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DISTRICT COURT-SRBA
TWIN FALLS CO., IDAHO
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REPORT REGARDING CONSUMPTIVE USE IN THE HAGERMAN AREA

In Re SRBA

Twin Falls County Civil Case No. 39576

Sub-Case Nos.: See Attachment A

36-31A
etal.

Report to the SRBA District Court

Prepared by the Idaho Department of Water Resources

Karl J. Dreher, Director

David B. Shaw, Adjudication Bureau Chief

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July 1, 1996

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REPORT REGARDING CONSUMPTIVE USE IN THE HAGERMAN AREA

INTRODUCTION

The purpose of this report is to describe the Idaho Department of Water Resources' (IDWR) methodology for computing irrigation consumptive uses in the Hagerman area. The general description of methods for computing irrigation consumptive use is provided in IDWR's Report Regarding Evaluation of Irrigation Diversion Rates. This report on consumptive uses in the Hagerman area serves to augment and expand on information relative to the consumptive use analysis. The estimate has been refined based on the availability of additional information regarding the climate of the area, and development of a procedure for utilization of that information to revise the Hagerman estimate.

DEFINITION OF TERMS

Evapotranspiration (ET). The combination of water transpired from vegetation and evaporated from the soil and plant surfaces.¹

Consumptive Use (CU). This term has both a technical definition and a statutory definition, as follows:

Technical Definition: The amount of water transpired by an actively growing or photosynthesizing plant plus water evaporated from soil and foliage in the area occupied by the growing plant. Consumptive use includes water incorporated into plant tissue, but this amount is minor so the term is normally used interchangeably with evapotranspiration (ET).²

Statutory Definition:³ The amount of water that does not remain in the water system after use or is not returned to the water system through return flows or seepage... for an irrigation water right [consumptive use] shall be based upon the most water consumptive crop that can be grown in the area during the period of the year when water is used for irrigation.

Units for consumptive use for irrigation are usually expressed in acre-feet per year per acre (AFY per acre).

¹ Soil and Water Engineering Terminology, p. 708.

² Wright, p. 663.

³ Section 42-1401A(2), Idaho Code.

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Consumptive Irrigation Requirement (CIR). The amount of water required for consumptive use that is artificially applied to the soil through irrigation, expressed in units of irrigation depth per season.⁴

Effective Precipitation (EP). The amount of water provided by precipitation which is capable of satisfying a part of the consumptive use, expressed in units of depth per season.⁵

National Oceanic and Atmospheric Administration (NOAA). An agency of the United States Government responsible for collection and reporting of atmospheric data.⁶

FAO Blaney-Criddle. A variation of the Blaney-Criddle methodology⁷ for the estimation of consumptive use, developed under the auspices of the Food and Agricultural Organization of the United Nations.⁸

DISCUSSION OF DIFFERENCES BETWEEN DEFINITIONS

Technical literature considers the consumptive use (CU) for irrigated cropland to be provided by two components, irrigation and precipitation.⁹ Measurements of quantities of water required for growing crops typically identify the total CU, without specifying whether this amount is provided by irrigation or by precipitation.¹⁰

On the other hand, the CU for irrigation as defined by Idaho statute, and thus the CU reported by IDWR for the recommendations of water rights, is the amount of water that must be provided by the irrigation system. This amount is technically the consumptive irrigation requirement (CIR), which is computed by subtracting the effective precipitation (EP) from the evapotranspiration (ET). For clarity in this report,

⁴ Sutter, R.J and G.L. Corey, p. 1.

⁵ Ibid., p.1.

⁶ Allen, R.G. and C.E. Brockway, p.10.

⁷ Blaney, H.F. and W.D. Criddle, p.1.

⁸ Doorenbos, J. and W.O. Pruitt, p. 1.

⁹ Sutter and Corey, p. 1.

¹⁰ Confirmed in personal communication with Dr. James L. Wright of the USDA Agricultural Research Service on June 27, 1996.

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the two types of consumptive use will be assigned subscripts, as follows:

$$CU_T = \text{Technical Consumptive Use} = ET$$

$$CU_s = \text{Statutory Consumptive Use} = ET - EP = CIR$$

BACKGROUND

The computation of irrigation consumptive uses in Idaho has been refined through the decades. An initial basis for computation of consumptive water uses was provided in a 1970 publication prepared by Corey and Sutter entitled "Consumptive Irrigation for Crops in Idaho." This study applied the SCS-Modified Blaney-Criddle Method to data obtained at forty-two weather stations in or near Idaho to compute consumptive uses (CU_T) and consumptive irrigation requirements (CIR) (equivalent to CU_s). These values were reported as functions of crops and months for various frequencies of occurrence.

