EXHIBIT D

Summary of Main Concerns

1) We agree with most of the recommendations made by DPU and are grateful for the hard work that has gone into this review.

2) **CONSERVATION RATES CANNOT BE APPLIED TO IRRIGATION WATER RIGHTS.** Our fundamental concern is the principle that conservation rates cannot be properly imposed on the use of water delivered pursuant to privately held water rights, especially those that were indisputably offered, accepted and relied upon for the express purpose of providing inexpensive irrigation water for improving property within the Dammeron Valley subdivision.

   Application of a conservation tariff to water right holders is inconsistent with the inherent concept of the right, and the responsibility, to fully beneficially use water as set forth in applicable law. Moreover, application of a conservation tariff to irrigation water rights has the potential risk of effectively being a constitutionally impermissible "taking" of a valuable property right, without just compensation. Fundamental legal principles applicable to water rights and to property rights, including those obtained in planned subdivisions, as well as important historical facts of Dammeron Valley development specifically, should be fully taken into account. The PSC should consider almost 30 years or more of reliance by water users on the subdivision design and intent, and various understandings, practices, adjustments and agreements made with the developer.

3) **IRRIGATION WATER RIGHT USE FEES SHOULD START AFTER TIER 1.** For these reasons, we believe that after Tier I basic household use is reached, rates for irrigation water delivered pursuant to water rights should be addressed in a different manner than retail residential consumption rates because of their different legal background and status. Water right rates should start after Tier I basic household use is reached and should not include a conservation fee unless and until the entire annual water right has been used.

4) **REQUESTED ADJUSTMENTS TO DPU'S RECOMMENDED TARIFF.** Based on these and other considerations, we believe the DPU's Recommended tariff should be adjusted as follows:

   a) All users, including Tier I, should pay proportionate repair and replacement costs (R&R) as part of the water use charge. DPU's Recommended tariff includes an extra R&R component for use of irrigation water rights, creating an inappropriate burden on irrigation water use and an inappropriate subsidy to all other water users since system R&R costs are paid proportionately by volume used in the water use charges;

   b) Tier I should be based upon the Division of Drinking Water requirements for daily residential use, i.e. 800 gallons per day (24,000 g/mth)[1]. Water users should not be charged a conservation fee for use within this range;

   c) Under both DVWW's Proposed tariff and DPU's Recommended tariff, irrigation water right rates should start after Tier I[2]. Any overage after full use of water rights would be priced starting at Tier II;

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[1] If it is decided that Tier I should stop at the indoor use only component of the total daily residential requirement (400 gpd;12,000g/mth), then water right rates should start after 12,000g/mth.

[2] The existing "tapping" system (which affects when the water right rates start) can be kept or eliminated. If kept, those with more than 1 "tap" should be given the option to surrender the additional "taps" and have their water right rates start after Tier I. Customers have been given the option to reduce their tapping, which Mr. Pace represented in 2008 as an open option. (Transcript of proceedings before the Public Service Commission of Utah. Docket 07-2025-T01, March 25, 2008)

d) The charge for delivery of water right irrigation water should be based upon state water law applicable to water rights. That is, water right rates should be based on the proportional and reasonable expenses of maintaining, operating and controlling the system.[3] Utah Code Ann. Sec. 73-1-9 (2010).

e) The existing monthly water rights cap should be modified to accommodate realistic seasonal irrigation requirements.[4] The reason for this request is that in the cooler months, the full monthly allowance is not needed and can't be used, and in the hotter months more water is needed but can't be used without higher prices because of the monthly cap. Thus, this artificial cap dissuades, if not prevents, water right holders from fully beneficially using their right according to seasonal requirements. The total annual allowance of 1 ac-ft would not change. In addition, the current cap unnecessarily prevents users from fully using their right (8 mths x 40,000g = 320,000 g/yr; 1 ac-ft = 325,851g; the difference is 5,851g unusable due to this "rounding" figure).

Further Discussion

State law calls for the beneficial use of water and establishes the proper charges for delivery of water rights.

- Waters in Utah are property of the public, subject to right to use. Utah Code Ann. § 73-1-1(1).
- "The Legislature shall govern the use of public water for beneficial purposes, as limited by constitutional protections for private property." Utah Code Ann. § 73-1-1(3).
- "Beneficial use shall be the basis, the measure and the limit of all rights to the use of water in this state." Utah Code Ann. § 73-1-3. In other words, to maintain the property right, the water right owner must put the water to use.
- "The use of water for beneficial purposes, as provided in this title, is hereby declared to be a public use." Utah Code Ann. § 73-1-5.
- "A water right, whether evidenced by a decree, a certificate of appropriation, a diligence claim to the use of surface or underground water, or a water user's claim filed in general determination proceedings, shall be transferred by deed in substantially the same manner as is real estate." Utah Code Ann. § 73-1-10.
- "When two or more persons are associated in the use of any dam, canal, reservoir, ditch, lateral, flume or other means for conserving or conveying water for the irrigation of land or for other purposes, each of them shall be liable to the other for the reasonable expenses of maintaining, operating and controlling the same, in proportion to the share in the use or ownership of the water to which he is entitled." Utah Code Ann. § 73-1-9.
- Section 73-1-9 establishes the basis upon which charges can be imposed for the water rights transferred by the developer and/or its related entities ("Dammeron") to the subsequent purchasers. The reasoning behind this provision pertains to the public interest in use of water of the state. "Because of the vital importance of water in this arid region both our statutory and decisional law have been fashioned in

[3] DPU's Recommended tariff includes a 50% ($0.15/1000g) surcharge for water delivered pursuant to irrigation water rights, resulting in a total price of $0.45/1000g. This is the surcharge referenced above that creates an inappropriate burden on use of irrigation water rights and an inappropriate subsidy for all other water users. We believe that a more modest amount should be initially adopted (closer to a total price of $0.32/1000g, as proposed by DVWW) at least until a study can be done to more accurately determine actual needs. In any case, the charges for delivery of irrigation water pursuant to water rights should not exceed the lowest charge for water delivery under the entire tariff.

