely rebound significantly above the baseline for a long period of time (many tens of pore volumes under natural gradient conditions) before decreasing back to baseline conditions. Meaningful predictions for vanadium are difficult to make because of the lack of sorption constants for V(IV) and V(III).

Foreword

Some mining processes use fluids to dissolve (or leach) a mineral without the need physically to remove the ore containing the mineral from an ore deposit in the ground. In general, these "in-situ" leach mining operations at uranium mines are considerably more environmentally benign than traditional mining and milling of uranium ore. Nonetheless, the use of leaching fluids to mine uranium contaminates the groundwater aquifer in and around the region from which the uranium is extracted. Consequently, the U.S. Nuclear

Regulatory Commission (NRC) requires licensees to restore the aquifer to established water-quality standards following the cessation of in-situ leach mining operations.

The NRC also requires licensees to ensure that sufficient funds will be available to cover the cost of decommissioning their facilities. For these uranium mines, restoration generally consists of pumping specially treated water into the affected aquifer and removing the displaced water — and thereby the undesirable contaminants — from the system. Because groundwater restoration represents approximately 40 percent of the cost of decommissioning a uranium leach mining facility, a good estimate of the necessary volume of treatment water is important to allow a good estimate of the cost of decommissioning.

This report summarizes the application of a geochemical model to the restoration process to estimate the degree to which a licensee has decontaminated a site where a leach mining process has been used. Toward that end, this report analyzes the respective amounts of water and chemical additives pumped into the mined regions to remove and neutralize the residual contamination using 10 different restoration strategies. The analyses show that strategies that used hydrogen sulfide in systems with low natural oxygen content provided the best results. On the basis of those findings, this report also summarizes the conditions under which various restoration strategies will prove successful. This, in turn, will allow more accurate estimates of restoration and decommissioning costs.

This report will be useful for licensees and State regulators overseeing uranium leach mining facilities, who need to estimate the volume of treatment water needed to decontaminate those facilities.

CONTENTS

FIGURES

TABLES

1 BACKGROUND

In-situ leaching (ISL) is a term that describes the process of contacting a mineral deposit with leaching fluids to dissolve the mineral without having to physically remove the ore from the subsurface. ISL uranium mining has the potential to produce uranium at lower costs than other mining methods.

The ISL mining technology is primarily limited to roll-front uranium deposits that are located in sandstone aquifers. The water-bearing unit of the aquifer containing the ore body must be confined by less permeable materials; uranium deposits found in water-table aquifers are not mined by ISL technology (Rojas, 1989).

The leaching fluid in the ISL mining process is referred to as the lixiviant solution. Lixiviant solutions are injected into the ore zone and the mixed leaching fluid and groundwater are then pumped out of the ground at a production well (Figure 1). The ideal lixiviant is one that will oxidize the uranium in the ore and contains a complexing agent that will dissolve and form strong aqueous complexes that remain dissolved and interact little with the host rock. Typical lixiviants for in-situ leach mining are salt

solutions of ions such as bicarbonate, carbonate, and sulfate that form stable complexes with the oxidized uranium, denoted as U(VI). Oxidants added to the lixiviant to cause the oxidation of uranium ore include oxygen, hydrogen peroxide, sodium chlorate, sodium hypochlorite, and potassium permanganate.

The principal regions of ISL mining facilities are located in the Wyoming Basins (Wind River, Shirley, Powder River, Great Divide), on the Colorado Plateau, or in the Gulf Coastal Plain of Texas. Leachable uranium deposits are found in sandstones that have been deposited in intermontane basins, along mountain fronts, or in near-shore marine or deltaic environments. The geologic environment favoring the formation of the roll front deposits is deficient in oxygen, has zones with less permeable siltstones and shales, and contains reducing agents such as carbonaceous material, hydrogen sulfide, or pyrite. Individual ore bodies in sandstone lenses rarely exceed a few hundred meters in length, commonly being a few tens of meters wide and 10 meters or less thick.

The spacing and arrangement of injection and production wells are unique for each ISL facility and depend on the hydraulic response of the aquifer to fluid injection or production. The arrangement of wells is similar to that in networks used for secondary recovery operations in oil fields. The net rates of injection and production are ideally balanced across all wells, such that fluid flow away from the well field is minimized.

Water-quality effects that can result from ISL mining may be caused by the excursion of lixiviant during injection or from natural migration of residual lixiviant and other ISL-affected ground water after mining has ceased. Numerous chemical interactions are possible between the lixiviant and the uranium ore, associated secondary minerals, and the host rock formation. The interactions can be divided into four broad chemical categories: 1) oxidation-reduction (redox) reactions, 2) dissolution reactions, 3) precipitation reactions, and 4) sorption and ion exchange reactions. The rates and degree to which these reactions occur are interdependent, that is to say, for example, precipitation reactions may be affected by sorption and ion exchange reactions. For this reason, it is useful to consider the possible reactions, or at least the most significant reactions, within an aqueous geochemical model. Common radioactive constituents that may be mobilized by uranium ISL mining activities include uranium, thorium, radium, radon, and their respective daughter products. Trace elements of concern with respect to water

Exhibit C

ScienceExpress | Report

Human-Induced Changes in the Hydrology of the Western United States

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Observations have shown the hydrological cycle of the western U.S. changed significantly over the last half of the twentieth century. Here we present a regional, multivariable climate-change detection and attribution study, using a high-resolution hydrologic model forced by global climate models, focusing on the changes that have already affected this primarily arid region with a large and growing population. The results show up to 60% of the climate related trends of river flow, winter air temperature and snow pack between 1950-1999 are human-induced. These results are robust to perturbation of study variates and methods. They portend, in conjunction with previous work, a coming crisis in water supply for the western United States.

