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Wyoming's Amended Proposed Findings of Fact Volume IIIB

Attorney General, State of Wyoming

BIG HORN ADJUDICATION

WYOMING'S AMENDED PROPOSED MASTER'S REPORT

CONCERNING WATER RIGHTS FOR THE

WIND RIVER INDIAN RESERVATION

1982

VOLUME III

Amended Proposed Findings of Fact

(Series 6 through 26)

PART B

FILED

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Margaret V. Hampton CLERK

DEPUTY

case # 4993

File # 333

Box 22

Findings of Fact
Relating to the Tribes' Claims
to Water for Future Project Lands

19-1 **The Tribes' Claim**

In their Amended Statement of Claims, the Tribes sought the right to divert 25,159 acre/feet of water annually to serve 9,970 additional acres within the United States five future projects.

19-1 See Amended Statement of the Shoshone and Arapahoe Tribes Concerning the Measurement of Tribal Reserved Water Rights, filed July 16, 1981.

19-2 The Tribes' Evidence

Mr. Bliesner testified for the Tribes with respect to the engineering analysis performed for the Tribes' two additional proposed irrigation projects. Mr. Bliesner was admitted as an expert in irrigation design engineering. Dr. Willardson testified for the Tribes with respect to the drainage design for these two additional projects. Dr. Willardson was admitted as an expert in irrigation and drainage engineering although prior to this litigation he had no experience in Wyoming and has not designed a large-scale drainage system which has been carried through to construction. Mr. Jack Keller testified concerning the irrigation systems designed by Mr. Bliesner.

19-2 Tr. 8260-8265 (Bliesner); Tr. 8573-8575 (Willardson); Tr. 8765-8767, 8811-8812 (Keller).

19-3 The Tribes' Arable Land Base

The arable land base upon which Mr. Bliesner developed irrigation systems is a portion of the lands testified to by Mr. Kersich of HKM. The evidence on these lands by both the U.S. and State experts is combined with evidence concerning the lands for which Dr. Mesghinna designed future irrigation projects. As such, the Master concludes that the arable land base for the Big Horn Flats Extension and Stagner Ridge projects suffer from the same deficiencies as the arable base for the United States' five future projects.

19-3 See Findings of Fact 18-1 et seq.; evidence accompanying Mr. Kersich and Mr. Toedter of HKM for the U.S., and Mr. Fowkes and Mr. Sommers for the State of Wyoming.

The conceptual irrigation development plan for Big Horn Flats and Stagner Ridge prepared by Keller Engineering relies upon the HKM arable land studies for future lands. Tribes' Exh. 13 (pp. 3 and 20).

19-4 Reduction in Tribes' Arable Land Base

The Court, having previously accepted the States' arable land base determinations hereby reduces the acreage within the Tribes' two additional proposed irrigation projects to coincide with that finding. The Court finds that irrigable acres in the following amounts exist in the Tribes' two additional proposed projects:

Project	Acreage
Big Horn Flats Addition	6,131.1
Stagner Ridge	897

19-4 Mr. Bliesner relied on the United States' arable land base in designing the two additional projects. Tr. 8268-8276 (Bliesner). Since the Court has accepted the State's arable land base, the reductions noted above must be made. In addition, Mr. Bliesner's on-farm system design includes many fields with topographical or cultural features which would reduce the actual acres under irrigation. Tr. 13279-13301 (Sostrom); Wyo. Exhs. WRIR FSO-5, FSO-6A, FSO-6B and FSO-6C. Mr. Sostrom prepared maps and tabulations of those acres within the Tribes' two additional projects which fall within the State's arable land base. Tr. 13297-13301 (Sostrom); Wyo. Exhs. WRIR FSO-6A, FSO-6B, FSO-6C and FSO-7. Some of the figures for acreage in Finding of Fact 19-4 do not coincide with the values listed in Wyo. Exhs. WRIR FSO-6A, 6B, 6C and 7. Generally these changes reflect clerical or mathematical errors in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes.

19-5 Tribes' Drainage Conclusions

Dr. Willardson designed a single interceptor drain for the entire Big Horn Flats and determined that Dr. Mesghinna designed more drainage for the future projects than would be needed.

19-5 Dr. Lymon S. Willardson testified for the Tribes as an expert on irrigation and drainage engineering. Tr. 8573-75 (Willardson). Dr. Willardson visited the Wind River Indian Reservation in June, 1981. Tr. 8581 (Willardson).

During this visit, Dr. Willardson decided that a single interceptor drain would sufficiently handle any drainage problems on the Tribes' proposed Big Horn Flats project. Tr. 8599 (Willardson). In addition, Dr. Willardson reviewed the drainage design for the proposed five future projects and concluded that Dr. Mesghinna designed more drainage than would actually be needed. Tr. 8602-12, 8657-66 (Willardson).

19-6 Deficiencies in Tribes' Drainage Analysis for Big Horn Flats Extension

In view of the uncertainties and inevitable drainage problems certain to arise and the extraordinary haste of the field effort, the Court is unable to rely on Dr. Willardson's conclusions regarding drainage and drainage design on the Tribes' proposed Big Horn Flats project.

19-6 Dr. Willardson concluded that there would not need to be any relief drainage on Big Horn Flats; that if a drainage problem arose, it would be at the change in slope or the change in elevation that occurred in the middle of the flat; that the drainage problem in the particular area could be handled with one intercepter drain that ran along the toe of the ridge; and that the excess water that would come from the irrigation system could be handled by natural drainage. Tr. 8587, 8588-95 (Willardson); Tribes' Exh. WRIR 13-6 (Sheet 3 of 7).

Dr. Willardson admitted that this drainage system design involves a great deal of uncertainty. He also found that drainage problems are certain to arise as a result of the uncertainty of the location of underground barriers which cannot be detected with the intensity of sampling on the Big Horn Flats area. Tr. 8597-98 (Willardson).

A previous Bureau of Reclamation study found conclusions totally contrary to Dr. Willardson's conclusions of sufficient natural drainage on Big Horn Flats. The Bureau found as follows:

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> Because of the tight shale and sandstone barrier in a relatively large area of Big Horn Flats, water mounds would build up in various locations necessitating relief and interceptor drains.

Wyo. Exh. WRIR SF-2 (Page 55).

Considering the uncertainties, inevitable problems, and the Bureau of Reclamation's conflicting conclusions to Dr. Willardson's conclusions, it is particularly disturbing that the entire field effort upon which Dr. Willardson relied to draw these conclusions for the 9,264 acre project, took place over a period of less than 2 hours. Tr. 8694 (Willardson).

19-7 Deficiencies in Tribes' Drainage Analysis of United States Future Projects

The Court is unable to rely on the conclusions of Dr. Willardson regarding drainage and drainage design on the proposed five future projects for the following reasons:

1. His methods are arbitrary;
2. His entire field effort, covering 50,000 acres, took place over a period of 20 hours;
3. Dr. Willardson relied on the drainage investigation data developed by Mr. Toedter and was unaware of the inadequacies of that data;
4. Soil profiles could not be precisely located in the field; and
5. He was unaware of the actual intensity of the HKM drainage investigation and would be uncomfortable with the reliability of his own conclusions if he was aware of the actual investigation intensity.

19-7 In addition to the Big Horn Flats Unit and Stagner Ridge, Dr. Willardson visited other areas of the proposed future projects on the Wind River Indian Reservation. The areas visited were those with drainage systems designed by Dr. Mesghinna. After reviewing the profile data in the HKM Drainage Analysis Report, and after examining the physical position, elevation, and the surroundings of the lands indicated as needing drainage, Dr. Willardson indicated on drainage maps those areas from which drainage could be removed entirely, areas where the drainage intensity could be arbitrarily reduced in half, and those areas which would require drainage as originally designed by Dr. Mesghinna. Tr. 8602-8612, and 8657-8666 (Willardson).

The entire field effort upon which Dr. Willardson relied to reach his conclusions regarding drainage of the proposed future projects took place over a period of 20 hours. This is equivalent to an intolerably hasty examination of over 2,500 acres per hour. Tr. 8694, 8706-07, 8712 (Willardson).

Dr. Willardson relied on the drainage investigation data developed by Mr. Toedter and contained within U.S. Exh. WRIR C-241A. The inadequacies of that data were unknown to Dr. Willardson. He made no attempt to investigate the development of the data and did not learn there are soil profiles not included in the data until after he had begun his testimony. Tr. 8708-09 (Willardson).

Dr. Willardson could not precisely locate, in the field, the soil profiles upon which he relied to reach his conclusions. For example, Dr. Willardson was aware of the existence of holes on Stagner Ridge, but he could not identify or locate the holes. Tr. 8707, 8710 (Willardson).

Had Dr. Willardson known the intensity of the HKM drainage investigation, he likely would have been uncomfortable with the reliability of his conclusions. Dr. Willardson admitted that if he had been involved in the drainage design for the future project areas from the beginning, he would have expected soil logs from holes of 10' or barrier of roughly one hole per 40 acres, and for deeper holes of

40' or barrier, a density of approximately 1 hole per 400 acres. He also stated that if the density of holes in the future project areas was actually one hole per 500 acres for holes to 10' or barrier, and 1 hole per 1,000 acres for deep holes, he would be less comfortable with the reliability of his conclusions. Dr. Willardson assumed that the density of logged holes on the future projects was about 1 hole per 100 acres and that a larger proportion of those holes were deep holes. Tr. 8709-10 (Willardson). The actual intensity of the HKM investigation, on about 43,000 acres (gravity) classified arable by the Bureau of Reclamation, is about one hole 6 feet or greater per 500 acres.

Drainage was reduced or removed on some areas with no apparent justification. Dr. Willardson stated that one of the primary factors that would justify removing drainage was the presence of gravel underneath the soil. Tr. 8609 (Willardson). However, the study areas Big Horn Flats 3b and North Crowheart 61, from which drainage was reduced by one-half and removed by Dr. Willardson, contain no indication of gravel in any of the logs. U.S. Exhs. WRIR C-241A, C-260; Tribes'

Exh. 13-7, 13-4. The drainage reduction and removal on these areas is particularly disturbing since these study areas contain fields on which Dr. Mesghinna designed drain spacing at less than the minimum standard of 200 feet.

19-8 Tribes' Future Projects--Claimed Costs and Water Requirements

Mr. Bliesner's conclusions with respect to acreage, water requirements and capital construction costs for the Tribes two additional projects may be summarized as follows:

	Big Horn Flats Addition	Stagner Ridge
Acreage	9,073	897
Diversion Requirements (acre-feet)	22,349	2,810
Capital Construction* Costs/acre	1,785	1,542

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* Costs not annualized and does not include annual operation and maintenance costs.

19-8 Tribes' Exh. 13.

19-9 Questionable Accuracy of Climate Data Used by Tribes

The Court finds that the accuracy of the climatological data used by Mr. Bliesner is questionable and as a result, his conclusions with respect to water requirements and costs are unreliable. Consequently, in order to compensate for the questionable accuracy of the water requirements, the system design and the predicted costs, the Court finds it necessary to increase the engineering and contingency costs.

19-9 Mr. Bliesner relied on Dr. Mesghinna's crop consumptive use determinations which were in turn based on Dr. Mesghinna's climatological data. Tr. 8283 (Bliesner). The reasons in support of Finding of Fact 18-17 make the importance of climatological data very clear and the reasons in support of Finding of Fact 18-18 illustrate the unreliability of the climatic data which led to the crop consumptive use determinations relied upon by Mr. Bliesner. When the accuracy of the input data is questionable, the accuracy of the output data, i.e., water requirements and costs, becomes suspect.

19-10 Consequences of Questionable Climate Data

The Court finds that due to the questionable accuracy of the climatic data relied upon by Mr. Bliesner and the questionable design of the on-farm systems, the pumping plants and the drainage system, the Court is unable to accept Mr. Bliesner's conclusions with respect to diversion requirements and capital construction costs.

19-10 The problems with respect to climatic data and cropping pattern were detailed in engineering Findings of Fact 18-17, 18-18, and 19-9. Design of the on-farm system is very dependent on soil intake rate. To determine this rate, Mr. Bliesner used an experimental instrument recently invented by a graduate student. Tr. 8306-8310 (Bliesner). The tests (six only) were conducted at the Big Horn Flats Addition site and the results varied by up to 10%. Tr. 8496-8498 (Bliesner); Wyo. Exh. WRIR RB-10. The Court should find the reliability of the soil intake rate data suspect and thus question the accuracy of the on-farm system designs.

The design of a massive pumping and water transmission system from Bull Lake Creek to the proposed Big Horn Flats Addition would require input from several different technical fields most of which Mr. Bliesner was not admitted as an expert in. There is no indication that he consulted with the wide variety of technical experts necessary in order to properly design such massive pumping plants. As a result, his conclusions with respect to design and costs are placed into question.

The drainage design, however limited it was, was based on a very cursory review of the two projects. Mr. Willardson spent little more than a few hours reviewing these projects. Tr. 8694-8706-8707 (Willardson).

19-11 Wyoming's Evidence Concerning the Tribes' Two Future Projects

Mr. Sostrom and Mr. Bishop testified for Wyoming with respect to the engineering analysis performed by the State for the Tribes' two additional proposed irrigation projects. Mr. Sostrom was admitted as an expert in engineering design and construction and construction cost estimating and has had many years of experience in both these areas in Wyoming. Mr. Bishop was admitted as an expert in water resources engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and years as the Wyoming State Engineer.

19-11 Tr. 12568-12577, 12611, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1; Tr. 12134-12140, 12152, 13691-13693, 13702-13705 (Bishop); Wyo. Exh. WRIR HFB-1.

19-12 Water Requirements for Tribes' Two Future Projects

The Court finds that the water requirements for irrigable lands within the Tribes' two additional proposed irrigation projects are as follows:

Project	Net Irrigation Requirement (acre-feet)	Diversion Requirement (acre-feet)
Big Horn Flats Addition	10,438.1	20,875.9
Stagner Ridge	1,525	3,050
	11,963.1	23,925.9

19-12 These figures were derived by Mr. Bishop using the assumptions adopted by the Court in Finding of Fact 18-20. Mr. Bishop used these assumptions and applied them to the irrigable lands located within the Tribes' two additional projects. Wyo. Exh. FFB-3. The figures for the water requirement in Finding of Fact 19-12 do not coincide with the values listed in Wyo. Exh. WRIR FFB-3. Generally these changes reflect clerical or mechanical errors in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes.

19-13 Capital Costs of Tribes Two Future Projects

The Court finds that the per acre capital construction costs to be used to determine the practicable irrigability of the Tribes' two additional projects are as follows:

Project	*Capital Construction Costs/Acre
Big Horn Flats Addition	2,667
Stagner Ridge	1,906

*Costs not annualized and do not include annual operation and maintenance costs.

19-13 These costs were derived by taking the per acre capital construction costs calculated by Mr. Sostrom, found in Wyo. Exh. WRIR FSO-4, and adding in additional costs for drainage and road construction. Wyo. Exhs. WRIR FSO-4 and FSO-4B.

The cost figures of Mr. Bliesner vary greatly from those of Mr. Sostrom (Wyo. Exh. WRIR FSO-4). The Court finds Mr. Sostrom's figures more reliable for the following reasons: (1) Mr. Sostrom included in his costs a mobilization fee of 6.17% which represents the cost of mobilization, bonding and insurance and is a real construction cost which must be considered. Mr. Bliesner failed to include this in his costs. Tr. 13352-13353 (Sostrom); Wyo. Exh. WRIR FSO-4 at pp. 2, 24, 28, 36 and 41; (2) Mr. Sostrom included costs for additional drainage and road construction, both of which were left out by Mr. Bliesner. Tr. 13328-13335 (Sostrom); (3) Mr. Bliesner's very low figure of 20% for engineering and contingencies was unsupported by any rationale or justification and is probably a reflection of his lack of experience in actual large project construction. Tr. 8334, 8374 (Bliesner); Tr. 13353 (Sostrom). Mr. Sostrom used a 35% figure for engineering and contingencies and based this on ASCE

Guide No. 45, consultation with a Mr. Goldman, an instructor at a construction management cost estimating seminar, and with Mr. Floyd Bishop and finally his many years of experience cost estimating large construction projects in Wyoming. Tr. 13251-13255, 13351-13355, 13447-13483 (Sostrom). Mr. Sostrom's figure may even be low in light of the questionable accuracy of the climatic data and cropping patterns; and (4) the very questionable low costs for pumping stations and drainage which perhaps is reflective of their predetermined objective to reduce costs as admitted by Mr. Bliesner. Tr. 8263 (Bliesner); Tr. 12190-12195 (Bishop).