In 1983, R.G. Allen and C.E. Brockway reported updated consumptive use estimates. In this study Allen and Brockway found that the FAO Blaney-Criddle method provided a more accurate prediction of the consumptive use of alfalfa hay, winter and spring grain and corn at Kimberly than had been achieved via the SCS-Modified Blaney-Criddle method. Thus the FAO Blaney-Criddle technique was utilized to compute monthly values for CU_T and CIR for twelve crops at 98 stations across the state.¹¹

Initiation of the Snake River Basin Adjudication prompted additional research in this arena by IDWR. Review of existing data resulted in the creation of reference maps which contain information regarding consumptive irrigation requirements, irrigation field headgate requirements, and irrigation seasons of use. The methodology used in creating these documents is included in a memorandum by Peppersack (1991). While the methodology identified in the Peppersack memorandum is still considered to be valid for most of the state, there are likely some locations where micro-climates will result in exceptions to the state-wide mapped values. Thus, IDWR anticipates the potential of reviewing certain areas as candidates for exceptions. Also, IDWR has contracted with Dr. C.E. Brockway via the Idaho Water Resources Research Institute and the University of Idaho to revise, update and publish the FAO Blaney-Criddle estimates throughout the state. This work is anticipated to be completed in 1997.

¹¹ The page from this report for the Bliss station used in this analysis is attached as Appendix A.

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Water users in the Hagerman area raised concerns that amounts of water initially recommended by IDWR were insufficient. These concerns resulted in the preparation of a study for Hagerman Water Right Owners Association by the University of Idaho (Hazen, et al, 1992). This study focused on rate of flow rather than annual volumes, and did not specifically identify a suggested modification of annual ET. However, research conducted by IDWR in response to this study resulted in a determination that additional ET evaluations relative to the Hagerman area were warranted.

FAO BLANEY-CRIDDLE METHODOLOGY

An alternative method for computing ET in the Hagerman area was suggested by Dr. C.E. Brockway in a meeting with IDWR staff on April 17, 1996. This method, which is described in a memorandum authored by Dr. Brockway and attached as Appendix B, consists of the following steps to determine irrigation consumptive use:

- a. Use a calibrated FAO Blaney-Criddle procedure for the nearest NOAA station.
- b. If the site has adequate temperature data (3 years +), adjust ET data from the nearest NOAA station based on March, April and May temperature differences.
- c. Adjust the predicted ET for altitude differences (+ 10% for each 1000 meters of elevation decrease).¹²
- d. Calculate ET for the selected risk level using published standard deviations for the NOAA site. (This step is applicable for the use of ET for diversion rate computations, but is beyond the scope of and is not necessary for the present analysis.)
- e. Adjust monthly ET for peak/mean CU ratio. (This step also is applicable for the use of ET for diversion rate computations, but is beyond the scope of and is not necessary for the present analysis.)

This proposed methodology was determined to be reasonable because the FAO Blaney-Criddle method used in the Allen and Brockway report is primarily temperature dependent, and adequate data for this analysis are available for this parameter. Temperature adjustments are based on published sensitivity analysis of ET estimation

¹² This suggested correction factor is based on a finding by J. Doorenbos and W.O. Pruitt, p.4.

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methods prepared by Brockway, et al (1985).

The 1983 Allen and Brockway ET estimates were based on actual mean monthly air temperature data from each location and secondary weather parameters from regional data. Regional secondary parameters were used because the data are only available at limited sites in Idaho. Since the estimates are primarily temperature dependent within a climatic region, adjustments for nearby stations based on temperature differences should give reasonable results. Temperature differences are based on springtime average temperature differences to avoid the effects of station aridity.¹³

APPLICATION OF FAO BLANEY-CRIDDLE METHODOLOGY

The procedure suggested by Dr. Brockway was conducted with the following results:

- a. The nearest NOAA station, which was selected for this analysis, is the station located at Bliss.
- b. Temperature data for Bliss and the Hagerman area which had been acquired from the University of Idaho were analyzed.¹⁴ These data were augmented with direct comparisons of temperature data for the months of March through May for five specific years.¹⁵ The determination of a temperature increase of 1.6 degrees Fahrenheit in Hagerman as compared with Bliss results in an increase of ET with percentages varying monthly.¹⁶
- c. The elevation difference between Bliss and Hagerman is -405 feet (-123.4 meters), resulting in a correction factor of + 1.234 percent.
- d. Monthly summary corrections to ET based on temperature and elevation differences are provided in Appendix G. For purposes of computing ET, only the 50th percentile of exceedence, or long-term average, value is used. Note that based on

¹³ Station aridity can effect ET estimates due to increased air temperature measurements at arid sites versus measurements over irrigated lands. The effects are least significant in the spring.

¹⁴ Appendix C contains climatological summary data for Bliss, and Appendix D contains corresponding data for Hagerman.

¹⁵ Appendix E contains the results of these comparisons.

¹⁶ Appendix F contains the monthly adjustments to the Hagerman ET resulting from temperature corrections.

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these data, pasture is found to be slightly more consumptive than alfalfa, so pasture is used as the reference standard. After adjustments for temperature and elevation are tabulated, the estimated ET is 1116 mm (equal to 43.9 inches or 3.66 feet) per season, resulting in a CU_T of 3.66 AFY per acre.

Computation of effective precipitation, EP, can be complex. As shown in Appendix C, the average annual precipitation at Bliss for the period from 1918 - 1989 was 9.4 inches. Appendix D demonstrates that the average precipitation at Hagerman from 1982 - 1990 was 10.94 inches. Thus, the EP at Hagerman is assumed to be the same as for Bliss. This value for the irrigation season was shown to be 76 mm (equal to 2.99 inches or 0.25 feet) in the 1983 Allen and Brockway study.