[4] The current monthly cap that is applied is 40,000g/mth. However, the previous Stipulation and Order (Exhibits G and H) allow 50,000g/mth, if within system capacity. Based on Mr. Pace's testimony that the system currently has the capacity to service his entire development plan, there would appear to be no doubt that the system can handle this amount.

recognition of the desirability and of the necessity of insuring the highest possible development and of the most continuous beneficial use of all available water with as little waste as possible." See, e.g., Wayman v. Murray City Corp., 23 Utah 2d 97, 100.

- The water rights that were conveyed back from purchasers to the developer and/or related entities, in exchange for a certificate, are held in trust by that entity. The current tariff makes that clear: "All Company certificated irrigation water rights will be held, conveyed and maintained by the Company on behalf of the owner." These rights were conveyed in trust, based upon representations made in connection with the transfer from the purchaser to Dammeron, which did not pay for the water right so acquired. Accordingly, the benefit of those certificates must be treated the same as the benefit of the deeded water rights.
- Water rights transferred by Dammeron are still freely transferred like any other Utah water right, except those that are held in trust which are transferred on the books of the company. (See testimony of Brooks Pace, Transcript of proceedings before the Public Service Commission of Utah. Docket 07-2025-T01, March 25, 2008)
- An example of the purchase of a water right after purchase of a lot can be seen in the deeds attached hereto. These rights were purchased for valuable consideration.
- The system has capacity to deliver these water rights at a rate consistent with applicable state water law.

Users have developed irrigation systems and lot improvements in reliance on irrigation water rates. In our case, we have made significant investments to develop a small horse pasture, including purchasing 1 acre foot with the purchase of the lot and another acre foot subsequently. Maintenance of this system and the landscape has required countless hours of labor. All of this is put in jeopardy if the irrigation rate is impacted with an onerous conservation rate and/or with an unfair R&R charge.

Reliance by customers on property law and past promises should be respected

Each subdivision in Dammeron Valley has a different plan of development. The Meadows and the Ranches, both platted in 1976 with lots of approximately 5 acres, were established with a "hobby farm" plan. The recorded covenants state "[R]aising of crops, horticulture, gardening, stabling of livestock … are permitted." (See attached covenants for Meadows)

Parties who purchase in planned subdivisions are legally entitled to rely upon the plans disclosed in the recorded covenants and upon the recorded documents and the legal principles that govern their interpretation. The Public Service Commission should not undermine these long-established legal principles.

Land that has been irrigated but cannot continue to be affordably irrigated will revert to weeds, affecting property values of the water right holders and of the community at large. Owners who have made lot improvements in reliance upon the ability to use state minimum residential water quantities without conservation fees will also be adversely impacted.

Imposing additional repair and replacement costs on irrigators is unjustified, unduly burdensome, and creates an unwarranted subsidy from water right owners to other water users.

Wear and tear on the water system occurs pro rata, with volumetric use. All rates should include the same amount for repair and replacement. Furthermore, each residential user pays (or should pay) for fixed system costs in the base rate prior to utilizing water at the irrigation rate so that irrigators bear their fair share in the base rate. The variable consumption rate of $0.30 per 1,000 gallons includes identified repair and replacement costs. If variable costs associated with volumetric use are properly allocated among all users, every gallon

delivered should pay a proportion of repair and replacement and thus, the addition of an arbitrary figure only to irrigation rates is unjustified, unduly burdensome to irrigators and creates an unfair subsidy from water right irrigators to all other water users. Furthermore, this additional burden placed on water right holders violates Utah Code § 73-1-9.

The rates currently proposed by Dammeron and the DPU would increase the costs for an irrigator with 2 acre feet who fully utilizes the monthly allowance by 233-273%. Under DPU's recommendation, the costs for an irrigator with 1 acre foot would increase by almost 300%. These increases cannot be sustained.

Limits on irrigation deliveries should be raised to at least 50,000 gallons per month

Those who have used, and thus protected the standing of their water rights with the Utah State Engineer, should not be penalized by having the economically feasible use of the irrigation water denied. There is no rational basis to limit that use to 40,000 gallons per month, especially during the summer months when most is needed. Prior to 2004, the tariff acknowledged the right to 50,000 acre feet per month. Pace testified in this matter that the current system capacity is sufficient to deliver all the water needed at buildout. Thus there is enough capacity, paid for by existing water users including irrigators, to allow irrigators sufficient water to utilize the right at the time when it is most needed. The limitation to 40,000 gallons per month is derived by dividing one acre foot (325,851 gallons) by 8 (and rounding down). However, the need for irrigation water occurs over a 6 month time period, beginning in April and ending in September. See 'SPRINKLERS, CROP WATER USE, AND IRRIGATION TIME WASHINGTON COUNTY" http://extension.usu.edu/files/publications/publication/ENGR_BIE_WM_33.pdf, Table 3 (copy attached). The need for irrigation water is thus about 54,000 gallons per month over these six months. Assuming some of the water might be used in the shoulder months of March and October, the irrigation rate should be returned to 50,000 gallons per month.

The 1986 Stipulation and Order support this conclusion. It should be noted, however, that no water right holder was identified as a party to the stipulation, the signatories to the stipulation could not bind these holders and State water law supersedes any conflicting provisions of the Stipulation and Order.

Drastic changes that result in large increases in monthly water charges should be avoided

A substantial increase in a water tariff to address both bookkeeping/accounting issues and a wholesale realignment of tariff, inconsistent with long-standing practice, is not in the public interest. These changes should be made in a moderate fashion to allow for the impacts to be ascertained and tariffs modified over time to address legitimate utility goals based upon adequate records of expenditures segregated into water company accounts.

Benefits to the developer should be clarified and if they exist, eliminated

- Have water deliveries to property owned by Dammeron been accounted for?
- Has Dammeron eliminated plans to deliver 250 acre feet of bulk water to itself or its proxies at a reduced rate? (See letter to PSC dated March 12, 2008, and draft proposed tariff 2008).
- Irrigation right water use charges should never be greater than the amount Dammeron pays for its own use or for any other bulk use or sale in any circumstance.