Due to Mr. Bliesner's naivete in costing large irrigation pumping plants, he did not use the U.S. Bureau of Reclamation Instructions for Estimating, Series 150, Appendix A. Dr. Mesghinna and Mr. Sostrom both used this reference with modifications for the smaller plants. Tr. 4363, 4730 (Mesghinna); Tr. 13328 (Sostrom).

Although the reduction in size of the irrigation system designs of Mr. Bliesner to conform to the State's arable land base will likely result in an increase in per acre capital construction costs, the Court concludes that the increase will be insignificant and therefore relies on Mr. Sostrom's per acre costs as illustrated in Wyo. Exh. WRIR FSO-4 and FSO-4B. Tr. 4486-4492 (Mesghinna).

19-14 Economic Evidence Concerning the Tribes' Two Future Projects

Two witnesses presented testimony concerning the economic feasibility of the two additional irrigation projects proposed by the Tribes. Dr. Ron Cummings testified concerning the feasibility of these projects on behalf of the Tribes and Dr. Jim Jacobs testified concerning the projects on behalf of Wyoming.

19-14 The results of Dr. Cummings' analysis are presented on page 12 of Tribes' Exh. WRIR-24, while Dr. Jacobs' results are given in Wyo. Exh. EJ-4, Part II, page 14.

19-15 Tribes' Economic Analysis of No Help

The Court finds the Tribes' economic analysis of the Big Horn Flats Extension and Stagner Ridge projects to be of little use since it does not incorporate contemporary standards. Instead, the Tribes' economic analysis presented by Dr. Cummings incorporates estimates of secondary benefits without consideration of potential secondary costs; and is based solely upon adjustments made to the United States' analysis, which the Court has found inferior to that of Wyoming's.

19-15 A detailed discussion of the reasons why the Court cannot rely upon Dr. Cummings' analysis is given in Findings of Fact 15-12 and 15-13.

19-16 Tribes' Two Proposed Future Projects Not Feasible

Based on the evidence, the Court finds Wyoming's economic analysis of the feasibility of the proposed Big Horn Flats Extension and Stagner Ridge analysis to be persuasive. The benefit/cost ratios presented in Wyoming Exhibit WRIR EJ-4, Part II, Table 12, p. 14, clearly demonstrate that the cost of the proposed projects far exceed the expected benefits.

This position is consistent with the Court's earlier findings, and is not surprising in view of the fact that the United States declined to present testimony concerning these two proposed projects based upon poor economic returns reflected in its own analysis.

19-16 Wyoming's economic analysis concerning these projects is detailed in Wyo. Exhs. EJ-3 and EJ-4.

The Court should further consider the fact that these two projects are located on lands for which Dr. Mesghinna considered designing irrigation projects. After considering the high costs of bringing these lands into production, and after consultation with the United States' economist, he rejected these two projects as being infeasible. Tr. 8276-8277 (Bliesner); Tr. 4301, 4322-4323, 4350 (Mesghinna). Thus, the United States did not seek water rights for these lands having examined them and concluded that they are not practicably irrigable. Having been rejected by the United States, a much higher test of acceptability must be shown for these two projects to overcome the conclusions of the United States. The Tribes' evidence fails to meet this test.

Findings of Fact

Relating to Type VIII Lands

20-1 Claim of the United States.

During its case-in-chief, the United States claimed the right to divert 6,512 acre-feet of water annually to serve 1,461 acres of land within Federal Indian Irrigation Projects (FIP's) which have never been irrigated. These are known as Type VIII lands.

20-1 U.S. Exh. WRIR C-277.

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20-2 Deficiencies in Type VIII lands arable base developed by the United States

The arable land base for the Type VIII lands and Arapahoe Ranch Area was developed using procedures and standards virtually identical with those used to identify the arable land base for the United States' future projects and Type VII lands. As a result, the Type VIII land base suffers the same deficiencies as the future project area study concerning definitions and inclusion of Class 4 land. In addition, the drainage investigation for the Type VIII lands is deficient as more fully set forth in Findings of Fact 23-5 and 23-6 herein. Accordingly, the Court cannot rely on the Type VIII arable land base developed by the United States.

20-2 Type VIII lands are located within the Federal Irrigation Projects. The Arapahoe Ranch Area lies within the future project area in the Owl Creek Basin. Mr. Waples testified to the arability of Type VIII lands and Mr. Kersich testified to the arability of the Owl Creek Unit later renamed the Arapahoe Ranch Area by Dr. Mesghinna. Tr. 10964 (Sommers); U.S. Exh. WRIR C-43; U.S. Exh. WRIR C-52.

The arable land investigation by HKM on Type VIII lands is virtually identical to the future project investigation. U.S. Exh. WRIR C-226 (p. 2).

Class 4 lands should be excluded from Type VIII lands which are within historic areas but have never been irrigated. Tr. 11133 (Sommers).

The drainage analyses for Type VII and Type VIII lands was combined in Mr. Toedter's analysis. Tr. 3936 (Toedter). The specific discussion of deficiencies regarding drainage for Type VII lands appears in Findings of Fact 23-5 and 23-6.

20-3 Wyoming's Type VIII arable land base is reliable.

The Court finds that Wyoming's arable land base for Type VIII and Arapahoe Ranch Area projects is more reliable than the arable land base developed by HKM for the United States. The following are the arable acres for sprinkler irrigation determined to exist in the Type VIII and Arapahoe Ranch Area projects:

Project No.	Project Name	Arable Acres
1	Ray Unit	0.0
2	Coolidge Unit	133.3
3	Subagency Unit	261.7
5	Upper Wind Unit (Dinwoody Bench)	302.8
6	Johnstown Unit	138.2
-	Arapahoe Ranch Area	183.0
	TOTAL	1019.0

20-3 Mr. Sommers' analysis of the arable lands for Type VIII tracts and the Arapahoe Ranch area involves the same process utilized for analysis of the future project lands. Tr. 10963-64, 10985 (Sommers). Wyo. Exh. WRIR SS-8, revised, accurately represents Mr. Sommer's professional opinion concerning the number of arable acres in each tract of Type VIII lands, with a plus or minus 10 percent error factor. Tr. 10965, 10968 (Sommers).

20-4 United States engineering expert for Type VIII and Arapahoe Ranch lands.

Dr. Mesghinna testified on behalf of the United States concerning his engineering analysis of the Type VIII lands and Arapahoe Ranch. Dr. Mesghinna was admitted as an expert in irrigation design engineering although, prior to this case, he had done no irrigation design work in Wyoming and none of the irrigation systems which he has designed have actually become operational.

20-4 Tr. 4008-4018, 5581-5582 (Mesghinna).

20-5 United States' conclusions re: Type VIII and Araphaoe Ranch lands.

Dr. Mesghinna's conclusions with respect to the acreage, water requirements and capital construction costs for the Type VIII and Arapahoe Ranch lands may be summarized as follows:

Units	Acreage	Diversion Requirements (acre-feet)	Capital Construction Costs/Acre*
Coolidge	200	1,001	1,421
Johnstown	190	951	982
Upper Wind	492	2,056	1,266
Subagency	306	1,531	1,509
Ray	28	118	2,007
Arapahoe Ranch	245	855	1,847
Totals	1,461	6,512	

* Costs not annualized and does not include annual operation and maintenance costs.

20-5 U.S. Exh. WRIR C-277.

20-6 Reduction of arable acreage within the Type VIII and Arapahoe Ranch lands to coincide with the Court's acceptance of Wyoming's arable land base determination.

The Court, having previously accepted the States' arable land base analysis and conclusions, hereby reduces the arable acreage within the Type VIII and Arapahoe Ranch lands to coincide with that finding. The Court finds that irrigable acres in the following amounts exist in the Type VIII and Arapahoe Ranch lands:

Unit	Acreage
Coolidge	200
Johnstown	124
Upper Wind	257
Subagency	257
Ray	0
Arapahoe Ranch	147
TOTAL	985

20-6 In addition to Findings of Fact 18-2 through 18-11 indicating the reliability of the State's arable land base over that of the United States, the Court should note the following additional problems in the Type VIII and Arapahoe Ranch irrigable land base developed by the United States:

1. The arable land base relied on by Dr. Mesghinna was provided him by HKM Associates (Tr. 5613-5615 (Mesghinna)) but, at least with respect to Arapahoe Ranch, is not the same arable land base testified to by Mr. Kersich of HKM. Tr. 5621-5623 (Mesghinna); U.S. Exh. WRIR C-52; Wyo. Exh. WRIR FM-8-A-52;

2. Dr. Mesghinna's fields include land classified Class 6 or nonarable by HKM. Tr. 5660-5667 (Mesghinna); 13302-13304 (Sostrom); Wyo. Exhs. WRIR FSO-15A, 15B, 15C, 15D and 15E;

3. Dr. Mesghinna's fields include Type IX or nonirrigable land. Tr. 5668-5671 (Mesghinna);

4. Dr. Mesghinna's fields include Type VII lands claimed by the United States. Tr. 5677-5682 (Mesghinna); and

5. Dr. Mesghinna's fields include many tracts which have been allotted to individual Indians. There was no evidence that these allotments would be available for irrigation as part of the farms designed by Dr. Mesghinna. Redesigning the farm units to exclude these areas may be so costly as to be prohibitive. Tr. 5686-5690 (Mesghinna).

Mr. Sostrom prepared tabulations of those acres within the Type VIII and Arapahoe Ranch lands which fall within the State's arable land base. Tr. 13304-13305 (Sostrom); Wyo. Exh. WRIR FSO-14.

20-7 Unreliability of United States' conclusions re: diversion requirements and cost.

The Court finds that the system designs for the Type VIII and Arapahoe Ranch lands are generally acceptable. However, due to the questionable accuracy of the climatic data and arable land base Dr. Mesghinna relied upon, the Court is unable to accept his conclusions with respect to diversion requirements.

20-7 See Findings of Fact 20-6, 18-17 and 18-18 and reasons in support thereof. Dr. Mesghinna relied on the same cropping patterns and crop consumptive use determinations previously used for the United States' five proposed projects. Tr. 5584, 5590 (Mesghinna).

20-8 Inaccuracy of United States' climatological data.

The accuracy of the climatological data used by Dr. Mesghinna is suspect and, as a result, his conclusions with respect to water requirements and costs are unreliable. In order to compensate for the questionable accuracy of the water requirements and, therefore, the predicted costs, the Court finds it necessary to increase the engineering and contingency costs associated with the systems designed by Dr. Mesghinna.

20-8 Dr. Mesghinna relied on the same climatological data and cropping patterns in his designs for the Type VIII and Arapahoe Ranch lands as he used to design the United States' five proposed projects. See Findings of Fact 18-17 and 18-18, supra.

20-9 Wyoming's engineering experts concerning Type VIII and Arapahoe Ranch lands.

Mr. Sostrom and Mr. Bishop testified on behalf of Wyoming with respect to the engineering analysis performed by the State for the Type VIII and Arapahoe Ranch lands. Mr. Sostrom was admitted as an expert in engineering design and construction and construction cost estimating and has had many years of experience in both these areas in Wyoming. Mr. Bishop was admitted as an expert in water resources engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and tenure as the Wyoming State Engineer.

20-9 Tr. 12568-12577, 12611, 13253-13255, 13302 (Sostrom); Tr. 12134-12140, 12152, 13693, 13702-13705 (Bishop).

20-10 Court's conclusions re: water requirements for Type VIII and Arapahoe Ranch lands.

The Court finds that the water requirements for irrigable lands within the Type VIII and Arapahoe Ranch lands are as follows:

Project	Net Irrigation Requirement (acre-feet)	Diversion Requirement (acre-feet)
Coolidge	367	734
Johnstown	232	464
Upper Wind	437	874
Subagency	481	962
Ray	0	0
Arapahoe Ranch	266.1	532.2
Totals	1,783.1	3,566.2

20-10 Mr. Bishop used the assumptions listed in Finding of Fact 18-20 and applied them to the State's arable land base within the Type VIII and Arapahoe Ranch lands to determine the figures listed in this Finding and in Wyo. Exh. WRIR FFB-1 and FFB-2. Some of the figures for water requirements in Finding of Fact 20-10 do not coincide with the values listed in Wyo. Exhs. WRIR FFB-1 and FFB-2. Generally these changes reflect clerical or mathematical errors or roundoff in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes.

20-11 Court's conclusions re: costs for Type VIII and Arapahoe Ranch lands.

The Court finds that the appropriate per-acre capital construction costs to be used to determine the practicability of irrigation of the Type VIII and Araphoe Ranch lands are as follows:

Project	*Capital Construction Costs/Acre
Coolidge	1,604
Johnstown	1,104
Upper Wind	1,738
Subagency	1,627
Ray	0
Arapahoe Ranch	1,683

*Costs not annualized and do not include annual operation and maintenance costs.

20-11 These figures were developed by Mr. Sostrom (Wyo. Exh. WRIR FSO-4C). The significant difference between Dr. Mesghinna's and Mr. Sostrom's costs is the engineering and contingency percentage. Dr. Mesghinna uses a 25% while Mr. Sostrom uses a 35% figure (compare Wyo. Exh. WRIR FSO-4C with U.S. Exh. WRIR C-277.) Additionally, Dr. Mesghinna again failed to include a mobilization fee of 6.17%. (See Finding of Fact 18-22 and reasons in support thereof.)

The higher engineering and contingency fee is more reliable especially in light of the questionably accurate input data, for example, climatic data, arable land base and cropping pattern. This, plus the mobilization fee, makes up the real difference between Dr. Mesghinna's and Mr. Sostrom's costs.

20-12 United States' and Wyoming's evidence re: economic feasibility of potential irrigable Type VIII lands.

The United States and the State of Wyoming presented the Court with benefit cost analyses of Type VIII lands within the boundaries of current Federal Irrigation Projects on the Wind River Indian Reservation.

The procedures used by both to assess the economic feasibility of Type VIII lands were similar to the procedures used by the respective parties in their analysis of proposed future projects.

20-12 Mr. Dornbusch's testimony regarding Type VIII lands appears at transcript pages 5719 through 5739. His results are summarized on page 16 of U.S. Exh. WRIR-C278. Mr. Dornbusch testified:

> In general, the approach was very similar to the one we did and which I described earlier on the new lands. Tr. 5719.

Dr. Jacobs' testimony concerning the economic feasibility of Type VIII lands is summarized on pages 14749 through 14755 and in Wyo. Exhs. WRIR EJ-3, Part II, page 19, and EJ-4, Part III, page 16.

20-13 Disagreement re: economic feasibility.

Consistent with their positions regarding the United States' proposed future projects, the United States and Wyoming were in sharp disagreement concerning the economic feasibility of Type VIII lands. The results of the United States' analysis showed that all of the proposed Type VIII future tracts were economically feasible.

Wyoming's analysis, on the other hand, showed that in no instance did benefits exceed costs for any of the Type VIII tracts proposed by the United States.

20-13 Page 16 of U.S. Exh. WRIR 278 shows the benefit-cost ratios derived by Mr. Dornbusch for proposed Type VIII lands. The corresponding ratios derived by Dr. Jacobs appear in Wyo. Exh. WRIR EJ-3, Part II page 19, for a 7 1/8 percent discount rate and EJ-4, Part II page 16 for a 4 percent discount rate.