For purposes of recommending a CU_s to the court for irrigation water rights in the Hagerman area,

$$\begin{aligned} CU_s &= \text{Statutory Consumptive Use} = ET - EP = CIR \\ &= 3.66 \text{ feet/year} - 0.25 \text{ feet/year} = 3.41 \text{ feet/year} \end{aligned}$$

IDWR has historically rounded irrigation consumptive use to the nearest half foot, so the recommendation in this instance would be that the value for CU_s in the Hagerman area is 3.5 AFY per acre.

YIELD OF IRRIGATED ALFALFA METHODOLOGY

Water users in the Hagerman area contracted with Dr. Brockway to obtain an estimate of ET for the Hagerman area.¹⁷ Based on his review, Dr. Brockway selected a study prepared by Dr. James L. Wright which was published in 1988. The study establishes a relationship between CU_T and the yield of irrigated alfalfa. Application of the study to the Hagerman area by Dr. Brockway resulted in his determination that if the annual yield of irrigated alfalfa is 10 tons per acre as was indicated by two local growers¹⁸,

¹⁷ Documentation for this analysis is found in the Affidavit of Charles E. Brockway, Ph. D. with attachments, provided to the Court as an attachment to the Brief in Support of Summary Judgement, submitted by Patrick D. Brown on May 31, 1996.

¹⁸ Affidavits alleging this amount of harvest were provided to the Court by Mr. John W. Jones, Jr. and Mr. Dan McFadden as attachments to the Brief in Support of Summary Judgement, Ibid. The potential to achieve alfalfa yields of this magnitude in the Hagerman area was confirmed by personal communication with Mr. Bob Vodraska, Twin Falls County Extension Agent, on June 27, 1996.

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then the consumptive use, CU_T or ET , is 3.75 AFY per acre.

As shown above, the anticipated effective precipitation in the study area is 0.25 feet per year, so the consumptive irrigation requirement, or CU_s , based on an ET of 3.75 AFY per acre is 3.5 AFY per acre. Thus, this consumptive use computation is consistent with the results of the FAO Blaney-Criddle Method.

It is interesting to note that the 1988 Wright report indicates that the estimate of ET found in his study (977 mm/year) was nearly 50 percent greater than the amount estimated by Sutter and Corey in 1970 (646 mm/year).¹⁹ This report does not reference the updated work reported by Brockway and Allen in 1983 which found the consumptive use to be 967 mm/year, because the Brockway and Allen report utilizes the same calibration data as used in the Wright report.²⁰

Both methodologies should provide similar outcomes if input data are accurate and consistent. However, to achieve widespread computation of consumptive use values, the FAO Blaney-Criddle method is the more practical technique for use by IDWR. The reasons for utilizing the FAO Blaney-Criddle method are included in the 1983 Allen and Brockway report, and are anticipated to be expanded in the 1997 report.

CONCLUSIONS

IDWR has spent significant effort developing methodologies for computing consumptive uses for irrigation around the state. However, climatic areas are broadly defined and some exceptions with distinct micro-climates might be encountered. Further analysis of the Hagerman area demonstrates that this area appears to qualify in this category, and IDWR can support an upgrade of the CU_s for the Hagerman area from 3.0 AFY per acre to **3.5 AFY per acre**.

The findings in this regard are consistent with the analysis of the FAO Blaney-Criddle method and an alternate method based on yield of irrigated alfalfa. As described in this report, the primary difference between the recommendation of Dr. Brockway via the alfalfa yield method and the application of the FAO Blaney-Criddle method is the difference in definition of consumptive use. Dr. Brockway's analysis concluded that the CU_T including effective precipitation (ET) is estimated to be 3.75 AFY per acre. By subtracting the ET of 0.25 feet per year, his recommendation is equivalent to a

¹⁹ Wright, p. 668.

²⁰ Personal communication with Dr. James L. Wright of the USDA Agricultural Research Service on June 27, 1996.

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CU_s of 3.5 AFY per acre. The revised amount recommended by the FAO Blaney-Criddle method is 3.41 AFY per acre, which is rounded by IDWR to 3.5 AFY per acre. The similarity in outcome between the two methods serves to substantiate the validity of the estimate procedures.

IDWR will continue to improve and adjust the prediction of consumptive use based on the results of the revision of the 1983 Allen and Brockway report that is presently under contract and is anticipated to be completed next year. Technical advances and the extensions of data records at weather stations across the state should improve predictive capabilities regarding water needs.