Recorded at Request of SECURITY TITLE CO. AUG 12 1977

at 10:15A. M. Fee Paid $4.00 A L Luit County Recorder

by ____ Dep. Book 223 Page 902 Ref.: 186214

Mail tax notice to Harold P. Christensen Address 2431 Allegheny Way, Placentia CA 92677

WARRANTY DEED

[CORPORATE FORM]

THE DAMMERON CORPORATION

organized and existing under the laws of the State of Utah, with its principal office at St. George, of County of Washington, State of Utah, grantor, hereby CONVEYS AND WARRANTS to

HAROLD P. CHRISTENSEN and WANDA L. CHRISTENSEN, husband and wife, as joint tenats with full rights of survivorship, and not as tenants in common,

of Placentia, California grantee for the sum of TEN And No/100----------($10.00)----------DOLLARS, and other consideration the following described tract of land in Washington County, State of Utah:

All of Lot 34, DAMMERON VALLEY MEADOWS, a Subdivision, according to the Official Plat thereof, on file and of record in the Office of the County Recorder of Washington County, Utah, as Entry No. 178381.

SUBJECT TO Easements, Restrictions and Rights of Way of Record.

The officers who sign this deed hereby certify that this deed and the transfer represented thereby was duly authorized under a resolution duly adopted by the board of directors of the grantor at a lawful meeting duly held and attended by a quorum.

In witness whereof, the grantor has caused its corporate name and seal to be hereunto affixed by its duly authorized officers this 30th day of May, A. D. 19 77.

Attest: Andrew B. Pace Secretary.

[CORPORATE SEAL]

THE DAMMERON CORPORATION ~~XXXXXXX Company~~

By A. Brooks Pace A. Brooks Pace President.

STATE OF UTAH, }
County of Washington } ss.

On the 30th day of May, A. D. 1977 personally appeared before me A. Brooks Pace and Andrew B. Pace who being by me duly sworn did say, each for himself, that he, the said A. Brooks Pace is the president, and he, the said Andrew B. Pace is the secretary of THE DAMMERON CORPORATION ~~XXXXXXX Company~~, and that the within and foregoing instrument was signed in behalf of said corporation by authority of a resolution of its board of directors and said A. Brooks Pace and Andrew B. Pace each duly acknowledged to me that said corporation executed the same and that the seal affixed is the seal of said corporation.

CLAIRE M. DALTON NOTARY PUBLIC STATE OF UTAH

Claire M. Dalton Notary Public.

My commission expires 4-3-81 My residence is Washington, Utah

902

WHEN RECORDED, MAIL TO

Wanda L. Christensen
29120 Vista VAlley Drive
Vista, CA 92084

Wanda L. Christensen
REQUEST: _____
BOOK 477 PAGE 829
FEE 2.00 ABS
1988 FEB 22 PM 12: 38
DOCUMENT NO 32697
HERBERT S BEATLEY
WASHINGTON CTY RECORDER
BY _____

WARRANTY DEED

THE DAMMERON CORPORATION, Grantor of Dammeron Valley, County of Washington, State of Utah, hereby CONVEYS and WARRANTS to WANDA L AND HAROLD P. CHRISTENSEN, Grantees of Vista, California, for the sum of Ten ($10 00) DOLLARS and other good and valuable consideration, the following described WATER RIGHT in Washington County, State of Utah

ONE (1) acre foot of water off Water User's Claim No 81-2167, Certificate No. 12318, to be used for irrigation purposes on Dammeron Valley Meadows Lot * 34

Water Rights conveyed by this deed are restricted to use for irrigation purposes only, and may not be sold or transferred outside of the Dammeron Valley Subdivisions, Washington County, Utah

WITNESS the hand of said grantor this 5th day of February, A.D. 1988.

THE DAMMERON CORPORATION

By Brooks Pace
BROOKS PACE, President

Attest June Pace
JUNE PACE, Secretary

(Corporate Seal)

STATE OF UTAH)
) ss
County of WASHINGTON)

On the 5th day of February, A D. 1988, personally appeared before me BROOKS PACE and JUNE PACE, the signers of the within instrument, who being by me duly sworn did say, each for himself, that he, the said BROOKS PACE is the President, and the said JUNE PACE is the Secretary of THE DAMMERON CORPORATION, and that the within and foregoing instrument was signed in behalf of said corporation by authority of a resolution of its board of directors and who duly acknowledged to me that said corporation executed the same and that the seal affixed is the seal of said corporation.

829

My Commission Exp 7/30/89
Residing at · Santa Clara, Utah

Melody Kesler
MELODY KESLER Notary Public

Recorded at Request of _____

at _____ M. Fee Paid $ _____

by _____ Dep Book _____ Page _____ Ref _____

Mail tax notice to GRANTEE _____ Address P.O. BOX 830
WASHINGTON, UT 84780

WARRANTY DEED

HAROLD P CHRISTENSEN and WANDA L CHRISTENSEN grantor
of VISTA, CA 92084 County of State of Utah, hereby
CONVEY and WARRANT to
JAMES K HANSEN and BARBARA G HJELLE,
husband and wife, as joint tenants with full rights of survivorship
grantee
of ST GEORGE, UT 84780 County of Washington, State of Utah
for the sum of *** TEN AND NO/100 ($10 00) and other considerations *** DOLLARS

the following described tract of land in Washington County,
State of Utah, to-wit

All of Lot 34, DAMMERON VALLEY MEADOWS, a Subdivision, according to the Official Plat thereof, on file and of record in the Office of the County Recorder of Washington County, Utah, as Entry No 178381

EXCEPTING THEREFROM, all coal and other minerals, together with the right of ingress and egress for the development and/or removal of the same

TOGETHER WITH ONE (1) ACRE FOOT OF WATER FROM WATER USERS CLAIN NO 81-2167, CERTIFICATE NO 12318, to be used for irrigation purposes on DAMMERON VALLEY MEADOWS LOT #34

Water Rights conveyed by this deed are restricted to use for irrigation purposes only, and may not be sold or transferred outside of the DAMMERON CALLEY SUBDIVISIONS, Washington County, Utah

00370746 Bk 0572 Pg 0484
RUSSELL SHIRTS * WASHINGTON CO RECORDER
1990 SEP 04 09:38 AM FEE $7.50 BY KJP
REQUEST: SECURITY TITLE CO

WITNESS the hand of said grantor, this 17th day of August A D 1990

Signed in the presence of

Harold P Christensen
HAROLD P CHRISTENSEN

Wanda L Christensen
WANDA L CHRISTENSEN

STATE OF ~~UTAH~~ California
COUNTY OF San Diego } SS

On the 17 day of August A D 1990 personally appeared before me HAROLD P CHRISTENSEN and WANDA L. CHRISTENSEN the signer of the within instrument who duly acknowledged to me that they executed the same.