20-14 Court concludes that Type VIII lands are not practicably irrigable.

Consistent with the Court's findings concerning the feasibility of the proposed future projects, the Court finds that the preponderance of evidence concerning the practicability of irrigating Type VIII lands lies in favor of Wyoming. The Court thus concludes that none of the proposed Type VIII future tracts are economically feasible to develop and thus none constitute practicably irrigable acreage. This result is consistent with the Court's finding concerning the proposed future projects, since both the costs and returns involved in developing Type VIII lands would be similar to those involved in developing the future projects.

20-14 See Finding of Fact 18-32 and reasons therefor.

While it is evident that some of the benefit-cost ratios on page 16, Part III of Wyo. Exh. EJ-4 are closer to unity than any of the five United States' future projects, the Type VIII lands still fail to pass a strict economic feasibility test.

Findings of Fact
Relating to Indian-Owned Lands
Claimed to be Potentially Irrigable

21-1 Tribes' Study and Claim

On behalf of the Tribes, Mr. Keith Higginson testified concerning Indian-owned "potentially irrigable" lands. Mr. Higginson claimed that 3943 acres were potentially irrigable. However, there is no evidence whatsoever that Mr. Higginson did any field work, took any soil samples, or did any land classification to determine the arability of those lands.

21-1 Mr. Higginson has many years experience in water resource engineering and is probably well-qualified to testify in his area of expertise. However, he has no first-hand experience in soil science or land classification. Tr. 8051-52 (Higginson). This lack of experience is evident in his study methods. Mr. Higginson developed no standards or even guidelines upon which to base his study. Tr. 8166-67 (Higginson). He visited most of the tracts in the winter and made visual observations but did not auger a single hole nor did he sample any soil whatsoever. Tr. 8052, 8097-98 (Higginson). Mr. Higginson relied on several government soil and land classification reports to determine arability. However, the publications upon which he relied (the Soil Conservation Service's Survey of the Riverton Area and the Soil and Range Resources Inventory by the Bureau of Indian Affairs Tr. 8063, 8096 (Higginson)) do not contain the specific information upon which arability determinations can be made. See Finding of Fact 15-3 and support therefor.

21-2 On behalf of the State of Wyoming, Mr. Sommers evaluated the arability of the Indian-owned fee lands testified to by Mr. Higginson. Mr. Sommers' evaluation considered all available information to determine arability. Mr. Sommers determined that 1,618 acres of the potentially irrigable "p" lands are arable.

21-2 Mr. Sommers used the same information as Mr. Higginson in his evaluation of potentially irrigable lands. Tr. 11100, 11164 (Sommers). He eliminated any lands classified Class 6 by either the Bureau of Reclamation or HKM. Tr. 11009-10, 11164-65 (Sommers). Where Mr. Higginson relied upon the Soil Conservation Service, Mr. Sommers excluded the land if it did not meet the minimum arability standards of HKM. Tr. 11166 (Sommers). Mr. Sommers gave the benefit of doubt to the land in question by including all acreages determined to be arable by the Bureau of Reclamation or HKM. Therefore, the total acreage of Wyo. Exh. WRIR SS-H is the maximum possible amount of arable land. Tr. 11005 (Sommers).

Mr. Sommers' final arable determination for potentially irrigable Indian-owned fee lands is 1618 acres. Wyo. Exh. WRIR SS-H.

21-3 Tribes' evidence concerning potentially Irrigable Indian-owned fee land.

Mr. Keith Higginson testified for the Tribes with respect to the engineering analysis performed for, what he termed, the "potentially irrigable" Indian-owned fee lands. Mr. Higginson was admitted as an expert in water resources engineering although during the last 25 years his work has largely been administrative and he has had little or no experience with actual irrigation system design, analysis of soils or the determination of water requirements for irrigation in Wyoming.

Á1-3 Tr. 8050-8052, 8055 (Higginson).

21-4 Wyoming's evidence concerning potentially Irrigable Indian-owned fee land.

Mr. Sostrom and Mr. Bishop testified concerning Wyoming's engineering analysis for the Indian-owned fee lands claimed to be "potentially irrigable." Mr. Sostrom was admitted as an expert in engineering design and construction and construction cost estimating and has had many years of experience in both of these fields while in Wyoming. Mr. Bishop was admitted as an expert in water resource engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and his tenure as the Wyoming State Engineer.

21-4 Tr. 12568-12577, 12611, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1; Tr. 12134-12140, 12152, 13691-13693, 13702-13705 (Bishop); Wyo. Exh. WRIR HFB-1.

21-5 Tribes' conclusions for Potentially Irrigable Indian-owned fee land.

Mr. Higginson's conclusions with respect to the acreage and water requirements for the claimed "potentially irrigable" Indian-owned fee land may be summarized as follows:

	Acreage	Diversion Requirement (acre-feet)
Potentially Irrigable Indian-Owned Fee	3,943	17,344

21-5 Tribes' Exh. 8, Appendix C. Mr. Higginson testified that of 14,544 acres he studied, 6,431 acres were "I" (irrigated) land, 3,943 acres were "P" (potentially irrigable) lands and 4,170 acres were "N" (nonirrigable) lands. Tr. 8071-72 (Higginson).

21-6 Court's conclusion re: acreage and water requirements for claimed Potentially Irrigable Indian-owned fee land.

The Court finds the following to be the irrigable acreage and corresponding water requirements for the claimed "potentially irrigable" Indian-owned fee lands:

Description	Acreage	Net Irrigation Requirement (acre-feet)	Diversion Requirement (acre-feet)
Higginson Tracts 69, 96 and 97	191	324.7	649.4

These tracts were included in the designs developed by Mr. Bliesner.

21-6 Higginson tracts 69, 96 and 97 are located within the Big Horn Flats Addition, one of the additional proposed projects designed by Mr. Bliesner. As such, they were included in Mr. Bliesner's engineering analysis. Tr. 8281 (Bliesner). The acreage has been reduced to comply with the project design developed by Mr. Bliesner. The water requirements were determined in accordance with the assumption previously adopted in Finding of Fact 18-20. See Wyo. Exh. WRIR FFB-3.

21-7 Lack of economic analysis results in no reserved water decreed.

The Court finds that an incomplete engineering analysis and no economic analysis was performed for the remainder of the acres claimed as "potentially irrigable" Indian-owned fee lands and therefore the Court is unable to decree any reserved water rights for these lands.

21-7 Mr. Higginson was not tendered or accepted by the Court as an expert in soils science, agricultural engineering or economics, yet he purported to combine all these fields in making his conclusions with respect to the claimed "potentially irrigable" Indian-owned fee lands. Prior to the engineering analysis, there must be a soils analysis to determine the arable land base. Mr. Higginson read through a few reports and decided to do this himself. However, land which he determined to be potentially irrigable in some cases had depths to barrier of only 20 to 40 inches, much less than the 72 inches required by the United States' soils experts and the 84 inches preferred by Wyoming's soils experts. Tr. 8223-8225 (Higginson).

Tracts 5, 8, 9, 11, 13, 14, 30, 31, 37, 66, 91, 101, 106, 108 and 116 have all or a portion of their acreage classified as Class 6, nonarable by either the Bureau of Reclamation or HKM Associates. Tr. 11165 (Sommers). Mr. Higginson relied on the 1962 BIA Soil and Range Inventory to evaluate the arability of many of the acres in tracts he surveyed. This publication provides insufficient data upon which to base arability determinations. U.S. Exh. WRIR C-43; Wyo. Exh. WRIR SS-H; see also Finding of Fact 15-2.

Finding of Fact 15-1 et seq. makes it clear that a complete engineering analysis and a determination of costs are essential to the quantification of practicable irrigable acres. Mr. Higginson made virtually no attempt to detail the existence of or need for irrigation system facilities. He made no investigation to determine whether existing ditches had sufficient capacity to serve the claimed "potentially irrigable" lands. In fact, six to ten of the tracts Mr. Higginson evaluated had no existing facilities to convey water. Tr. 8197, 8200 (Higginson). Without designing irrigation systems, it becomes impossible to proceed to the next steps in a complete engineering analysis, i.e., the determination of water requirements and costs.

Mr. Higginson made no attempt to determine the drainage requirements for the lands he classified as "potentially irrigable," nor did he determine whether solving drainage problems was within the economic capability of the lands. Tr. 8152-8237 (Higginson). As a result of Mr. Higginson's incomplete engineering analysis, he was unable to determine the costs of bringing these lands into production and consequently no economic analysis was performed. Tr. 8057-8058, 8095-8096 (Higginson).

Without an economic analysis, the Court is unable to classify these lands as practicably irrigable and thus the Tribes' claim to water for these lands must be denied.

Note: The State of Wyoming has intentionally submitted no Findings of Fact, numbered 22-1, et seq.

Findings Of Fact
Relating to
Type VII Lands

23-1 The United States' claim.

During its case-in-chief, the United States claimed the right to divert 48,380 acre feet of water annually to serve 8002 acres of historically irrigated but presently idle Type VII land.

23-1 Wyo. Exh. WRIR HS-4.

23-2 United States' experts re: land classification.

The arable land classification of Type VII land was performed by HKM Associates. The United States presented the testimony of Mr. Ross Waples in support of its claim. Mr. Waples relied on Mr. Toedter for opinions concerning drainage. Although Mr. Waples lacks a great deal of experience, he is more qualified to present opinions on arable land than Mr. Kersich and the Court accepted Mr. Waples as an expert in land classification and soil science.

23-2

Mr. Waples has no experience in Wyoming or in the vicinity of the Wind River Indian Reservation except for work done in conjunction with this case. U.S. Exh. WRIR C-157; Tr. 3289 (Waples). Mr. Waples has never testified previously as an expert witness regarding land classification work. Tr. 3303 (Waples). Nevertheless, the Court admitted Mr. Waples as an expert in land classification and soil science. Tr. 3315 (Waples).

23-3 Deficiencies of United States' arability studies for Type VII lands.

The Court finds that the arability conclusions of the United States' experts for Type VII lands are deficient in many of the same aspects as the United States' arability study of the future project areas. Specifically, definitions, standards, and methodology are inadequate. In addition, the Court finds that the HKM Type VII arable land study is further incapacitated by an unwarranted relaxation of arability standards for non-project areas and the failure of HKM to follow the standards set forth.

23-3 The HKM historic lands investigation consisted of virtually the same techniques as used by HKM for the future lands study. With exception of drainage considerations and tillage standards, the land classification standards are identical for the two studies. The definitions, land classes, and general methodology are nearly identical for the two studies. The deficiencies of the future lands in these aspects have been discussed at length in Findings of Fact 18-3 through 18-8. Thus, the historic lands study is very similar to the future lands study, and is likewise deficient in these aspects. U. S. Exhs. WRIR C-226 (pp. 1-17); C-43 (pp. 1-25); Tr. 10797 (Sommers).

As with the future land study, the historic land drainage standards vary considerably from the Bureau of Reclamation standards. In an attempt to justify the differences, Mr. Waples contends that HKM's premise and end point are different from those of the Bureau; thus, different standards. He further states that the HKM historic study deals with large scale farm development rather than individual units. Tr. 3488 (Waples). However, he later stated that the HKM historic lands are small individual tracts and that the Bureau of Reclamation study deals with large scale projects. Tr. 3516 (Waples).

The non-project land classification standards are based on the project land classification standards. However, the non-project standards are more lenient than the project standards for tillage and drainage considerations. The relaxation of standards in these two areas was based on observations of currently irrigated lands which did not meet project standards. Drainage requirements were deemed unnecessary and the depth to barrier standard for Class 4 was reduced to 4 feet. In addition, the requirement of minimum depths of "good, free-working soil" was deleted. Tr. 3335-3336 (Waples); U.S. Exh. WRIR C-226 (p. 14). Therefore, although HKM stated that "stringent land classification standards were necessary" for the historic lands study, the standards were in fact relaxed and land classification determinations were subject to the classifier's judgment in the field. U.S. Exh. WRIR C-226 (p. 2); Tr. 3417-18, 3468, 3517, 3607, 3488 (Waples).

Mr. Sommers felt it was improper to exclude the drainage requirement and depth of good free-working soil in non-project lands and standards. Tr. 11138-39 (Sommers). One example of an errant result for relaxing the non-project standards was observed on Mr.

Enos' farm where he stated that he had no intention of ever irrigating a portion of his Type VII land because it was "too rocky." Tr. 11139 (Sommers).

In some cases, HKM failed to follow their own standards. For example, Mr. Waples used his own judgment rather than HKM standards in determining arability of parcels with high alkalinity. Tr. 3601-13, 3665-73 (Waples). In addition, Mr. Waples classified 41 tracts less than 5 acres in size in violation of the standards. These tracts total 102.5 acres and require an annual diversion of 592.2 acre feet. U. S. Exh. WRIR C-226 (Tables 1, 5, 6 and 7). Also, Mr. Waples did not adhere to the minimum tract size standards for twelve tracts, classified Class 2 gravity, less than 10 acres in size. The tracts are 1-50X, 2-34X, 2-35X, 3-3X, 7-10X, 7-12X, 16-14X, 15-3X, 15-4X, 18-4X, 35-2X and 35-3X. U.S. Exh. WRIR C-226 (Tables 6 and 7).

23-4 Eliminating Class 4 lands from Type VII lands.

The Court finds that Class 4 lands should be excluded from Type VII lands. The exclusion of Class 4 lands results in the elimination of 1,481 acres with a total annual diversion requirement of 8,266.9 acre feet from the irrigable acres claimed by the United States.

23-4 The Bureau of Reclamation requires special engineering and economic analysis to support the inclusion of Class 4 land in a determination of arability. Wyo. Exh. SN-5 (Section 115.4.2B). Mr. Waples admitted that he and HKM did not conduct specific engineering and economic analysis prior to including Class 4 lands in the arable base. Tr. 3546 (Waples).

The Bureau of Reclamation down-classed most Class 4 land to Class 6 in their drainage investigations on the Federal Irrigation Projects on the Reservation. Wyo. Exh. WRIR SS-A6 (p. 7). In addition, the Bureau has never mapped Class 4 land in anticipation of irrigation on the Wind River Indian Reservation and adjacent areas. Wyo. Exhs. WRIR SF-1, SS6, SK-10.

23-5 Drainage problem.

Drainage is a pervasive problem within the historically irrigated Type VII areas on the Wind River Indian Reservation and particularly within the Federal Irrigation Projects.

23-5 The Bureau of Reclamation drainage investigations of the Wind River Irrigation Project on the Wind River Indian Reservation during the 1960's found drainage to be a pervasive problem. The drainage investigations were conducted on currently irrigated areas within the Federal Irrigation Projects of the Reservation. The investigations were on soils with a high water table and a general seep condition. Tr. 10997-11000 (Sommers); Wyo. Exh. WRIR SS-6. The currently irrigated land on the Wind River Indian Reservation is recognized to be in need of "full scale reclamation" including installation of drainage. U.S. Exh. WRIR C-150 (p. IX.15).

Additionally, there is a problem with high water table on Type VII lands. HKM failed to study or profile the existing water table within the Federal Irrigation Projects on the Wind River Indian Reservation. In many cases the HKM logs on Type VII and Type VIII lands note a shallow depth to water table of one to four feet. U.S. Exh. WRIR C-228A. Also, problems with water table are prevalent on Type VII lands since most are surrounded by irrigated lands or lie adjacent to streams. Tr. 10999 (Sommers). Mr. Stetson agrees that water table information is necessary for engineering design. Tr. 5538 (Stetson).

23-6. Problems with United States' drainage analysis.