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LIST OF APPENDICES

- Appendix A - Data for the Bliss Station, Estimated CU and CIR, (Allen & Brockway, 1983)
- Appendix B - Proposed Approach for Computing Monthly Estimates for ET in the Hagerman Valley, presented by Dr. Charles Brockway, April 16, 1996
- Appendix C - Temperature and Precipitation Records for Bliss, Climatological Summary for 1918 - 1989
- Appendix D - Temperature and Precipitation Records for Hagerman, Climatological Summary for 1982 - 1990
- Appendix E - Selected Yearly Comparisons of Temperature Between Bliss and Hagerman
- Appendix F - ET Adjustments based on Temperature Differences Between Bliss and Hagerman
- Appendix G - Monthly Estimates for ET in the Hagerman Valley, based on the Approach Outlined in Appendix B

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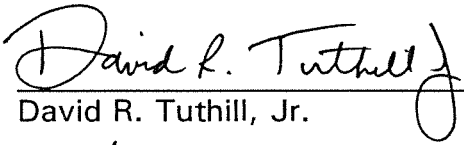
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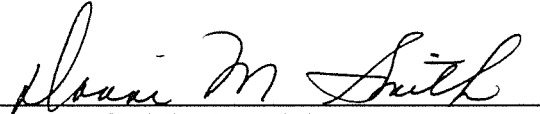
State of Idaho)
) ss.
County of Ada)

David R. Tuthill, Jr., being first duly sworn, upon oath, deposes and says:

That I am the Acting Adjudication Bureau Chief for IDWR, that I have prepared the foregoing report, know its contents, and that the statements contained therein are true to the best of my knowledge and belief.


David R. Tuthill, Jr.

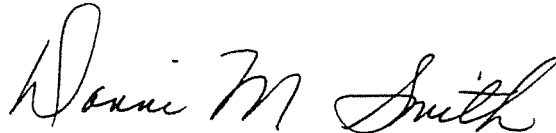
Subscribed and sworn to before me this 1st day of July, 1996.


Notary Public for Idaho
Residing at: Bouse
My commission expires: 12-5-2000

Certificate of Mailing

I certify that on the 1st day of July, 1996, I hand delivered copies of the foregoing document, including all attachments to the following:

Patrick D. Brown
P.O. Box 389
Twin Falls, ID 83303-0389


Person delivering documents

Est. CU and CIR.		BISS		(Allen & Brockway, 1983) mm/day and mm/season											
MO	NYRS	PREC	ETR	ALFH.	BEANS	F.CRN	SILGE	S.CRN	PEAS	POTAT	SBEET	SGRAN	WGRAN	PAST.	VEGES
AVE ET	3	46	.87	2.14											.98
AVE IR	3	46100.00													.56
STDD ET	3	46	.68	.35											.16
STDD IR	3	46100.00													.34
STDD ET	3	46	1.44	-.00											-.00
STDD IR	3	46100.00													-1.26
AVE ET	4	47	.72	5.28	3.30	2.04	2.04	2.04	1.60	1.58	1.58	1.65	4.82	3.27	
AVE IR	4	47100.00			2.86	1.59	1.59	1.59	1.25	1.20	1.20	1.31	4.37	2.85	
STDD ET	4	47	.59	.47	.29	.15	.15	.15	.14	.14	.14	.15	.43	.29	
STDD IR	4	47100.00			.57	.43	.43	.43	.39	.34	.34	.38	.69	.55	
STDD ET	4	47	1.18	.20	.20	.20	.24	.24	.20	.20	.20	.20	.20	.20	
STDD IR	4	47100.00			-.39	-.72	-.74	-.74	-.61	-.54	-.65	-.59	-.22	-.38	
AVE ET	5	47	.87	6.79	6.29	2.04	2.04	2.04	3.85	2.19	2.04	5.11	6.79	5.23	2.07
AVE IR	5	4795.74			5.68	1.59	1.59	1.59	3.39	1.85	1.59	4.62	6.20	4.68	1.73
STDD ET	5	47	.65	.49	.46	.15	.15	.15	.28	.16	.15	.27	.49	.38	1.15
STDD IR	5	4795.74			.77	.40	.43	.43	.53	.37	.44	.62	.78	.67	.36
STDD ET	5	47	1.16	.24	-.24	-.24	-.24	-.24	-.24	-.24	-.24	-.24	-.24	-.24	-.24
STDD IR	5	4795.74			-.42	-.72	-.74	-.74	-.53	-.65	-.75	-.42	-.36	-.46	-.67
AVE ET	6	47	.84	8.41	7.32	3.26	3.66	3.66	6.82	5.77	3.91	8.39	8.41	6.47	4.40
AVE IR	6	4791.49			6.72	2.86	3.20	3.20	6.30	5.36	3.43	7.83	7.81	5.92	4.03
STDD ET	6	47	.82	.47	.41	.18	.21	.21	.38	.32	.22	.47	.47	.36	.25
STDD IR	6	4791.49			.89	.33	.61	.61	.78	.63	.63	.89	.93	.80	.54
STDD ET	6	47	.99	.64	-.31	-.63	.63	.63	.61	.64	.62	.62	.64	.63	.62
STDD IR	6	4791.49			-.31	-.55	-.56	-.56	-.25	-.20	-.55	-.15	-.21	-.33	-.33
AVE ET	7	47	.30	8.54	6.94	7.37	7.68	7.68	2.89	7.17	8.14	7.05	6.80	6.57	6.57
AVE IR	7	4772.34			6.79	2.24	7.53	7.53	2.89	7.06	7.98	6.92	6.67	6.44	6.40
STDD ET	7	47	.32	.26	.21	.23	.24	.24	.09	.22	.25	.34	.21	.20	.20
STDD IR	7	4772.34			.37	.35	.38	.38	.21	.32	.40	.54	.35	.34	.34
STDD ET	7	47	2.40	.05	-.02	-.03	-.04	-.04	.03	.02	.11	.02	.04	.02	.03
STDD IR	7	4772.34			-1.55	-1.32	-1.44	-1.44	-2.06	-1.17	-1.44	-1.35	-1.48	-1.54	-1.22
AVE ET	8	46	.37	7.18	5.41	4.97	6.63	6.63	5.57	7.06	7.06	1.47	1.32	5.33	5.72
AVE IR	8	4665.22			5.27	2.25	6.48	6.48	5.46	6.32	6.32	1.37	1.32	5.33	5.61
STDD ET	8	46	.60	.33	.25	.23	.30	.30	.26	.26	.32	.07	.06	.55	.26
STDD IR	8	4665.22			.51	.44	.57	.57	.44	.44	.60	.23	.28	.50	.45
STDD ET	8	46	3.27	.24	-2.46	-2.33	-2.22	-2.22	.25	.25	.26	.23	.24	.23	.23
STDD IR	8	4665.22			5.60	3.67	3.67	3.67	-1.98	-1.98	-2.18	-3.38	-3.47	-2.38	-1.95
AVE ET	9	46	.49	5.60	3.67	.77	4.19	4.19	3.29	4.86	4.86	4.32	4.32	3.83	3.83
AVE IR	9	4678.26			.41	.27	.31	.31	3.29	4.36	4.36	4.09	4.09	3.65	3.65
STDD ET	9	46	.60	.41	.27	.06	.06	.06	.24	.24	.24	.32	.32	.28	.28
STDD IR	9	4678.26			-.34	-.49	-.52	-.52	.39	.39	.39	.37	.37	.34	.34
STDD ET	9	46	1.75	-.34	-1.04	-1.75	-.93	-.93	-.34	-.34	-.34	-.34	-.34	-.34	-.34
STDD IR	9	4678.26			3.73	1.26	1.04	1.04	-.88	-.88	-.86	-.91	-.91	-.79	-.79
AVE ET	10	47	.61	3.73	1.26	.96	1.04	1.04	2.17	2.47	2.47	2.88	2.88	2.56	2.56
AVE IR	10	4795.74			.35	.12	.10	.10	.24	.24	.24	2.56	2.56	2.27	2.27
STDD ET	10	47	.61	.35	.12	.39	.36	.36	.48	.48	.48	.51	.51	.43	.43
STDD IR	10	4795.74			-.04	-.04	-.04	-.04	-.04	-.04	-.04	-.04	-.04	-.04	-.04
STDD ET	10	47	1.84	-.04	-1.32	-1.32	-.93	-.93	-.88	-.88	-.86	-.91	-.91	-.79	-.79
STDD IR	10	4795.74			566.	529.	774.	742.	464.	781.	921.	722.	888.	1047.	692.
AVE ET	SE	45	118.5	1457.	1044.	774.	742.	698.	420.	854.	854.	673.	817.	975.	658.
AVE IR	SE	45	0.0	0.	968.	721.	698.	698.	17.	21.	23.	23.	31.	29.	18.
STDD ET	SE	45	42.9	43.	50.	15.	19.	19.	39.	39.	45.	46.	51.	51.	32.
STDD IR	SE	45	0.0	0.	54.	31.	36.	38.	.33	.22	.09	.34	.25	.20	.09
STDD ET	SE	45	.30	.08	.29	.15	.08	.03	.20	.22	.09	.12	.25	.20	.09
STDD IR	SE	45			-.05	-.54	-.30	-.47	-.50	-.26	-.30	-.12	-.12	-.12	-.33

IDWR EXCESS FLOW ANALYSIS SUGGESTED PROCEDURE

C.E. BROCKWAY P.E.

1. Select risk level for ET analysis, ie 20%
- 2 Selection of Applicable ET for site
 - a. Recommend using calibrated FAO Blaney-Criddle procedure for nearest NOAA station
 - 98+ stations in Idaho
 - Temperature driven with regional coefficients which incorporate altitude recognized procedure
 - amenable to adjustment for temperature and altitude
 - b. If site has adequate temperature data (3 years +) adjust nearest NOAA station ET for average March, April, May temperature differences; if not don't adjust
Use ET/temperature sensitivity analysis published in Brockway, Johnson, Wright and Coiner**
 - c. Adjust nearest NOAA station for altitude difference (+10%/1000meters)
 - d. Calculate ET for selected risk level using published std dev for NOAA site
 - e. Adjust monthly ET for peak/mean CU ratio
3. Select Appropriate Input Variables for Hubble analysis
 - a. Crop distribution-either historical or allowable, ie: crop mix or monoculture
 - b. Irrigation method, soils, run length, furrow Q, roughness etc
 - c. Account for variation in effective rooting depth with time for shallow rooted soils
 - d. Alter furrow Q based on every row or every-other- row irrigation practice
- 4 Determine if early season diversion Q governs magnitude of diversion requirement or if alternative irrigation management will mitigate.
5. If minimum irrigation efficiency for any crop is desired, run program to 'force' efficiency measures.