OFFICIAL SEAL
DAVID YODKOVIK
NOTARY PUBLIC-CALIFORNIA
SAN DIEGO COUNTY
MY COMM. EXP. JUNE 14, 1991

My Commission Expires 6/14/91

David Yodkovik
Notary Public

Residing at Carlsbad, Ca.

PROTECTIVE COVENANTS AND DECLARATION

OF BUILDING AND USE RESTRICTIONS

ARTICLE I

PREAMBLE

KNOW ALL MEN BY THESE PRESENTS:

THAT WHEREAS, the undersigned, being the owners of the following described real property located in Washington County, State of Utah, and more particularly described as follows:

Beginning at the Northwest Corner of the Northeast one-quarter (¼) of the Northwest one-quarter (¼) Section 20, Township 40 South, Range 16 West, Salt Lake Base and Meridian. Said point being North 89° 40' 15" West 1334.16 feet along the section line from the North one-quarter (¼) Corner of said Section 20 and running thence South 00° 11' 38" East 2664.32 feet to the Southwest Corner Southeast one-quarter (¼) of the Northwest one-quarter (¼) of said Section 20, thence South 00° 09' 49" East 1338.03 feet to the Southwest Corner of the Northeast one-quarter (¼) of the Southwest one-quarter (¼) of said Section 20, thence South 89° 49' 17" East 1317.51 feet to the Southeast Corner of the Northeast one-quarter (¼) of the Southwest one-quarter (¼) of said Section 20, thence South 89° 49' 26" East 1318.57 feet to the Southeast Corner of the Northwest one-quarter (¼) of the Southeast one-quarter (¼) of said Section 20, thence 00° 17' 39" East 1341.16 feet to the Northeast Corner of the Northwest one-quarter (¼) of the Southeast one-quarter (¼) of said Section 20, thence North 00° 16' 54" East 1669.38 feet along the 1/16 line to the southwesterly right-of-way line of Utah State Highway #18, thence North 29° 45' 20" West 883.51 feet along said right-of-way, thence South 60° 14' 40" West 420.00 feet to a point of tangency with a 270.32 foot radius curve to the right, thence southwesterly 140.39 feet along the arc of said curve, thence West 1016.42 feet to a point of tangency with a 15.00 foot radius curve to the right, thence northwesterly 23.56 feet along the arc of said curve, thence North 1134.15 feet to a point of tangency with a 425.00 foot radius curve to the right, thence northeasterly 446.87 feet along the arc of said curve, thence North 60° 14' 40" East 510.29 feet to the southwesterly right-of-way of State Highway #18, thence North 29° 45' 20" West 50.00 feet along said right-of-way, thence South 60° 14' 40" West 510.29 feet to a point of tangency with a 475.00 foot radius curve to the left, thence southwesterly 499.45 feet along the arc of said curve, thence South 135.95 feet, thence West 645.65 feet to the west line of the Southeast one-quarter (¼) of the Southwest one-quarter (¼) of Section 17, Township 40 South, Range 16 West, Salt Lake Base and Meridian, thence South 00° 02' 07" East 536.14 feet to the point of beginning containing 231.98 Acres.

do hereby establish the nature of the use and enjoyment of all Lots in Dammeron Valley Meadows, as described above, and do declare that all conveyances of said lots shall be made subject to the following conditions, restrictions and stipulations, to wit;

Entry No. 178382 Recorded at request of Security Title Co.
Date October 15, 1975 at 1:15 P.M. Book 204 Page 290-294 Fee $6.50
Washington County Recorder, Ey _____ Deputy.

ARTICLE II

RESIDENTIAL AREA COVENANTS

1. LAND USE: This land is intended primarily for residential use. The Washington County Commission has zoned the land RA-5: to provide areas for small farms, hobby farms, and agricultural developments. Household pets, raising of crops, horticulture, gardening, stabling of livestock along with their accessory building and uses are permitted.

2. EASEMENT: Easements for installation and maintenance of utilities, drainage facilities and ingress and egress are reserved as shown upon the recorded plat of the above subdivision. If an owner desires to abandon the 25.0' Road and Utility Easement he must do so in conjunction with the adjoining property owners thereby making a total abandonment of the 50.00' easement and said abandonment must be approved by the DAMMERON VALLEY LANDOWNERS ASSOCIATION.

3. BUILDING TYPE: No more than one detached single family dwelling, not to exceed two and one-half stories in height and a private garage and carport for not more than three cars and all buildings and barns as necessary. This does not restrict the provisions of paragraph 9, infra. All fences shall be erected of new material which enhance the appearance of the landscape. Rail or split rail type fences normally associated with ranch settings are approved. All other types of fences require the prior approval of the Board of Trustees prior to their being installed. All buildings shall be set back at least thirty (30) feet from property lines or recorded easements.

178382

4. GARAGE AND REFUSE DISPOSAL: No lot shall be used or maintained as a dumping ground for rubbish. Trash, garbage, rubbish or other waste shall not be kept except in sanitary containers. All incinerators or other equipment for the storage or disposal of such material shall be kept in a clean and sanitary condition. Each lot and its abutting

street are to be kept free of trash, weeds and other refuse by the lot owner. No unsightly materials or other objects are to be stored on any lot in view of the general public. No activity which may become an annoyance or a nuisance to the neighborhood will be allowed.

