Water for Commercial Oil Shale Development in Utah: Clarifying How Much Water is Needed and Available
By John C Ruple and Robert B Keiter*

Utah contains an estimated 150 billion barrels of ‘recoverable’ oil trapped in its extensive oil shale formations – enough oil single-handedly to satisfy 100 per cent of the United States’ oil demand for 21 years at current consumption rates. Most authorities assume that commercial oil shale development will require significant quantities of water, a constraining resource in a region that receives, on average, less than nine inches of precipitation annually and where water resources are already over-appropriated. The technical water requirements of commercial oil shale development are poorly understood, but this represents only part of the problem. Utah operates under the prior appropriations system of water allocation whereby the first in time is the first in right. Unanswered legal and political questions create uncertainty regarding the amount of available water within the most geologically prospective area and the rights of competing water appropriators. This article addresses two foundational questions: (1) apportionment of the only major surface water source within the most geologically prospective area between competing users in Colorado and Utah; and (2) the terms and extent of Indian reserved rights.

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This article reflects research conducted by the University of Utah’s Institute for Clean and Secure Energy as part of a comprehensive analysis of water resource considerations applicable to commercial oil shale development. Industry and opponents alike agree that water availability could be key to developing a viable commercial oil shale industry:

‘Today, more than ever before, a variety of competing industrial, municipal, agricultural, tribal, and environmental interests in 7 states as well as Mexico battle over every acre foot of water in the Colorado River system. Farmers and ranchers, recreational anglers and whitewater rafters, and residents of major metropolitan areas, not to mention endangered fish species and the other members of the region’s intricate ecosystem, rely on adequate flows and water quality in the Colorado and its tributaries. Water is a potential dealbreaker for any extraction process that requires too much or poses too great a risk of groundwater contamination.’

This article focuses on two critical uncertainties regarding water availability: (1) apportioning the White River between Colorado and Utah; and (2) settling Ute Indian reserved water rights. It also offers concrete steps to clarify the availability of water resources for this yet unproven and controversial industry.

To understand the fix we must begin with the problem; to understand the problem we must put into context the resource and land where it is found. The first section of this article provides an introduction to oil shale, its potential importance as a source of energy for the United States and its availability for commercial development. The second section discusses water for commercial oil shale development – how much is needed, where it might come from and how water is managed in Utah’s harsh, arid landscape. The third section starts from the understanding that almost all of the water within the Uinta Basin flows into the basin from points to the east and asks how much water must upstream users make available to Utah and, by implication, to commercial oil shale development. The next section addresses unresolved Indian reserved rights claims to large quantities of water, claims that are senior to almost all other water rights within the basin and that could therefore upend existing water rights. The fifth section summarises the problems and sets out recommendations to provide clarity for those competing for scarce water resources.

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Background

What is oil shale and why do we care?

Oil shale is a sedimentary rock containing solid bituminous materials that are released as petroleum-like liquids and gases when the shale is heated. The process of heating shale and capturing resulting liquids and gases is called retorting and can occur in combination with conventional mining methods (surface retorting) or by in place liquification and gasification (in-situ retorting).3

The world’s largest known oil shale deposits are contained in the Green River Formation, which covers portions of Colorado, Utah and Wyoming4 (see Figure 1). Estimates of the Green River Formation’s in-place resources range from 1.5 to 1.8 trillion barrels.5 Potentially recoverable oil shale resources are estimated at between 500 billion and 1.1 trillion barrels of oil.6 At a mid-range estimate of 800 billion barrels, the Green River Formation contains more than three times Saudi Arabia’s proven oil reserves.7 Current US demand for petroleum products is about 20 million barrels per day; therefore, 800 billion barrels of shale oil would last for more than 400 years, assuming oil shale could be used to meet a quarter of that demand.8 Utah’s resources, which are shown in Figure 2, are but a fraction of this, yet still represent an estimated 147.4 billion barrels of oil equivalent.9 Applying these same assumptions, Utah contains enough oil shale to supply 25 per cent of the United States’ oil needs for almost 85 years.

Commercial oil shale production could benefit consumers by reducing world oil prices, and it may offer security benefits for the United States by reducing dependence on foreign fuels.10 The extent to which oil shale production would reduce oil prices depends on the behaviour of other oil-producing nations, and would be greater if these nations maintain current oil production levels in spite of increased shale oil production.11

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4 While Utah’s resource base is smaller than that found in Colorado, Utah’s oil shale resources are often found close to the surface and in seams of appreciable thickness. Ibid 7.
5 Ibid 6.
6 Ibid 8–9.
7 Ibid 1.
8 Ibid 9.
9 Based on resources capable of producing at least 25 gallons of oil per tonne of shale and less than 3,000 feet below the surface. If shales bearing 15 gallons per tonne and subject to the same overburden constraints were developed, available resources increase to 292.3 billion barrels. Michael D Vanden Berg, Utah Geological Survey, Basin-Wide Evaluation of the Uppermost Green River Formation’s Oil-Shale Resource, Uinta Basin, Utah and Colorado (2008) 7.
10 Bartis et al, note 3 above, at 28–29.
Figure 1. Oil shale deposits of the Green River formation in Colorado, Utah and Wyoming
Figure 2. Uinta Basin, Utah
While oil shale development could provide significant energy resources, a commercial oil shale industry has thus far failed to develop. In fact, oil shale has long been heralded as the answer to US energy needs and has repeatedly fallen victim to boom–bust cycles, most recently in the 1970s and early 1980s. Today, regulatory uncertainty, concerns over adverse environmental impacts, and wide fluctuations in the price of oil are often cited as obstacles to development. These concerns and associated uncertainty complicate efforts to obtain financing for costly oil shale developments.

**Leasing federal oil shale resources**

Current oil shale leasing and development discussions centre almost exclusively on Bureau of Land Management (BLM) administered lands. While these federal lands represent some of the richest oil shale deposits in the United States, not all of the potential oil shale resources available in Colorado and Utah are federally owned. Within the Uinta Basin, the Utah Geological Survey estimates tribal, state and private interests control 45 per cent of oil shale resources. Understanding how land status affects access to oil shale resources provides much-needed context for water resource discussions.

Oil shale is considered a ‘leasable’ mineral under the federal Mineral Leasing Act 1920, and those seeking to develop oil shale on public lands must obtain a lease from the BLM. Until recently, the BLM lacked regulations governing the oil shale leasing process, begging such fundamental questions as what areas would be open for leasing, the royalty rate applicable to a lease, the size and length of a federal lease and the process for obtaining a lease.

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12 For a discussion of failed attempts to develop oil shale resources, see Andrew Gulliford, *Boomtown Blues: Colorado Oil Shale* (2003). See also Hanson and Limerick, note 2 above.


14 The BLM manages approximately 258 million acres of federal land surface and 700 million acres of federally owned subsurface minerals, most of which is located in the western United States. BLM lands are managed to promote ‘multiple uses’ and provide a ‘sustained yield’ of environmental values and natural resources. 43 USC § 1701(a)(7).

15 This article focuses on oil shale resources in Colorado and Utah because of their interdependent water resources and because ‘[i]n general, the rich Wyoming deposits are situated in thinner, less continuous layers and represent a less favorable development target, compared with the Colorado and Utah deposits’. Bartis et al, note 3 above, at 8. Accordingly, as the Rand Corp concluded, ‘[w]hen commercial oil shale operations begin, operations are likely in both Utah and Colorado’. Ibid 7.

16 Vanden Berg, note 9 above, at 8.

17 30 USC § 241.
In August 2005, Congress enacted the Energy Policy Act 2005. In section 369 of the Act, referred to as the ‘Oil Shale, Tar Sands, and Other Strategic Unconventional Fuels Act of 2005’, Congress declared that oil shale and tar sands are strategically important domestic energy resources that should be developed to reduce the United States’ growing dependence on oil from foreign sources. Section 369 of the Act also authorised the Secretary of the Interior to establish regulations for a commercial oil shale leasing programme and directed the Secretary to ‘complete a programmatic environmental impact statement for a commercial leasing program for oil shale and tar sands resources on public lands, with an emphasis on the most geologically prospective lands in Colorado, Utah, and Wyoming’. Consistent with this mandate the BLM first issued research, discovery and development leases (RD&D leases), also authorised under section 369, and then began developing a commercial leasing programme. As the BLM explained:

‘By initiating a research, development and demonstration leasing process, the BLM can provide itself, state and local governments, and the public, with important information that can be utilized as BLM works with communities, states and other Federal agencies to develop strategies for managing any environmental effects and enhancing community infrastructure needed to support the orderly development of this vast resource. This will be valuable information for a rulemaking addressing commercial oil shale leasing.’

This section discusses BLM’s RD&D leasing programme as well as its commercial leasing regulations and the process by which those regulations were enacted.

**RD&D leasing**

On 9 June 2005, the BLM published a notice in the Federal Register, initiating an RD&D leasing programme by soliciting nominations of 160-acre parcels of public land to be leased in Colorado, Utah and Wyoming. As the BLM explained, it was proceeding with RD&D leases ‘in furtherance of the President’s National Energy Policy’. Parcels leased under the RD&D programme are available to investigate oil shale recovery technologies and inform potential future commercial leasing decisions and regulations,
building the foundation for a subsequent commercial leasing programme. In response to 19 nominations, the BLM issued six RD&D leases; five in Colorado and one lease in Utah. The five leases in Colorado will investigate in-situ retorting while the one lease in Utah will utilise surface retorting combined with an underground mine constructed and abandoned during the last oil shale boom. Each RD&D lease contains a preference right allowing conversion of the RD&D leases plus 4,960 additional acres to a commercial lease on demonstration of a successful method for producing oil from shale. The terms of these RD&D leases include a requirement for additional environmental review before conversion to a commercial lease, which would include the preference lease acreage. All six RD&D leases remain active, but none has proceeded to commercial development.