BLISS 4 NW

GOODING County Station 101002

CLIMATOLOGICAL SUMMARY
Calendar Year 1918 -1989

DATE		TEMPERATURES (F)										PRECIPITATION (IN)											
		MONTHLY MEANS		DAILY RECORDS		DEGREE DAYS		TOTALS		DAILY		SNOWFALL		SNOWDEPTH									
MONTH		MAX	MIN	HI	LO	YR DAY	YR DAY	HEAT	COOL	MEAN	MAX	YR	HI	YR DAY	MEAN	MAX	YR	MAX	YR DAY				
Jan		34.4	18.6	26.2		65	53	12		1134	0	1.26	4.51	70	1.26	36	1	8.2	34.8	29	20	49	21
Feb		40.9	23.0	31.6		69	86	25		869	0	0.99	3.82	86	0.85	82	14	4.4	25.0	49	28	49	6
Mar		49.9	27.9	38.2		85	23	31		751	0	0.90	3.34	38	0.90	43	8	1.6	11.8	38	8	49	1
Apr		62.3	33.9	47.6		90	39	28		474	3	0.72	2.36	35	0.72	44	20	0.6	3.3	75	0	.	.
May		72.4	41.5	56.6		101	19	27		252	27	0.85	3.23	21	1.26	53	28	0.1	1.0	55	0	.	.
Jun		80.8	48.7	64.4		109	40	19		74	119	0.64	2.81	63	1.05	69	23	0.0	0.0	.	0	.	.
Jul		90.8	54.7	72.3		111	24	1		6	217	0.21	1.62	32	0.93	32	12	0.0	0.0	.	0	.	.
Aug		85.8	52.0	67.7		109	24	27		18	181	0.25	2.97	68	1.15	78	16	0.0	0.0	.	0	.	.
Sep		76.1	43.7	58.9		104	55	5		137	39	0.41	2.12	59	1.11	61	9	0.0	0.5	65	0	.	.
Oct		65.3	35.2	49.7		92	64	7		414	1	0.67	2.75	23	0.97	46	1	0.2	2.0	71	0	.	.
Nov		46.4	26.9	35.4		77	49	5		781	0	1.30	4.43	83	2.00	83	30	3.2	25.0	85	18	85	29
Dec		37.3	21.6	29.0		68	39	10		1073	0	1.19	5.30	64	1.37	64	23	5.3	24.8	51	17	85	1
ANNUAL		61.9	35.6	48.1		111				5984	586	9.40	5.30		2.00			23.6	34.8		28		

HAGERMAN 2 SW

Station 103932

GOODING County

CLIMATOLOGICAL SUMMARY

Calendar Year 1982 - 1990

DATE	TEMPERATURES (F)										PRECIPITATION (IN)												
	MONTHLY MEANS		DAILY RECORDS				DEGREE DAYS		TOTALS		DAILY		SNOWFALL		SNOWDEPTH								
			HI	YR	DAY	LOW											YR	DAY	MEAN	MAX	YR	DAY	MEAN
MONTH	MAX	MIN	MONTH	HI	YR	DAY	LOW	YR	DAY	HEAT	COOL	MEAN	MAX	YR	HI	YR	DAY	MEAN	MAX	YR	MAX	YR	DAY
Jan	39.6	19.9	29.8	55	90	13	-18	84	18	1085	0	1.04	1.54	90	0.58	90	15	1.0	1.0	83	.	.	.
Feb	46.8	23.7	35.3	74	86	26	-9	89	6	831	0	1.74	3.76	88	0.93	86	13	0.0	0.0	.	5	83	7
Mar	57.9	31.1	44.5	83	86	29	13	85	4	628	0	1.10	2.48	89	0.65	86	8	0.0	0.0	.	0	.	.
Apr	68.6	36.5	52.6	91	88	13	18	83	7	371	3	0.59	1.03	90	0.45	90	28	0.0	0.0	.	0	.	.
May	76.4	43.3	59.9	98	86	31	26	84	7	197	45	0.96	1.52	90	0.88	88	7	0.0	0.0	.	0	.	.
Jun	85.8	50.8	68.3	104	88	20	34	84	2	47	154	0.63	2.53	84	0.83	84	11	0.0	0.3	85	0	.	.
Jul	91.7	53.9	72.8	104	90	13	39	83	16	10	259	0.28	1.24	82	0.39	82	2	0.0	0.0	.	0	.	.
Aug	90.7	51.4	71.0	104	90	9	37	88	23	10	205	0.67	1.81	87	0.94	83	10	0.0	0.0	.	0	.	.
Sep	80.7	41.6	61.1	98	87	2	24	84	25	146	36	0.36	1.06	85	0.55	85	9	0.0	0.0	.	0	.	.
Oct	70.9	32.8	51.9	90	90	2	20	82	19	399	0	0.74	1.94	82	0.85	82	30	0.0	0.0	.	0	.	.
Nov	51.9	26.9	39.4	82	88	1	-1	85	23	760	0	1.51	3.07	83	0.70	83	18	0.0	0.0	.	0	.	.
Dec	38.2	16.4	27.3	67	87	7	-25	90	22	1160	0	1.32	3.30	83	0.60	83	7	1.6	4.4	85	6	83	4
ANNUAL	66.6	35.7	51.2	104			-25			5644	703	10.94	3.76		0.94			2.7	4.4		6		6

