Dry-Year Water Supply Reliability Contracts: A Tool for Water Managers

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This guidebook is part of an ongoing series intended to assist public agencies, non-profit organizations and the private sector with design and implementation of water acquisition programs to improve water supply reliability during drought and under climate change.

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The purpose of this guidebook is to provide an overview of what steps are needed to create an effective water acquisition program using a dry-year water supply reliability contracts ("reliability contracts"), as well as to provide the reader with a concise menu of decision and evaluation criteria. This guidebook examines design and implementation factors, as well as the challenges and potential shortcomings of utilizing a reliability contract. While reliability contracts have been used in the USA and elsewhere; they are not yet common and involve unique design considerations to accomplish the goals of a water acquisition program.

Reliability Contract Background[1]

Water supply availability can be variable and may become even more difficult to predict as climate change progresses (Garrick and Jacobs 2006; Williams 2007). There are many approaches to address supply variability, and temporary water transfers linked to dry conditions are one method for mitigating variability in regional water supplies.[2]

We use the term reliability contract[3] to refer to contractual arrangements made in advance of need under which a change in water use is triggered by low supply conditions. Like all contracting devices, a reliability contract specifies payment and risk sharing between the contractor and contractee.[4] The contract generally specifies up-front payment and then exercise payments if the trigger event occurs, and may extend for one year or any number of predetermined years. Under this scenario, the contractor guards against at least five risks while the contractee receives consideration.[5]

First, the contractor guards against the threat of drought as the option may be exercised if the trigger event occurs (Williams 2007). Second, by not purchasing or leasing the water outright, the contractor guards against the threat of having too much water in relatively wet years; consequently, the contractor minimizes the likelihood of

[1] This guidebook is not intended to be used in lieu of legal advice. If the user intends to enter into a contract it is advisable to retain an attorney.

[2] It is important to note that it may be necessary to secure the permission of a state or federal agency to transfer the water from one party to another and to change the manner and location of use. In some cases, the regulatory agency may seek funding from the requestor to perform any necessary impact analysis and for the creation of a mitigation fund.

[3] A water supply reliability contract may take the form of an option contract or other similar contract. Because there is a large degree of overlap between the two contracts, an option contract framework is generally used and distinguished where appropriate.

[4] The contractor is the party seeking to procure water. The water-selling parties, or contractees, are generally irrigators. This is because irrigator water withdrawals account for approximately 40% of the freshwater withdrawals in the United States and 80% in the western United States (USGS 2009).

[5] Consideration may take a variety of forms: a monetary payment, debt forgiveness, favorable pricing for services, livestock feed to substitute for crops not grown, water management benefits or other services. If the contractee is a grower, then consideration received can be treated as analogous to producing another “crop” (forbearance) in the farm’s financial risk management portfolio.

purchasing excess water and associated costs of storing permanent water acquisitions and of storing the excess (Williams 2007).[6] Third, the contractor guards against the risks associated with political resistance to permanent water transfers, which may limit the quantity and duration of a transfer agreement (Howe 1996). Fourth, the contractor guards against the risk of price volatility over time (Woo et al. 2001). The contractor locks in a contractual rate for the life of the contract and is insulated from market rate variation.[7,8] Finally, a reliability contract may mitigate the likelihood or impact of urban demand hardening because water is transferred only if the trigger event occurs.[9] Therefore, urban users may be more willing to participate in conservation measures due to the extra protection provided against drought or shortage.

If an option contract framework is used, the party selling the option receives a negotiated payment per volume of water and refrains from using that volume for the contractually specified period.[10] The reliability of this arrangement rests on the probability that water is available in the system for the entitlement holder. Under severe dry conditions, even very senior entitlements may not yield water. When the option is exercised, the contractor pays the contractee a specified additional amount of consideration (exercise payment) per volume of water obtained; the irrigator then fallows a portion of her land in order to transfer water that would have been used for irrigation to the contractor in accordance with the terms of the contract (Hass 2006). The upfront consideration (option premiums) and exercise payments can help to smooth out the typical variability in agricultural revenues by diversifying an irrigators agricultural portfolio to include water leasing revenues (Mays, et al. 2002).[11]

If a different type of reliability contract is used (instead of an option contract framework), many of the important components of the process remain the same. In each case there is a negotiated upfront payment and a trigger event is identified. If the trigger occurs, then the contractor is entitled to use the volume of water specified in the contract.

A key distinction between the typical option contract framework and other

6 Storing the excess water underground may be an added mitigation measure if the contractor has access to a recharge facility. (Guenther 2008).

7 As water price and scarcity increases, contractors face associated increased levels of uncertainty. As a result, contractors may seek multiple arrangements so that they have some choice regarding where to get water and how much to pay. This process of seeking multiple deals, however, may ultimately increase the procurement costs of water because searching and negotiation across multiple potential agreements is costly.