The Type VII historic lands have the same drainage analysis problems as the future lands. The drainage analysis problems include:

1. The inadequacy of the drainage standards,
2. The unreasonably inadequate intensity of investigation in light of the history and geologic complexity of the area,
3. The lack of uniformity within study areas,
4. The inaccuracy of some data,
5. The reliance of HKM on information not supportive of final conclusions,
6. The consideration by HKM of select information,
7. The subjective selection of some information to support arability of lands which would have been classified nonarable.
8. The reliance on information from nonarable land and the absence of data on some areas to support arability.

In addition, the drainage investigation intensity is even less than for the future lands study. Also, there are cases within the historic lands study with average hydraulic conductivity and depth to barrier values simply assigned to meet minimum standards without supporting evidence.

23-6 Virtually all of the same drainage analysis deficiencies exist for Type VII lands as occur on the future projects. Tr. 10997 (Sommers). In addition, the drainage investigation intensity for the Type VII lands is even less than for the future lands and is far less than reasonable for a reliable investigation in an area with pervasive problems. About 7,221 acres of land classified as arable Type VII and Type VIII land are scattered throughout approximately 80,000 acres of drainage investigation study areas. Throughout the 80,000 acres only 54 holes are listed as relied upon by Mr. Toedter to determine the average depth to barrier and hydraulic conductivities for the study areas. This converts to an intensity of one hole per 1,480 acres. Of the 19 study areas delineated in the drainage investigation for the historic lands, 5 contain only one hole and 8 contain only two holes relied upon to determine the average depth to barrier and hydraulic conductivity. U.S. Exh. WRIR C-226 (p. 39); U.S. Exh. WRIR C-241B; U.S. Exhs. WRIR C-237 through C-240.

The investigation intensity is even less for the study areas which contain a very large area with very little investigation. For example, the Upper Wind Area 1

contains about 10,000 acres with only one hole relied upon to determine average hydraulic conductivity and depth to barrier. The one hole has a shale barrier at 8 feet. This level of investigation is far less than reasonable for a reliable investigation. U.S. Exh. WRIR C-241B. U.S. Exh. WRIR 237A.

In some cases within the historic lands area the conclusions regarding average hydraulic conductivity and depth to barrier are simply values assigned to meet minimum standards with no supporting evidence at all. For example, the Ray and Coolidge drainage analysis study area C-3 contains 2 logged holes. Both holes were assigned a hydraulic conductivity of 0.1 inch per hour as was the study area. Mr. Toedter stated that for a soil with the minimum hydraulic conductivity of 0.1 inch per hour, a minimum depth to barrier of 30 feet would be required to meet the minimum 200 feet drain spacing standard. One of the holes occurring in study area C-3 was logged to a depth of 10 feet without reaching barrier and the other hole indicates a shale barrier at 34 inches. However, based on these 2 holes Mr. Toedter assigned an average depth to barrier of 30 feet for the entire study area. This value which is three times the depth

of the deeper logged hole and thirteen times the depth of the shallow hole, is the minimum depth to barrier which will allow a minimum 200 feet drain spacing for this soil. U.S. Exh. WRIR C-241B; U.S. Exh. C-228A (Photo 16-379-112, hole 9); Tr. 3739-40 (Toedter).

Another study area with an average weighted hydraulic conductivity of 0.1 inch per hour is Ray and Coolidge area R-4. This study area was also assigned an average depth to barrier of 30 feet, with the deepest logged holes only to a depth of 20 feet. U.S. Exh. WRIR C-241B.

23-7 Inadequacies of United States' arability conclusions.

The Court finds that it cannot reasonably rely on the arability conclusions of HKM for Type VII lands due to inadequacies evident in:

1. The definition of arable land and arable land classes,
2. The land classification standards,
3. The further relaxation of standards for non-project lands,
4. The failure to follow the standards,
5. The inclusion of large amounts of Class 4 land,
6. The grossly inadequate drainage investigation, and
7. The complete lack of backhoe pits.

Therefore, the Court must rely on the State's arable land base for Type VII lands.

23-7 The inadequacies have been discussed at length in previous Findings of Fact:

1. The definition of arable land and arable land classes are discussed in Findings of Fact 18-3 and 23-3.
2. The land classification standards are discussed in Findings of Fact 18-3 and 23-3.
3. The further relaxation of standards for nonproject lands is discussed Finding of Fact 23-3.
4. The failure to follow the standards is discussed in Finding of Fact 23-3.
5. The inclusion of large amounts of Class 4 land is discussed in Finding of Fact 23-4.
6. The inadequacy of the drainage investigation is discussed in Findings of Fact 18-6 and 23-6.

HKM did not use any backhoe pits in their land classification work for the historic lands. U.S. Exhs. WRIR C-226 and C-228A, C-228B and C-228C.

23-8 State's expert testimony re: evaluation of Type VII lands.

The State of Wyoming presented the testimony and exhibits of Mr. Sommers to evaluate the arability of the Type VII lands claimed by the United States. Mr. Sommers excluded land if it did not meet HKM's minimum arability standards, if it was Class 4 land, or if there was insufficient evidence upon which to determine arability. Based on Mr. Sommers' analysis, the Court finds that there are a total of 4,650.7 arable acres within Type VII lands.

23-8 Mr. Sommers' qualifications are discussed earlier in Finding of Fact 18-9. Wyo. Exh. SS-7 Rev., represents Mr. Sommer's professional opinion regarding the total number of Type VII arable acres of land in areas testified to by Mr. Waples, with a plus or minus 10% error. Land which did not meet the HKM standards, did not have a logged hole or was classified as Class 4 was excluded. Tr. 10966, 10987 (Sommers).

23-9 United States' engineering expert for Type VII lands. Mr. Thomas Stetson testified on behalf of the United States with respect to the engineering analysis performed for the Type VII lands. Mr. Stetson was admitted as an expert in engineering, although prior to this case, he had no experience in determining water requirements for irrigation in Wyoming.

23-9 Tr. 5208, 5220-5221, 5255 (Stetson).

23-10 Wyoming's engineering experts for Type VII lands.

Mr. Sostrom and Mr. Bishop testified on behalf of the State concerning their engineering analysis of the Type VII lands. The Court accepted Mr. Sostrom as an expert in engineering design and construction and construction cost estimating and he has many years of experience in both these areas in Wyoming. Mr. Bishop was admitted as an expert in water resources engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and his tenure as the Wyoming State Engineer.

23-10 Tr. 13691-13693, 12152, 12134-12140 (Bishop); Wyo. Exh. WRIR HFB-1; Tr. 12611, 12576, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1.

23-11 United States' conclusions re: acreage and water requirements for Type VII lands.

Mr. Stetson's conclusions with respect to acreage and water requirements for the Type VII lands may be summarized as follows:

	Acreage	Diversion Requirements (acre-feet)
Type VII	8,002	48,380

23-11 Tr. 5264 (Stetson). See Wyo. Exh. WRIR HSO-6A.

23-12 Calculation of water requirements.

The Court adopts the following assumptions for calculating the water requirements of irrigable acres within the Type VII lands:

1. If the Type VII lands are actually irri- gated, they will fall into the other land use types as determined by HKM in about the same proportion as unadjudicated in-use lands and that proportion is 64%, Types I, II and III, 22% Type IV and 14% Type V; and

2. A net irrigation requirement for Type IV and Type VI (partial service) lands of 30% of full supply; and

3. A net irrigation requirement for Type V (incidental or subirrigated) lands of 0% of full supply; and

4. Water short areas receive no water after mid-July; and

5. An overall efficiency of 50%.

23-12 Mr. Bishop, former Wyoming State Engineer and a person with a great deal of experience in determining water requirements in Wyoming, agrees with all five of these assumptions. He used them in calculating the water requirements for the Type VII lands. Tr. 12168, 13693-13696, 13723-13726 (Bishop); Wyo. Exh. WRIR HFB-2. The suggestion that Type IV and VI lands be given a net irrigation requirement of 30% of full supply and that Type V lands be given 0% was initially made by Mr. Robert Toedter, an agricultural engineering witness for the United States. Tr. 6938-6939 (Toedter). These figures are reasonable, especially in light of the agreement between the parties. In light of Mr. Bishop's lengthy experience in administering water rights in Wyoming, he is well qualified to say that water cutoff to water-short areas in mid-July is a reasonable assumption.

Achieving an overall efficiency of 50% is also realistic. Mr. Bishop testified that a 50% overall efficiency for the Type VII lands is realistic. Tr. 12168, 13723-13726 (Bishop). This opinion finds support from Mr. Billstein, Mr. Bliesner and Dr. Mesghinna. Although the results of Dr. Mesghinna's work as exhibited in U.S. Exh. C-245 show an overall

efficiency of about 35% (Tr. 12167 (Bishop)), his earlier work product showed overall efficiencies of 43% to 64% for the five future projects (Wyo. Exh. FM-106 submitted at Tr. 4850 is a copy of Deposition Exh. 22 from the January 20, 1981 Deposition of Dr. Mesghinna). Mr. Billstein and Mr. Bliesner both testified that efficiencies within the Reservation could be easily increased anywhere from 10 to 15% above the efficiencies used to quantify the United States' and Tribes' claims. Both testified that efficiencies of 50% were achievable. Tr. 7277-7283, 7303-7304 (Billstein); Tr. 8543-8545 (Bliesner). Efficiencies of 50% are not only achievable, but should be a minimum requirement given in this age of critical water shortage and the necessity to conserve in any way possible.

The proportioning out of the Type VII lands seems the only practical approach to determining the requirements for lands that are idle. Assuming that they will all be one type of land or another is simply impractical and unrealistic.

23-13 Court's conclusions re: acreage and water requirement for claimed Type VII lands.

The Court finds the following to be the irrigable acreage and water requirements for the Type VII lands claimed as practicably irrigable by the United States:

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
1 & 37	Ray Unit	1,109.2	1,386.7	2,773.4
2	Coolidge Unit	706.4	902.3	1,804.6
3	Subagency Unit	146.6	216.8	433.6
4	Wind River 'A' Canal	0	0	0
5	Dinwoody Bench Area	311.7	436.4	872.8
6	Johnstown Unit	51.1	75.2	150.0
7	Lefthand Unit	267.5	396.0	792.0
8	Midvale Irrigation District	0	0	0
9	LeClair Irrigation District	56.4	83.5	167.0
10	E. Fork Wind River	0	0	0
11	Dinwoody Creek	0	0	0
12	Dry Creek	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
13	Bull Lake Creek	37.3	50.4	100.8
14	Meadow Creek	51.9	65.9	131.8
15	Dry Pasup Creek	73.0	46.0	92.0
16	Crow Creek	92.2	61.1	122.2
17	Willow Creek	0	0	0
38	Sand Draw	0	0	0
19	Wind River Main Stem	178.9	247.9	495.8
30	Main Stem Big Horn River	24.2	35.8	71.6
18	Cottonwood Creek	53.9	41.0	82.0
20	Muddy Creek	103.3	74.2	148.4
21	Five Mile Creek	0	0	0
22	N. Fork Little Wind River	132.1	165.1	330.2
23	S. Fork Little Wind River	0	0	0
24	Main Stem Little Wind River	214.6	322.6	635.2
25	Sage Creek	600.7	414.5	829.0
26	Crooked Creek	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
27	Trout Creek	0	0	0
28	Spring Creek	0	0	0
29	Big Horn Draw	0	0	0
37	Mill Creek	0	0	0
31	N. Fork Popo Agie River	0	0	0
32	Main Stem Popo Agie River	0	0	0
34	Main Stem Owl Creek	0	0	0
33 & 36	S. Fork Owl Crk & Tribs	35.0	24.2	48.4
35	Mud Creek	0	0	0
36	Red Creek	0	0	0
	Totals	4,245.9	5,045.5	10,080.8

23-13 Mr. Stetson relied on the United States' arable land base in performing his engineering analysis for the Type VII lands. Tr. 5226-5228 (Stetson). (See Findings of Fact 18-2 through 18-11 indicating the reliability of the State's arable land base over that of the United States'.) Mr. Sostrom prepared tabulations of those acres within the Type VII lands which fall within the State's arable land base. These are the acres depicted above and listed in Wyo. Exhs. WRIR HSO-5 and HSO-9.

The determination of water requirements in this finding is based upon the assumptions in Finding of Fact 23-12 as applied to the State's arable land base located within the Type VII lands. Wyo. Exh. WRIR HFB-2; Tr. 13693-13696 (Bishop). Some of the figures for acreage and water requirements in Finding of Fact 23-13 do not coincide with the values listed in Wyo. Exhs. WRIR HSO-5, HSO-9 and HFB-2. Generally these changes reflect clerical or mathematical errors in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes. In addition to the reasons listed in support of the previous finding, there are additional problems with Mr. Stetson's analysis of water requirements:

1. Mr. Stetson relied on the climatic data used by Dr. Mesghinna on the future lands engineering analysis. Tr. 5294-5298 (Stetson). The questionable accuracy of this data makes Mr. Stetson's water demand values suspect. See Findings of Fact 18-17 and 18-18 and the reasons in support thereof;

2. Mr. Stetson made none of the assumptions listed in Finding of Fact 23-12. In fact, he assumed full service even on those lands which he knows were historically, and are presently, partial service (Tr. 5443-5447 (Stetson));

3. In calculating historic water duty, Mr. Stetson included waste water in his determinations (Tr. 5352-5358 (Stetson)); Mr. Stetson assumed full service throughout the season for water-short areas (Tr. 5511-5513 (Stetson));

4. Mr. Stetson relied on incomplete historic records and only used the period from 1938 to 1949 (Tr. 5258, 5352 (Stetson)); Mr. Stetson used efficiencies of 16.2% to 39.5% for Type VII lands within the federal irrigation projects and a figure of 35% for non-project lands (Tr. 5238, 5258 (Stetson)).

These figures are unrealistically low in light of the real need for increased efficiency in the use of water in areas where water is so vital to economic survival. Mr. Bishop's 50% figure is more in line with the necessity of water conservation.

23-14 Court's conclusions re: costs for Type VII lands.

The Court finds that the capital construction costs to be used in determining the economic feasibility of the Type VII lands are those depicted in Wyoming Exhibits WRIR HSO-6 and HSO-6A.

23-14 The cost figures in Wyo. Exhs. WRIR HSO-6 and HSO-6A were developed by Mr. Sostrom (Tr. 12650-12652 (Sostrom)). The Court finds Mr. Sostrom's figures reasonable and reliable in light of his lengthy experience in construction cost estimating in Wyoming and the realistic approach he has taken in determining costs for the claimed future lands. Mr. Stetson, on the other hand, has made some questionable assumptions that make his cost figures suspect. In calculating water requirements, Mr. Stetson considers all lands as full service even though a large percentage of the Type VII lands are probably Types IV, V and VI. At the same time, he fails to take into account any costs which will be required to bring these lands into full service irrigation (Tr. 5457-5460 (Stetson)). In determining the costs of canals or ditches and the costs of repair and maintenance necessary to put Type VII lands into irrigation, Mr. Stetson allocated part of the costs to adjacent unadjudicated in-use or adjudicated lands. By so doing, the actual costs to bring the Type VII lands into irrigation are artificially reduced, thus making them look more favorable when an economic feasibility analysis is performed (Tr. 5533-5535 (Stetson)). This approach is

inconsistent with Dr. Mesghinna's cost analysis for Type VIII lands in which he did not allocate costs (Tr. 5605-5611 (Mesghinna)).

23-15 Benefit cost analyses of Type VII lands.

The United States and the State of Wyoming both presented benefit cost analyses of historically irrigated but idle Type VII lands. In evaluating the economic feasibility of Type VII lands, both the United States and Wyoming used procedures similar to those used by their respective parties in evaluating the economic feasibility of the United States' proposed future projects.

23-15 Mr. Dornbusch's testimony concerning Type VII lands appears on transcript pages 5739 through 5762. Mr. Dornbusch testified that his cropping patterns for Type VII lands differed somewhat from those he used for the future projects (Tr. 5741), but his crop prices were identical to those he used for the future projects (Tr. 5742). He also testified that his assumed yields were the same as for the future projects except for water-short lands and Class 4 soils, for which he assumed reduced yields. Tr. 5793. Mr. Dornbusch based his flood irrigation costs for Type VII lands on publications by Wyoming's witness, Mr. Agee (Tr. 5747). His system costs were based upon adjustments to data supplied by Tom Stetson. Tr. 5755 (Dornbusch).