In addition to its June 2005 bid solicitation, BLM issued a second invitation to initiate RD&D leasing on 15 January 2009. The second solicitation departed from the 2005 model by increasing the size of the initial lease tract from 160 to 640 acres, but without a preference right. As BLM explained, ‘640 acres is sufficient acreage to support research and development and also to allow for the eventual expansion into commercial operations’. The 2009 solicitation also included several less significant revisions intended to promote consistency with BLM’s recently issued commercial leasing regulations.

The 2009 lease solicitation was not well received. In one of its first acts, the Obama administration withdrew the solicitation, explaining, ‘[t]he new Administration intends to review and reconsider certain aspects of the current solicitation, including lease acreage and the rules that would govern conversion of an [RD&D] lease to a commercial lease, particularly those related to royalty rates’. While criticism of the royalty rate for RD&D leases converted into commercial leases received the most intense public scrutiny, the change in lease size may have been more significant. At 640 acres, these leases may not have been large enough to support technologies reliant on surface mining and retorting, especially in light of spent shale disposal requirements. The decision to disfavour more traditional technologies

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24 Ibid 33754.
25 Ibid.
26 Ibid.
27 74 Fed Reg 2612 (15 January 2009).
28 74 Fed Reg 8983 (27 February 2009).
29 Spent shale disposal is the largest single land disturbance associated with underground mining and is expected to account for 90 per cent of ground disturbance even if 30 per cent of the spent shale could be returned to the mine. US Department of Interior, Bureau of Land Management, Proposed Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah, and Wyoming and Final Programmatic Environmental Impact Statement (September 2008) (hereinafter ‘Final PEIS’) 4–9.
lacked explanation and ran counter to the policy underlying the RD&D programme – to encourage evaluation of different technologies.

Presently, six RD&D leases remain in effect, none of which has demonstrated commercial viable development methods. While RD&D leases have yet to yield commercially viable production technologies, they are well suited to testing new technologies and encouraging innovation. Continued utilisation of RD&D leases, in some form, can help answer many of the questions discussed elsewhere in this analysis.

**Commercial leasing**

As noted above, section 369 of the Energy Policy Act 2005 authorised the Secretary of the Interior to establish regulations for a commercial oil shale leasing programme.30 On 18 November 2008, the Secretary of the Interior issued final rules for oil shale management on public lands.31 The new rules include provisions governing pre-lease exploration, leasing processes, bonding, operations, reclamation and inspection and enforcement. Specifically, the rules apply to federal lands within portions of Colorado, Utah and Wyoming excluding national parks, national recreation areas, lands within incorporated cities, towns and villages and lands subject to special protections as a matter of law (for example Wilderness Study Areas).32 BLM’s rules allow the issuance of exploration licences covering up to 25,000 acres33 and leasing of up to 5,760 acres,34 limiting leaseholders to no more than 50,000 acres in any one state.35 Leases are subject to a US $2.00 per acre annual rental charge36 and production royalties starting at five per cent and increasing to 12.5 per cent over time.37 Environmental reviews are required again before a lease or exploration licence is issued and before approving a plan of development.38

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30 The Mineral Leasing Act 1920, 30 USC 241(a) provides BLM authority to allow exploration, development and utilisation of oil shale resources on BLM-managed public lands. Prior to issuance of BLM’s commercial oil shale leasing regulations, there was little formal direction to guide commercial leasing decisions, and while the Secretary of the Interior has discretion to lease tracts for commercial oil shale development without regulations, regulations provide much-needed clarity to potential lessees, the public and the BLM.

32 See 73 Fed Reg 69471 (18 November 2008), codified at 43 CFR § 3900.10.
33 43 CFR § 3910.31(c).
34 43 CFR § 3827.20.
35 43 CFR § 3901.20.
36 43 CFR § 3903.40.
37 43 CFR § 3903.52.
38 43 CFR § 3900.50.
On 16 January 2009, a coalition of environmental organisations filed suits, challenging both the final leasing rule’s validity and the adequacy of BLM’s environmental review of commercial oil shale leasing. Both suits remain pending at the time of writing. No commercial oil shale leases have been offered or issued, and federal lands are likely to remain effectively closed to commercial oil shale development until these legal challenges are resolved.

Non-federal resource owners

While no new federal oil shale bearing lands are currently available for leasing, it would be a mistake to assume that oil shale development is at a standstill. ‘Today, private property owners, mainly energy companies, control about 20% of the land that overlies oil shale deposits in the Piceance Basin and the associated mineral rights – enough, according to some, to get an oil shale industry off the ground without the incentive of federal leases.’

Within Utah’s Uinta Basin, tribal, state and private interests control 45 per cent of oil shale resources capable of producing at least 25 gallons of shale oil per ton of rock. These non-federal resources are not subject to BLM leasing regulations and therefore may be developed independently of federal action. Different policy perspectives on oil shale development could lead to divergent development strategies and increase competition for scarce resources such as water. The three primary non-federal resource owners, and their perspectives on oil shale development, are discussed below.

Utah is ‘open for business’

In stark contrast to the federal government, Utah actively promotes oil shale development with former Governor Huntsman declaring Utah ‘open for business as it relates to oil shale’. Recently inaugurated Governor Herbert echoes this sentiment, summarily dismissing concerns that oil shale development is premature. In Utah, there are 99 active state leases conveying

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39 Colorado Environmental Coalition v Kempthorne, 1:09-CV-00085-JLK and 00091-JLK (D Colo pending).
40 Hanson and Limerick, note 2 above, at 12.
41 Vanden Berg, note 9 above, at 8.
43 Ibid.
rights to develop oil shale on over 97,848 acres of state land.\textsuperscript{44} Leased lands are administered by the School and Institutional Trust Lands Administration (SITLA), which is mandated to maximise income for the current beneficiaries while preserving trust assets for future beneficiaries.\textsuperscript{45} Trust beneficiaries, as SITLA’s name implies, are public schools and institutions funded by revenue generated from trust lands, and ‘beneficiaries do not include other governmental institutions or agencies, the public at large, or the general welfare of this state’.\textsuperscript{46}

\textit{The Northern Ute Tribe and NOSR No 2}

The federal government owes a trust obligation to Indian tribes\textsuperscript{47} and oversees the use of Indian land for mining and mineral development.\textsuperscript{48} Subject to approval by the Secretary of the Interior, any federally recognised tribe may:

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‘[E]nter into any joint venture, operating, production sharing, service, managerial, lease or other agreement… providing for the exploration for, or extraction, processing, or other development of, oil, gas, uranium, coal, geothermal, or other energy or nonenergy mineral resources… in which such Indian tribe owns a beneficial or restricted interest, or providing for the sale or other disposition of the production or products of such mineral resources.’\textsuperscript{49}
\end{quote}

The Department of the Interior is therefore heavily involved in most decisions regarding energy development on Indian land and would play a major role in most plans to develop tribal oil shale resources.

Naval Oil Shale Reserve (NOSR) No 2 represents an important exception to this general rule. In the early 20th century, with the US Navy transitioning from coal to liquid fuels and concerned over fuel availability, the President of the United States issued a series of executive orders setting aside three

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\textsuperscript{44} Figures are as of 31 October 2008. Statistics were compiled from data provided by the School and Institutional Trust Lands Administration (SITLA) and are available at http://168.178.199.154/publms/contents.htm. These figures reflect active leases; an additional 71 inactive leases cover over 96,281 acres.
\textsuperscript{45} Utah Code Ann § 53C-1-102(2).
\textsuperscript{46} Utah Code Ann § 53C-1-102(2)(d).
\textsuperscript{47} For a comprehensive discussion of the basis for the United States’ trust obligations as well as the responsibilities contained therein see Conference of Western Attorneys General, \textit{American Indian Law Deskbook} (3d, 2004).
\textsuperscript{48} See 25 USC § 397 (allowing tribes, with the consent of the Secretary of Interior, to lease certain lands).
\textsuperscript{49} 25 USC § 2102(a).
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federal oil shale reserves.\textsuperscript{50} Naval Oil Shale Reserve No 2 (88,890 acres) was located in Utah’s Carbon and Uintah counties and created out of the Uintah and Ouray Indian Reservation.\textsuperscript{51} The National Defense Authorization Act 2000\textsuperscript{52} transferred approximately 84,000 acres of NOSR No 2 back to the Ute Indian Tribe,\textsuperscript{53} which received the land and minerals free of federal trust obligations.\textsuperscript{54} Therefore, development of these lands does not require Department of the Interior approval or authorisation.\textsuperscript{55} To date, the Northern Ute Tribe has not adopted a position on commercial oil shale development.