Water is perhaps the most precious natural commodity in the western United States. Numerous studies indicate the hydrology of this region is changing in ways that will negatively impact the region (*1–3*). Between 1950 and 1999 there was a shift in the character of mountain precipitation, with more winter precipitation falling as rain instead of snow (*2, 4, 5*), earlier snow melt (*4, 6*), and associated changes in river flow (*7–10*). In the latter case, the river flow experiences relative increases in the spring and relative decreases in the summer months. These effects go along with a warming over most of the region that has exacerbated these drier summer conditions (*5, 8, 11*).

The west naturally undergoes multi-decadal fluctuations between wet and dry periods (*12*). If drying from natural climate variability is the cause of the current changes, a subsequent wet period will likely restore the hydrological cycle to its former state. But global and regional climate models forced by anthropogenic pollutants suggest human influences could have caused the shifts in hydrology (*2, 13–15*). If so, these changes are highly likely to accelerate, making modifications to the water infrastructure of the western U.S. a virtual necessity.

In this paper, we demonstrate statistically that the majority of the observed low frequency changes in the hydrological cycle (river flow, temperature, and snow pack) over the western U.S. from 1950-1999 are due to human-caused climate changes from greenhouse gases and aerosols. This result is obtained by evaluating a combination of global-climate and regional-hydrologic models, and sophisticated data analysis. We use a multivariable detection and attribution (D&A) methodology (*16–18*) to show the simultaneous hydro climatic changes observed already differ significantly in length and strength from trends expected due to natural variability (detection), and differ in the specific ways expected of human-induced effects (attribution). Focusing on the hydrological cycle allows us to assess the origins of the most relevant climate-change impacts in this water-limited region.

We investigate simultaneous changes from 1950-1999 (*19*) in snow pack (snow water equivalent or SWE), the timing of runoff of the major western rivers, and average January through March daily minimum temperature (JFM T_{min}) in the mountainous regions of the western U.S. (*20*). These three variates arguably are among the most important metrics of the western hydrological cycle. By using the multivariable approach we obtain greater signal to noise ratio than from univariate D&A alone (see below).

The SWE data are normalized by October-March precipitation (P) to reduce variability from heavy or light precipitation years. Observed SWE/P and temperature were averaged over each of nine western mountainous regions (Fig. 1) to reduce small spatial scale weather noise. The river flow variate is the center of timing (CT), the day of the year one half of the total water year flow has occurred, computed from naturalized flow in the Columbia, Colorado and Sacramento/San Joaquin rivers. CT tends to decrease with warming due to earlier spring melting.

Selected observations from these regions/variables are displayed in Fig. 2, showing the trends noted above, along with substantial regional differences and "weather noise." SWE/P trends in the nine regions vary from -2.4 to -7.9% per decade, except in the southern Sierra Nevada where the trend is slightly positive. The JFM T_{min} trends are all positive and range from 0.28-0.43°C/decade, while the river CT arrives between 0.3 to 1.7 days/decade earlier. The challenge in D&A analysis is to determine whether a specific, predetermined signal representing the response to external forcing is present in these observations.

We compared the observations with results from a regional hydrologic model forced by global climate model runs. One of the global models, the Parallel Climate Model (PCM) (*21*), has been used previously in hydrological studies in the western U.S. (*22*) and realistically portrays important features of observed climate and the amplitude of natural internal variability. The second climate model, the anthropogenically forced medium resolution MIROC (*23–25*), was selected from the current IPCC AR4 set of global runs (*26*) because it

had available many 20th century ensemble members with daily data, and because of its high degree of realism in representing the Pacific Decadal Oscillation (PDO). We used the anthropogenically forced versions of these models to obtain an estimate the expected signal not confounded by other forcing mechanisms. The models provided multiple realizations (10 for MIROC, and 4 for PCM) of the historical response of the climate system to anthropogenic forcing. The daily output from these coarse horizontal-resolution model results was downscaled to a 1/8° × 1/8° latitude/longitude grid by two different statistical methods [Bias Correction and Spatial Disaggregation, BCSD (*27*) and Constructed Analogues, CA (*28*)]. The downscaled temperature and precipitation data were supplied as input to the Variable Infiltration Capacity, (VIC) hydrological model, (*15, 27, 29*) to obtain river flow and SWE/P.