5. TEMPORARY STRUCTURES: All temporary structures including mobile homes, must be approved by the DAMMERON VALLEY LANDOWNERS ASSOCIATION. Approval will only be given for no greater than one (1) year for purposes of a temporary residence while a permanent residence is being constructed.

6. SIGNS: No sign of any kind shall be displayed to the public view on any lot except (a) one professional sign of not more than one square foot, (b) one sign of not more than five square feet, advertising the property for sale or rent, or (c) signs used by a builder to advertise the property during the construction and sales period.

7. OIL AND MINING OPERATIONS: No oil drilling, oil development operations, oil refining, quarry or mining operations of any kind shall be permitted upon or in any lot.

178382

8. COMMERCIAL ENTERPRISE: No commercial business shall be permitted on any lot in the subdivision without prior approval of the DAMMERON VALLEY LANDOWNERS ASSOCIATION.

9. DIVISION OF LOTS: If any lot owner should desire to divide his property into smaller parcels it must be approved by the DAMMERON VALLEY LANDOWNERS ASSOCIATION and applicable County and State agencies, and must also have the approval of the adjacent property owners and all property owners within three hundred (300) feet of the property line of the property being divided.

ARTICLE III

GENERAL PROVISIONS

1. ARCHITECTURAL CONTROL: No building shall be erected, placed or altered on any lot without approval of the Board of Trustees of DAMMERON VALLEY LANDOWNERS ASSOCIA-

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TION INC., no fence or wall shall be erected, placed or altered on any lot, and no mobile home will be allowed upon any lot without the approval of the Board of Trustees. The Board of Trustees approval or disapproval as required in these covenants shall be in writing within thirty (30) days after plans and specifications have been submitted.

2. ENFORCEMENT: These covenants shall be binding and inure to the benefit of all present and future owners of the property and they may be enforced by the Board of Trustees or by appropriate action in a Court of Law. If it becomes necessary for an owner or the DAMMERON VALLEY LANDOWNERS ASSOCIATION to enforce these covenants, the party in violation of these covenants shall be responsible for paying all costs of enforcement including a reasonable attorney's fees incurred by the enforcing party.

3. TERMS OF COVENANTS: These covenants are to run with the land and shall be binding on all parties and all persons claiming under them for a period of forty (40) years from the date these Covenants are recorded, after which time said Covenants shall be automatically extended for succession periods of ten (10) years unless an instrument signed by a majority of the then owners of the lots has been recorded, agreeing to change said Covenants in whole or in part.

178382

4. SEVERABILITY: Invalidation of any one of these Covenants by judgment or court order shall in no wise affect any of the other provisions which all remain in full force and effect.

5. ASSIGNMENT OF POWERS: Any and all rights and powers of the Grantor herein contained may be delegated, transferred or assigned. Whenever the Grantor is used herein, it includes assigns or successors in interest of the Grantor.

6. MEMBERSHIP IN CORPORATION: Membership in the DAMMERON VALLEY LANDOWNERS ASSOCIATION, INC., is appurtenant to and shall be an incident of ownership of any lot in

DAMMERON VALLEY MEADOWS SUBDIVISION.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 1st day of September, 1976.

By _____
A. BROOKS PACE, President

By _____
ANDREW B. PACE, Secretary

STATE OF UTAH)
: ss.
COUNTY OF WASHINGTON)

On the 1st day of September, 1976, personally appeared before me A. BROOKS PACE and ANDREW B. PACE, who being by me duly sworn did say, each for himself, that he, the said A. BROOKS PACE is the President, and he, the said ANDREW B. PACE is the Secretary of the Dammeron Corporation, and that the within adn forgoing instrument was signed in behalf of said Corporation by authority of a resolution of its Board of Directors and said A. BROOKS PACE and ANDREW B. PACE each duly acknowledged to me that said Corporation executed the same and that the Seal affixed is the seal of said Corporation.

_____
NOTARY PUBLIC
Residing at St. George, Utah 84770

My Commission Expires:
4-3-77

CLAIRE M. DALTON
NOTARY PUBLIC
STATE OF UTAH

SPRINKLERS, CROP WATER USE, AND IRRIGATION TIME
WASHINGTON COUNTY

Robert W. Hill, Extension Specialist - Irrigation
Vernon Parent, County Agent - Washington County

June 2002 ENGR/BIE/WM/33

Sprinkler irrigation has been an important part of Utah's agricultural production since the early 1950s. About 40% of Utah's 1.3 million irrigated acres are watered with sprinklers, including hand move, wheel move, center pivot and other types. Sprinklers can be a good investment when properly designed, installed, maintained and managed. For every acre-foot of water supplied to an efficient sprinkler system, a farmer can expect to harvest about 1 3/4 tons of alfalfa and 46 bushels of wheat. In contrast, the expected harvest with a typical surface irrigation system (flood or furrow) is less than 1 1/4 tons of alfalfa or about 30 bushels of wheat for each acre-foot of water applied. Sprinklers apply water more efficiently and uniformly than typical surface irrigation systems, thus they produce more yield for each acre-foot of water

Not all water applied by an irrigation system is used by the crop. Some water is lost to deep percolation, evaporation, or runoff. Application efficiency (Ea) is a term that tells how much of the water applied by the system is actually stored in the root zone for crop use. In Utah a typical sprinkler system has an Ea of 70% which means that 70% of the water applied by the sprinkler heads is actually stored in the soil for crop use. The actual Ea depends on how evenly the sprinklers distribute water as well as other factors such as operating pressure, nozzle size and spacing, sprinkler maintenance condition, wind, air temperature and humidity (day versus night), and irrigation scheduling. In Utah, the average efficiency of surface irrigation is less than 50% as compared to the higher sprinkler efficiency values of more than 65% for well managed systems.

SPRINKLER IRRIGATION MANAGEMENT

An efficient sprinkler system is the result of good system design, proper irrigation scheduling and careful operation and timely maintenance.

DESIGN

A well designed sprinkler system applies water uniformly to the soil surface, and is capable of applying enough water to meet the peak demands of the crop without producing excess runoff. Good design considers such factors as pressure, nozzle size and spacing; wind, air temperature and humidity (day versus night); soil intake rate; crop rooting depth and water use rates.