**Private lands**

The General Mining Law 1872\textsuperscript{56} was enacted to promote mineral exploration and development in the western United States. Under the Act, prospectors could locate a mining claim on most federal lands.\textsuperscript{57} Once a valuable mineral was discovered and required filings made, a claim was considered valid and the claimant could mine the resource without payment of royalties to the federal government. Holders of valid claims could also ‘patent’ or buy claims, which became private property.\textsuperscript{58} In 1897, Congress passed the Oil Placer Act, confirming that oil, gas and oil shale are locatable minerals under the 1872 Act.\textsuperscript{59}

Passage of the Mineral Leasing Act 1920, which applies to oil shale, marked a change in course, replacing the system of location and patent with requirements that miners obtain leases before developing most minerals on federal lands and pay royalties on minerals produced.\textsuperscript{60} However, provisions of the Mineral Leasing Act allow patenting of claims filed prior to the Act’s effective date (25 February 1920),\textsuperscript{61} provided that the claimant conducted

\textsuperscript{50} Naval Oil Shale Reserves (NOSRs) Nos 1 and 3 are located in Colorado and remain under federal control. While not discussed as part of this article, additional information regarding NOSRs Nos 1 and 3 will be included in future publications released by the University of Utah’s Institute for Clean and Secure Energy.


\textsuperscript{52} Pub L 106-398.

\textsuperscript{53} Ibid. See also Andrews, note 13 above, at 28.

\textsuperscript{54} Pub L 106-398 § 3405(b) and (c).

\textsuperscript{55} ‘The land conveyed to the Tribe under subsection (b) shall not revert to the United States for management in trust status.’ Ibid § 3405(b)(3).

\textsuperscript{56} Codified as amended at 30 USC §§ 22–54.

\textsuperscript{57} 30 USC § 29.

\textsuperscript{58} A US $5 per acre fee applied to ‘lode’ or hard rock mineral claims, 30 USC § 28; US $2.50 per acre applied to ‘placer’ or unconsolidated mineral claims. 30 USC § 37.

\textsuperscript{59} 29 Stat 526 (11 February 1897).

\textsuperscript{60} 30 USC §§ 181–287.

\textsuperscript{61} 30 USC § 193.
annual labour and improvements as required under the 1872 Act. While a precise accounting of the amount of land patented to date remains elusive, a 1980 US Supreme Court opinion addressing oil shale patents identified 349,088 acres that were successfully patented and transferred into private hands. Subsequent litigation and settlements extended patents for significant additional lands, mostly in Colorado and Utah. One prospective oil shale developer in Utah, the Oil Shale Exploration Company (OSEC), controls more than 46,000 acres of prime oil shale lands.

In sum, between state, tribal and private lands, significant acreage is available for commercial oil shale development, regardless of whether the federal government actively pursues a commercial leasing programme. The number of resource owners and their varying perspectives on oil shale development could prompt conflicting development policies. The nascent oil shale industry should remember that, in spite of diligent efforts to avoid the mistakes of the past, it ‘runs the risk that its image will be shaped by the least cautious and deliberate operator’.

**Water resources**

As a foundational element of Western water law, the prior appropriations doctrine provides a reasonably clear and predictable means of allocating scarce water resources, and it includes sufficient flexibility to facilitate reallocation of water among competing water users. However, for the prior appropriations doctrine to function, the terms of competing water rights must be reasonably clear. Senior water users can place a ‘call’ on the river, demanding junior appropriators cease diversions until the senior rights are fully satisfied, but the party placing the call must be able to demonstrate seniority. Where a water user believes that other users have exceeded the scope of their water rights, those contemplating an objection must be able to ascertain the terms and conditions of the various conflicting rights. Likewise, for market reallocation of water rights to succeed, the parties involved must

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62 30 USC § 28.
64 See *TOSCO Corp v Hodel*, 611 F Supp 1130 (D Colo 1985) vacated because of settlement at 826 F 2d 948 (10th Cir 1987).
66 Hanson and Limerick, note 2 above, at 44. Hanson and Limerick, as well as Guilliford, note 12 above, provide a cautionary tale of past efforts to develop oil shale and the problems of poorly planned development.
67 This is not to say that existing law will lead to desirable water allocation, only that the prior appropriation doctrine is capable of addressing allocation when demand exceeds supply.
be able to agree on the economic value of the rights to be conveyed, and this depends on the terms of not only the rights to be conveyed, but their terms as compared to competing rights.

For those planning for commercial development of Utah’s oil shale resources, including those planning for population growth that will come with such development, fundamental uncertainties regarding the nature and extent of water rights within the Uinta Basin could undermine efforts to secure adequate supplies of water. The White River flows into Utah from Colorado, but no formal agreement controls the amount of water that Colorado must allow to flow to its downstream neighbour. Furthermore, the existence of very large and very senior Ute Indian reserved rights claims threatens to pre-empt rights already secured by other water users within the region – agricultural, municipal and energy producers alike. Resolving these two issues would benefit water users within the basin, reducing uncertainty, and facilitate a more accurate assessment of the adequacy of potential sources of supply.

This section begins with a discussion of the water needed for commercial oil shale development and for regional development anticipated independent of oil shale. It next discusses the major sources of water for oil shale development within Utah’s most geologically prospective area. It then concludes with a summary of water resource regulation and its role in resolving competing demands for scarce water resources, providing a foundation for addressing interstate allocation concerns and Indian reserved rights.

**Water demand**

Commercial oil shale development will require water. Total demand depends on the number and size of facilities, as well as the water demand associated with various competing technologies. While these variables are all unknown at this time, it is reasonable to expect oil shale development will require one to three barrels of water for each barrel of oil produced.\(^\text{68}\) An emergent industry will indirectly induce demand by increasing the rate of population growth and associated municipal water demand.

Uncertainty regarding technological requirements and indirect water demand raise questions about the net demand for water resources, creating uncertainty for oil shale developers, regulators and policy-makers. While putting reliable numbers to water demand is at best problematic, competition between municipal, agricultural, energy, industrial and in-stream water uses will increase, and some seeking to use water will be left, quite literally, high and dry.

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\(^{68}\) See Final PEIS, note 29 above, at 4–11.
As Jennifer Gimbel, Executive Director of the Colorado Water Conservation Board, encapsulates, ‘[w]hen you are dealing with water, you are dealing with our future. It’s going to take choices, and it’s going to take trade-offs’.69 These realities and the uncertainties involved in commercial oil shale development suggest that planners and policy-makers will obtain immediate benefits from inventorying available water resources and addressing the vagaries of water law. The discussion that follows flows from this premise, identifying gaps in water resource policies and, where appropriate, recommending alternative means of moving forward.

**Water supply**

While the actual water demands associated with commercial oil shale development are at best uncertain, we can say that commercial oil shale development will require water, that the amount of water required is likely to be proportional to the size of the industry that develops and that water resources near prime oil shale bearing lands are already in short supply. With these factors in mind, this section identifies the most logical sources of water for oil shale development within the Uinta Basin, setting the stage for an analysis of interstate allocation and tribal water rights issues.

**Surface water**

The Piceance and Uinta Basins,70 which are home to the richest and most extensive oil shale reserves in North America, both drain to the White River. The White River flows west from its headwaters in Colorado’s Flat Tops Wilderness, crossing the border with Utah before joining the Green and eventually the Colorado River (see Figure 1 above and 3 below). On average, the White River near the Colorado–Utah border discharges 590,100 acre-feet annually.71 Flows are highly variable year to year and season to season, with spring run-off swelling the river to an average discharge of 1,765 cfs during June, almost five times the average discharge experienced in December and January (350.1 and 353.5 cfs, respectively).72

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70 The Uinta Basin includes portions of eastern Utah draining to the Uinta, Duchesne, White or Green Rivers.
71 Final PEIS, note 29 above, at 3–81. One acre foot equals 0.81 cubic decameters.
72 US Department of the Interior, Bureau of Land Management, Final White River Dam Project Environmental Impact Statement 59 (May 1982) (hereinafter ‘White River Dam FEIS’). Between 1923 and 1978, average monthly flows just west of the state line peaked at 2,934 cfs; monthly low flows over the same period were just 140 cfs. Ibid.
Utah’s richest oil shale resources are located along the White River, east of the Uinta and Ouray Indian Reservation (see Figure 2). As the only major surface water source close to Utah’s richest oil shale resources, the White River is of particular importance, especially considering that the financial cost of obtaining water from the White River is much lower than that of alternate sources. Accordingly, earlier oil shale development proposals relied heavily on plans to construct a dam on the White River, declaring the White River the ‘first-choice source of water’.73

The White River as well as the vast majority of the most geologically prospective areas for oil shale are contained in Utah’s Drainage Area 49, Southeast Uinta Basin. As of June 2009, there were 1,652 water right claims within Area 49, dating from as early as 1861.74 Surface waters are fully appropriated and new water rights are unavailable. Groundwater resources are also in scarce supply, generally limited to domestic or temporary supplies, when they are available at all.75 Accordingly, any new diversion or consumptive use within the area must be accompanied by change applications filed on existing water rights.76

The State of Utah is one of the largest water right holders and therefore one of the best potential sources of water. In 1965, the state filed to appropriate 350 cfs and 250,000 acre-feet from the White River and its tributaries,77 identifying the intended uses as mining, drilling and retorting oil shale.78 The Utah Division of Water Resources filed connected applications with the BLM, seeking authorisation to construct an 11.7-mile long reservoir just west of the Colorado border. As proposed, the reservoir would have impounded 109,250 acre-feet of water and had an active storage capacity of 70,700 acre-feet.79 Interest in the project waned when the price of oil fell sharply and the project was never built. Given the low elevation and high evaporation associated with this site, plus endangered species concerns with the White River, the project is unlikely to obtain a second lease of life. However, some of