We used the downscaled model results to estimate an anthropogenic "fingerprint" for the PCM and MIROC models (*30*). The fingerprint describes the joint variability of SWE/P, JFM T_{min}, and river flow (Fig. 3) (*20*). The model fingerprints are very similar in spite of the different external forcings used (*20, 26*). The results show that warmer temperatures accompany decreases in SWE/P and decreases in CT of major western river systems. The sign of each variable is a monopole, indicating a coherent regional-scale signal over the western U.S.

The temporal component of the fingerprint (not shown) is well-represented by a simple trend. This implies the fingerprint primarily captures the spatial expression of long-term changes, and not shorter-period climate modes (such as ENSO or the PDO).

The signal strength is calculated as the least-squares linear trend of the projection of a data set (model or observations) onto the fingerprint (see supplemental information for details). Fig. 4 (upper) shows the ensemble mean signals for our various model runs and the observations (*20*). The observations show a positive signal indistinguishable from the PCM and MIROC anthropogenically-forced runs. These signals exclude zero at the 95% confidence interval, thus achieving "detection".

We used 1600 years of downscaled control run data from two different global models (*20*) to estimate the probability that the observed signal could be due to natural, internal variability (Fig. 4, lower panel). The observed signal falls outside the range expected from natural variability with high confidence ($p < 0.01$). In separate analyses for both PCM and MIROC, the likelihood that the model signal arises from natural internal variability is between 0.01 and 0.001 (*20*). The different downscaling methods have little impact on these results. We conclude natural internal climate variability alone cannot explain either the observed or simulated changes in SWE/P, JFM T_{min}, and CT in response to anthropogenic forcing.

PCM simulations forced solely by the combined impacts of observed solar variability and volcanic activity (Sol/Vol, Fig. 4) show a signal with sign opposite to that observed. We conclude solar and volcanic forcing also fail to explain the observed hydrological changes.

Might anthropogenically-induced precipitation changes account for our results? This is unlikely since our variables are chosen to minimize sensitivity to precipitation fluctuations. However, previous work has identified an anthropogenic effect on global-scale changes in precipitation (*31*). We conducted a univariate D&A analysis on precipitation, comparing the fingerprint obtained from the anthropogenic runs to the control runs and observations. The results (Fig. 4, lower) show that the observed changes in precipitation over the nine western U.S. mountain regions are indistinguishable from natural variability. We found the same for model precipitation (not shown). We conclude that while precipitation may be affected by anthropogenic forcing on larger scales or in other regions, or in this region in the future, it cannot explain the strong changes in western U.S. hydrology from 1950-1999.

Finally, the observations are consistent with the anthropogenic model runs. The observed signal is stronger than found in either model, but the differences are not statistically significant. The ensemble mean signal strength from PCM is 60% of the observed signal strength, i.e., PCM estimates three-fifths of the projected trend can be ascribed to human effects. The two downscaling methods give somewhat different signal strengths (Fig. 4), but the attribution holds no matter which is chosen. We conclude that application of a rigorous, multivariable D&A methodology shows a detectable and attributable signature of human effects on western hydrology.

We examined the time evolution of signal and noise by projecting the observations (signal) and control run data (noise) onto the multivariable fingerprint, then fitting linear trends of increasing length L to the resulting projected time series. This enables us to calculate a signal-to-noise (S/N) ratio as a function of L (from 10 to 50 years) Figure 5 shows the S/N ratio rises above the 5% significance threshold no later than 1986. This result is robust to uncertainties in the model fingerprint, model-based noise estimates, and statistical downscaling method (*20*). We also repeated the D&A analysis without areal weighting, and found it made no difference to our conclusions.

The variables examined here co-vary in a physically and internally-consistent way: an increase in minimum temperature is associated with less SWE/P and earlier runoff. Quantitatively, we also compared the S/N obtained from separate analyses of each variable with that obtained for the full multivariable problem (*20*). For fixed choices of fingerprint, noise, and downscaling (*32*), the S/N from the separate SWE/P, JFM T_{min} and CT analyses were 2.90, 2.95 and 1.85, respectively, all significant at about the 0.05 level or above. The multivariable analysis had a S/N of 3.62, and so has quantitative value as well as providing a test of whether SWE/P, JFM T_{min}, and CT co-vary in a physically consistent way.

In summary, our results are robust with respect to uncertainties in model estimates of anthropogenic climate fingerprints and natural variability, downscaling method, and the choice of univariate or multivariate D&A analysis. Estimates of natural variability used for significance testing agree well with those derived from paleo proxies (*20*). The analyses show with high confidence that the majority of the detrimental changes already seen in western U.S. hydrology are caused by human-induced effects. PCM, which has the most realistic signal strength, shows human effects account for 60% of the observed 1950-99 trend in signal strength. MIROC accounts for 35% of the trend. Based on Fig. 4

(upper) and the discussion of MIROC in the supporting material, the PCM number seems more reliable.