8 Likewise, this can be attractive to the contractee because she is also insulated from the variation in market rate.

9 Demand hardening is the concept that as a water service area becomes more efficient, it becomes more difficult to save increased volumes of water during a shortage or drought (Maddaus 2008).

10 In an option contract framework, the up-front payment is generally called an option premium. In other reliability contracts, however, the up-front payment is not considered a premium; rather, it is exactly what the name suggests: an up-front payment.

11 Hansen, et al. calculated that gains of trade could be had by parties and that prices converge to a relatively competitive level even in thin markets.

reliability contracts is the payment structure and/or the type of consideration exchanged. For instance, instead of paying an option premium, a contractor may elect to purchase an irrigator's land and then lease that land back to the irrigator and allow the irrigator to continue irrigation. If an agreed upon trigger occurs, the irrigator relinquishes the right to irrigate.[12] In this case, neither an option premium nor an exercise payment is paid to the irrigator; however, this arrangement is still considered a reliability contract because it is an arrangement made in advance of need that is triggered by a specific event.[13]

A dry-year supply reliability contract can extend for a single year or for any number of contracted years (Mays, et al. 2002).[14] The time horizon of the contract will depend in part on the type of water supply variability that the contractor would like to mitigate (Mays, et al. 2002).[15] As with any contract, details should be developed and finalized before water shortage conditions occur, or at least with adequate time for all parties to agree to review and agree on its terms.[16]

The procured water may move to a different type of user or be temporarily used out of its original geographic area. Therefore, it is important to consider the potential impacts on parties affected by, but not engaging in, the transactions. For instance, a result of not using the water in a particular area (or on a particular farm) may be that return flows that downstream users expect are no longer available.[17,18] Additionally, if irrigators are paid to fallow their fields there may be lost income to agricultural laborers due to reduced demand for labor services (Sunding, Mitchell and Kubota 2004). To offset such third party economic impacts, payments to affected third parties might be included in the contractual arrangements (Sunding, Mitchell and Kubota 2004).

It may also become necessary to consider the potential environmental impacts

[12] This type of arrangement is often referred to as a "contingent lease-back."

[13] This is not the only type of non-option contract supply reliability contract. A contractor may creatively tailor a contract to suit her needs. Several other examples of these types of arrangements are explained in the section below.

[14] Some participants may be wary of participating in multiple year contracts or even participating in too many consecutive years (SacBee 2004). Irrigator caution in water transactions has also been documented in the Yakima River basin (Rux 2008). To this end, it is important to build trust with the contractees/irrigators so that they feel involved and a part of the process.

[15] Mays, et al. (2002) provide an example where the time horizon for the length of the option contract may be different if the purpose of the contract is to potentially acquire a volume of water during an earthquake versus periodic drought.

[16] The volume of water to be obtained if options are called must not exceed the volume of water that is legally allowable. For instance, while an irrigator may enter into a reliability contract, the maximum volume that may be called and transferred is typically that irrigator's consumptive amount. Relevant laws should be consulted. It is important to note that although the consumptive volume may be transferrable, the contractor may receive less than the consumptive volume because of conveyance losses.

[17] If an irrigator diverts a volume of water but not all of it is consumed, then the non-consumed portion (seepage and runoff) may return to the original watercourse. When, however, the water is conveyed sufficiently far away from the original water source, return flows patterns will be altered.

[18] Generally, the procured water must be upstream from the diversion point. If it not upstream, then groundwater/surface water and storage exchanges may be available in some instances.

of fallowing, although the impacts may be considered positive or negative. For instance, fallowing may lead to the potentially negative impacts of erosion or excessive dust. This may become particularly acute in situations where the reliability contract is several years in length. One potential solution to this problem is to rotate land fallowed (Headwaters 2004). Fallowing, however, may lead to positive benefits in some situations. Assuming that larger volumes of water are kept in the watercourse, riparian habitat and fish populations may benefit (Israel and Lund 1995).

The types of environmental impacts (positive and negative) that ought to be considered are case specific and in some cases, a mitigation strategy may be integrated into the supply reliability contract.

Potential Water Transfer Complications

Before examining individual reliability contracts, it is important to briefly enumerate the potential complications inherent in any transaction that moves water from one user and/or location to another. These include: a) the financial and environmental costs of moving the water from one place to another may exceed the benefits gained from trading water (Hartwell 2007); b) water rights can be difficult to measure or vague; c) geographical boundaries and legal restrictions may limit water-trading. For instance, state law may not permit interbasin transfers or interstate transfers[19] (Hartwell, 2007; Garrick 2008); d) statutory protection and political considerations may require consideration of environmental or third parties impacts resulting from the transfer (Colby 2000; Hartwell 2007); e) there may be conveyance loss due to evaporation or seepage.[20]