74 Priority lists for each of the 51 drainage areas within Utah are available at www.water-rights.utah.gov/cblapps/prioritylist.exe?Startup=NOW.
76 Ibid.
77 Utah State Division of Water Resources, White River Dam Project: Proposed Action Plan (Revised) (November 1980) 3. This reflects 100 per cent of the river’s flow during low-flow periods.
78 Ibid.
79 White River Dam FEIS, note 72 above, at 1. The difference between capacity and active storage is attributable primarily to capacity dedicated to sediment storage.
the water rights held by the State Board of Water Resources may be available through leases from the state.80

As it did with respect to the White River, the State of Utah filed to appropriate significant flows from the Flaming Gorge Reservoir on the Green River, as well as from tributaries to the Green River. The State of Utah has leased much of this water to other users, allowing the state to control water use and discourage speculation. Some water could be available from this source, provided it is economically feasible to convey this water to areas undergoing oil shale development.81 However, under rules promulgated by the Division of Water Resources, which holds the state’s water rights in Flaming Gorge Reservoir, water is unavailable for ‘a mining or gravel pit operation’.82 Mining is undefined in the rule; if mining is interpreted to include commercial oil shale development, it could limit availability of this water source.83 Even if commercial oil shale development were deemed a permissible use, leases supporting oil shale development would be last in line under regulatory priorities favouring domestic, municipal, agricultural and industrial uses associated with political subdivisions.84

The last oil shale boom also prompted construction of Red Fleet Reservoir, approximately ten miles north of Vernal. Declining oil prices and the waning prospect of shale oil development led to an oil shale ‘bust’, leaving about 70 per cent of Red Fleet water unsubscribed as of a decade ago.85 It is unclear whether this water source remains undersubscribed. What water remains available, if any, is likely to go fast as planners anticipate growing water demands. Even if available for commercial oil shale development, the

80 See, eg, water right nos 49-304 and 49-1239, which can be found at www.waterrights.utah.gov/cgi-bin/wrprint.exe?Startup.
81 Water rights held by the State of Utah but stored in a reservoir operated by the federal government pursuant to the Warren Act, 43 USC § 523-24, are distinguishable from water rights held by the Bureau of Reclamation. The latter are subject to preferential use for irrigation under s 9(c) of the Reclamation Act, 43 USC § 485h(c). Accordingly, municipal or industrial development may rely on water supply contracts from the Bureau of Reclamation only to the extent ‘it will not impair the efficiency of the project for irrigation purposes’. Ibid. But, ensuring Bureau water is used for irrigation may free up state water rights for non-irrigation uses.
82 Utah Admin Code § R653-8-3(2) (a).
83 Whether the rule’s prohibition against use of such stored water for mining applies to commercial oil shale development is unclear as the state reportedly supported use of water from Flaming Gorge to support commercial oil shale development during the 1980s. The rule, which was promulgated in 1998, after the most recent boom–bust cycle, may reflect an important change in policy or may have been directed at more conventional mining operations.
84 Utah Admin Code § R653-8-3(1).
distance and rugged terrain between Red Fleet Reservoir and prime oil shale lands could make use of this water prohibitively expensive.

Other important river systems and potential water supply sources for commercial oil shale development include the Yampa River as well as the Duchesne River and its tributaries (including the Uinta and Lake Fork Rivers), which drain to the Green and Colorado rivers. The Yampa is a potential source of supply for developments in Colorado. The Green River and its tributaries are potential sources of supply in Utah, though diversions from the Green River would involve a system of pipelines and pumping that would significantly increase costs over those associated with withdrawals from the White River.\textsuperscript{86} The Colorado River is south of most major oil shale resources, but still important as a potential source. Furthermore, changes to its tributaries will have an impact on this highly regulated river.

The Yampa is located north of the White River and flows westward, parallel to the White River before flowing into the Green River within Dinosaur National Monument, roughly five miles east of the Colorado–Utah border. Some water may be legally and physically available from the Yampa, subject to constraints imposed by the Endangered Species Act\textsuperscript{87} and the Law of the River.\textsuperscript{88} But because of late priority dates, reliable water supplies would be available only during spring run-off, necessitating construction of large water storage projects.\textsuperscript{89} Shell Oil recently filed for the right to divert up to 375 cfs from the Yampa, during high-flow periods.\textsuperscript{90} Shell believes this is sufficient to fill a 45,000-acre-foot reservoir it proposes to build off the main stem of the Yampa, upstream of Dinosaur National Monument.\textsuperscript{91} Shell’s application generated significant opposition from local water users concerned about a potential loss of water resources as well as from those concerned about adverse impacts to protected fish species.\textsuperscript{92} In addition to Shell’s pending

\textsuperscript{86} Utah Department of Natural Resources and Energy, Utah Energy Office, An Assessment of Oil Shale and Tar Sands Development in the State of Utah, Phase II: Policy Analysis 27 (1982).

\textsuperscript{87} 16 USC §§ 1531-43.

\textsuperscript{88} The term ‘law of the river’ refers to the body of law that has developed around Colorado River management, including interstate compacts, Supreme Court decrees, an international treaty and a large body of administrative law. See generally notes 121–129 below.

\textsuperscript{89} Colorado Water Conservation Board, Statewide Water Supply Initiative 7-82 (November 2004).

\textsuperscript{90} Tom Ross, ‘Shell Oil’s Pursuit of Local Waters Could Have Big Impacts’, The Steamboat Pilot and Today (11 January 2009).

\textsuperscript{91} Ibid.

proposal, there are 34 conditionally decreed rights for reservoirs within Colorado’s portion of the White River Basin.93 Not all of these projects can or will be built, but they are an important indication of both the level of preparation for commercial oil shale development that has occurred as well as the potential for diversions upstream of Utah.

Groundwater

Groundwater provides an additional potential source of water that could supplement, or even supplant, surface water development. While a detailed analysis of groundwater resources is beyond the scope of this analysis, ample information is available to obtain a fair picture of available resources. According to the BLM, practical groundwater withdrawal limits within the south-east Uinta Basin are approximately 20,000 acre-feet per year,94 but this figure appears to ignore the state’s decision to close the basin to most new water appropriations.95

Aside from legal availability, three issues will dominate any assessment of groundwater resources. First, groundwater that is in continuity with surface water will be regulated to ensure groundwater depletions do not result in injury to senior surface water right holders.96 Since most shallow groundwater is hydraulically connected to surface waters such that groundwater withdrawals may reduce stream flows, shallow groundwater formations are unlikely to represent a viable source.97 Groundwater could, however, be developed in exchange for releases from surface water storage facilities, potentially avoiding major infrastructure costs of building pipelines

94 Final PEIS, note 29 above, at 3–84.
95 See note 75 above.
96 Colorado Ground Water Comm’n v North Kiowa-Bijou Groundwater Management Dist, 77 P 3d 62, 69–70 (Colo 2003) (holding that ‘[b]ecause tributary ground water is connected to surface waters, use of this ground water may reduce available surface water that decreed appropriators would otherwise be able to divert in order of priority. Thus, it is classified as if it were surface water, and like surface water, it is subject to the constitutional right of prior appropriation’). Utah water law does not distinguish between surface water and groundwater, and ‘no one can interfere with the source of supply of [a] stream, regardless of how far it may be from the place of use, and whether it flows on the surface or underground, in such a manner as will diminish the quantity or injuriously affect the quality of the water of these established rights’. Little Cottonwood Water Co v Sandy City, 258 P 2d 440, 443 (1953).
97 Note, in Colorado, most groundwater is presumed tributary to surface water. See Simpson v Bijou Irrigation Co, 69 P 3d 50, 59–60 (Colo 2003).
and pumping stations. The feasibility of such exchanges depends on the ability of surface water releases to replace water lost to the river system from the diversion of tributary groundwater.

Secondly, the quality of deep groundwater within the most geologically prospective area is highly variable and can be high in salts and dissolved solids. Water quality requirements associated with various production processes remain uncertain and must be resolved if groundwater is to be part of the equation. While groundwater could be used for non-industrial aspects of oil shale development, such as dust abatement and reclamation, concerns over increased salinity to the Colorado River as well as trace mineral contamination warrant careful consideration. Finally, groundwater travel time varies by location and in places is very slow. As a result, the rate at which groundwater withdrawals can occur will be limited by aquifer drawdown concerns and potential interference with other water users.

Water regulation

In Utah, and throughout the arid west, water is considered a public resource and administered by the state consistent with the public interest. Except for a small number of water rights obtained before codification of Utah’s water code, all water rights are obtained through application with the Office of the State Engineer. A five-part test must be met before the State Engineer can issue a new water right:

98 A comprehensive discussion of the need for and regulation of storage will be included in forthcoming publications by the University of Utah’s Institute for Clean and Secure Energy.

99 See, eg, Statewide Water Supply Initiative, note 89 above, at 3–77 (‘Many lower tributaries in the Piceance Creek Basin… exhibit poor quality due primarily to the streams being fed by groundwater in contact with oil shale. These streams have exceedingly high concentrations of dissolved solids, sulfates, and other minerals associated with oil shale’). See also Bechtel Petroleum Inc, White River Shale Project Detailed Development Plan, Oil Shale Tracts Ua and Ub (hereinafter ‘Detailed Development Plan’) 2-79 to 2-97 (August 1981) (on file with authors).