Our results are not good news for those living in the western United States. The scenario for how western hydrology will continue to change has already been published using one of the models employed here [PCM (*2*)] as well as in other recent studies of western US hydrology [e.g., (*15*)]. It foretells of water shortages, lack of storage capability to meet seasonally changing river flow, transfers of water from agriculture to urban uses and other critical impacts. Since PCM performs so well in replicating the complex signals of the last half of the 20th century, we have every reason to believe its projections and to act on them in the immediate future.

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19. Note this period excludes the large scale changes in runoff, precipitation and water storage that has occurred in the southwest, especially the Colorado River drainage, since 2000. We do not claim that the large changes since 2000 are necessarily the result of human-induced warming.
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32. The choices were CCSM3-FV noise for significance testing, PCM fingerprint, and statistical downscaling with the CA method. In the multivariable case, PCM noise was used for normalization.

33. This work was supported by the Lawrence Livermore National Laboratory through an LDRD grant to the Scripps Institution of Oceanography (SIO) via the San Diego Super Computer Center (SDSC) for the LUCSiD project. The MIROC data was generously supplied by the National Institute for Environmental Studies Onogawa, Tsukuba, Ibaraki, JAPAN. The PCM simulation had previously been made available to SIO by the National Center for Atmospheric Research for the ACPI project. This work was also partially supported by Dept of Energy and NOAA through the International Detection and Attribution Group. The LLNL participants were supported by DOE-W-7405-ENG-48 to the Program of Climate Model Diagnoses and Intercomparison (PCMDI). The USGS and SIO provided partial salary support DC and MD at SIO; the California Energy Commission provided partial salary support for DP and HH at SIO.

Supporting Online Material

www.sciencemag.org/cgi/content/full/1152538/DC1
SOM Text
Figs. S1 to S3
References

2 November 2007; accepted 23 January 2008
Published online 31 January 2008; 10.1126/science.1152538
Include this information when citing this paper.

Fig. 1. Location map showing averaging regions over which SWE/P and JFM T_{min} were determined. The hatching shows the approximate outline of the three main drainage basins used in this study.

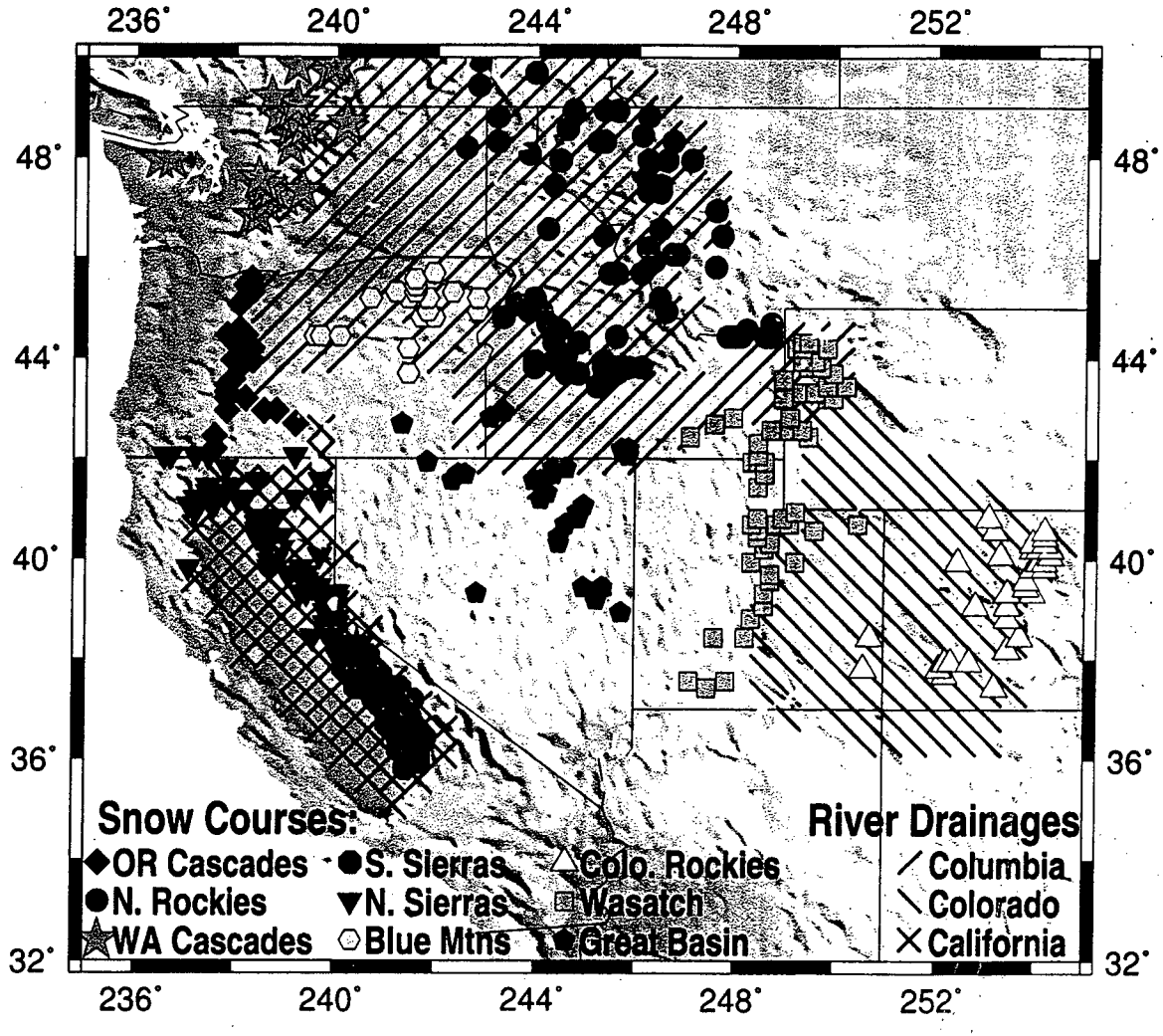
Fig. 2. Observed time series of selected variables (expressed as unit normal deviates) used in the multi variate detection and attribution analysis. Taken in isolation, seven of nine SWE/P, seven of nine JFM T_{min}, and one of the three river flow variables have statistically significant trends.