Dry-Year Reliability Contract Examples

Option Contracts

Dry-year option contracts have been used intermittently in California beginning in the early 1990s (Jercich 1995). In 1995, the state of California's Water Bank negotiated contracts with local irrigation districts for the option to purchase 29,000 acre-feet of water (Jercich 1995).[21] The Bank was permitted to call the option by May 1995 and if the option was not called, the irrigators kept their option premiums (Jercich 1995).[22] In this instance, the options were not called because the winter

[19] The transfer process may be contractually complex. For instance if a central Arizona municipality entered into a forbearance arrangement with an irrigation district on the Colorado River, under which the district does not divert its full entitlement so the water could be used by the city, it would be necessary to create a formal arrangement involving Reclamation, the irrigation district, the municipality and CAWCD to move non-CAP water from the Colorado River through their system.

[20] It is important to note that contracts may be designed to mitigate the negative impacts of these potential complications. For instance, with respect to potential environmental or third party impacts a system of rotating eligible participants (or tracts of land) may be used. An alternative strategy may be employed whereby the auctioneer takes a predetermined percentage of the revenue and distributes that to the impacted parties and/or localities. The auctioneer needs to be aware of potential complications and must be creative in devising solutions when attempting to contend with them.

[21] The price paid for the option premium was $3.50 per acre-foot (Jercich 1995).

[22] If the options were called, the price paid to the irrigators would have been a pre-negotiated price of $35.50 – $41.50 per acre-foot, in 1995 dollars (Jercich 1995).

months were wetter than anticipated, so additional water was unnecessary (Jercich 1995).

In the winter of 2002, the Metropolitan Water District of Southern California (MWD) negotiated with the Sacramento Valley irrigation districts for one-year option contracts for 146,000 acre-feet of water (CDWR 2002; Jenkins 2008). Under the contract terms, MWD had until March 2003 to call the option and if the option was not called, the irrigators kept their option premium (CDWR 2002; Jenkins 2008).[23] Because the end of 2002 and beginning of 2003 was dry, MWD called all of the options (MWD 2003a; Jenkins 2008). In April, after the options were called, it began to rain – making the called water unnecessary (MWD 2003b; Jenkins 2008). As a result, MWD had more water than could be stored and much of the option water flowed out to the ocean (Jenkins 2008).

In an effort to minimize the likelihood of repeating the 2003 experience, MWD negotiated with the irrigation districts for an additional year of option contracts. However, it negotiated with the irrigators to extend the deadline to call the optioned water from March to April in exchange for a higher option premium (MWD 2004; Jenkins 2008).[24] In 2005, this contract modification was validated as a relatively heavy rain hit in April, making calling the optioned water unnecessary (Jenkins 2008).[25]

In addition to relatively short-term option contracts, MWD has also entered into a long-term (35-year) fallowing contract with the Palo Verde Irrigation District (PVID) beginning in 2005. Under the terms of the agreement, a base load area of approximately 6,000 acres will be fallowed for each of 35 years up to a maximum of 24,000 acres in any 25 years and a maximum of 26,500 in any 10 years (PVID 2004a).[26,27] MWD determines the acreage for fallowing and that is based upon forecast demand, supply and storage conditions. Regardless of the volume of water called in any particular year, MWD must call at least 12,000 acres on average over the 35 years of the program to fulfill contractual requirements (PVID 2004a). In return, MWD agreed to pay $3,170 per water toll acre times the landowner's maximum fallowing commitment, where a maximum of 35% of a particular landowner's land is eligible for the sign up payment (Trends 2004). If an option is called, MWD will pay an additional $602 per acre fallowed that year (PVID 2004a).[28]

Other Supply Reliability Contracts

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[23] The option premium was $10 an acre-foot. If the option was called, MWD was obligated to pay an additional $90 per acre-foot for the option water (Jenkins 2008).

[24] MWD agreed to pay the irrigators an option premium of $20 per acre-foot for the ability to call the water in April instead of March (Jenkins 2008).

[25] Although MWD paid a total of $1.25 million in option premiums in 2005, it would have had to pay $16 million if it had purchased the water outright.

[26] The years do not need to be consecutive.

[27] Participants are not allowed to switch to groundwater if options are called. Additionally, the agreement requires participating irrigators to participate in land management measures including weed control and erosion control (PVID 2004b).

[28] Annual payments will be adjusted by 2.5% per year for the first ten years and then between 2.5% and 5% in all subsequent years based on the Southern California Consumer Price Index (PVID 2004a).

In addition to the typical option contract framework, there are other interesting examples of agreements that may be made in advance of need and are triggered by a particular event. The first is the Bonneville Power Administration's (BPA) load reduction program. BPA is a federal agency headquartered in Portland, Oregon which markets hydro-generated power to the Pacific Northwest (BPA 2008). Because electricity generation is tied to water availability, a reduction in water volume can limit generation capacity. In dry years, BPA uses a load reductions and load buy-backs in an effort to limit their own water demand (BPA 2002). This ensures that minimum stream flows for fish passage are observed (BPA 2001). Years are considered 'dry' when winter runoff is below a predetermined volume (BPA 2006).