100 The Colorado River system is regulated to control increases in salinity. Increased salinity resulting from natural and anthropogenic actions, if not managed and controlled properly, has the potential to have a negative impact on other resources and complicate oil shale development. In 1974, Congress enacted the Colorado River Basin Salinity Control Act, Pub L 93-320, codified as amended at 43 USC § 1571, and great care will be required to ensure that commercial oil shale development will not result in increased salinity.

101 See, eg, Utah Code Ann § 73-1-1 (‘All waters in this state, whether above or under the ground are hereby declared to be the property of the public’).

102 Utah Code Ann § 73-3-1.
1. there must be unappropriated water available;
2. the proposed appropriation cannot impair existing rights or interfere with more beneficial uses;
3. the proposed plan to develop the water must be physically and economically feasible and not detrimental to the public welfare;
4. the applicant must have the financial resources to complete the proposed project; and
5. the application must be filed in good faith and not for purposes of speculation or monopoly.103

If granted, a water right will prescribe the source of supply, the point of diversion, the rate of diversion, the quantity of water that can be appropriated, the nature of use allowed, the period of use and the place of use.104 While the process in Colorado is somewhat different, the substantive requirements effect a similar result.105

A recent study commissioned by Western Resource Advocates details water rights for oil shale development within western Colorado, demonstrating the extent to which the energy industry has already acquired water in anticipation of future development. As the study explains:

‘Companies interested in oil shale development have established conditional water rights associated with more than 200 proposed structures, such as a diversion or storage dam in the Colorado River and White River Basins, dating back more than 50 years. … [T]here are 114 proposed structures with conditional rights in the White River Basin. These conditional structures include proposed reservoirs, pipelines (most with pumps), ditches, wells, and springs. These rights would enable a total direct diversion of… nearly 5,700 cfs in the White River Basin. They would provide for total storage of… over 1 million af in the White River Basin. …

In addition to establishing conditional water rights, energy companies have been actively purchasing existing agricultural ditch rights. … Acquisition of ditches provides control of water with senior priorities, especially important on the flow-limited tributaries in which they are located. … 57 ditches in the White River Basin are now [at least partially] owned by energy companies. … The decreed absolute diversion rates associated with these ditches total approximately 200 cfs. The total annual volume of water diverted under these rights, on average, is approximately 19,000 af.’106

103 Utah Code Ann § 73-3-8.
104 Utah Code Ann § 73-3-2.
105 Water law in the western United States, while a matter of individual state law, draws from a common tradition. While administration may differ from state to state, the general principles of law remain largely constant. For a survey of water law see A Dan Tarlock, Law of Water Rights and Resources (2008) or the multi-volume Robert E Beck (ed), Water and Water Rights (2004 edn).
106 Western Resource Advocates, note 93 above, at 7–9.
While water rights may exist on paper, legal and physical availability is far from clear. It is likely that there is insufficient water to satisfy all water rights, and some rights may have insufficient economic value to justify the high cost of development.

Given that not enough water exists to satisfy all who seek the region’s scarce resources, the question becomes whose rights will prevail? The maxim of ‘first in time, first in right’ is the foundation on which Western water law is built. Each water right has a priority date established in accordance with statutory requirements or, in the case of pre-water code rights, corresponding to the date on which the appropriator first initiated successful and diligent efforts to put the water to a beneficial use. When demand for water exceeds available supply, those with senior rights can require full or partial curtailment of junior water users’ diversions, leaving these users with junior priorities with less than their allotted amount of water, or none at all. Thus, the more senior the water right, the more valuable it is during times of drought.

As the value of water relates directly to its availability, senior rights are much more valuable than their junior counterparts because they provide a more certain source of supply. Western water law has the flexibility to accommodate reallocation to economically more profitable uses and water rights may be conveyed separately from the land on which they are used. Changes in the use of a water right are also allowed subject to the general rule that they cannot result in an injury to other water users. It follows

107 Utah Code Ann § 73-3-1; see also United States v County of Denver, 656 P 2d 1, 12 (Colo 1982) (noting that the doctrine of prior appropriation generally governs, in one form or another, the acquisition of water rights in the 19 western states).

108 Sanpete Water Conservancy Dist v Carbon Water Conservancy Dist, 226 F 3d 1170, 1173 (10th Cir 2000) (holding a senior appropriator is guaranteed the full measure of his or her appropriation before any junior claim may be satisfied).

109 Until recently, Utah’s water code included an important exception to this general rule whereby: ‘[I]n times of scarcity, while priority of appropriation shall give the better right as between those using water for the same purpose, the use for domestic purposes, without unnecessary waste, shall have preference over use for all other purposes, and use for agricultural purposes shall have preference over use for any other purpose except domestic use.’ Utah Code Ann § 73-3-21 (2008). While this provision was never invoked by a court of law, it provoked considerable discussion and represented a potential foil to those using water for lower preference activities. The Utah legislature has repealed the provision effective 11 May 2010. Neither the House nor Senate committee report indicates the reason for the revocation, noting only that the amendment received a ‘favorable’ recommendation. Reports of the House Natural Resources, Agriculture, and Environment Committee (3 February 2009) and Senate Natural Resources, Agriculture, and Environment Committee (20 February 2009).

110 Water rights evidenced by shares of stock in a corporation are transferred as personal property in accordance with provisions of the Uniform Commercial Code. Utah Code Ann § 73-1-10(2). Water rights evidenced by certificate, decree or diligence claim are conveyed as real property. Utah Code Ann § 73-1-10(1)(a).

111 Utah Code Ann § 73-3-3(2)(b).
that when inadequate water is available to satisfy the needs of all prospective users, markets develop and water rights are conveyed to economically higher uses. Historically, conversion of agricultural water rights to municipal and industrial rights has facilitated a significant amount of western expansion.

Consistent with statutory provisions encouraging economically efficient use, a wasteful use of water is not protected, and appropriators are generally unable to hold water rights for future, speculative needs. Thus, if a water right is not put to a beneficial use within the statutory period it reverts back to the state and is available for appropriation. These timelines may be extended where the applicant exercises due diligence in developing water rights, and for the reasonable needs of public water suppliers based on projected population growth or other water use demand.

The concept of relinquishment is important because many prospective oil shale developers obtained significant water rights in anticipation of the development that appeared certain in the 1970s. These companies and their successors in interest hold significant water rights, the continued validity of which is subject to state law. So far, Colorado’s Water Court has generally accepted water right holders’ efforts as sufficient to demonstrate diligent development, but the longer such rights remain contingent, the more difficult it may become to demonstrate diligent development.

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112 Important exemptions exist under most state permitting systems, allowing municipalities to secure senior domestic water sources sufficient to meet projected demand. While these rights must eventually be perfected through beneficial use, the timeline for right perfection is much longer. See, eg, Utah Code Ann § 73-3-12(2)(c). Similarly, Colorado grants conditional water rights for infrastructure-intensive water developments that may require years of planning and construction. See Colo Rev Stat § 32-92-103(6). Conditional rights allow permittees to secure water right priority in advance of development and beneficial use. In the absence of such rights, capital acquisition costs would be likely to be much higher given the uncertainty associated with the underlying water right.

113 See, eg, Utah Code Ann § 73-1-4(2)(a).

114 See, eg, Utah Code Ann § 73-3-12.


116 See, eg, Municipal Subdistrict, Northern Colorado Water Conservancy Dist v Getty Oil Exploration Co, 997 P 2d 557 (Colo 2000) (holding that under the ‘can and will’ test, Getty ‘can’ develop oil shale given existing technology and ‘will’ on changed economic considerations), Municipal Subdistrict, Northern Colorado Water Conservancy Dist v OXY USA, Inc, 990 P 2d 701 (Colo 1999) (holding conditional water right application not filed for purposes of speculation and OXY ‘can’ develop oil shale given existing technology and ‘will’ on changed economic considerations), Municipal Subdistrict, Northern Colorado Water Conservancy Dist v Chevron Shale Oil Co, 986 P 2d 918 (Colo 1999) (holding economic conditions properly considered in evaluating adequacy of efforts to perfect water rights for oil shale), but see Bar 70 Enterprises, Inc v Highland Ditch Ass’n, 694 P 2d 1253 (Colo 1985) (holding the association had not used reasonable diligence in developing its conditional water right), and Bar 70 Enterprises, Inc v Tosco Corp, 708 P 2d 1297 (Colo 1985) (denying claimed appropriation date for conditional water right because Tosco failed to demonstrate diligent development).
While converting senior irrigation rights to other purposes is a relatively common practice and does not create new demands on the system, three points deserve mention. First, irrigation rights almost invariably allow diversion of far more water than can be consumed, the excess being used to pressurise the irrigation system. However, when irrigation rights are converted to other uses, only the amount of water actually consumed is available for the changed use, so irrigation rights that appear large on paper may be much smaller in application. This important factor was, surprisingly, overlooked in earlier efforts to acquire water for oil shale development.\footnote{University of Wisconsin-Madison, \textit{Oil Shale Development in Northwestern Colorado: Water and Related Land Impacts} (1975) 198–200.}

Secondly, when irrigation rights are converted to other uses, the previously irrigated land is taken out of agricultural production. Farms with the most valuable water rights are also the largest, oldest and most established farms in the area. Removing these farms from productive agriculture can have a transformative affect on communities. Finally, the most prospective area for oil shale includes critical habitat for four species of fish protected under the federal Endangered Species Act (ESA),\footnote{16 USC §§ 1531–44.} the protection of which has an indirect impact on water availability.\footnote{How the ESA, and in particular the four species of protected fish that make their home in the most geologically prospective area, will impact oil shale development will be addressed in more detail in the Institute for Clean and Secure Energy’s forthcoming analysis of environmental, legal, socio-economic and policy issues critical to the development of commercial oil shale leasing.} While not discussed in detail as part of this article, the ESA will play a critical role in future water availability and development, as it already does elsewhere on the Colorado River.\footnote{See generally Robert W Adler, \textit{Restoring Colorado River Ecosystems: A Troubled Sense of Immensity} (2007).}

In sum, commercial oil shale development will bring with it a flood of change applications and development of conditional water rights. Water managers and policy-makers must evaluate carefully the security of supplies intended to support growing populations and pursue alternative sources. In a world where little if any unappropriated water exists, economically less profitable users will give way to more profitable uses. The shifts that will come with commercial oil shale development will fundamentally change the character of communities throughout Colorado and Utah.