Fig. 3. Fingerprints from the multivariate analysis of PCM and MIROC.

Fig. 4. Ensemble average signal strength (upper, standard deviations of the fingerprint's principal component per decade) and percentile rank of ensemble mean signal strength for the indicated model runs with respect to the combined (CCSM3-FV and PCM) control run (lower). Percentile values calculated by Monte Carlo resampling of the control run

taking into account N, the varying number of ensemble members. PCM (BCSD) and PCM (CA): PCM runs with anthropogenic forcing, with two different downscaling methods as described in the text (N=4). MIROC: MIROC runs with anthropogenic forcing (N=10). Sol/Vol: PCM runs with only solar and volcanic forcing included (N=2). The cross shows the signal strength obtained from the observations (N=1). For comparison purposes, also shown is the observed signal strength from a separate analysis of precipitation changes over the nine mountain regions (diamond). Values outside the hatched and crosshatched regions are significant at the 0.01 and 0.05 level, respectively.

Fig. 5. Time dependent S/N estimates for two different estimates of natural variability. The x-axis is the last year of L-length linear trend in the signal estimate.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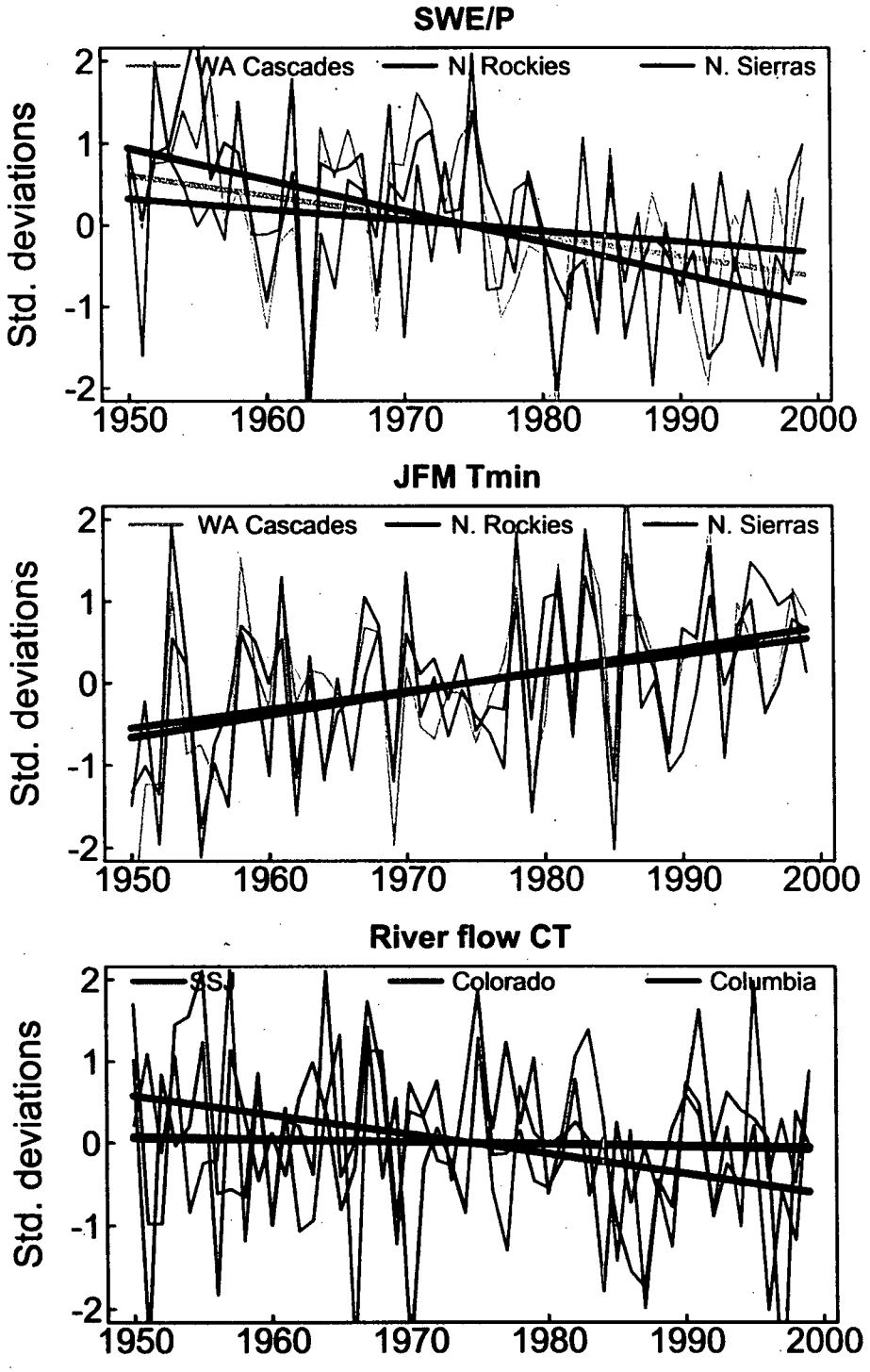
244°
248°
252°
48°
44°
40°
36°
32°
Snow Courses:
OR Cascades
S. Sierras
Colo. Rockies
N. Rockies
N. Sierras
Wasatch
WA Cascades
Blue Mtns
Great Basin
River Drainages
Columbia
Colorado
California