Dr. Jacobs' testimony concerning the economic feasibility of Type VII lands appears at 14755-14769 and 14790-14795 of the transcript.

23-16 Practicably irrigable acreage of Type VII lands. The United States and Wyoming were in agreement that at least some of the Type VII lands are economically feasible to develop in the future and thus constitute practicably irrigable acreage. The results of the United States' analysis indicate that all Type VII lands, as defined by the United States, are economically feasible and constitute practicably irrigable acreage.

Wyoming's analysis, summarized in Wyoming Exhibits WRIR EJ-16 and WRIR EJ-17, indicate that between 2,503 and 4,061 acres of Type VII constitute practicably irrigable acreage, depending upon whether a 4% or 7-1/8% discount rate is used.

23-16 The results of the United States' economic analysis of Type VII lands is summarized in U.S. Exh. WRIR C-278 (pp. 39-41). The results show that all Type VII lands have benefit-cost ratios in excess of one at a 4% discount rate.

The results of Wyoming's economic analysis of Type VII lands are summarized in Wyo. Exhs. WRIR-EJ 16 and EJ-17, at 7-1/8% and 4% discount rates, respectively. The acreage totals in EJ-16 and EJ-17 are based upon Mr. Sostrom's and Mr. Sommers' evaluation of Mr. Stetson's work. Tr. 12652 (Sostrom).

23-17 Court adopts Wyoming's findings re: practicably irrigable acreage of Type VII lands.

Consistent with the Court's findings concerning the feasibility of the proposed future projects, the Court finds that the preponderance of evidence indicates that Wyoming's conclusions concerning practicably irrigable acreage among Type VII lands should be adopted. The Court finds that there are 2,503.5 acres of Type VII lands for which benefits exceed cost at both 7-1/8% and 4% discount rates, and thus constitute practicably irrigable acreage.

23-17 Wyo. Exh. WRIR EJ-16, EJ-17. The Court should adopt Wyoming's findings regarding the feasibility of Type VII lands for the reasons set forth in Findings of Fact 18-26 through 18-32 concerning the United States' proposed future projects. Consistent with the burden of proof borne by the United States in this adjudication, the Court should require a demonstration of economic feasibility over a range of discount rates ranging from 4% to 7-1/8%, and thus conclude that the amount of practicably irrigable acres among Type VII lands is as shown in Wyo. Exh. WRIR EJ-16.

Findings of Fact
Relating to
Unadjudicated In-Use Lands

24-1 Categories of United States' historic claims

At trial, the United States' historic claim for irrigated agriculture was divided into three categories: Adjudicated lands, unadjudicated in-use lands, and historically irrigated but idle Type VII lands. Unadjudicated in-use lands were defined by Mr. Billstein as "those lands which are presently receiving irrigation water but do not lie within adjudicated water right service areas."

24-1 Finding of Fact 16-1; U. S. Exh. WRIR C-138 at p. 1, Tr. 1898-1899, 1947 (Billstein).

24-2 United States' claim

At trial, the United States presented testimony claiming reserved water rights for 34,850 acres of unadjudicated in-use Indian trust lands on the Wind River Reservation. The only witness to testify on behalf of the United States in support of its acreage claims for federal reserved water rights for unadjudicated in-use lands was Mr. Ronald Billstein.

24-2 Prior to testifying in regard to unadjudicated in-use lands, Mr. Billstein was accepted in this case as an expert in the area of water planning. Tr. 50-52, 1896. He is the division director of water resource studies at HKM and was the project manager for hydrology, water quality, soils, dam sites and system operations studies for HKM. Tr. 1895 (Billstein). The unadjudicated in-use lands study involved several other people at HKM, none of whom testified in support of the United States' claim. Messrs. Waples, Saunders and Johnston performed the majority of the study and made numerous interpretations in the field. Tr. 1899, 1928 (Billstein). Mr. Waples did testify concerning Type VII and Type VIII lands but not unadjudicated in-use lands. Tr. 3285 et seq., 3698 (Waples). Neither Mr. Saunders nor Mr. Johnston ever testified before the Master and were never qualified as experts. Mr. Billstein actually spent only three days in the field reviewing the lands, primarily from a helicopter. Tr. 1986, 2125 (Billstein).

As a result of the study conducted by HKM, Mr. Billstein concluded that there are 34,850 acres of unadjudicated in-use lands on the Wind River Indian Reservation. Tr. 1970 (Billstein), U.S. Exhs. WRIR

C-138, C-55-A, C-55-B. The acreage shown on U.S. Exh. C-55-A purports to reflect the lands depicted in blue on U.S. Exhs. C-56 through C-136. Tr. 1956 (Billstein).

24-3 Deficiencies in United States' evidence.

The deficiencies in the United States' testimony in support of its reserved rights claims for unadjudicated in-use lands fall into two general categories: (1) conceptual deficiencies, and (2) deficiencies in the facts presented.

24-3 See Findings of Fact 24-4 through 24-13.

24-4 Conceptual deficiencies.

The first category of deficiencies in the United States' claim for unadjudicated in-use lands is conceptual, involving deficiencies in its approach to reserved water rights for this category of land. The Court finds that the United States conceptual approach to quantifying reserved water rights for unadjudicated in-use lands is deficient in that it fails to establish the requisite elements of irrigability or practicably irrigable acreage, including: (1) arability, (2) engineering feasibility, (3) economic feasibility, and (4) water availability.

24-4 The United States divided its claim for irrigated agriculture into several categories of lands. However, the standard of practicable irrigability applies with equal force to each category. The elements of practicable irrigability are:

1. The lands are arable in that they are capable of supporting sustained irrigation;
2. Using current technology, engineers can design systems capable of delivering sufficient irrigation water to the lands and capable of draining excess irrigation water from them;
3. These systems and the farming units can be designed, built, operated and maintained at costs which do not exceed the returns which will be realized from the land; and
4. There exists a reliable source of irrigation water upon which prudent farmers, investors, engineers and economists would rely, when the water supply is administered in accordance with applicable law.

See Findings of Fact 15-1 through 15-27 and support therefor.

24-5 Failure to establish arability.

The Court finds that the United States' conceptual approach fails to establish the arability of the unadjudicated in-use lands. Absent a showing of arability, there can be no finding of irrigability.

24-5 As with all categories of land, before a parcel of unadjudicated in-use land can be deemed to be irrigable, it must first be shown to be arable. See Finding of Fact 15-1 et seq., supra. Mr. Waples, the United States' soils scientist, defined irrigable lands as "arable lands for which irrigation facilities are or plan to be provided." Wyo. Exh. WRIR C-226, p. 41. Arable lands were defined by the United States as "those lands which are capable of sustained irrigation. Wyo. Exh. WRIR C-226, p. 40. Inherent in this definition is the requirement that the United States provide either direct evidence establishing that the chemical and physical characteristics of the land are such that it can support long-term irrigation or they supply indirect evidence (for example, a history of successful irrigation) from which it can reasonably be implied that the chemical and physical characteristics of the soil are sufficient to support long-term irrigation. The United States failed to do either. Present use of a parcel of land, by itself, is insufficient evidence of arability to form the basis for quantifying a federal reserved water right. It fails to demonstrate directly the chemical and physical nature of the soil and it also fails to show arability indirectly because of the extended time element inherent in the definition of arability.

The United States presented no evidence of the physical or chemical nature of the soils of the unadjudicated in-use lands. Mr. Billstein expressly acknowledged that the unadjudicated in-use lands were not categorized "in terms of an arability classification." No analysis of soil or depth to barrier of the type performed on the future lands was performed on the unadjudicated in-use lands. Tr. 2622 (Billstein). This failure of the United States to provide any evidence of the physical and chemical nature is particularly surprising since such information was readily available. Despite the existence of logged soils holes in many of the parcels claimed by the United States as unadjudicated in-use, Mr. Billstein acknowledged that the soils logs were not considered in reaching his conclusions. Tr. 2206, 2399 (Billstein). Typing of the unadjudicated in-use lands was a secondary consideration to the entire analysis. The main idea was simply to map irrigation service and irrigation use. Tr. 2624, 2660 (Billstein). The United States' failure to provide any evidence showing the physical and chemical characteristics of the unadjudicated in-use lands, despite the ready availability of such information, should preclude the Court from making any findings that the unadjudicated in-use lands or parts thereof are arable.

If, as a matter of law, sufficient indirect or circumstantial evidence could be presented from which the arability of lands could be implied, the United States clearly failed to present such evidence in the present case. This deficiency in the United States' evidence stems from the "long-term" element inherent in the definition of arability. None of the material considered by HKM was sufficient to satisfy the requirements of the long-term element of arability.

In determining whether lands were in-use, Mr. Billstein relied, in part, on infrared photography. However, Mr. Billstein acknowledged that the infrared photography he used in his unadjudicated in-use lands analysis merely showed what a parcel looked like on that particular day at that particular time. Tr. 2610 (Billstein). Similarly, for the black and white aerial photography from Horizons, Mr. Billstein acknowledged that the aerial photograhs merely reflect the condition of the land on one day. Tr. 2620 (Billstein). In fact, Mr. Billstein admitted that HKM made no study of the long-term irrigation of unadjudicated in-use lands. Tr. 2145 (Billstein). They made no determination of the amount of land in-use in any year other than 1980. Tr. 2651 (Billstein).

The United States' approach to its future lands claim stands in monumental contrast to the approach taken with the unadjudicated in-use lands. In the future land analysis, the United States sought to determine the arability and irrigability of the land over the 100-year period of the proposed future projects. For the unadjudicated in-use lands, however, the United States appears completely satisfied with merely looking at the land for a single moment in time or, at most, a single year. Such a brief period of consideration is clearly insufficient to satisfy the long-term aspect inherent in the definition of arability.

This deficiency in the United States' analysis is particularly surprising in view of Mr. Billstein's admission that agriculture is dynamic and therefore different amounts of acreage are in-use in any one year. Tr. 2649, 2650 (Billstein). Even without a physical/chemical analysis, perhaps a series of photographs or field observations over a period of numerous years might be sufficient to establish a presumption that the land could support long-term irrigation. However, the United States' experts' observations at one point in time or, at most, in a single year are clearly deficient to establish any

such implication. Therefore, the evidence presented by the United States in support of its unadjudicated in-use claim is conceptually deficient to establish arability. The United States' failure to present sufficient evidence to establish the arability of the unadjudicated in-use lands precludes the Court from awarding any quantity of water to those lands under a federal reserved water right. Absent a showing of arability there can be no showing of practicable irrigability.

24-6 United States' engineering expert.

Mr. Thomas Stetson testified for the United States with respect to the engineering analysis performed for the unadjudicated in-use lands. Mr. Stetson was admitted as an expert in engineering, although previous to this case, he had no experience in determining water requirements for irrigation in Wyoming.

24-6 Tr. 5208, 5220-5221, 5255 (Stetson).

24-7 Failure to establish engineering element.

The Court finds that the United States' conceptual approach fails to establish the engineering element of irrigability with regard to the unadjudicated-in-use lands. Neither Mr. Stetson nor any other witness on behalf of the United States presented any evidence that the existing irrigation systems are capable of delivering a full supply of irrigation water to these lands. The mere fact of present use is insufficient to establish this essential element of practicability of irrigation. Without evidence of the engineering element, the Court cannot find that these lands are irrigable.

24-7 The definition of "practicably irrigable acreage" requires the claimant of a federal reserved water right to show that under current technology, a system can be designed that is capable of delivering sufficient irrigation water to the lands in question. See Findings of Fact 15-1 et seq. Other than observing that the lands were in-use during 1980, the United States performed no study and made no determination of the adequacy, from the engineering perspective, of the existing supply and delivery systems on the unadjudicated in-use lands. Mr. Billstein admitted that the unadjudicated in-use lands study did not involve any type of system design. Tr. 2146, 2150 (Billstein).

The fact that water was delivered to a particular parcel of land at one time in a single year is insufficient to establish the engineering element of irrigability. The testimony presented establishes at best that some water was delivered at one point in time. There is absolutely no evidence in the record regarding the capacity of existing conveyance and delivery systems nor of the present condition of the systems nor of the quantity of water that is actually being applied to a particular parcel. Thus there is

no basis in the record upon which the Court can conclude that water in sufficient quantities can be delivered to the unadjudicated in-use lands. This deficiency renders the United States' analysis conceptually inadequate. The failure of the United States to present sufficient evidence of the engineering feasibility element of practicably irrigable acreage with regard to unadjudicated in-use lands, precludes the Court from awarding any quantity of water to those lands under a federal reserved water right. Absent a showing of engineering feasibility, there can be no showing of practicable irrigability.

24-8 Limitation on engineering testimony.

The only area of engineering to which Mr. Stetson testified in connection with unadjudicated in-use lands was the duty of water. He concluded that there were 34,427 acres of unadjudicated in-use lands requiring an annual diversion of 222,915 acre-feet.

24-8 Tr. 5252-5253 (Stetson).

24-9 Wyoming's engineering experts.

Mr. Sostrom and Mr. Bishop testified for the State with respect to the engineering analysis performed for the unadjudicated in-use lands. Mr. Sostrom was admitted as an expert in engineering design and construction, construction cost estimating and aerial photointerpretation and has many years of experience in all these fields in Wyoming. Mr. Bishop was admitted as an expert in water resources engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his work experience and years of service as the Wyoming State Engineer.

24-9 Tr. 13691-13693, 12152, 12134-12140 (Bishop); Wyo. Exh. WRIR HFB-1; Tr. 12611, 12576, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1.

24-10 Calculation of water requirements.

The Court adopts the following assumptions for calculating the water requirements of irrigable lands within the United States, and Tribes claim for unadjudicated in use lands.

1. A net irrigation requirement for Type IV and Type VI (partial service) lands of 30% of full supply; and

2. A net irrigation requirement for Type V (incidental or sub-irrigated) lands of 0% of full supply; and

3. Water short areas receive no water after mid-July; and

4. An overall efficiency of 50%.

24-10 Mr. Bishop, a former Wyoming State Engineer and very experienced in determining water requirements in Wyoming, agreed with all of these assumptions, having used them to calculate the water requirements for the United States' historic irrigation claims. Tr. 12168, 13693-13694, 13725 (Bishop); Wyo. Exh. WRIR HFB-1A, HFB-1B. The suggestion that Type IV and VI lands be given a net irrigation requirements of 30% of full supply and that Type V lands be given 0% was initially made by Mr. Robert Toedter, an agricultural engineering expert for the United States. Tr. 6938-6939 (Toedter). The Court should find these figures reasonable, especially in light of the agreement between the parties. The Court should also find that a water cutoff to water-short areas in mid-July is a reasonable assumption in light of Mr. Bishop's lengthy experience in administering water rights in Wyoming.

Achieving an overall efficiency of 50% is very realistic. Mr. Bishop testified that a 50% overall efficiency could be achieved for the historic irrigation systems. Tr. 12168, 13725 (Bishop). This opinion finds support from both Mr. Billstein and Mr. Bliesner who testified that efficiencies within the

Reservation could be easily increased anywhere from 10% to 15% above the efficiencies used to quantify the United States' and Tribes' claims. Both testified that efficiencies of 50% were achievable. Tr. 7277-7283, 7303-7304 (Billstein); Tr. 8543-8545 (Bliesner). Efficiencies of 50% are not only achievable, but should be a minimum requirement given the West's critical water shortage and the necessity to conserve in any way possible.