### Water flowing into Utah – the size of the pie

The bedrock principle on which Western water law draws its strength is the notion of first in time, first in right. While the analytical purity of
this doctrine is hard to question, its application requires knowledge of important facts – who possesses water rights, the terms and any limiting conditions associated with those water rights, and the relative priorities of competing water rights. In the absence of this information, the comparative worth of water rights cannot be judged, the security of supplies is called into question, and markets struggle to reallocate assets of uncertain value. Uncertainty regarding these foundational terms threatens commercial oil shale development. With respect to the White River, we do not know how much water Utah’s upstream neighbours must allow to pass downstream. But before turning to the White River, we must first review the White River’s place in the larger Colorado River system.

**Colorado River Compact**

As part of the Colorado River System, the White River is subject to the Colorado River Compact,\(^\text{121}\) which apportions surface water among the seven states that drain to the Colorado River. These states are Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming\(^\text{122}\) (see Figure 3). The Compact divides the Colorado River watershed into upper and lower basins based on whether lands drain to the Colorado River at points above or below the town of Lee Ferry, Arizona.\(^\text{123}\) Under the Compact, both the upper and lower basins are entitled to annual consumptive use of up to 7,500,000 acre-feet of water.\(^\text{124}\) The lower basin is also ‘given the right to increase its beneficial consumptive use of such waters by one million acre-feet per annum’.\(^\text{125}\) Mexico is entitled to 1,500,000 acre-feet pursuant to the Treaty with Mexico.\(^\text{126}\) Mexico’s entitlement is provided out of surplus flows; when surplus flows are unavailable the obligation is born by equal reductions in each basins’ apportionment.\(^\text{127}\)

The upper basin’s entitlement to 7,500,000 acre-feet annually is misleading because the upper basin agreed to deliver an average of

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\(^{122}\) Colorado River Compact at Preamble.

\(^{123}\) Ibid art II §§ (f) and (g).

\(^{124}\) Ibid art III § (a).

\(^{125}\) Ibid art III § (b).


\(^{127}\) Colorado River Compact at art II § (c).
Figure 3. The Upper Colorado and Lower Colorado Basins
7,500,000 acre-feet of water at Lee Ferry without regard to the amount of water in the river. Since surpluses are seldom available to satisfy Mexico’s rights, the upper basin’s share of the obligation to Mexico is a 750,000 acre-feet burden, meaning the upper basin is really obligated to deliver 8,250,000 acre-feet at Lee Ferry. By acceding to this delivery obligation, the upper basin assumed the risk that it may have to reduce water consumption to satisfy its obligations to the lower basin. Moreover, the upper basin’s ability to consume its full apportionment was based on assumed levels of flow that rarely occur. During compact negotiations it was widely assumed the Colorado River annual flows averaged at least 17,400,000 acre-feet at Lee Ferry. However, estimated and gauged flow from 1906 to 2005 averaged 15,072,000 acre-feet (ranging between 5,399,000 and 25,432,000 acre-feet). Studies correlating tree ring growth to historic flows indicate that even this may overstate available flows.

In light of more realistic estimates of river flows, the upper basin states’ obligation to the lower basin and obligations to Mexico, the upper basin states are left with an average annual allocation of at most 6,000,000 acre-feet,

128 Ibid art III §§ (a) and (d).
129 Under very limited circumstances, the upper basin states’ delivery obligations can be reduced to 7,480,000 acre-feet if Lake Powell’s storage capacity falls below 9,500,000 acre-feet (39 per cent of capacity) and Lake Mead is above the 1,025-foot elevation level. Delivery obligations can be reduced further to 7,000,000 acre-feet annually if Lake Powell’s storage capacity falls below 5,900,000 acre-feet (24 per cent of capacity). US Department of Interior, Record of Decision, Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (December 2007) 50. Such shortages have not occurred during the period of operation for these two facilities but appear possible based on longer-term in-stream flow estimates and in light of modelled in-stream flow reductions attributable to climate change.
130 See Adler, note 120 above, at 22.
131 Norris Hundley, Jr, Water and the West: The Colorado River Compact and the Politics of Water in the American West (1975) 184. But see Eric Kuhn, The Colorado River: The Story of a Quest for Certainty on a Diminishing River (Roundtable ed, 8 May 2007) 22 n 63 (on file with authors) (reporting that compact negotiators claimed the Colorado River had a total supply of as much as 21.6 million acre-feet).
and possibly much less. Climate change, the effects of which are difficult to project, further undermines water availability within the Upper Colorado River Basin. As the National Academy of Sciences recently concluded:

‘The 20th century saw a trend of increasing mean temperatures across the Colorado River basin that has continued into the early 21st century. There is no evidence that this warming trend will dissipate in the coming decades; many different climate model projections point to a warmer future for the Colorado River region…. Based on analysis of many recent climate model simulations, the preponderance of scientific evidence suggests that warmer future temperatures will reduce future Colorado River streamflow and water supplies. Reduced streamflow would also contribute to increasing severity, frequency, and duration of future droughts.’

While the amount of water available remains in serious question, we do know how available resources will be divided. The upper basin states’ share of the Colorado River is apportioned according to the Upper Colorado River Compact. Arizona receives 50,000 acre-feet annually; Colorado, New Mexico, Utah and Wyoming receive 51.75, 11.25, 23 and 14 per cent of the remainder, respectively. Applying these percentages to an assumption that 6,000,000 acre-foot is available to the upper basin, Colorado and Utah’s average annual consumptive rights from the Colorado River and its tributaries are 3,079,000 and 1,369,000 million acre-feet, respectively. Despite disagreement about how best to quantify water use within each state, reasonable estimates are that, during an average year, Colorado has roughly 1,000,000 acre-feet of unused appropriations under the Compact.

134 The amount of water available to the upper basin states is a matter of considerable controversy. Eric Kuhn, General Manager of the Colorado River Water Conservancy District, evaluated several scenarios for determining water available to the upper basin after satisfying delivery obligations, concluding that upper basin states should plan on a reasonable yield of 5,250,000 acre-feet. Notably, this estimate does not account for inflow reduction attributable to climate change and assumes shortages will occur in six per cent of all years. See Eric Kuhn, The Colorado River: The Story of a Quest for Certainty on a Diminishing River (Roundtable ed, 8 May 2007) 104–05 (on file with authors).


137 Upper Colorado River Compact at art III § (a).

138 Between 1998 and 2006, Colorado consumed an average of 2,060,000 acre-feet of Colorado River Basin water annually. See US Department of the Interior, Bureau of Reclamation, Provisional Upper Colorado River Basin Consumptive Use and Losses Reports available at www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html. Given a right to consume up to 3,079,00 acre-feet annually, Colorado has roughly 1,000,000 acre-feet remaining.
Utah has, during an average year, roughly 520,000 acre-feet of unused Colorado River apportionments. Some of this water may come from the White River, but exactly how much is unclear.

While the Colorado River Compact and Upper Colorado River Compact apportion rights between respective states, they do little to address management of interstate rivers, and no agreement is in place regarding the White River. The absence of a formal agreement leaves unresolved questions of Colorado and Utah’s respective rights to the only significant surface water source flowing through the most geologically prospective oil shale area.

**Apportionment options**

In the absence of an agreement regarding apportionment of the White River, Colorado and Utah have three options to resolve their respective rights. The states can litigate their claims before the US Supreme Court, they can negotiate a mutually acceptable apportionment or they can turn to Congress to apportion flows through legislation. These three options are addressed in turn, and while all have shortcomings, a negotiated settlement represents the preferable option.

In the absence of an agreement regarding their respective rights to the White River, Colorado and Utah could pursue litigation. A suit between states would be subject to the US Supreme Court’s original jurisdiction.

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139 Between 1998 and 2006, Utah consumed an average of 848,000 acre-feet of Colorado River Basin water annually. Ibid. Given a right to consume up to 1,369,000 acre-feet annually, Utah has roughly 520,000 acre-feet remaining. Note, however, the Utah Division of Water Resources believes even less water is available, 416,000 acre-feet as of 2000. See D Larry Anderson, Utah’s Perspective: The Colorado River (2nd edn, Utah Division of Water Resources, 2002) 8.

140 In some cases, states sharing tributary river systems have entered into compacts apportioning their respective rights and addressing common management. For example, the Upper Colorado River Compact requires Colorado to deliver an average of 500,000 acre-feet per year at a point upstream of Dinosaur National Monument. Upper Colorado River Compact at art XIII § (a). A Memorandum of Understanding between Colorado and Utah for Pot Creek (in the Green River drainage) establishes a schedule of priorities for use in both states and defines a period before which direct flow diversions cannot be exercised, namely 1 May of each year. Statewide Water Supply Initiative, note 89 above, at 4–5.