An important component to this arrangement is that BPA's dry-year buy-backs may only be used during specified times during the calendar year for some purposes. For example, a buy-down is available whenever the direct service industries (DSI) are operating at high capacity and are willing to participate whereas an irrigation buy-down is available only between April and September and must be implemented prior to planting (BPA/KC 2001).

Another example of an innovative supply reliability agreement occurred in Utah when a city paid a farmer $25,000 for a 25-year dry year option and agreed to provide $1,000 and 300 tons of hay in any year that the option was exercised (Clyde 1986). Because of this agreement, the city was able to acquire the volume of water that it desired and the farmer was able to continue farming operations. A similar model was used by the Oregon Water Trust when it paid a farmer $6,600 to compensate him for not growing hay to feed his livestock (Anderson 1998).

A similar supply reliability contract is a conditional lease-back. A conditional lease-back is an agreement in which land and water are purchased by the entity desiring long-term control of the water and are leased back to the irrigator so that irrigation can continue except when water is needed to replace drought shortfalls (Colby 2003). This is similar to an option contract in the sense that the water may be called periodically and irrigation suspended. In order for this arrangement to be attractive to farmers, the up-front payment by the water seeking entity to purchase the farm and water rights must be attractive, along with the timing of notice to cease irrigation and other terms of the lease.

Structuring the Reliability Contract[29]

A preliminary consideration when engaging in a dry-year reliability contract is to determine what volume of water is needed to

[29] It cannot be overemphasized that it is necessary to consult local and federal laws to determine what volumes are legally available to be transferred, if any. For instance, a state may only allow an irrigator's consumptive volume to be traded (as opposed to the diversion or beneficial use volume). *See*, Section 1725 of the California Water Code. And this transfer is likely to be subject to transportation losses due to seepage and/or evaporation. Additionally, to ensure the legal validity of the contract, the buyer and seller must be aware of the volume that is legally available to be transferred, if any.

achieve the desired levels of supply reliability.[30] Because it costs the contractor more money to keep a larger volume of water in option, the goal is to keep the minimum volume of water in option to achieve adequate insurance against supply shortfall. This balancing should incorporate available climate and hydrological models used for predicting supply variability, where practical (Hartmann 2005; Troch et al. 2008; Lyon, et al. 2008; Tueling et al. 2007; Hirsch et al. 1993; Salas 1993; Stedinger et al. 1993). The models can assist in the determination of whether a year is expected to be relatively wetter or dryer, and in dryer years, or in those years when reservoir storage is low, it may be appropriate to place more water in option.

It is also necessary to determine with whom to contract. Generally it is expedient to contract with parties that own relatively senior water rights, as they are less likely to have supply interruptions (Mayes, et al. 2002). The contractor may purchase the option to more junior rights, but because such rights are not as secure as more senior rights the water may not be available during drought.[31] Also, it may be necessary to either rotate eligible participants or eligible tracts of land from one contract period to the next to minimize some of the negative impacts associated with fallowing (IID 2007).[32]

When utilizing an option contract, an important issue is the determination of how much money to spend per volume of water for the option premium, and how much to spend per volume of water if the options are exercised (the exercise payment). With respect to the option premium, from the perspective of the contractor, the minimum amount of money that is necessary to keep the option open is desirable. However, the contractee likely wants to receive a large premium for enrolling a portion of their acreage. Negotiations must be successfully concluded between the contractor and the contractee to determine a mutually acceptable trade. Likewise, if the option is called, the contractor would like to spend the minimum amount of money where the contractee would like to receive the maximum payment. Again, the contractor and contractee must negotiate to determine an acceptable amount of money per volume of water on the called water.

Determining how much to pay for the option premium and exercise payment can be a difficult task, and in regions with relatively rare transactions, it may be difficult to find a basis for comparison. Nevertheless, the prices paid should reflect current market conditions (as nearly as possible) for water rights and the level of risk associated with supply

[30] It is also important to decide whether to utilize an option contract or other form of reliability contract.

[31] Purchasing senior rights helps ensure that wet water rights are likely to be transferred rather than paper rights. If water is needed by the contractor, it is important that wet water rights are transferred (Yardas 1989).

[32] Rotating the eligible participants can provide an additional side benefit of making the non-selected participants feel involved in the process.

shortfalls.[33] Put differently, the offer amount should be gauged against the benefits foregone by using the water in the manner proposed by the contract and foregoing the usual use of the water (Jaeger and Mikesell 2002). While many potential methods of establishing a value for water exist, three methods are commonly used. First is the sales comparison method, which uses direct observation of transactions prices in voluntary water transfers (Colby, Pittenger and Jones 2007; Young 2005). This method may be appropriate where sales information of voluntary water transaction exist and is available in a particular area or basin. However, because water transactions are relatively uncommon, this approach may not be appropriate in all instances.