These assumptions are applicable across the board. There is no reason to increase efficiencies for future projects and still condone past inefficiency by quantifying reserved water rights based on past inefficiency. Reserved water rights are special. They generally go to the front of the line in priority date and cannot be lost by nonuse as compared to the neighboring nonclaimed lands subject to present administration under state law. As a result, it is incumbent upon the Court to scrutinize the quantification of those rights carefully and only grant the minimal amount of water necessary to meet the purposes of the Reservation. It would not be in keeping with this careful approach to quantify water rights based on past inefficiency.

24-11 Court's conclusions re: acreage and water requirements for unadjudicated in-use lands.

The Court finds the following to be the irrigable acreage and water requirements for the unadjudicated in-use lands claimed as practicably irrigable by the United States:

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
1 & 37	Ray Unit	3,500.2	5,149.9	10,299.6
2	Coolidge Unit	2,788	4,372.3	8,744.2
3	Subagency Unit	1 526	3,005.5	6,011
4	Wind River 'A' Canal	514	639.7	1,279.2
5	Dinwoody Bench Area	2,896	5,479.3	10,970.2
6	Johnstown Unit	200	345.8	691.6
7	Lefthand Unit	418	690.7	1,381.4
8	Midvale Irrigation District	457.8	643	1,285.9
9	LeClair Irrigation District	825	1,379.1	2,758.1
10	E. Fork Wind River	7	3.8	7.6
11	Dinwoody Creek	103	67.0	134.0
12	Dry Creek	62	100.5	201.0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
13	Bull Lake Creek	11	8.9	17.8
14	Meadow Creek	154	161.3	322.6
15	Dry Pasup Creek	38	33.4	66.8
16	Crow Creek	28	22.8	45.6
17	Willow Creek	0	0	0
38	Sand Draw	0	0	0
19	Wind River Main Stem	383	568.2	1,136.1
30	Main Stem Big Horn River	0	0	0
18	Cottonwood Creek	135	41.5	83
20	Muddy Creek	572.3	291.4	582.5
21	Five Mile Creek	25	7.2	14.4
22	N. Fork Little Wind River	1,241	1,959.1	3,918
23	S. Fork Little Wind River	611	682.9	1,365.8
24	Main Stem Little Wind River	332.8	402.3	804.4
25	Sage Creek	323	146.5	292.9
26	Crooked Creek	45	59.2	118.4

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
27	Trout Creek	194	256.4	512.6
28	Spring Creek	73	129.2	258.4
29	Big Horn Draw	8	2.2	4.4
37	Mill Creek	0	0	0
31	N. Fork Popo Agie River	77	119.4	238.8
32	Main Stem Popo Agie River	19	14.8	29.6
34	Main Stem Owl Creek	0	0	0
33 & 36	S. Fork Owl Crk & Tribs	28	24.2	48.4
35	Mud Creek	129	86.2	172.4
36	Red Creek	0	0	0
	Totals	17,724.1	26,893.7	53,796.7

24-11 Mr. Stetson relied on the United States' arable land base in performing his engineering analysis for the unadjudicated in-use lands. Tr. 5226-5228 (Stetson). See Finding of Fact 24-5 and the reason in support thereof indicating the reliability of the State's arable land base over that of the United States. Mr. Sostrom prepared tabulations indicating those acres within the unadjudicated in-use lands which fall within the State's arable land base. Wyo. Exhs. WRIR HSO-3A, HSO-9 and HFB-5A.

The determination of water requirements was based upon the assumptions in Finding of Fact 24-10 as applied to the State's arable land base located within the unadjudicated in-use lands. Wyo. Exhs. WRIR HFB-1A, HFB-1B and HFB-5A; Tr. 13693-13696 (Bishop). Some of the figures for acreage and water requirements in Finding of Fact 24-5 do not coincide with the values listed in Wyo. Exhs. WRIR HSO-3A, HSO-9 and HFB-5A. Generally these changes reflect clerical or mathematical errors or roundoff in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for these changes. In addition to the reasons listed in support of Finding of Fact 24-10, the Court

should note the following additional problems with Mr. Stetson's analysis of water requirements: (1) Mr. Stetson relied on the climatic data used by Dr. Mesghinna on the future lands engineering analysis. Tr. 5294-5298 (Stetson). The questionable accuracy of this data makes Mr. Stetson's water demand values suspect. See Findings of Fact 18-17 and 18-18 and the reasons in support thereof; (2) Mr. Stetson made none of the assumptions listed in Finding of Fact 24-10. In fact, he assumed full service even on those lands which he knows were historically and are presently receiving only partial service (Tr. 5443-5447 (Stetson)); (3) in calculating historic water duty, Mr. Stetson included waste water in his determinations (Tr. 5352-5358 (Stetson)); (4) Mr. Stetson assumed full service throughout the season for water short areas (Tr. 5511-5513 (Stetson)); (5) Mr. Stetson relied on incomplete historic records and only used the period from 1938 to 1949 (Tr. 5258, 5352 (Stetson)); (6) Mr. Stetson used overall efficiencies of 16.2% to 39.5% for unadjudicated in-use lands within the federal irrigation projects and a figure of 35% for non-project lands (Tr. 5238, 5258 (Stetson)). These figures are unrealistically low in light of the real need for increased efficiency in the use of water

in areas where water is so vital to economic survival. Mr. Bishop's 50% figure is more in line with the necessity for water conservation.

24-12 Reserved rights may not be decreed where economic analysis is lacking.

The Court finds that neither the United States nor the Tribes conducted an economic analysis on the unadjudicated in-use lands listed in Finding of Fact 24-11. Without such an analysis, these lands cannot properly be classified as practicably irrigable and thus no reserved water rights can be decreed for these lands.

24-12 Mr. Stetson did not develop costs for the unadjudicated in-use lands (Tr. 5440-5441, 5491 (Stetson)). The reason Mr. Stetson gave for not developing costs was that he was not requested to do so. The definition of "practicably irrigable acreage" requires the claimant of a federal reserved water right to establish that the systems needed to irrigate and drain the lands in question can be designed, built, operated and maintained at costs which do not exceed the returns which will be realized by the sale of crops grown on the land. See Findings of Fact 15-1 et seq. This excess of returns over costs has been referred to throughout the course of the trial as "economic feasibility." Tr. 13360; see also Wyo. Exh. JK-1; counsel for U.S. and Tribes again at Tr. 13361. See Findings of Fact 15-1 et seq.

If the United States had presented sufficient evidence regarding the condition and capacity of existing supply and delivery systems, then perhaps the design and construction portions of economic feasibility could be ignored in connection with the unadjudicated in-use lands. As demonstrated by the previous finding, however, the United States failed to do so.

Even if the design and construction costs could be ignored, operation and maintenance costs would still exist. There is no evidence that the returns from the unadjudicated in use lands would exceed the operation and maintenance costs of the existing systems. No evidence was provided showing the expected operation and maintenance costs nor the expected returns from the unadjudicated in-use lands. Mr. Billstein admitted that the unadjudicated in-use lands study did not involve any type of cost analysis or system design Tr. 2146, 2150 (Billstein) and that no economic analysis was performed in connection with these lands. Tr. 2419, 2420 (Billstein).

The need for an economic analysis is not obviated by the fact that these lands were in use at one single point in time. Use at a single point in time is no evidence, much less sufficient evidence, of long term economic feasibility. An individual irrigator may only now be beginning to realize that his project is not economically feasible. The vast number of acres that the United States identified as lands that were irrigated at some point in time in the past, but now stand idle (the Type VII lands) represent a foreboding memorial to the economic infeasibility of many previous irrigation operations.

Therefore, the United States' approach to establishing all four elements of practicably irrigable acreage, including economic feasibility, simply by showing that the lands were irrigated at one point in time is conceptually deficient.

The failure of the United States to present sufficient evidence of the economic feasibility of irrigating the unadjudicated in-use lands precludes the Court from awarding any quantity of water to those lands under a federal reserved water right. Absent a showing of economic feasibility, there can be no showing of practicable irrigability.

24-13 Failure to establish water availability.

The Court finds that the United States' conceptual approach fails to establish that there exists a reliable source of irrigation water for the unadjudicated in-use lands. Absent a showing of an adequate water supply, there can be no finding of practicably irrigable acreage.

24-13 The definition of practicably irrigable acreage requires the claimant of a federal reserved water right to establish that there exists a reliable source of irrigation water upon which prudent engineers and economists would rely when the water supply is administered in accordance with applicable law. See Findings of Fact 15-1 et seq.

It is readily apparent that the mere fact that a parcel of land received water on a particular day or in a particular year is no evidence, much less sufficient evidence, to support a finding that there is a reliable source of water that could be used to irrigate the parcel over the long term. Yet, the only evidence offered by the United States was that the lands were observed to be "in use" during 1980. The failure of the United States to present sufficient evidence of the availability of water in adequate quantities during the requisite portions of the year to irrigate the unadjudicated in-use lands, precludes the Court from awarding any quantity of water to those lands under a federal reserved water right.

24-14 Factual deficiencies in the United States' testimony. The second category of deficiencies in the United States' claim for reserved rights for unadjudicated in-use lands is factual deficiencies in the testimony and exhibits presented.

24-14 See Findings of Fact 24-15 through 24-20.

24-15 Deletion of lands outside the reservation.

The Court finds that the United States can assert no claim for lands outside the boundaries of the Wind River Reservation as those boundaries were stipulated to by the United States, the Tribes and the State. All lands included by Mr. Billstein as unadjudicated in-use lands that lie outside the stipulated boundaries must be deleted from his acreage totals. This deletion amounts to 55 acres. (Tract 34-1 = 46 acres; Tract 33-2 = 9 acres).

24-15 On April 15, 1980 the United States, the Tribes and the State of Wyoming stipulated in writing to the boundaries of the Wind River Indian Reservation. Stipulation Concerning the Boundaries of the Wind River Indian Reservation. It is clear from the face of the stipulation that all of the boundaries of the Reservation are within the Wind River Meridian. See p. 1 of Stipulation. During cross-examination, Mr. Billstein acknowledged that some of the lands he had included as unadjudicated in-use had legal descriptions based upon the 6th rather than the Wind River Meridian. Tr. 2169-2177, 2186-2188 (Billstein). These lands are, by definition, not part of the Reservation and cannot serve as the basis for a federal reserved water right.

24-16 Obstacles to arability.

The Court finds that the acreage claimed by the United States to be unadjudicated in-use must be reduced by the number of acres covered by trees and brush, haystacks and stockyards, drains, ditches and canals, farm buildings and farm yards, roads, dikes, draws and ravines, stock ponds and reservoirs and the number of acres of high, dry, alkali lands. These obvious obstacles to arability amount to 6,549 acres.

24-16 There are a number of obvious physical obstacles that preclude irrigating or developing some land on the reservation. On cross-examination, Mr. Billstein acknowledged that the lands he had classified as unadjudicated in-use included some obstacles such as trees and brush. Tr. 2628 (Billstein). HKM apparently attempted to exclude some obvious obstacles such as major and secondary roads and major farmsteads. Tr. 2587 (Billstein). However, examination and review of the aerial photographs admitted as exhibits C-56 through C-136 reveal numerous obstacles that remain within the delineated boundaries of unadjudicated in-use lands. The lands include haystacks and stockyards, drain ditches and canals, buildings and farmyards, roads and dikes, draws and ravines, and stockponds and reservoirs. Tr. 2599, 2600, 2628 (Billstein). Examination of the infrared aerial photography referred to during Mr. Billstein's cross-examination reveals that he also failed to exclude several high, dry, alkali parcels. Tr. 2208, 2609, 2647 (Billstein). This last category of lands contains very little moisture or vegetation cover and therefore lacks any red color on the infrared photography. Tr. 2208 (Billstein).

Therefore the number of unadjudicated in-use acres claimed by the United States must be reduced by the number of those acres covered by the above-listed obvious obstacles to irrigation. These obstacles total 6,549 acres. Tr. 2603-2604, 2792-2800, 2885.

24-17 Inaccuracy of photographs.

In performing the unadjudicated in-use study, HKM relied heavily at several stages in their analysis on aerial photographs provided by Horizon, Inc. HKM's reliance was misplaced however, primarily because the head of HKM's study, Mr. Billstein, assumed the photographs to be of a higher degree of accuracy than they were, in fact. HKM's heavy reliance on less accurate photography renders their unadjudicated in-use lands study and the resulting conclusions suspect.

24-17 HKM's first step toward determining the number of unadjudicated in-use acres on the Wind River Reservation was to obtain a set of recent aerial photographs of the Reservation. Tr. 1901 (Billstein). Once obtained, these photographs were used throughout HKM's analysis. They also used the aerial photographs to determine study areas, analyze present use, perform a stereoscopic analysis and determine the acreage included in each parcel they identified as unadjudicated in-use by using a planimeter. Tr. 1904, 1917, 2000 (Billstein). The aerial photographs used by HKM were taken in the fall of 1979 and the early summer of 1980 by the firm of Horizon, Inc. Tr. 1901 (Billstein).

Mr. Billstein testified that it was his impression that the aerial photographs from Horizon, Inc. were individually scale rectified. He testified that the photographs were reviewed by Horizon for tilt and that a quadrangle rectification process or a linear rectification process was performed. Tr. 2000 (Billstein).

In an effort to clarify the nature and characteristics of the aerial photographs relied upon so heavily by the United States, the State called Mr. Jack Dozzi. Mr. Dozzi is the Vice-President of Operations for Horizon, Inc. of Rapid City, South Dakota, the firm from whom HKM ordered the aerial photographs that were eventually admitted as Exhibits C-56 through C-136. Tr. 11624. Mr. Dozzi was the principal in charge of filling the order requested by HKM on behalf of the United States. Tr. 11639-11640 (Dozzi)

Mr. Dozzi is a highly qualified and certified aerial photogrammetrist, having received much of his early training from Mark Hurd Aerial Surveys, a pioneer firm in the field of aerial photography. Tr. 11628. As Vice-President of Operations, Mr. Dozzi deals with over 300 aerial photography projects per year. Since 1965 Mr. Dozzi has been involved in county-wide type photography projects and the development of products for county coverage in approximately 50 counties in the mid-West and the West. Tr. 11631. Through his extensive training and expertise, Mr. Dozzi is a highly qualified expert in the field of aerial photogrammetry and was, accordingly, accepted by the Court as an expert. Exhibit DP-1, Tr. 11639 (Dozzi).

The testimony of Mr. Dozzi clearly indicates that Mr. Billstein's conclusions regarding the accuracy of the aerial photographs were incorrect. Rather than being scale rectified photos as testified to by Mr. Billstein, they were merely scale ratioed. Tr. 11645-11646, 11655, 11667 (Dozzi). The photographs are therefore correspondingly less accurate than Mr. Billstin believed them to be.

Although the difference in accuracy between a scale rectified versus a scale ratioed photograph is essentially one of degree, it is a significant difference. Tr. 11639-11708, passim (Dozzi). The primary difference between the two types is that a scale rectified photo is corrected for tilt while a scale ratioed photo is not and scale rectification of a photograph involves using a greater number of control points or cross distances than is generally used when a photo is merely scale ratioed. Tr. 11654, 11655.

The conclusion stemming from Mr. Dozzi's testimony is that the photographs relied upon extensively by HKM throughout all phases of their analysis, including boundary designation, stereoscopic analysis, land use

determinations and planimetering were less accurate than HKM and Mr. Billstein believed them to be. Tr. 11671 (Dozzi). Therefore, the factor of reliability and accuracy attributable to the aerial photographs and the acreages derived from them must be reduced accordingly.

In addition to the testimony of Mr. Dozzi, the State also presented the testimony of Mr. Dave McRobbie. Mr. McRobbie was accepted by the Master as an expert in land surveying. Tr. 11744 (McRobbie). Mr. McRobbie performed a ground verification study of the a portion of aerial photographs, checking corners, section lines, and scales generally. Tr. 11744. Due to limitations of time and access to Reservation lands, Mr. McRobbie could only review a few of the aerial photos. Tr. 11737 et seq., 11827 (McRobbie).