SWE/P
WA Cascades
N. Rockies
N. Sierras
Std. deviations
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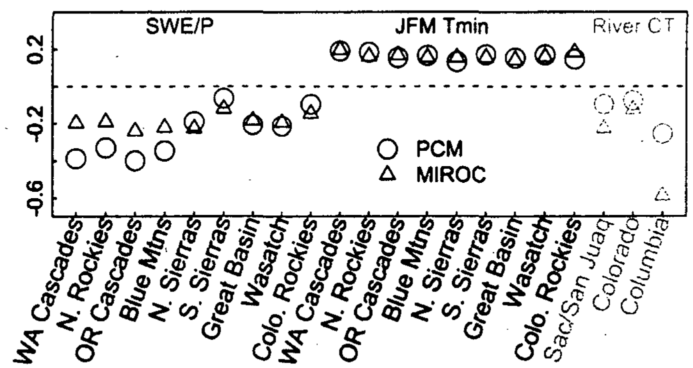
1
0
-1
-2
1950
1960
1970
1980
1990
2000
JFM Tmin
WA Cascades
N. Rockies
N. Sierras
Std. deviations
River flow CT
SSJ
Colorado
Columbia
Std. deviations


SWE/P
JFM Tmin
River CT
0.2
-0.2
-0.6
PCM
MIROC
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N. Rockies
OR Cascades
Blue Mtns
N. Sierras
S. Sierras
Great Basin
Wasatch
Colo. Rockies
WA Cascades
N. Rockies
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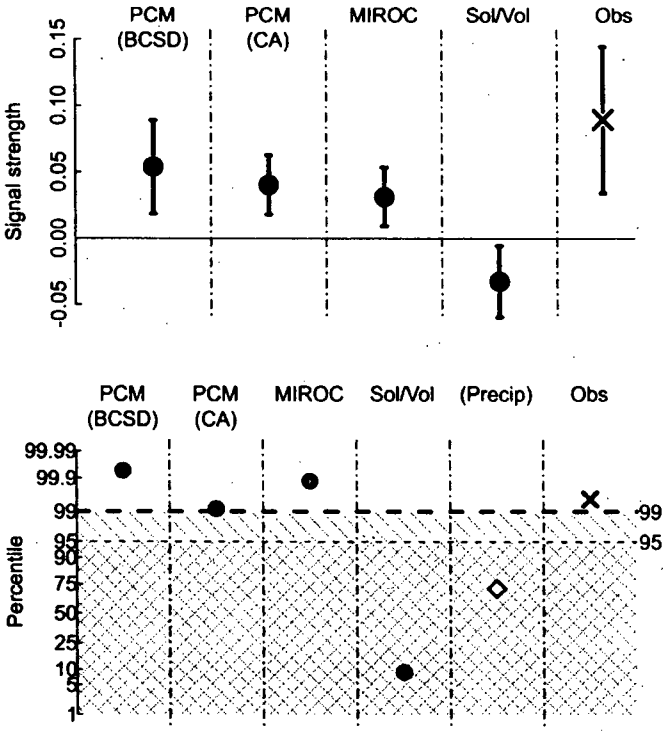
Wasatch
Colo. Rockies
Sac/San Juaq
Colorado
Columbia