Second is the water-crop production function method, which measures the relationship between water application and crop output and is useful for locations and crop mixes where "accurate up-to-date water crop functions are available" (Colby, Pittenger and Jones 2007). The models can be used to show how crop yields, farm operations and net income will respond when water supplies are constrained, and can therefore provide insight into the values that irrigators may place on their water entitlements (Jaeger and Mikesell 2002). However, this approach is limited to regions for which the necessary data and production functions are available. The third approach is the residual (or farm budget) method, which estimates net returns over variable costs per acre for regional crop mixes. (Colby, Pittenger and Jones 2007; Young 2005). This method provides insight into the role of crop input and output prices and quantities in determining on-farm water values (Young 2005; Colby, Pittenger, and Jones 2007).[34]

In years of relative water scarcity or high demand (or the expectation of scarcity or high demand) prices would be relatively higher. Nevertheless, in order for a deal between the two parties to be realized, the sum of money paid to the irrigator must equal or exceed the net income she would have received had her land not been fallowed (Hass 2006). Also, if the contractor is assigning a greater level of risk to the irrigator by extending the date at which the option can be called, as was the case with MWD in 2003, the option premium would be expected to be higher (Jenkins 2008). As with any negotiation strategy, the contractor should have a predetermined budget for the amount

[33] This may be difficult to accomplish, particularly when the contract extends for multiple years. Additionally, "the value of water varies enormously, depending on the supply source's reliability, quantity of water, access and cost of conveyance, duration and firmness of contractual commitments, and the buyer's type of use and alternative sources of comparable water supplies" (Water Strategist 1997). Additionally, economic conditions, federal farm programs, political climate and many other variables may impact the prices paid.

[34] The Water Strategist suggests using an Equivalent Single Price (ESP) technique for calculating the value of a water contract when the expected volume of deliveries is different from year to year. Under this method, ESP = present value payments/present value deliveries; the payments then have financial integrity (Water Strategist 1997). This method could be considered when the option recurs annually.

of money it is willing to spend if the optioned water is called and a predetermined budget for the option payments.

It may also be necessary to determine when the contractees will be compensated for participating in the contract.[35] At a minimum, the contractees must be paid by a particular date for engaging in the option contract and a date (or date range) must be specified for which the contractee must be paid if the option is called. If the option is called the contractee may be paid in installments over the time period the water is being used for other purposes (IID 2004b).

An important related concern when structuring the option contract is to determine the date range within which the option may be called. In this determination, two main issues are important: first the window to call the option must be timed such that the contractor is able to take delivery of the water when it is most likely to be needed. For instance, if the optioned water is needed in summer the contractor will want the call window to be in spring not in fall. If the options are called too early, the contractor faces the risk that the optioned water will no longer be needed if late spring rains ease the drought.

Second, the contractor's optimal timing windows must be counterbalanced against financial considerations for irrigators in their seasonal farm planning and operations cycle.[36] If the call window is negotiated near to or after the planting cycle, then irrigators will demand a higher option premium in consideration of crop production costs already incurred. The closer to the planting cycle that the option window is open, the more costly it is for the irrigator to cease irrigation on short notice. MWD encountered this timing issue in 2003 and increased the premium that it paid irrigators for keeping the option window open an additional month (Jenkins 2008).

Trigger Mechanisms

A practical consideration is determining what events will cause the option to be called. There is no clear cut method for determining when to call an option; however, the trigger should be pre-specified, objective, not influenced by actions of parties to the agreement and observable to the participants so that they have a reasonable expectation of the outcome and the trigger should be related to the ultimate purpose of the optioned water (Mayes, et al. 2002). For instance, calling the optioned water may be based upon stream flow levels (Willis, et al. 1998; CDWR 2000). That is, the option would be called if stream flow fell below a predetermined critical level. Stream flow was proposed as a trigger for calling an option in the Snake River Basin to ensure adequate water levels for the salmon population (Willis et al. 1998). In areas where winter runoff provides an important water supply, winter runoff volume may be used as a trigger mechanism (BPA 2002). BPA has used

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[35] This is true for both the option payment and the exercise payment.

[36] For an example of the potential differences in crop planting cycle, see Sample Dry-Year Supply reliability Contract section.

runoff volume as an indicator of when to employ dry-year techniques to ensure water availability.