TEMPERATURE AND ELEVATION DATA FOR BLISS AND HAGERMAN

YEAR	1983	1985	1988	1989	1990
MAR/APR/MAY AVG. TEMP. FOR HAGERMAN	50.2	50.7	51.5	52.8	54.1
MAR/APR/MAY AVG. TEMP. FOR BLISS	48.5	47.7	50.6	52.4	52.3
TEMPERATURE DIFFERENCES	1.6	3.1	0.9	0.4	1.8
AVG. OF TEMP. DIFFERENCES	1.6				
ELEVATION OF HAGERMAN (FT.)	2875				
ELEVATION OF BLISS (FT.)	3280				
ELEVATION DIFFERENCE (FT.)	-405				

SOURCE OF INFORMATION: IDAHO STATE CLIMATOLOGIST

NOTE: ALL TEMPERATURES ARE IN DEGREES FAHRENHEIT

TEMPERATURE SENSITIVITY OF ET
ESTIMATES FOR BLISS BASED ON A
+ 1.6 DEGREE F TEMPERATURE CHANGE

APRIL	+ 7.5%
MAY	+ 5.7%
JUNE	+ 4.9%
JULY	+ 4.1%
AUGUST	+ 4.4%
SEPTEMBER	+ 5.4%
OCTOBER	+ 7.7%
SEASON	+ 5.3%

BLISS ET ESTIMATES BASED ON FAO-BC FROM ALLEN & BROCKWAY, 1983

TEMPERATURE SENSITIVITY BASED ON BROCKWAY ET AL., 1985

ALTITUDE ADJUSTMENT FOR ET ESTIMATE FROM
BLISS TO HAGERMAN

10% DECREASE FOR EACH 1000M INCREASE IN
ELEVATION

ELEVATION DIFFERENCE FROM BLISS TO
HAGERMAN = -405 FT = -123.4m

-10%/+1000m (-123.4m) = +1.23%
= -123.4m

Values of monthly ET estimated for the Hagerman Valley
adjusted from the Bliss Station
(mm/day)