PCM (BCSD)
PCM (CA)
MIROC
Sol/Vol
Obs
Signal strength
0.15
0.10
0.05
0.00
-0.05
PCM (BCSD)
PCM (CA)
MIROC
Sol/Vol
(Precip)
Obs
Percentile
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99.9
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95
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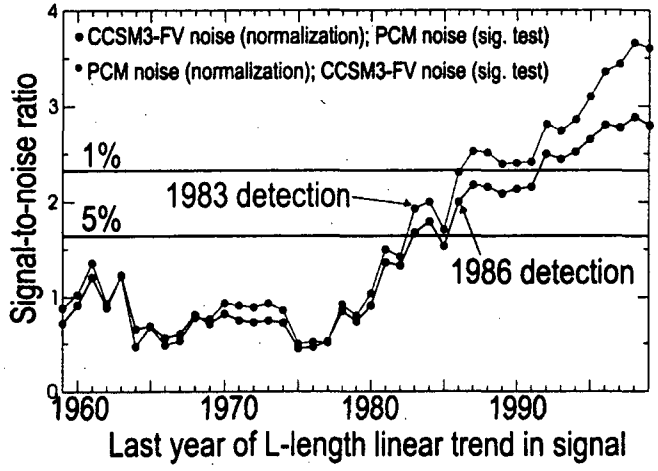
50
25
10
5
1
99
95


• CCSM3-FV noise (normalization); PCM noise (sig. test)
• PCM noise (normalization); CCSM3-FV noise (sig. test)
1%
5%
1983 detection
1986 detection
Signal-to-noise ratio
0
1
2
3
4
1960
1970
1980
1990
Last year of L-length linear trend in signal

- Exhibit D -

Joint South-Central and North-Central Sections, both conducting their 41st Annual Meeting (11–13 April 2007)
Paper No. 33-5
Presentation Time: 10:25 AM-10:45 AM

REVISED LITHOSTRATIGRAPHY OF LATE PALEOGENE AND NEOGENE STRATA OF THE HIGH PLAINS AQUIFER IN WESTERN NEBRASKA, USA

LAGARRY, Hannan E.[1], LAGARRY, Leigh Anne[1], SWINEHART, James B.[2], and LEITE, Michael B.[1], (1) Department of Physical & Life Sciences, Chadron State College, Chadron, NE 69337, nebearthmomma@yahoo.com, (2) Conservation and Survey Division, School of Nat Rscs, Univ of Nebraska-Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517

Based on detailed (1:24,000) 1996-2006 geologic mapping and lithostratigraphic correlations, we revise, redescribe, and redefine strata of the High Plains Aquifer in western Nebraska, including volcaniclastic sandstones of the Arikaree Group (late Paleogene-early Neogene) and epiclastic sandstones of the Ogallala Group (Neogene). This sequence is underlain by impermeable siltstones of the White River Group and overlain by Quaternary deposits. The base of the Arikaree Group is narrowly incised into underlying strata and consists of fluvial sandstones and conglomerates of the West Ash Creek beds, Alliance beds, and the Gering Formation. This interval is the source of many spring-fed creeks and rivers in northwestern Nebraska. Overlying these are thick, widespread eolian sandstones of the Fort Robinson beds. These are overlain by eolian sandy siltstones of the Anderson Ranch Formation, compact eolian siltstones of the Antelope Creek beds, fluvial and eolian sandstones of the Metcalf beds, and eolian sandstones of the Mission Ranch beds. These strata are restricted to the Niobrara River canyon, high points of the eastern part of the Pine Ridge, and northeast of the Whiteclay Fault. The base of the Ogallala Group is the Runningwater Formation, which we divide into overbank sandstones of the Starvation Gulch beds and the fluvial sandstones and conglomerates of the Rushville beds. This unit is a source of municipal water. These strata are overlain by gravels filling the trace of the Whiteclay Fault called the Whiteclay gravel beds. This unit is a local water source. These strata are overlain by the Box Butte Formation, consisting of fluvial sandstones of the Red Valley Member and nodular claystone of the Dawes Clay Member. These strata are overlain by calcareous fluvial sandstones of the Sand Canyon Formation. These strata are overlain by discontinuous fluvial valley fills of the Sheep Creek and Olcott Formations. Overlying these strata are fluvial sandstones of the Wolf Creek beds. These beds are located along high points of the central Pine Ridge and along the South Dakota Border near Whiteclay. These strata are overlain by discontinuous fluvial valley fills of the Snake Creek Formation and the Patton Creek beds. This work was supported by 1996-2006 USGS STATEMAP programs, the University of Nebraska-Lincoln, the Nebraska National Forest, and Chadron State College.

Joint South-Central and North-Central Sections, both conducting their 41st Annual Meeting (11–13 April 2007)
General Information for this Meeting

Session No. 33
Neogene Depositional Environments, Paleoclimatology and Stratigraphic Architecture of the Succession Forming the High Plains Aquifer
Kansas Union, University of Kansas: Jayhawk
8:20 AM-12:00 PM, Friday, 13 April 2007

Geological Society of America *Abstracts with Programs*, Vol. 39, No. 3, p. 65

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL
Before Administrative Judges:
Ann Marshall Young, Chair
Dr. Richard F. Cole
Dr. Fred W. Oliver

In the Matter of	Docket No. 40-8943
CROW BUTTE RESOURCES, INC. (In Situ Leach Facility, Crawford, NE)	ASLBP No. 07-859-03-MLA-BD01
	February 22, 2008

NOTICE OF APPEARANCE

COMES NOW, the undersigned and pursuant to 10 CFR Section 2.314(b) enters his appearance in this matter.