The flow rate from a sprinkler nozzle depends upon nozzle size and water pressure. Flow rates for selected nozzle sizes and pressures are given in Table 1. Typical sprinkler flow rates may vary from 4 gallons per minute (gpm) from a 5/32-inch nozzle at 30 pounds pressure to over 11 gpm from a 7/32-inch nozzle at 70 pounds pressure. The nozzle size is usually stamped on the side of the nozzle. Wheelmove systems typically have 3/16-inch nozzles.

On sloping fields there may be considerable pressure differences between sprinkler heads on high and low ends of the line. In this situation, flow control nozzles may be used to improve the uniformity of water application. Flow control nozzles apply water at nearly the same rate when operated within the rated pressure range of the nozzle.

Precipitation Rate (How hard is it raining?):

The Precipitation Rate (Pr) is the rate at which water is delivered from the nozzle, averaged as inches per hour, over the area covered by one nozzle. It is important to consider the Pr when designing a sprinkler system, since water will run off if applied faster than the soil can absorb it. Precipitation rate can be calculated using the following formula:

$$\text{Pr (inches/hr)} = 96.3 \times \text{nozzle flow rate (gpm)/area covered (ft}^2\text{)} \quad (1)$$

Table 1. Sprinkler Pressure and Flow Rate.

Nozzle size	Nozzle Pressure, psi 30	40	50	60	70
Inch	Nozzle flow rate, gallons per minute (gpm)				
5/32	3.9	4.5	5.0	5.4	5.8
11/64	4.7	5.4	6.0	6.6	7.1
3/16	5.5	6.3	7.0	7.7	8.3
13/64	6.4	7.4	8.2	9.0	9.7
7/32	7.4	8.6	9.6	10.5	11.3

Note: Flow rates are for agricultural sprinkler heads with brass nozzles. Sprinkler nozzle flow rate is proportional to the square root of the water pressure at the base of the nozzle, thus doubling the pressure does not double the flow rate.

Precipitation rate can be calculated as follows: In a typical wheelmove system, each sprinkler covers 2400 square feet. This is based on a spacing of 40 feet between sprinklers on the line, and a 60 foot move (40' × 60' = 2400 square feet). With 3/16 inch nozzles that are operating at 50 pounds pressure, the nozzle flow rate is 7.0 gpm (from Table 1). The precipitation rate would be:

$$Pr = 96.3\ (7.0\ gpm)/2400\ ft^2 = 0.28\ inches\ per\ hour$$

Application Rate (How much of the rain stays in the soil?):

The Application Rate (Ar) is the average rate at which water is stored in the soil, in inches per hour.

$$Ar = Application\ Efficiency\ (Ea) \times Precipitation\ rate\ (Pr) \qquad (2)$$

Typical sprinkler application efficiency values vary from 60% to 80%, with 70% a reasonable average.

Example:

$Ar = (70/100) \times 0.28 \cong 0.20$ inches per hour

How Long to Irrigate (Duration):

The duration of irrigation needed to store the crop irrigation requirement (evapotranspiration, Et) in the root zone is:

$$Irrigation\ Duration\ (hours) = Crop\ Irrigation\ requirement\ (inches)/Ar \qquad (3)$$

***Example*:** Determine how many hours to irrigate in July. Assume a crop irrigation requirement (Et) of 8.5 inches, 3/16 inch diameter nozzles operated at 50 psi and 40' × 60' spacing (use results of previous examples).

Hours to irrigate in July = 8.5 inches/ 0.20 inches/hour ≅ 43 hours
Assuming that the sprinklers were moved twice per day (11 ½ hour sets) then about four irrigations (4 ≅ 43/11.5) are needed in July. This is equivalent to one 11 ½ hour irrigation about every 8 days [8 ≅ 31/(43/11.5)].

Calculated irrigation duration for nozzle sizes of 5/32 to 7/32 and pressures of 50 and 60 psi are given in Table 2. The durations shown in Table 2 were obtained from the use of Table 1 and Equations 1, 2, and 3, assuming sprinkler spacing of 40' by 60' and 70% application efficiency. The Table 2 duration value corresponding to the above example is 43.2 hours, which is found at the intersection under the 3/16 nozzle, 50 psi column and the 8.5 inches of water required row. Crop water use estimates for Utah are given in Hill (1994).

IRRIGATION SCHEDULING

Irrigation scheduling is the process of determining when to irrigate and how much water to apply. It depends upon design, maintenance, and operation of the irrigation system and the

availability of water. The objective of irrigation scheduling is to apply only the water that the crop needs, taking into account evaporation, seepage, runoff losses, and leaching requirements. Scheduling is especially important to pump irrigators if power costs are high. Common irrigation scheduling approaches include the following:

1. Irrigation on fixed intervals or following a simple calendar, i.e., when a water turn occurs or according to a predetermined schedule.
2. Irrigating when the neighbor irrigates.
3. Observation of visual plant stress indicators.
4. Measuring (or estimating) soil water by use of instruments or sampling techniques such as probes.
5. Following a soil-water budget based on weather data and/or pan evaporation.
6. Some combination of the above.

Table 2. Required Irrigation Duration for Selected Irrigation Water Requirement Values.