141 See US Const art III § 2. Under Utah law, the State Engineer is specifically authorised to file suit to resolve interstate allocation issues. Utah Code Ann § 73-4-2. (‘For the purpose of co-operating with the state engineers of adjoining states in the determination and administration of rights to interstate waters and for such other purposes as he may deem expedient, the state engineer, with the approval of the executive director and the governor, is authorized to initiate and to join in suits for the adjudication of such rights in the federal courts and in the courts of other states without requiring a petition of water users as provided by Section 73-4-1. The state engineer, with the approval of the executive director and the governor, may also commence, prosecute and defend suits to adjudicate interstate waters on behalf of this state or its citizens in the courts of other states, in federal courts, and in the Supreme Court of the United States.’)
In addressing interstate allocation disputes, the Court applies the rule of equitable apportionment. As Professor Tarlock explains, ‘[t]he doctrine of equitable apportionment is a flexible rule that allows the Supreme Court to consider a variety of factors in determining what is a fair state share’,\textsuperscript{142} and as such is highly fact dependent. In determining whether one state is ‘using, or threatening to use, more than its equitable share of the benefits of a stream, all of the factors which create equities in favor of one state or the other must be weighed as of the date when the controversy is mooted’.\textsuperscript{143} ‘[T]he effort always is to secure an equitable apportionment without quibbling over formulas.’\textsuperscript{144}

As interstate allocation decisions are highly fact dependent, and the weight the Court gives to various considerations is an evolving matter of law, neither Colorado nor Utah can be confident in the outcome of a suit to apportion their respective rights in the White River. Moreover, neither state stands to gain through protracted litigation. The fact-intensive nature of these cases may explain why the Supreme Court disfavors equitable apportionment cases, preferring states to resolve matters on their own.\textsuperscript{145}

Rather than allow uncertainty to fester or rely on what would almost certainly be long and complex litigation, the states should negotiate a compact for the White River. Interstate compacts\textsuperscript{146} provide states with a more flexible means of apportioning flows and achieving related objectives. Less formal agreements that do not increase the political power of the states at the expense of the federal government can also create a binding agreement between the party states.\textsuperscript{147} Negotiated settlements avoid a potential thicket of procedural problems, such as ripeness, that accompany litigation.\textsuperscript{148} Such compact negotiations were proposed at least once before,\textsuperscript{149} but have never proceeded to fruition.

A third alternative means of allocating White River flows is for Congress to apportion Colorado and Utah’s respective rights, though this is the least

\textsuperscript{142} A Dan Tarlock, Law of Water Rights and Resources (2008) § 10.16.
\textsuperscript{143} Colorado v Kansas, 320 US 383, 394 (1943).
\textsuperscript{145} See Texas v New Mexico, 462 US 544, 567 n 13 (1983).
\textsuperscript{146} Interstate compacts are authorised by art I § 10 of the US Constitution and require congressional ratification.
\textsuperscript{147} See New Hampshire v Maine, 426 US 363, 369 (1076) (‘application of the Compact Clause is limited to agreements that are “directed to the formation of any combination tending to the increase of political power in the States, which may encroach upon or interfere with the just supremacy of the United States”’) quoting Virginia v Tennessee, 148 US 503, 519 (1893).
\textsuperscript{149} Letter from Utah Governor Calvin L Rampton to Colorado Governor John D Vanderhoof (11 December 1973) (on file with authors).
appealing or likely option. The Commerce Clause of the US Constitution provides Congress with authority to allocate interstate rivers to further federal interests.150 There is little question that increasing domestic energy production and reducing reliance on imported oil would further such federal interests. However, congressional action furthering federal interests may not produce a resolution amenable to both or even one of the states involved. Accordingly, Congress has been reluctant to apportion interstate rivers through legislation, acting only when negotiations break down and litigation proves impractical.151

In the end, how Utah and Colorado choose to resolve their competing claims to the White River is of less importance than the actual resolution. As one prominent water law scholar notes: ‘Until state claims have been reduced to definite rights in specific quantities of water, private capital cannot afford the investment risk, states will have difficulty selling bonds, and even the federal government will not authorize projects.’152 Thus even if commercial oil shale development does not come to pass, clarity as to their respective rights will benefit residents of both states as they plan for growth and increasing demands for water that are unrelated to oil shale.

Whose rights win – dividing the pie

Setting aside questions of how much water we can reasonably expect to flow into Utah, we can still ask how this pie of unknown size would be divided. We know that the first in time is the first in right, so the nature and extent of the rights held by the Uinta Basin’s earliest inhabitants are a logical place to begin. Unfortunately, while there is little doubt as to the seniority of Indian water rights, almost every other aspect of those rights remains unsettled, including: the amount of water they control; when, where and for what purposes it could be used; and where it would come from. Ute Indian water rights represent a potential source of supply for commercial oil shale development – a source of supply that, because of its size and seniority, could displace long-time water users. Conversely, if developed for agricultural or domestic uses, the tribe’s reserved rights could make it more difficult for oil shale producers to acquire adequate water supplies.

151 See, eg, the Boulder Canyon Project Act, 43 USC §§ 617–617f (apportioning flows of the lower Colorado River) and the Truckee-Carson-Pyramid Lake Water Rights Settlement Act, Pub L. 101-618 (12 December 1990) (apportioning the Truckee River basin between California and Nevada). Both Acts were passed only after years of conflict and failed attempts to resolve disputes through other means.
Indian reserved rights

The Uintah and Ouray Indian Reservation, which is home to the Northern Ute Tribe of Indians, is located in Utah’s Uinta Basin, approximately 150 miles east of Salt Lake City. The reservation was established by Executive Order on 3 October 1861. Under the landmark case, *Winters v United States*, creation of federally recognised Indian reservations impliedly reserved to the Indians the water needed to meet the needs of the reservation, even if water rights are not expressly discussed or quantified in the relevant treaty. The priority date associated with Indian reserved rights is the date on which the reservation was created. Unlike water rights granted under state law, Winter’s rights are not subject to forfeiture or abandonment for non-use, and can lie dormant for many decades. These reserved rights claims must be satisfied by the states in which the reservation lies, and will be debited against the state’s apportionment under the Law of the River.

Quantification of Indian reserved rights is no simple task. Initial efforts created open-ended decrees focusing on the tribe’s ‘reasonable needs’, providing the government leave to apply for a modification of the decree any time the tribe’s needs exceed the amount of water decreed. Cases held reserved rights hinged not on historical use, but on the ‘future as well as the present needs of the Indian Reservation’. In seeking to promote finality and objectivity, the Supreme Court held: ‘how many Indians there will be and what their future needs will be can only be guessed… [T]he only feasible and fair way by which reserved water for the reservations can be measured is irrigable acreage.’

153 For a detailed discussion of reservation establishment and subsequent modifications see *Ute Indian Tribe v State of Utah*, 521 F Supp 1072, 1092–1150 (D Utah 1981) (involving reservation disestablishment and jurisdictional implications). While *Ute Indian Tribe* was reversed in part, it contains a wealth of valuable, historic information.
155 *Arizona v California*, 373 US 546, 600 (1963) (holding the United States reserved water rights for the Indians effective as of the time reservations were created). The Uintah Valley Indian Reservation was created by Executive Order in 1861. The Spanish Fork Reservation was created by treaty on 6 June 1865. The two were subsequently combined into the Uintah and Ouray Indian Reservation. The reserved rights doctrine was extended into reservations created by Executive Order in *United States v Walker River Irrigation Dist*, 104 F 2d 334, 336 (9th Cir 1939).
157 *Arizona v California*, 376 US 540, 346 (1964) (holding water delivered to the tribes is to be applied against the total allocation for each state within which the reservation is located).
158 *Conrad Investment Co v United States*, 161 F 829, 832 (9th Cir 1908).
In the leading case on quantification based on irrigable acreage, *In re General Adjudication of All Rights to Use Water in the Big Horn River System (Big Horn I)*, the Wyoming Supreme Court determined that the primary purpose of the Wind River Indian Reservation was to promote agriculture among the resident tribes and the proper measure of the tribes’ reserved rights was ‘those acres susceptible to sustained irrigation at reasonable costs’. This has become known as the practicable irrigable acreage (PIA) standard.

The PIA standard, while successful in satisfying both finality and objectivity requirements, suffers from other problems. Quantifications of reserved rights may reflect projects that will never be developed. Conversely, where reservations were established in particularly harsh and arid areas, little if any of the reservation may meet minimum standards of economic feasibility. Recognising these problems, the Arizona Supreme Court, in *In re General Adjudication of All Rights to Use Water in Gila River System and Source (Gila V)*, rejected the PIA standard, choosing instead to balance a ‘myriad of factors’ in quantifying reserved rights. The Arizona Court began its quantification efforts by noting that ‘the essential purpose of Indian reservations is to provide native American people with a “permanent home and abiding place”, that is, a “livable” environment’. It went on to explain:

‘Other right holders are not constrained in this, the twenty-first century, to use water in the same manner as their ancestors in the 1800s… [A]griculture has steadily decreased as a percentage of our gross domestic product[, and j]ust as the nation’s economy has evolved, nothing should prevent tribes from diversifying their economies if they so choose and are reasonably able to do so. The permanent homeland concept allows for this flexibility and practicality. We therefore hold that the purpose of a federal Indian reservation is to serve as a “permanent home and abiding place” to the Native American people living there.’