Another potential trigger for calling optioned water is reservoir elevation. Because a particular reservoir may be used to determine whether drought conditions exist, a contract may be structured such that if a chosen reservoir falls below a predetermined target elevation (or volume) some of the optioned water may be called (CDWR 2000). In areas where groundwater is used to supplement surface water, marked increases in groundwater pumping may be used as a trigger to call optioned water (CDWR 2000). A dramatic increase in groundwater pumping may indicate drought conditions because it may imply that surface water resources are limited. In order for this trigger to be effective groundwater pumping must be measured and a threshold for calling the optioned water must be developed. If groundwater is used to supplement surface water supplies, then it may be valuable to create a trigger index based on some combination of reservoir levels and groundwater conditions.

There is potential to use climate forecast information for several purposes related to dry year water use arrangements (Hartmann 2005). Climate forecasts potentially can be used to assess how frequently an option is likely to be exercised over a specific period of years. This may affect the terms of the contract and the payments parties require to participate. In addition, climate forecasts may also be useful to determine when to call optioned water within a specific year. Climate change is projected to alter the probability, magnitude and duration of water shortages in the Southwest (Hartmann 2005). Climate and water supply forecasts may be useful in predicting how often a trigger condition would occur in a decade. This information can be valuable in structuring the contract as the contractor likely will want more frequent opportunities to exercise options and irrigators may wish to have higher option premiums to compensate them for more frequent disruption of farm operations. More general climate information, such as whether a particular year is strong El Nino with snowpack likely to be above average, can be valuable to both contractor and irrigators in their planning.

In some years it may be the case that not all of the options need to be exercised, and so it is necessary to develop a decision rule for selecting which options to exercise.[37] Any method that is logical and clearly enumerated to program participants may be employed for this purpose. For instance, one method that may be utilized is to exercise the options starting from the most senior (i.e. most secure) water right to the most junior until the desired water supply is acquired.[38] However, senior water rights may command a premium and cost more per unit of water transferred. An alternate selection rule would be to exercise

[37] An additional caveat may be included that those that are not selected this year have priority in the subsequent years.
[38] It may be desirable to only contract with irrigators that have a desired priority date; i.e. with irrigators with the most secure entitlements.

options moving from lowest cost per unit to higher costs until water reliability needs are satisfied. Another possible method is to employ a random selection scheme among water entitlements of similar cost and reliability characteristics.[39]

Monitoring and Evaluation

After a volume of water is called in a reliability contract, it is necessary to implement a monitoring and enforcement scheme to ensure that program participants comply with contract terms. Typically this involves ensuring that participants cease irrigation on the lands the contract obligates them to refrain from irrigating for the time period agreed upon. Because monitoring and enforcement of irrigation for specific land parcels can be costly, it is important to utilize tools appropriate for the given situation. Regardless of what tools are utilized, it is important to clearly specify what agency is responsible for monitoring compliance and how that compliance will be determined.

Several tools to enforce the terms of the contract may be available. For instance, in some situations locking irrigation gates may be appropriate (IID 2004a). Another manner of ensuring compliance is to utilize remote sensing imagery to ensure that water is not being used on specific tracts of land. Remote sensing imagery can distinguish whether land is being actively irrigated in many arid areas. A common manner of enforcement, however, may be to have enforcement staff drive through and inspect parcels that are no longer supposed to be irrigated.

As with any implemented program, conducting an evaluation is necessary to determine success or failure. The goal of a water supply reliability contract is to manage the risk associated with water supply variability while minimizing the cost to do so. In a given year, therefore, it is appropriate to first consider whether the proper volume of water is optioned or exercised. A contractor is interested in exercising a sufficient number of options to minimize the risks associated with water variability while avoiding exercising too many options such that the program becomes unduly expensive.

By the very nature of this type of contract, however, options would only be called when they are necessary. That is, on average the option contract scheme should bring about the desired result by properly insulating the contractor from risk. Thus, to judge a program's efficacy, it may be helpful to study a series of years to determine whether the underlying hydrologic model is effective at determining probabilities of shortage. This type of long term analysis can assist in determining whether too many, or not enough, options are being exercised from year to year and whether modifications to the contract should be made.

It may also minimize the likelihood of false positive and false negative results. A false positive occurs when the trigger

[39] In some circumstances it may be appropriate to design a system where those individuals (or acreage) not selected this year have priority the following year. This can help in minimizing the negative environmental impacts associated with continuously fallowing the same land.

indicates an upcoming shortage and water options are exercised but not actually needed. A false negative occurs when an insufficient volume of water is optioned and a genuine shortage materializes. If the volume of water called when the trigger occurs consistently overshoots or undershoots the volume actually needed, then it may be necessary to alter the trigger indicator and the underlying hydrologic model that indicates probabilities of shortage, and to update the volume of water optioned.

Another important measure of success is the amount of money paid to: (1) create the options (or the upfront payment amount); and (2) pay for the called options (or the consideration paid if the trigger occurs).[40] If a volume of water was called in option, then one measure for assessing the success of the program is whether the cost of obtaining the optioned water is less than the cost of an alternative supply method. Alternative methods may include storing water in a reservoir or underground (i.e. banking the water for a later date) or obtaining water after it is needed through auctions, leases, purchases or any combination of the three.