Irrigation	**Nozzle size, inches**									
Water	5/32		11/64		3/16		13/64		7/32	
Req'd,	Pressure psi									
inches	50	60	50	60	50	60	50	60	50	60
	Irrigation Duration, Hours									
0.5	3.6	3.3	3.0	2.7	2.5	2.3	2.2	2.0	1.9	1.7
1.0	7.1	6.6	5.9	5.4	5.1	4.6	4.3	4.0	3.7	3.4
1.5	10.7	9.9	8.9	8.1	7.6	6.9	6.5	5.9	5.6	5.1
2.0	14.2	13.2	11.9	10.8	10.2	9.2	8.7	7.9	7.4	6.8
2.5	17.8	16.5	14.8	13.5	12.7	11.6	10.9	9.9	9.3	8.5
3.0	21.4	19.8	17.8	16.2	15.3	13.9	13.0	11.9	11.1	10.2
3.5	24.9	23.1	20.8	18.9	17.8	16.2	15.2	13.8	13.0	11.9
4.0	28.5	26.4	23.7	21.6	20.3	18.5	17.4	15.8	14.8	13.6
4.5	32.0	29.7	26.7	24.3	22.9	20.8	19.5	17.8	16.7	15.3
5.0	35.6	33.0	29.7	27.0	25.4	23.1	21.7	19.8	18.5	17.0
5.5	39.2	36.3	32.6	29.7	28.0	25.4	23.9	21.8	20.4	18.6
6.0	42.7	39.6	35.6	32.4	30.5	27.7	26.1	23.7	22.3	20.3
6.5	46.3	42.9	38.6	35.1	33.1	30.1	28.2	25.7	24.1	22.0
7.0	49.8	46.2	41.5	37.8	35.6	32.4	30.4	27.7	26.0	23.7
7.5	53.4	49.4	44.5	40.5	38.1	34.7	32.6	29.7	27.8	25.4
8.0	57.0	52.7	47.5	43.2	40.7	37.0	34.7	31.6	29.7	27.1
8.5	60.5	56.0	50.4	45.9	43.2	39.3	36.9	33.6	31.5	28.8
9.0	64.1	59.3	53.4	48.5	45.8	41.6	39.1	35.6	33.4	30.5
9.5	67.6	62.6	56.4	51.2	48.3	43.9	41.2	37.6	35.2	32.2

Note: Irrigation duration, hours, calculated from flow rate in Table 1 and from Equations (1), (2), and (3) assuming sprinkler spacing of 40' by 60' and 70% application efficiency. Irrigation water required is equivalent to crop evapotranspiration, if rainfall is ignored (see Table 3).

For irrigation scheduling to be most useful at a specific location, the following should be done:

1. Evaluate the irrigation system. Determine application depth, efficiency, and operating capabilities and constraints.
2. Select an appropriate irrigation scheduling method.
3. Monitor performance at intervals during the growing season.
4. Perform a post-season evaluation and determine changes for next year.

OPERATION AND MAINTENANCE

To realize the full benefit of the sprinkler system, it must be operated according to design and properly maintained throughout the irrigation season. This may involve special operating techniques such as using an offset hose or alternating between day and night on successive irrigation cycles to improve distribution uniformity. Where pressure differences within a sprinkler system result in low uniformity of water application, special hardware such as flow control nozzles or pressure regulators may be required.

An audit or evaluation of the irrigation system is recommended if you suspect that the system is not as efficient as it should be. An audit determines application depth, distribution uniformity, and hydraulic performance of the supply system. If a pump is used, it is tested to determine fuel or energy use efficiency. An audit may also identify steps to improve system operation and maintenance.

Good operation also includes matching the set time (or rotation time with a center pivot) with the applied irrigation water depth and application rate to maximize the fraction of water stored in the root zone. Field irrigation (application) efficiency is the ratio of water stored in the root zone divided by the water delivered to the field. For example, if 50 acre inches of water are delivered to a 10 acre field during an irrigation and 30 acre inches are stored in the root zone, then the application efficiency (Ea) is 60% (60 = 100 × 30/50). If a field is under-irrigated, a high irrigation efficiency could result with a low uniformity. Conversely, an over-irrigated field will have a low irrigation efficiency, regardless of the high uniformity, because of the deep percolation. Thus, a knowledge of the soil moisture content prior to irrigation is essential to maintaining a high application efficiency while providing for optimum crop water use and growth.

CROP WATER USE

The single most important factor influencing plant growth and crop yields is soil water availability. A good understanding of how water influences crop growth is essential for good water management. Water is the most massive of the inputs to crop yield. It takes 120 pounds of water (evapotranspiration only) to produce 1 pound of potatoes, 560 pounds of water for 1 pound of alfalfa hay and 790 pounds of water for 1 pound of wheat.

Soil water availability is affected by infiltrated irrigation water and rainfall, drainage and evapotranspiration. The crop irrigation requirement, or evapotranspiration (Et), is the combination of transpiration from plant leaves plus evaporation from adjacent soil surfaces. While crop Et can be measured, it is most often estimated with equations from weather data collected locally. Estimated average monthly crop water use (Et) for alfalfa, pasture, spring grain, turf, corn, and garden in La Verkin, St. George, and Veyo are given in Table 3. Seasonal Et is higher in St. George than in Veyo for all crops except small grains. Monthly rates do very between all three sites depending on the growing season of the crop.

Assuming that the soil water depletion is completely replenished with each irrigation, the irrigation requirement is equal to Et minus effective rainfall. As a general rule, field crops should be irrigated whenever the soil water depletion approaches 50% of the available water in the root zone (see Appendix). This minimizes crop stress and keeps yields high. In the peak crop water use period in an arid area, the occurrence of rain is often neglected in determining an irrigation schedule.

Table 3. Monthly Crop Evapotranspiration for La Verkin, St. George, and Veyo Power House. Thirty year average for period 1961 - 1990.

Site	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Season Total
Alfalfa Water Use, Inches											
La Verkin		1.86	4.86	6.24	7.16	8.05	7.40	5.23	2.58		43.38
St. George		2.47	4.65	7.24	8.14	8.27	7.26	5.45	3.21	0.38	47.06
Veyo P.H.		0.35	3.89	6.76	7.25	7.09	6.35	5.38	1.27		38.34
Garden Water Use, Inches											
La Verkin			0.05	1.91	4.33	7.36	4.13	1.20	0.12		19.09
St. George		0.45	1.57	4.15	7.85	6.95	2.03	1.31	0.54		24.84
Veyo P.H.			1.34	3.49	7.35	6.69	1.92	1.22	0.40		22.43
Orchard Water Use, Inches											
La Verkin		0.73	3.05	7.07	10.32	11.74	9.11	5.84	1.10		48.96
St. George		0.81	3.50	8.13	11.09	12.19	9.38	5.56			50.65
Veyo P.H.			1.60	5.18	9.01	10.28	8.50	5.99	0.55		41.11
Pasture Water Use, Inches											
La Verkin		1.85	3.32	5.15	6.34	7.01	5.52	3.98	2.40	0.23	35.80
St. George	0.12	2.26	3.59	5.61	6.68	7.28	5.82	4.25	2.50	0.80	38.89
Veyo P.H.		0.61	2.93	4.61	5.94	6.16	5.08	3.77	1.67		30.77
Sp Grain Water Use, Inches											
La Verkin	0.45	2.34	5.01	7.72	2.72						18.24
St. George	0.49	2.50	5.39	8.40	2.87						19.65
Veyo P.H.		0.22	2.03	6.78	8.89	2.89					20.82
Turf Water Use, Inches											
La Verkin		1.98	2.87	4.44	5.46	6.03	4.75	3.43	2.07	0.19	31.24
St. George	0.12	2.21	3.09	4.83	5.75	6.27	5.01	3.66	2.15	0.69	33.79
Veyo P.H.		0.86	2.60	3.97	5.12	5.31	4.38	3.25	1.44		26.93