1. Identification: Marc A. Ross

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Fax: (303) 454-3306
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2. Client Information:

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3. Professional Affiliation:

I have been admitted by the ColoradoState Supreme Court to practice in all Colorado courts since 2005. My State Bar ID Number is 36140.

I am also admitted to practice by the United States District Court for the Middle District of Pennsylvania, the District Court of New Jersey, and the3rd Judicial Circuit Courts of Appeals of the United States.

4. Authorization:

I am authorized by my client, Rock the Earth, to take all actions necessary, reasonable and appropriate in my representation in this matter.

Respectfully submitted,

BY: _/Marc A. Ross/_____

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1536 Wynkoop St., Suite B200
Denver, CO 80202
(303) 454-3304

DATE: February 22, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL
Before Administrative Judges:
Ann Marshall Young, Chair
Dr. Richard F. Cole
Dr. Fred W. Oliver

In the Matter of	Docket No. 40-8943
CROW BUTTE RESOURCES, INC.	ASLBP No. 07-859-03-MLA-BD01
(In Situ Leach Facility, Crawford, NE)	February 22, 2008

NOTICE OF APPEARANCE

COMES NOW, the undersigned and pursuant to 10 CFR Section 2.314(b) enters his appearance in this matter.

1. Identification: Harold S. Shepherd

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2. Client Information:

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3. Professional Affiliation:

I have been admitted by the Oregon and Washington State Supreme Courts to practice in all Oregon and Washington courts since OR – 1989/WA - 2003. My State Bar ID Numbers are OR – 91101/WA – 33456.

I am also admitted to practice by the United States District Court for the District of Oregon and the Ninth Judicial Circuit Courts of Appeal of the United States.

4. Authorization:

I am authorized by my client, Center for Water Advocacy and Robert Lippman, to take all actions necessary, reasonable and appropriate in my representation in this matter.

Respectfully submitted,

BY: *s/Harold Shepherd*
Harold Shepherd
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL
Before Administrative Judges:
Ann Marshall Young, Chair
Dr. Richard F. Cole
Dr. Fred W. Oliver

In the Matter of	Docket No. 40-8943
CROW BUTTE RESOURCES, INC. (In Situ Leach Facility, Crawford, NE)	ASLBP No. 07-859-03-MLA-BD01
	February 22, 2008

AMENDED CERTIFICATE OF SERVICE

I hereby certify that copies of the "NOTICE OF APEARANCES FOR MARC A. ROSS AND HAROLD S. SHEPHERD, MOTION OF CENTER FOR WATER ADVOCACY, ROCK THE EARTH AND ROBERT LIPPMAN FOR LEAVE TO FILE A BRIEF *AMICUS CURIAE,* AND *BRIEF OF AMICUS CURIAE* " in the above captioned proceeding have been served on the following persons by deposit in the United States Mail as indicated by an asterisk (*); and by electronic mail as indicated by a double asterisk (**) on this 22ND day of February, 2008:

Judge Ann Marshall Young, Chair * **
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001
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Judge Fred W. Oliver * **
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Judge Richard F. Cole * **
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Mrs. Johanna Thibault * **
Board Law Clerk
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Office of the Secretary * **
Attn: Docketing and Service
U.S. Nuclear Regulatory Commission
Washington, DC 20555
E-mail: Hearing.Docket@nrc.gov
(original & 2 copies)

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Respectfully submitted,

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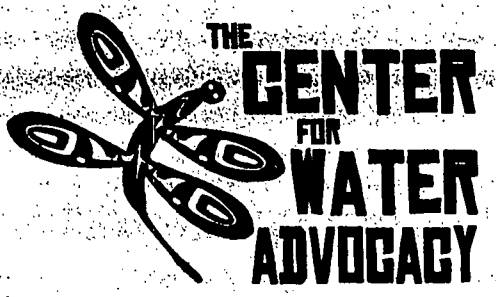

February 22, 2008

Office of the Secretary
Attn: Docketing and Service
U.S. Nuclear Regulatory Commission
Washington, DC 20555
E-mail: Hearing.Docket@nrc.gov
(original & 2 copies)

RE: In the Matter of Crow Butte Resources, Inc. (License Amendment for the North Trend Expansion Project); Docket No. 40-8943-MLA; ASLBP #07-859-03-MLA-BD01

Dear Docketing and Service:

Please find an original and two copies of the attached the following documents related to the above matter:

1) Notice Of Appearances For Marc A. Ross And Harold S. Shepherd;
2) Motion Of Center For Water Advocacy, Rock The Earth And Robert Lippman For Leave To File A Brief *Amicus Curiae;*
3) Brief Of *Amicus Curiae* "; and
4) Certification of Service.

Please contact me if you any questions regarding this filing.

Very Truly Yours,

Harold S. Shepherd
Staff Attorney