	MO	ETR	ALFH.	BEANS	F.CRN	SILGE	S.CRN	PEAS	POTAT	SBEET	SGRAN	WGRAN	PAST.	VEGES
AVE ET	4	5.28	3.30					1.60	1.58	1.58	1.65	4.82	3.27	
TMP ADJ	4	5.68	3.55					1.72	1.70	1.70	1.77	5.18	3.52	
ALT ADJ	4	5.75	3.59					1.74	1.72	1.72	1.80	5.25	3.56	
STDD ET	4	0.47	0.29					0.14	0.14	0.14	0.15	0.43	0.29	
ADJ STDD	4	0.80	0.49					0.24	0.24	0.24	0.26	0.73	0.49	
80PCT ET	4	6.42	4.01					1.94	1.92	1.92	2.01	5.86	3.97	
AVE ET	5	6.79	6.29	2.04	2.04	2.04	2.04	3.85	2.19	2.04	5.11	6.79	5.23	2.07
TMP ADJ	5	7.18	6.65	2.16	2.16	2.16	2.16	4.07	2.31	2.16	5.40	7.18	5.53	2.19
ALT ADJ	5	7.27	6.73	2.18	2.18	2.18	2.18	4.12	2.34	2.18	5.47	7.27	5.60	2.21
STDD ET	5	0.49	0.46	0.15	0.15	0.15	0.15	0.28	0.16	0.15	0.37	0.49	0.38	0.15
ADJ STDD	5	0.80	0.75	0.25	0.25	0.25	0.25	0.46	0.26	0.25	0.61	0.80	0.62	0.25
80PCT ET	5	7.94	7.37	2.39	2.39	2.39	2.39	4.51	2.56	2.39	5.98	7.94	6.12	2.42
AVE ET	6	8.41	7.32	3.26	3.66	3.66	3.53	6.82	5.77	3.91	8.39	8.41	6.47	4.40
TMP ADJ	6	8.82	7.68	3.42	3.84	3.84	3.70	7.15	6.05	4.10	8.80	8.82	6.79	4.62
ALT ADJ	6	8.93	7.77	3.46	3.89	3.89	3.75	7.24	6.13	4.15	8.91	8.93	6.87	4.67
STDD ET	6	0.47	0.41	0.18	0.21	0.21	0.20	0.38	0.32	0.22	0.47	0.47	0.36	0.25
ADJ STDD	6	1.27	1.11	0.49	0.57	0.57	0.54	1.03	0.86	0.59	1.27	1.27	0.97	0.68
80PCT ET	6	10.00	8.71	3.87	4.36	4.36	4.20	8.11	6.85	4.65	9.98	10.00	7.69	5.24
AVE ET	7	8.54	6.94	7.37	7.68	7.68	7.47	2.99	7.17	8.14	7.05	6.80	6.57	6.57
TMP ADJ	7	8.89	7.22	7.67	7.99	7.99	7.78	3.11	7.46	8.47	7.34	7.08	6.84	6.84
ALT ADJ	7	9.00	7.31	7.77	8.09	8.09	7.87	3.15	7.56	8.58	7.43	7.17	6.92	6.92
STDD ET	7	0.26	0.21	0.23	0.24	0.24	0.23	0.09	0.22	0.25	0.22	0.21	0.20	0.20
ADJ STDD	7	0.58	0.47	0.51	0.53	0.53	0.51	0.20	0.49	0.56	0.49	0.47	0.44	0.44
80PCT ET	7	9.49	7.71	8.20	8.54	8.54	8.30	3.32	7.97	9.05	7.84	7.56	7.30	7.30
AVE ET	8	7.18	5.41	4.97	6.63	6.63	6.38		5.57	7.06	1.47	1.32	5.53	5.72
TMP ADJ	8	7.50	5.65	5.19	6.92	6.92	6.66		5.82	7.37	1.53	1.38	5.77	5.97
ALT ADJ	8	7.59	5.72	5.25	7.01	7.01	6.74		5.89	7.46	1.55	1.40	5.84	6.05
STDD ET	8	0.33	0.25	0.23	0.30	0.30	0.29		0.26	0.32	0.07	0.06	0.25	0.26
ADJ STDD	8	0.70	0.53	0.49	0.64	0.64	0.62		0.55	0.68	0.15	0.13	0.53	0.55
80PCT ET	8	8.18	6.17	5.66	7.54	7.54	7.26		6.35	8.04	1.68	1.50	6.29	6.51
AVE ET	9	5.60	3.67	0.77	4.19	4.19			3.29	4.86			4.32	3.83
TMP ADJ	9	5.90	3.87	0.81	4.42	4.42			3.47	5.12			4.55	4.04
ALT ADJ	9	5.97	3.92	0.82	4.47	4.47			3.51	5.19			4.61	4.09
STDD ET	9	0.41	0.27	0.06	0.31	0.31			0.24	0.36			0.32	0.28
ADJ STDD	9	0.66	0.43	0.10	0.50	0.50			0.39	0.58			0.52	0.45
80PCT ET	9	6.53	4.28	0.90	4.89	4.89			3.84	5.67			5.04	4.47
AVE ET	10	3.73	1.26		1.04					2.48			2.88	
TMP ADJ	10	4.02	1.36		1.12					2.67			3.10	
ALT ADJ	10	4.07	1.37		1.13					2.70			3.14	
STDD ET	10	0.35	0.12		0.10					0.24			0.27	
ADJ STDD	10	0.47	0.16		0.14					0.32			0.36	
80PCT ET	10	4.46	1.51		1.25					2.98			3.45	
AVE ET	SE	1457	1044	566	774	742	598	464	781	921	722	888	1047	692
TMP ADJ	SE	1534	1099	596	815	781	630	489	822	970	760	935	1102	729
ALT ADJ	SE	1553	1113	603	825	791	637	495	833	982	770	947	1116	738

ET and standard deviation data (AVE ET and STDD ET) for Bliss weather station taken from Appendix E (unpublished) of Brockway, C.E., and R.G. Allen, 1983, Estimating Consumptive Irrigation Requirements for Crops in Idaho, Idaho Water and Energy Resources Research Institute.

Adjustments to standard deviation (ADJ STDD) based on Allen & Brockway Report, pp. 18, and Allen, R.G., and J.L. Wright, 1983, Variation Within Measured and Estimated Consumptive Use Requirements, Proceedings of the Irrigation and Drainage Specialty Conference of the American Society of Agricultural Engineers, Jackson Hole, Wyoming, July 20-22, 1983, pp. 1-12.

Temperature adjustment (TMP ADJ) based on temperature differences between Bliss and Hagerman and temperature sensitivity of ET estimates given in Brockway, C.E., G.S. Johnson, J.L. Wright, and A.L. Coiner, 1985, Remote Sensing for Irrigated Crop Water Use - Phase 1, Water Resources Research Institute, pp. 101-107.

Altitude adjustment (ALT ADJ) based on Doorenbos, J., and W.O. Pruitt, 1977, Crop Water Requirements, Food and Agriculture Organization of the United Nations, p. 59.

80th percentile ET values (80PCT ET) calculated based on Walpole, R.E., and R.H. Meyers, 1985, third edition, PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS, New York: Macmillan Publishing Company, pp. 132-144 and 574.

ATTACHMENT A

36-00003A
36-00003C
36-00003E
36-00003F
36-00034B
36-00035J
36-00039C
36-00039E
36-00039J
36-00039N
36-00047
36-00061
36-00062
36-00063
36-00064B
36-00079
36-00085A
36-00086C
36-00092
36-00103F
36-00106
36-00108B
36-10283B
36-10409