Adapted from: Consumptive Use of Irrigated Crops in Utah, Utah Agricultural Experiment Station Research Report No. 145. Oct. 1994.

CALCULATING AN IRRIGATION INTERVAL

The information needed to determine the interval between irrigations is available soil water in the root zone, crop water use (Et) rate (inches per day), and allowable soil water depletion at irrigation. Conversely, the irrigation system applied water depth (if fixed for all irrigations) could be used in place of the allowable depletion.

Example A: Simple Irrigation Calendar. Determine the irrigation interval and application depth for alfalfa on sandy loam at St. George. Use July Et and a root depth of 5 ft. Irrigate when one half of the available soil water has been depleted, i.e., when the management allowed depletion (MAD) is 50%.

From Table 3, July Alfalfa Et at St. George is 8.27 inches.
Average daily Et rate = 8.27 inches/31 days = 0.27 inches/day.

Soil water holding capacity (sandy loam) is1.5 inches/ft (from Appendix).
Root zone available water = 5 ft × 1.5 inches of water/ft = 7.5 inches of water.

At a MAD of 50% depletion between irrigations, the irrigation amount is 7.5 × .5 = 3.8 inches for each irrigation.
Irrigation interval = Irrigation amount/daily Et rate = 3.8 inches/0.28 inches per day ≅ 14 days.

Summary: Irrigate every 14 days, storing 3.8 inches of irrigation water in the root zone.

Example B: Alternate irrigation interval if wheelmove sprinklers are moved twice per day. Assume 3/16 inch nozzles at 50 psi and 40 ft by 60 ft spacing (see examples with Equations 1, 2, and 3 previously), and the same situation as in Example A above.

The net irrigation is 2.3 inches stored in the soil (2.3 inches = an application rate of 0.20 inches per hour x 11.5 hours per set).
The irrigation interval = 2.3 inches/0.27 inches per day = about 8 1/2 days.

Summary: Irrigate every 8 days, storing 2.3 inches of irrigation water in the root zone.

Both of these examples use the average daily Et rate for the month to illustrate the calculations. If a real time soil water budget method of irrigation scheduling were used, it would account for the day to day variations in Et and rain. This would result in varying the irrigation interval as needed.

SUMMARY

Good sprinkle irrigation requires:

- Understanding of Soil-Water-Plant Relationships
- Proper irrigation timing and amount depends on soil water holding capacity, weather, and crop growth progress
- Adequate Design and Installation
- Proper Operation and Maintenance

- Dedication and Commitment of Resources to Manage (i.e., the ***WILL*** to manage)

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APPENDIX

Available Water-holding Capacity of Soils

Soil Texture	Inches of available water per foot of moist soil	Permeability rate[1] Inches/Hour
Sands and fine sands	0.5 - 0.75	1.0 - 10
Very fine sands, loamy sand	.8 - 1.0	1.0 - 3
Sandy Loam	1.2 - 1.5	0.5 - 3
Loam	1.9 - 2.0	0.3 - 0.8
Silt loam, silt	2.0	0.2 - 0.4
Silty clay loam	1.9 - 2.0	0.01 - 0.2
Sandy clay loam, Clay loam	1.7 - 2.0	0.1 - 0.6

Typical Crop Rooting Depths

Crop	Typical active root Zone depth, feet
Alfalfa	5
Corn	4 - 5
Small Grains	3 - 4
Dry Beans	3
Pasture	1.5 - 2.5
Potatoes	2 - 3
Turf	1 - 2
Vegetables	1.5 - 3

Note: Allowable depletion to avoid crop water stress is usually about 50% of available water holding capacity for most field crops.

[1]Normal ranges. Intake rates vary greatly with soil structure and structural stability.

The web site address for "Consumptive Use of Irrigated Crops in Utah," UAES Research Report #145, and the data tables used in Table 3 herein is found by going to the Utah Division of Water Rights home page at: http://nrwrtl.nr.state.ut.us/

Then select "Publications" and then select "Consumptive Use Tables."

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For additional reading/resource material see:

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MSU Agronomy Notes Series numbers 44, 47, 49, 53, 102, and 122. J.W. Bauder. Soil and Water Specialist; Plant, Soils and Environmental Science Department, Montana State University, Bozeman, MT 59717. Telephone (406) 944-5685; email: jbauder@montana.edu.

Pacific Northwest Extension Publication, PNW Series numbers 286-292. Jan. 1986. Available from University of Idaho Cooperative Extension Service, Moscow, ID 83843. Titles in this series include: *Pumping Plant Efficiencies, Offsets for Stationary Sprinkler Systems, Irrigation Runoff Control Strategies, Irrigation Scheduling, Converting Sprinkler Systems to Lower Pressure, Sizing Irrigation Mainlines and Fittings, Electrical Demand Charges-How to Keep them Low, Extending Electric Motor Life.*

Additional information on wheel move sprinkler management is available on the Utah State University web site at:

http://extension.usu.edu/publica/engrpub2.htm

BIE/WM-05 "Maintenance of Wheelmove Irrigation Systems"
BIE/WM-08 "Wheelmove Sprinkler Irrigation Operation and Management"

WHERE CAN YOU GET HELP?

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