Based upon his admittedly limited review, Mr. McRobbie found errors in locations and distances indicated on the aerial photos of up to 17%. Tr. 11777 (McRobbie). Consequently, he concluded that planimetering these photographs would not provide accurate information of acreages. Tr. 11779 (McRobbie).

In short, the unrefuted testimony of Messrs. Dozzi and McRobbie establishes that the aerial photographs upon which the United States relied so heavily were less accurate and reliable than represented by Mr. Billstein to the Court.

24-18 Deletions from United States' claims.

The Court finds that prior to examining the State of Wyoming's independent analysis of the unadjudicated in-use lands claimed by the United States, 3579.9 acres must be deleted from the total claimed by the United States'. This figure is based solely upon data developed by the United States own experts, which shows these lands to be Class 6 and therefore nonarable. An additional 934.8 acres must be deleted from the United States' claim as a result of a variety of admissions made by the United States' experts. A contrary finding would allow the United States to assert a reserved water right based on irrigation of admittedly nonarable or otherwise deficient lands.

24-18 Mr. Craig Sommers performed a portion of the State's analysis of the United States' unadjudicated in-use lands. Tr. 12422. Mr. Sommers was previously qualified and accepted by the Court as an expert in soils science and agronomy. (Tr. 12422) Mr. Sommers reviewed all of the information that the United States' experts relied upon or prepared regarding the unadjudicated in-use lands to the extent such materials were available to the State. Tr. 12432. This information included the photographs which were placed in evidence through the testimony of Mr. Billstein as U.S. Exh. C-56 to C-136 (commonly referred to as "the hydrographic photos"), photographs provided by Mr. Waples through discovery and HKM's soils logs.

Based on this review of the United States' materials, Mr. Sommers prepared two exhibits showing the number of acres that, by virtue of the United States' own materials, should be excluded from their unadjudicated in-use claims. Wyo. Exh. SS-1000 sets forth 3,579.9 acres of unadjudicated in-use lands that the United States' materials show as Class 6, not arable. Tr. 12434. This determination was made by HKM, the United States' consultant. Tr. 12441. Exhibit SS-1001 shows

934.8 acres claimed by the United States as unadjudicated in-use lands that the United States' materials show should not be included for the various reasons indicated. Tr. 12446-12448.

Therefore, even before considering the State's independent analysis of the unadjudicated in-use claim, 4,514.7 acres must be deleted from the acres testified to by Mr. Billstein.

24-19 Wyomings' engineering expert.

Mr. Sostrom was accepted by the Court as an expert in the fields of engineering design and construction, construction cost estimating and aerial photography interpretation and analysis.

24-19 Mr. Sostrom has extensive experience in engineering, particularly in the area on and around the Wind River Indian Reservation. Wyo. Exh. HSO-1. He is presently employed by Banner Associates, Inc. as the project manager for the Big Horn Adjudication. Other than the present case, Mr. Sostrom's duties at Banner include design of miscellaneous civil engineering projects in water resources development, site grading and transportation, writing of project specifications for construction projects, and construction and contract management of construction projects.

Prior to joining Banner in 1975, Mr. Sostrom gained several years of experience at the Wyoming Highway Department, where his highway location work closely involved evaluation of irrigated lands. Since highways commonly cross irrigation projects and act as a dike and a nuisance to a rancher or irrigator, Mr. Sostrom's duties with the Highway Department required determining which lands were adjudicated, which lands were actually receiving water and how to continue to supply water to those lands with the least interruption or infringement, despite the highway. This type of work requires researching the State

Engineer's and the Board of Control's files, detailed land surveying, personal contact with irrigators regarding their system operation, estimating construction costs and a great deal of photographic interpretation. Tr. 12572-12574 (Sostrom). The similarities between the work involved with the Highway Department and the work involved in reviewing the United States' claim for historically irrigated lands are many and make Mr. Sostrom eminently qualified to render opinions on presently irrigated lands.

In addition to his experience and training as an engineer and photographic interpreter, Mr. Sostrom is intimately familiar with the Wind River Indian Reservation, having lived in the area all of his life. Tr. 12568 (Sostrom).

24-20 Wyomings' analysis.

Mr. Sostrom performed an independent analysis of the United States' unadjudicated in-use claim including a tract-by-tract analysis.

24-20 The study of unadjudicated in-use lands was conducted primarily under the auspices of Mr. Henry Sostrom. The study consisted of three parts: (1) a color infrared aerial photography study followed by (2) a black and white aerial photography study, and finally (3) a tract-by-tract analysis of the United States' claim. Tr. 12615 (Sostrom).

The purpose of the color infrared aerial photography study was to preliminarily evaluate the historically irrigated lands on the Wind River Indian Reservation. Tr. 12621 (Sostrom). The primary tool for this initial study was color-infrared aerial photography (CIR) flown between 1974 and 1979 that provided full coverage of the Wind River Indian Reservation. Tr. 12623 (Sostrom). Mr. Sostrom also utilized USGS topographic contour maps, USGS orthophoto quads, SCS-State irrigated lands study photos, BIA land status maps, and the Water Division No. 3 Adjudication Record (commonly referred to as the "Blue Book"). Tr. 12621 (Sostrom).

Mr. Sostrom conducted a very intense photo interpretation analysis on the CIR for physical evidence of presently or historically irrigated

fields. Historically irrigated fields whose outline or ditches were barely discernable from long periods of idleness were outlined and included within the total acres of the identified historically irrigated lands. Tr. 12624 (Sostrom)

The boundaries between the trust and fee lands were plotted onto the acetate overlays of the CIR on which the identified historically irrigated fields were outlined. The boundaries were established from a 1969 BIA land status map. There was no attempt at this stage to distinguish lands with adjudicated water rights from unadjudicated in-use lands, as the interest was in determining all acres on which irrigation actually has been and is being conducted.

The outlined areas were measured with a planimeter and summarized by fee and trust for each stream. The acreage total of historically irrigated trust acres which include present and past unadjudicated and adjudicated lands was 35,860 acres. Tr. 12621 (Sostrom). The black and white aerial photo study was conducted during October 1979 through mid-January 1980.

The black and white photos (scale: 1" = +/- 1000') were flown in October 1979 and June and July 1980. The same data and photographs used in the color infrared study were utilized to assist with the interpretation of the black and white photos which showed more detail than the infrared photos. Tr. 12622 (Sostrom).

The historically irrigated areas identified from the photos were outlined on acetate overlays on the black and white photos and categorized as "Presently Irrigated," "Subirrigated," "Previously Irrigated," or "Possibly Previously Irrigated." "Presently Irrigated" are lands identified as having had water applied during the season the photography was taken as well as lands appearing to be idle but estimated to have been irrigated within the most recent decade. "Previously Irrigated" lands are those identified to be idle with irrigation systems readily visible, there may be a light cover of sagebrush apparent. "Possibly Previously Irrigated" are lands for which it is difficult to conclude whether they were irrigated regularly previously. The area may now be overgrown in sagebrush, small trees, willows or appear the same as the surrounding range land, and with the outline of

the previously irrigated land generally identifiable on the photo. Tr. 12624 (Sostrom).

The fee-trust ownership boundaries were tranferred to the acetate overlays from a 1976 BIA land ownership map, from Tribes' Exh. M-1 and data from the county clerks of Fremont and Hot Springs County.

The acres for each tract were determined with a planimeter and summarized by "trust only" and "trust plus fee" for each stream. This summary appears in Exhibit HSO-H:

	Unadjudicated	Adjudicated	
Presently In-Use	26,100	5,000	31,100
Previously Irrigated	4,500	2,800	7,300
Possibly Previously Irrigated	2,100	1,100	3,200
	32,700	8,900 =	41,600

Tr. 12623 (Sostrom). Although Mr. Sostrom misspoke himself and stated that there were only 24,700 unadjudicated presently in-use lands, the State acknowledges and the Record reflects that the correct acreage is 26,100. This is substantiated in the record by the total acreage of

unadjudicated plus adjudicated presently in-use lands shown on Wyo. Exh. HSO-H to be approximately 31,100. Tr. 13632 (Sostrom)

The final stage of the State's analysis was the tract-by-tract evaluation of the United States' claims. The purpose of the tract-by-tract analysis differs from the color infrared and the black and white studies. The purpose of this final stage of the State's analysis was to determine which lands actually received water during the season the photos were flown, regardless of the land type or condition of the tract. Tr. 12747, 13026 (Sostrom).

This analysis was conducted under Mr. Sostrom's supervision by comparing the photo of each tract on the Billstein hydrographics to the State's black and white photos, to the color infrared photos, and to hand-held photographs taken by Mr. Sostrom while visiting the reservation by automobile and helicopter. Tr. 12696 (Sostrom).

Mr. Sostrom's conclusion as to the number of unadjudicated in-use acres on the reservation is set forth in Wyo. Exh. HSO-3A, which shows approximately 17,800 acres with an annual diversion requirement of approximately 54,000 acre-feet.

24-21 Court's conclusions re: acreage and water requirements. The Court adopts the State's analysis and finds that there are 17,724.1 acres of unadjudcated in-use lands on the Wind River Indian Reservation and that they are entitled to divert 53,796.7 acre-feet annually for the purpose of irrigating these lands.

24-21 The Court should adopt the State's, rather than the United States' analysis of the number of unadjudicated in-use acres on the Wind River Indian Reservation for a variety of reasons.

First, by their own admission, many of the lands included in the United States' claim for unadjudicated in-use land are nonarable. By definition, nonarable lands are not irrigable and therefore cannot qualify for a federal reserved water right based on practicable irrigability. The State excluded from its analysis all lands admitted by the United States to be nonarable.

A second, and related, reason is that the United States failed to consider all the available information, especially information and classifications developed by its own experts. The United States merely viewed the land and the aerial photos. What they did not consider was the land classification work performed by their fellow experts. In view of the State's limited access to the Reservation to do its own field study, HKM's land classification work is the most probative information

available regarding the physical or chemical nature of the land, that is, its arability. This is not to say that the State fully supports HKM's study in its entirety or that there are not problems with the study. The State relied on HKM's study only because it had no alternative and lacked the time and opportunity to perform its own study. The State considered this data in its analysis but the United States, for some unarticulated reason, chose not to do so.

Third, Mr. Sostrom is much more familiar with the area, having grown up on the Reservation and obtained much of his engineering and photointerpretation experience and training there. This familiarity with an area is increasingly important in areas such as the Wind River Indian Reservation because of the complexity of factors involved.

Additionally, Mr. Sostrom personally supervised virtually all of the State's analysis and performed much of it himself. To the extent he relied on the work of Mr. Sommers as the basis for some of that work, Mr. Sommers testified to the development of those bases.

This is in contrast to the United States' analysis testified to by Mr. Billstein. Mr. Billstein did virtually none of the original field work personally. His only personal observations were made from a helicopter during a three-day whirlwind tour of the study lands. Most of his testimony was not the result of his own work or analysis. Rather, most of Mr. Billstein's testimony was based on his conversations with others such as Messrs. Waples, Saunders, Johnston and Twitchell even though he was unable to recall the substance of those conversations on cross examination.

Combining Mr. Sostrom's greater familiarity with his own analysis and the area being studied as well as his consideration of all the pertinent information, including the United States' own land classification, the Court should adopt the results of the State's study as summarized in Wyo. Exh. HSO-3A.

Findings Of Fact

Relating To The

Indian-Owned Currently Irrigated Lands

25-1 Tribes' evidence re: arability of lands currently irrigated.

The Tribes claimed the right to divert 29,380 acre-feet of water annually to serve 6431 acres of land claimed to be currently irrigated and owned in fee by Indians. While Mr. Higginson testified concerning the arability of these lands, there is no evidence whatsoever that Mr. Higginson performed any field work, bored holes, took soil samples, or did any land classification to determine the arability of those lands.

25-1 Tribes' Exh. 8. While Mr. Higginson has many years of experience in water resource engineering and is probably well-qualified to testify in his area of expertise, he has no hands-on experience in soil science or land classification. Tr. 8051-52 (Higginson). This lack of experience is evident in his study methods. Mr. Higginson developed no standards or even guidelines upon which to base his arability study. Tr. 8166-67 (Higginson). He visited most of the tracts during the winter and made visual observations but did not auger a hole or sample the soil. Tr. 8052, 8097-98 (Higginson). Mr. Higginson relied on several government soil and land classification reports to determine arability. However, the publications upon which he relied (the Soil Conservation Service Survey of the Riverton Area and the Soil and Range Resources Inventory by the Bureau of Indian Affairs) do not contain specific information upon which arability determinations can be made. Tr. 8063, 8096 (Higginson).

25-2 Wyoming's expert re: arability of currently irrigated acres.

As an expert for the State of Wyoming, Mr. Sommers evaluated arability of the currently irrigated Indian-owned fee lands. Mr. Sommers' evaluation examined the sufficiency of information upon which Mr. Higgonson relied to determine arability. Mr. Sommers determined that the Tribes' claim of 6,431 acres currently irrigated "I" lands should be reduced by 292 nonarable or subirrigated acres.

25-2 Mr. Sommers analyzed the HKM land classification soil logs and HKM hydrographic photos (U.S. Exhs. WRIR C-56 through C-136 and C-227-1 through C-227-12) applicable to any land classified as currently irrigated "I" lands by Mr. Higginson. Mr. Sommers found that about 180 acres were nonarable Class 6 land and that about 112 acres were subirrigated. These acreages should be subtracted from the United States' claim. His evaluation and acreages are posted in Wyo. Exh. WRIR SS-1003. Tr. 12451-53, 12422 (Sommers).

25-3 Tribes engineering evidence for presently irrigated Indian-owned fee land.

Mr. Higginson also testified concerning his engineering analysis of the currently irrigated Indian-owned fee lands. Mr. Higginson was admitted as an expert in water resources engineering although during the last 25 years his work has largely been administrative and he has had little or no experience with actual irrigation system design, analysis of soils or the determination of irrigation water requirements in Wyoming.

25-3 Tr. 8050-8052, 8055 (Higginson).

25-4 Wyoming's evidence concerning presently irrigated Indian-owned fee land.

Mr. Sostrom and Mr. Bishop testified on behalf of Wyoming regarding their engineering analysis of the Indian-owned fee lands claimed to be presently irrigated. The Court accepted Mr. Sostrom as an expert in engineering design and construction and construction cost estimating; he has many years of experience in both of these fields in Wyoming. Mr. Bishop was admitted as an expert in water resource engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and his tenure as the Wyoming State Engineer.

25-4 Tr. 12568-12577, 12611, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1; Tr. 12134-12140, 12152, 13691-13693, 13702-13705 (Bishop); Wyo. Exh. WRIR HFB-1.

25-5 Calculation of water requirements.

The Court adopts herein the assumptions listed in Finding of Fact 24-10 for calculating the water requirements of the "presently irrigated" Indian-owned fee lands.

25-5 These assumptions concerning water requirements for unadjudicated in-use lands are equally applicable documenting irrigated lands owned in fee by Tribal members. There is no reason to increase efficiencies for future projects and still condone past inefficiency by quantifying reserved water rights based on past inefficiency. In this age of water scarcity, it is incumbent upon the Court to scrutinize the quantification of all reserved water rights carefully and grant only the minimal amount of water necessary to fulfill the primary purposes of the Reservation. It would not be in keeping with this careful approach to quantify reserved water rights based on past inefficiency. See also support for Finding of Fact 24-10.

25-6 Court's conclusions re: acreage and water requirements for claimed presently irrigated Indian-owned fee land.