If it is less costly, or more secure, to engage in an alternative supply reliability strategy, then it may be more effective to utilize that alternative. In order to compare across alterntatives, it is important to consider the whole range of costs incurred for the reliability contract[41] and compare that against the total costs of implementing an alternative program.[42]

This discussion assumes a series of single year contracts; however, a long-term contract may be analyzed in a similar manner. The long-term contract can be examined on a year-to-year basis or over the life of the contract. A contractor must be aware, however, that because she receives a higher level of security for a longer-term contract (because of the guarantee of water availability by the contractee for a longer period of time), the up front and exercise payments may be higher on average.[43] However, a relatively shorter-term contract, because the terms can be renegotiated on a more frequent basis, may exhibit a higher degree of variability from contract to contract. Therefore, it may be necessary to determine whether it is more cost effective to enter into a series of short-term contracts or a long-term contract. But this must be counterbalanced by the fact that the contractor receives a higher degree of security in a relatively longer-term contract.[44]

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[40] This must include all of the costs associated with contracting and contract administration.

[41] This includes the cost of all of the option premiums plus the payments paid for the options that were exercised plus any contract administration costs.

[42] Another strategy that may be employed by the contractor is to do nothing at all. The costs associated with that strategy include costs of a potentially having an insufficient water supply.

[43] However, this is not necessarily the case because the irrigators are also provided with security due to obtaining the up-front option premiums.

[44] It may be that an optimal contract length can be determined. This contract length will minimize both risk associated with water supply variability and cost while also providing the contractor the opportunity to be responsive to changing conditions.

In order to fully assess the effectiveness of the program, it is also necessary to consider the contract administration and monitoring costs. Because of their relative complexity, negotiating and drafting reliability contracts are time and labor intensive; legal counsel will likely be necessary to negotiate and draft a contract and the cost(s) may be high. Assuming that a contract is consummated, there may be additional contract monitoring costs to consider. It is necessary to monitor irrigators' water consumption to ensure that they are following the terms of the agreement.[45] If they are not following its terms, it may be necessary to spend additional resources to enjoin their use.[46]

Summary

Reliability contracts are one potentially valuable tool for acquiring water supplies as part of an overall strategy to address the increased supply uncertainty and longer, more severe droughts that are expected to accompany to climate change. This guidebook is part of an ongoing series intended to assist public agencies, non-profit organizations and the private sector with design and implementation of water acquisition programs to improve water supply reliability during drought and under climate change.

[45] Even if the State is ultimately responsible for calls and monitoring, the State may require funding for providing the service.

[46] This may be done by way of a simple cease and desist letter from counsel or it may be necessary to litigate the issue in a court of law.

Checklist for Dry-year Supply Reliability Contracts

This checklist has been developed to highlight reminders intended to assist with the dry-year option contract implementation process.

Preliminaries

- ☐ **Determine volume of water desired.**
- ☐ **Determine whether a reliability contract is the most cost effective type of water supply acquisition method. Compare against:**
  - **Doing nothing.**
  - **Leases.**
  - **Spot market.**
  - **Outright purchases.**
  - **Other possible water acquisition methods.**
- ☐ **Set planning and implementation timeline.**
  - Are there seasonality or planting cycles to consider?
  - Start of publicity, outreach and informational meetings.
- ☐ **Determine eligibility to participate.**
  - Should there be constraints on the type or location of eligible water entitlements?
  - Are there supply stability issues?
- ☐ **Determine the volume that each person may offer.**
  - May individuals offer their entire permit amount? Their historical diversion amount? Their consumptive use amount?
- ☐ **Develop a public information and participant engagement plan and timetable.**
- ☐ **Develop a method for determining which options to exercise if some, but not all, of the options are exercised (i.e. set a priority system).**
- ☐ **Determine whether side payments may be necessary as a result of fallowing activities (due to lack of return flow or environmental consequences).**
- ☐ **Determine how and when contractees will be compensated.**

Contract Design

- ☐ **Determine an overall option contract budget.**
  - Determine prices for the option and for calling the option.
- ☐ **Determine the number of years that the contract will remain valid**.
- ☐ **Determine whether to employ an option contract framework or another framework.**
  - If an option contract framework is chosen:
    - Determine starting and ending dates for the window to call the options.
  - If a different supply reliability contract design is chosen:
    - Determine the bounds of that agreement: what may be traded and how consideration may be made.
- ☐ **Determine the trigger mechanism.**
  - Surface stream flow levels.
  - Snowpack levels.
  - Reservoir levels.
  - Increased groundwater pumping.
  - Climate.