In the PIA standard’s stead, the Arizona Court identified five non-exclusive considerations for quantifying reserved rights:

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162 *Big Horn I*, 753 P 2d 76, 101 (Wyo 1988).
165 35 P 3d 68 (Ariz 2001).
168 Ibid 76 (internal quotations and citations omitted).
1. the tribe’s history and culture;
2. ‘the tribal land’s geography, topography, and natural resources, including groundwater availability’;
3. the reservations ‘[p]hysical infrastructure, human resources, including present and potential employment base, technology, raw materials, financial resources, and capital’;
4. past water use; and
5. ‘a tribe’s present and projected future population’.169

Whether this homeland theory or the PIA standard is applied in quantifying Ute reserved rights has important implications. To date, state–tribal negotiation efforts have involved the PIA standard, but as no formal agreement is in place, application of the homeland theory should not be precluded.

**Ute Water Rights Compact**

Great effort has gone into quantifying the Northern Ute’s reserved rights, resulting in two important draft settlement agreements.170 Settlement of the Northern Ute’s reserved water rights was addressed in the Ute Water Indian Water Compact, which was codified into state law subject to ratification by the parties.171 Resolution of the federal government’s obligations to help the tribe develop its water resources resulted in the Complementary Ute Indian Rights Settlement, which was added to the federal Reclamation Projects Authorization and Adjustment Act 1992.172 Neither Act, however, was ratified through the required referendum of the tribe’s membership.173 Since the stumbling blocks to ratification have thus far purportedly involved administrative concerns rather than the quantity,174 seniority or

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174 The volume of water available to the Tribe was based on a report, commissioned by the Tribe, identifying existing and potentially irrigable acreage as well as the water duty associated with various areas. Ute Indian Tribe of the Uintah and Ouray Reservation, Utah, *Tabulation of Ute Indian Water Rights* (October 1990) 1 (on file with authors). Under the settlement, the state would be responsible for diverting water into the reservation water system and the Tribe and federal government would be responsible for subsequent administration within the reservation. Utah Code Ann § 73-21-2. For a detailed discussion of prior efforts to resolve the Northern Ute’s water rights, including an extensive discussion of concerns over state administration, see John Shurts, *Indian Reserved Water Rights: The Winters Doctrine in its Social and Legal Context, 1880s-1930s* (2000). Another area of concern involved restrictions on transfers of water to users in the lower basin. See Pub Law 102-575 at § 503(c) (30 October 1992) and *Native Waters: Contemporary Indian Water Settlements and the Second Treaty Era* at 174 (discussing concerns over potential transfer to Las Vegas and southern Nevada).
potential use of the tribe’s reserved water rights, the Ute Indian Water Compact is a reasonable starting point for discussing the tribe’s rights. Under the Compact, the tribe would obtain the right to divert up to 471,035 acre-feet of water annually, with the right to deplete up to 248,943 acre-feet, the majority of which would come from the Green and Duchesne river systems, which are farther away from Utah’s oil shale rich lands. The tribe could divert 66,502 acre-feet from the White River and its tributaries, consuming up to 32,880 acre-feet. During the month of August, this equates to a right to divert almost one-half of the river’s flow. The priority date for these rights would be 1861 or 1882, except when water is supplied from storage in the Central Utah Project.

Under the Ute Indian Water Compact, water allocated to the tribe ‘shall not be restricted to any particular use, but may be used for any purpose selected by the tribe’, including ‘sale, lease, or any other use whatsoever’. Furthermore, the Compact anticipated that the tribe could change the point of diversion, place of use or nature of use – including transferring water to uses off the reservation, subject to the requirements of state law and approval of the Secretary of the Interior. The ability to change the point of diversion as well as the nature and place of use provide important flexibility for adapting to needs of a fledgling oil shale industry – assuming the tribe chooses to support development.

As extensive and well positioned as the tribe’s water rights may be, they were quantified years ago based on agricultural use and potentially irrigable acreage, and therefore include limits coinciding with the irrigation season. Diversionary rights are available from 10 April to 10 October, and the rate of diversion varies throughout that period. Since the right to use water under the settlement is seasonal in nature while the energy industry’s needs are year round, industrial use of tribal water rights would depend on reservoir construction. Moreover, the exercise of Indian reserved water rights is likely subject to restrictions imposed by the Endangered Species Act, which could limit the ability to divert water

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176 Figures are based on average monthly stream flow as measured at the Watson Gage and reported by the United States Geological Survey, http://waterdata.usgs.gov/nwis/nwisman/?site_no=09306500&agency_cd=USGS, and water duties as set out in Table 6 of Tabulation of Ute Indian Water Rights, note 174 above.
177 Utah Code Ann § 73-21-2, art III.
178 Ibid.
179 Ibid.
181 Ibid.
or construct reservoirs. The breadth of the proposed settlement, if finalised in similar form, has the potential to shape commercial oil shale development. The tribe’s water rights would be senior to all but a handful of water rights within the basin and therefore not subject to call during times of shortage. If the tribe chooses to develop its reserved rights – regardless of the use to which those waters are put – water rights throughout the basin that were long considered stable will be cast into doubt, suddenly becoming quite junior. The tribe, therefore, stands in a uniquely powerful position to influence oil shale development, either supplying needed water or effectively handcuffing the nascent industry by dictating that water be used for other purposes.

While the Ute Indian Water Compact represents the best estimation of the Ute Tribe’s reserved water rights, the Compact is but an estimate. As already noted, it was not ratified by the tribe and therefore is not binding. Likewise, the quantifications on which the Compact is based may not reflect either the extent of acreage that could be put into cultivation with modern irrigation practices or water duties applicable to modern technology. Most importantly, the Compact predates the homeland theory espoused by the Arizona Court. Whether the homeland theory would lead to more or less water is unclear, but it could lead to more year-round water. Thus, the Compact stands as a caution to the extent of Ute reserved rights as well as uncertainty in their quantification and terms.

This continued uncertainty regarding tribal reserved rights casts a cloud over not only oil shale development, but development in general. Development of tribal reserved rights could put all other water rights in the basin at risk, especially given the need to maintain minimum flows for federally protected species. Accordingly, resolution of tribal reserved rights and clarification of water development plans should be a high priority.

As with interstate allocation, the State of Utah and the Northern Ute Tribe of Indians have at least two options for settling reserved rights claims.

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182 Endangered Species Act concerns will be addressed in more detail as part of forthcoming publications by the Institute for Clean and Secure Energy at the University of Utah. For a case study on the ESA’s application to Indian reserved rights see, eg, Adrian N Hansen (Note), ‘The Endangered Species Act and Extinction of Reserved Rights on the San Juan River’ (1995) 37 Ariz L Rev 1305 (concluding enforcement of the ESA precluded new Indian water projects along the San Juan River, interfering with the tribes’ ability to use their senior water rights).

183 The tribe can maintain its water rights without use, in which case existing water users would be unaffected by settlement. However, the prospect that the tribe will neither use nor lease its valuable water resources is questionable enough to cast a shadow over rights junior to the tribes.

184 Water duty is the total amount of irrigation water required to mature a particular crop, usually expressed as acre-feet per acre.
The parties can turn to the courts for resolution, but such a course of action will take years and precious financial resources. Such an adversarial approach will undoubtedly strain relationships between the tribe and state, complicating relationships that will be necessary to manage water resources into the future. Rather than litigate, the parties can resume negotiations. Tremendous effort has already gone into establishing the legal and factual foundation necessary to resolve these reserved rights claims. Renewed interest in the basin’s energy resources could provide a springboard for further negotiations.

Conclusion

Certainty regarding the extent of available water supplies and water right priorities is critical in resolving competing claims to scarce water resources – precisely the kinds of claims that will increase in frequency with commercial oil shale development. Several concrete steps could clarify the nature and comparative value of existing water rights. First, the White River flows through Colorado and Utah’s richest oil shale resources, yet Colorado and Utah’s respective rights to the river remain uncertain. Colorado and Utah should negotiate a compact clarifying each states’ respective water rights. Such an agreement would have added utility if it addressed non-consumptive uses. In the absence of an agreement, water users in Utah will be left to question how much water will flow to them. Without knowing how much water will be available, competing water users will be left to guess how senior a water right must be to guarantee a reliable supply of water. Such uncertainty will hinder reallocation of rights and complicate efforts to obtain capital for infrastructure improvements. These problems affect not only the oil shale industry, but all water users who must plan for increasing demands and decreasing supplies. Now is the time to resolve the question.

Secondly, the Ute Indian Tribe’s reserved rights claims are massive and senior to those of almost every other water user within the Uinta Basin. The potential to subordinate most existing water rights to the tribe’s water rights is a cloud over all water users within the basin, not just those held by the energy industry. Finalising the Ute Indian water settlement should be a high priority, and it must clearly articulate the extent to which water resources may be transferred to non-Indians, used for commercial and industrial purposes and used off the reservation.

Once these two foundational water rights questions are resolved, the nascent oil shale industry, as well as those competing with it for
scarce water resources, will have some level of certainty regarding water resource availability in this arid region. Clarifying water availability is an important step and will pave the way for efforts to address the other environmental issues awaiting resolution. Indeed, the larger question is what competing uses and values are we, as a society, willing to forego to enable oil shale development?