Post Supply Reliability Contract Evaluation

- ☐ **Determine the evaluation methods to be used for auction success.**
  - What type of metrics will be used to assess option contract success? Should success be based upon obtaining a desired volume of water? Upon minimizing procurement costs? Upon minimizing

auction costs? Based upon a calculation of benefit per dollar spent? Through the use of focus groups or surveys? Or some other method?
  - Develop a plan to collect data needed for evaluation.
- ☐ **Monitor actual change in water use to assure compliance.**
- ☐ **Determine whether improvements can be made to the option contract process for the future.**
  - Were the goals achieved? If not, what can be done to improve the outcome?

Sample Dry-Year Supply Reliability Contract Timeline

Assuming that there is a probability that water will be needed in the following period, it may be necessary to utilize a dry-year supply reliability contract. What follows is timeline that would be typical of a contract lasting one year. This sample timeline will need to be modified based on the particular area, months in which drought is likely to limit water supplies, type of crops grown, and length of contract.

I. *Summer:*

Conduct preliminary assessments. Determine the likelihood additional water will be necessary and the volume of water that is desired. Set acquisition budgets. Begin forming program goals and expectations. Begin publicity and outreach.

II. *Fall*

Begin preliminary negotiations with irrigators. Determine whether to utilize an option contract framework or another similar arrangement. If an option contract framework is chosen, this includes negotiating option premiums and exercise payments amounts. If a different type of agreement is used, determine how to implement that agreement. This includes determining the payment structure. In either case, it is necessary to determine how and when irrigators will be paid. Set the trigger mechanism that will cause the water to be called.

III. *Winter*

Conclude negotiations with irrigators, draw up agreement and obtain necessary signatures and other authorizations to formalize contract If modifications are necessary to existing infrastructure (i.e. remote sensing technology, locks on head gates, etc.) it may be necessary to conduct installation. If specified in the contract, begin paying the option premiums (if option contracts are used).

IV. *Spring*

Continue paying option premiums (if specified in the contract). If the predetermined trigger event occurs, determine what volume of water to call (if any). If a volume of water is called, begin monitoring operations (including locking head gates and monitoring changes in lands irrigated) to ensure that participating irrigators are complying with the agreement. If specified in the contract, begin payment (begin paying up-front payments or option premiums).

V. *Summer*

Continue paying up-front payments/option premiums (if specified in the contract). Continue monitoring operations. Conduct final assessment of the effectiveness of the program. Begin paying exercise payments (if a volume of water was called in the Spring). Begin preliminary assessment for the next year of contracts.

As indicated, the timeline may have to be adjusted based upon the type of crops grown by participating irrigators. In order to ensure program cost effectiveness, it is important to select relatively low value crops for fallowing and provide irrigators with sufficient notice such that they do not invest resources in preparation and planting activities, if water is called by the contractor. For example, the table below lists the months that planting typically begins in Yuma County, Arizona and illustrates the importance of adjusting the timeline based upon the crops grown (Colby, Pittenger and Jones, 2007; Teegerstrom and Knowles, 1999; Teegerstrom and Tickes, 1999; Teegerstrom, Palumbo, and Zerkoune, 2001).

Months Planting Begins For Various Crops – Yuma County, Arizona	
Crop	***Month***
Alfalfa 1st year	August – October
Alfalfa other years	N/A
Cotton	December – March
Wheat	December
Fall Lettuce	July – September
Spring Lettuce	October – November

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Glossary

Called option – Optioned water that is purchased, or called, by the contractor.

Conditional Lease-back – an agreement whereby land is purchased by the entity desiring long-terms control of water and where the land is leased back to the irrigator so that farming operations may continue except when the water is needed to replace drought shortfalls.

Contingent water contract – see, dry year water option contract.

Contractee – In a supply reliability contract, the contractee is the party selling the option. Generally the contractees in this scenario are irrigators.

Contractor – In a supply reliability contract, the contractor is the party purchasing the option to call the water in the future.

Dry year option contract – A contract where a contractor pays the contractee a premium for the option to exercise the option at a later date.

Dry-year water supply reliability contract – A contract that is designed to shift the risk of water supply variability. Under this scheme, the contractor pays the contractee a sum of money (in advance of need) for the option to call on the option at a future date. Includes both dry-year option contracts and other similar reliability contracts.

Exercise payment – The payment that is made to a contractee when options are called (or exercised).

Junior water rights – In a state recognizing the doctrine of prior appropriation, a junior water right holder is a person that may appropriate water but only after relatively senior right holders appropriate.

Option premium – The amount of money paid by the contractor to the contractee to keep the option open.

Senior water rights – In a state recognizing the doctrine of prior appropriation, a senior water rights holder owns rights to a relatively more secure source of water. These rights are the most valuable.

Up-front payment – The payment paid to a contractee up-front in a dry year water supply reliability contract. May or may not be considered an option premium.