The Court finds that the irrigable acreage and water requirements for the "presently irrigated" Indian-owned fee lands are as follows:

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
1 & 37	Ray Unit	355	650.5	1,300.6
2	Coolidge Unit	181	270.8	541.6
3	Subagency Unit	178	338.9	677.8
4	Wind River 'A' Canal	186	368.3	736.6
5	Dinwoody Bench Area	1,402	2,645.9	5,291.8
6	Johnstown Unit	0	0	0
7	Lefthand Unit	0	0	0
8	Midvale Irrigation District	1,278	2,526.1	5,052.2
9	LeClair Irrigation District	224	419	838
10	E. Fork Wind River	0	0	0
11	Dinwoody Creek	0	0	0
12	Dry Creek	48	95.1	190
13	Bull Lake Creek	0	0	0
14	Meadow Creek	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
15	Dry Pasup Creek	320	576	1,152
16	Crow Creek	0	0	0
17	Willow Creek	0	0	0
38	Sand Draw	0	0	0
19	Wind River Main Stem	179	300.7	601.2
30	Main Stem Big Horn River	0	0	0
18	Cottonwood Creek	0	0	0
20	Muddy Creek	35	63	126
21	Five Mile Creek	0	0	0
22	N. Fork Little Wind River	187	331	662
23	S. Fork Little Wind River	10	17.7	35.4
24	Main Stem Little Wind River	0	0	0
25	Sage Creek	50	31.5	63
26	Crooked Creek	0	0	0
27	Trout Creek	0	0	0
28	Spring Creek	0	0	0
29	Big Horn Draw	0	0	0
37	Mill Creek	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
31	N. Fork Popo Agie River	0	0	0
32	Main Stem Popo Agie River	0	0	0
34	Main Stem Owl Creek	330	316.8	633.6
33 & 36	S. Fork Owl Crk & Tribs	0	0	0
35	Mud Creek	0	0	0
36	Red Creek	83	158.5	317
	Totals	5,046	9,109.8	18,218.8

25-6 Mr. Higginson's conclusions with respect to irrigated acreage are unreliable for the following reasons:

(1) Mr. Higginson spent only 7 to 10 days in the field visiting 116 of 120 widely scattered tracts of land. Most of this field time was during the non-irrigation season, Tr. 8064, 8097-8098, 8116 (Higginson);

(2) Mr. Higginson did no field sampling at any of the tracts analyzed, Tr. 8052, 8097-8098 (Higginson);

(3) He used copies of Mr. Billstein's black and white hydrograhic photographs rather than color infrared photographs to determine if lands were currently irrigated, Tr. 8098-8099, 8108 (Higginson);

(4) Mr. Higginson included Type V incidental or sub-irrigated lands within his category of irrigated lands, Tr. 8145 (Higginson);

(5) Although he relied on several publications for information on the Wind River Indian Reservation, Mr. Higginson never developed any classification standards for the lands he determined to be arable, Tr. 8167 (Higginson);

(6) Mr. Higginson did not have any aerial photo coverage of tracts 4, 7, 29, 47, 103 and 107, Tr. 8109 (Higginson);

(7) He did not even visit tracts 4, 85, 89 and 120, Tr. 8110 (Higginson); and

(8) Mr. Higginson is not a soils scientist and, therefore, is not qualified to make arability determinations nor was he admitted as an expert in aerial photointerpretation. Mr. Higginson essentially tried to eliminate the role of the soil scientist in determining the practicability of irrigation by short-cutting the arability determination. For these reasons, the Court should find unreliable Mr. Higginson's determination of acreage for the "presently irrigated" Indian-owned fee lands. Mr. Sostrom, who was admitted as an expert in aerial photointerpretation and Mr. Sommers, who was admitted as an expert in soils science, provided persuasive evidence with respect to the acreage of arable and irrigated Indian-owned fee lands. Wyo. Exh. WRIR HSO-10; Wyo. Exh. WRIR SS-1003; Tribes' Exh. CS-1.

In calculating water requirements, the Court should rely on the assumptions listed in Finding of Fact 24-10. Using these assumptions and applying them to the State's determination of irrigable Indian-owned fee land, Mr. Bishop derived the figures for water requirements listed above and contained in Wyo. Exhs. WRIR HFB-4 and HFB-5A. Tr. 13698-13699 (Bishop). Some of the figures for acreage and water requirements in Finding of Fact 25-6 do not coincide with the values listed in Wyo. Exhs. WRIR HFB-4 and HFB-5A. Generally, these changes reflect clerical or mathematical errors or round-off in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes.

Apparently, Mr. Higginson did not consider any of the assumptions listed in Finding of Fact 24-10.

25-7 Lack of economic analysis results in no reserved water decreed.

The Court finds that neither the United States nor the Tribes conducted an economic analysis of the Indian-owned fee lands claimed to be presently irrigated. Without such an analysis which demonstrates the economic feasibility of long-term irrigation of these lands, they cannot properly be classified as practicably irrigable and thus no reserved water rights can be decreed for them.

25-7 See generally Findings of Fact 15-1 through 15-27. Mr. Higginson did not develop costs for the Indian-owned fee land claimed to be presently irrigated. The determination of practicably irrigable acreage requires some evidence showing that the acreage in question can sustain long-term irrigation at reasonable cost. Id. The fact that land was historically or is presently irrigated is not probative of whether the costs of irrigation were or are reasonable. Since no evidence has been put forth by the United States or the Tribes demonstrating that these lands can be irrigated at reasonable costs, there is no basis in the record upon which the Court can declare these lands to be practicably irrigable and, therefore, no reserved water can be decreed for the irrigation of them. See generally Findings of Fact 15-9 through 15-23 and reasons therefor.

Findings of Fact
Relating to the
Adjudicated Lands

26-1 In its Statement of Claims, the United States asserted the right to divert 272,324 acre-feet of water annually to service 61,486 acres of historic lands not including adjudicated lands. In presenting its claims at trial, the United States divided the historic lands into adjudicated, unadjudicated in-use, and Type VII (unadjudicated irrigable lands). The United States defined "adjudicated lands" as those lands within the historic lands study area that are "contained within certificates of appropriation of the State of Wyoming."

26-1 Tr. 1898 et seq.; Findings of Fact 16-1, 16-2.

26-2 United States' claim

Based solely on its "Amended Motion to Take Judicial Notice," the United States asked the Court to conclude that there are 16,557.54 acres of adjudicated lands on the Wind River Indian Reservation that are entitled to a reserved water right. Later, the United States tendered Exhibit WRIR 304-Adj, represented to be a compilation of the state-awarded water rights listed in the Amended Motion for Judicial Notice. Side-by-side comparison of the two documents reveals significant differences. For example, the total acreage set forth in Exhibit 304-Adj is 17,411.04 acres, over 1,000 acres less than represented in the United States' Amended Motion. The interplay between these two documents and which document controls remains unknown to the Court.

26-2 On March 9, 1981, the United States submitted a motion requesting the Master to take judicial notice that a state-certificated water right is prima facie evidence that the lands covered thereby are irrigable. See United States' Motion to Take Judicial Notice. After discovering numerous errors, the United States withdrew its original motion and, on March 16, 1981, submitted an Amended Motion to Take Judicial Notice. See United States' Amended Motion to Take Judicial Notice. The Amended Motion listed the permit number, stream source, ditch number and number of acres covered by each permit. Id. The sum of the acreages listed in the amended motion was 16,557.54 acres. This appeared to be the adjudicated acreage for which the United States asserted a reserved right until counsel for the United States tendered U.S. Exh. WRIR 304-Adj to the Master on June 16, 1981. According to counsel's representations, there should be no differences in the permits, parcels and acres listed in the amended motion and those listed in U.S. Exh. 304-Adj because the latter was merely a "housekeeping" matter.

> Just for housekeeping purposes, what I would like to do is enter a supplement to [the Amended] motion that generally sets out the permit number, the proof number, the aerial photo number that we have been using sets that out, the ditch name, we have assigned tract numbers to each individual piece, and the acres contained within each tract.
>
> Certainly it is just a housekeeping matter so we can keep track of it.

Tr. 7204 (Echohawk).

> Essentially, these exhibits that I have identified are just supplements to our briefs for ease in administration.

Tr. 7211 (Echohawk).

Side-by-side comparison reveals several differences between the amended motion and Exhibit 304-Adj, including (1) different numbers of acres for various permits; (2) different number of total acres listed; (3) inclusion of some permit numbers that had previously been excluded; and (4) exclusion of permits that had previously been included. The United States failed to provide the Court with any guidance as to the interplay between the two documents and which document controls in case of a conflict.

26-3 Deficiencies in United States' claim

The United States' claims in connection with adjudicated lands, as presented at trial, suffer from conceptual and factual deficiencies.

26-3 The same standard that is applied to all other categories of land in determining the number of practicably irrigable acres must be applied with equal intensity to the adjudicated lands in connection with which the United States has asserted federal reserved rights. The United States acknowledges that practicable irrigability, for the purpose of quantifying a federal reserved right, is defined as the ability of land to sustain long-term irrigation at reasonable cost. See Finding of Fact 15-1 and support therefor. However, the United States' presentation at trial in connection with adjudicated lands failed to satisfy even the most rudimentary requirements as discussed more fully in the following findings and support.

26-4 United States' reliance on Wyoming state law

The most significant conceptual deficiency in the United States' approach was its erroneous reliance on state water rights as the basis for a federal reserved water right. The Court finds that in awarding a state water right to cover a particular parcel of land, the State makes no determination regarding the arability or irrigability of the parcel. The failure of the United States to present any testimony regarding the arability of the adjudicated lands renders the record void of any basis upon which the Court could conclude that these lands are arable and, in turn, irrigable.

26-4 The United States acknowledged that "practicable irrigability" is the ability of land to sustain long-term irrigation at reasonable cost. Tr. 1145-1146 (Kersich); see also Finding of Fact 15-1. As demonstrated previously, this definition consists of four parts: (1) the lands must be arable in that they are capable of supporting sustained irrigation; (2) under current technology, engineers must be able to design systems capable of delivering sufficient irrigation waters to the lands and capable of draining excess irrigation water from them; (3) these systems and farming units must be able to be designed, built, operated and maintained at costs which do not exceed the returns which will be realized from the land; and (4) there is a reliable source of irrigation water. See Findings 15-1 et seq.

The United States claims state-awarded water rights to be "prima facie" evidence of "irrigability." Prima facie evidence is defined as such evidence "as will suffice until contradicted by other evidence." Angus Hunt Ranch v. REB, 577 P.2d 695, 648 (1968). Applying

the definition of prima facie evidence to the United States' definition of irrigability, the Court must resolve whether, in connection with the adjudicated lands claim, the fact that the Wyoming Board of Control adjudicated a water right covering a particular parcel of land alone constitutes sufficient evidence to support a finding by the Court that the parcel is capable of sustaining long-term irrigation at a reasonable cost. Review of relevant Wyoming law and the unrefuted testimony of Mr. Christopulos clearly require this issue to be resolved in the negative.

Under Wyoming law, there are two separate and distinct systems for adjudicating state-awarded water rights. These two systems are commonly referred to as the "permit system" and the "general adjudication system." Tr. 7766 et seq. (Christopulos). In its Memorandum in Support of

its Amended Motion to take Judicial Notice, the United States asserts that the Wyoming State Board of Control considers the irrigability of the land in adjudicating a water right under state law. See Amended Motion to Take Judicial Notice (March 16, 1981). In support of its assertion, the United States cites Wyo. Stat. 41-4-305(x), one of the statutes comprising the general adjudication system codified at sections 43-4-301 to -310. This statute is entirely irrelevant to the present case because, as testified to by Mr. Christopulos, few, if any, of the rights listed in the amended motion to take judicial notice were adjudicated under the general adjudication system. All but 5 of the 200 listed permits were adjudicated under the permit system of which section 41-4-305(x) is not a part. Tr. 7776 et seq. (Christopulos).

The only case cited by the United States, Nichols v. Hufford, 21 Wyo. 477, 133 P. 1084 (1913), is equally irrelevant. See Memorandum In Support of United States' Amended Motion to Take Notice and for Order that Adjudicated State Water Rights are

Prima Facie Evidence of Irrigability In Determining Reserved Water Rights (May 28, 1981). Although the Nichols court briefly discussed irrigability under the statute involved, that statute was part of the general adjudication rather than the permit system. Nichols involved a Board-initiated adjudication under the general adjudication system, not an individually initiated adjudication under the permit system. Therefore, the Nichols case and the statute discussed therein are not relevant to any of the state-awarded rights the United States seeks to have judicially noticed, all but five of which were adjudicated under the permit system.

In order to comprehend fully the magnitude of the United States' error in asserting that state-awarded water rights are prima facie evidence of irrigability, one must consider the process the Board of Control uses in adjudicating a water right under the permit system. The only testimony presented on this issue was that of the Wyoming State Engineer, Mr. Christopulos.

Mr. Christopulos' testimony makes it clear that in adjudicating a water right under the permit system, as was done with virtually all the rights listed in the United States' Motion, the Board of Control makes no inquiry into the irrigability of the lands involved. Mr. Christopulos testified that in adjudicating a water right for irrigation, the Board of Control does not consider the physical or chemical nature of the parcel of land involved, nor does the Board attempt to determine whether the land can support sustained irrigation, nor does the Board make any determination of the economic feasibility of irrigating the lands involved.

The obvious conclusion to be derived from Mr. Christopulos' testimony is that, in adjudicating a water right under the permit system (as was done for almost all of the rights listed in the United States' Amended Motion), the Wyoming Board of Control makes no determination of the arability of the land, its suitability for long-term irrigation or the cost of irrigation. The office of the Wyoming State Engineer and the

Board of Control make no inspections which would go to the issue of whether the lands involved are irrigable. Tr. 2459 to 2468 et seq. (Christopulos). The examination by the State in awarding a water right is limited to observing whether the water claimed in the permit was actually applied to the amount of land claimed in the permit. See Hamp v. State, 19 Wyo. 377, 118 P. 653, 656 (1911). See also Opinion of Wyoming Attorney General 31, 34 (1901).

The United States provided no testimony or other evidence to refute the testimony provided by State Engineer Christopulos. The Court cannot disregard uncontradicted testimony unless the testimony is "evasive, equivocal, improbable, impossible or inconsistent with other testimony." Yentzer v. Hemmenway, 440 P.2d 7, 12 (Wyo. 1968); Ward v. Yoder, 355 P.2d 371, 373-74 (Wyo. 1960). Mr. Christopulos' testimony was none of the above, and remains as the only testimony available to the Court on this issue.

26-5 Failure to establish arability

The Court finds that the United States' conceptual approach fails to establish the arability of the adjudicated lands. Absent a showing of arability, there can be no finding of irrigability.

26-5 As with all categories of land, before a parcel of adjudicated land can be deemed to be irrigable, it must first be shown to be arable. See Findings of Fact 15-1 et seq., supra. Mr. Waples, the United States' soils scientist, defined irrigable lands as "arable lands for which irrigation facilities are or plan to be provided." U.S. Exh. WRIR C-226 (p. 41). Arable lands were defined by the United States as "those lands which are capable of sustained irrigation. U.S. Exh. WRIR C-226 (p. 40). Inherent in this definition is the requirement that the United States provide either direct evidence establishing that the chemical and physical characteristics of the land are such that it can support long-term irrigation or they supply indirect evidence (for example, a history of successful irrigation) from which it can reasonably be implied that the chemical and physical characteristics of the soil are sufficient to support long-term irrigation. The United States failed to do either.

The United States did not directly demonstrate the chemical and physical nature of the soil nor

did it indirectly show arability because of the extended time element inherent in the definition of arability. No analysis of soil or depth to barrier of the type performed on the future lands was performed on the adjudicated lands. This failure of the United States to provide any evidence of the physical and chemical nature is particularly surprising since such information was readily available. Despite the existence of logged soils holes and land classifications by HKM in many of the parcels claimed by the United States as adjudicated lands, no witness testified and no evidence was introduced to demonstrate arability. Tr. 12450 (Sommers); Tr. 12668 (Sostrom). The United States' failure to provide any evidence showing the physical and chemical characteristics of the adjudicated lands, despite the ready availability of such information, should preclude the Court from making any findings that the adjudicated lands or parts thereof are arable. Without a demonstration of arability there cannot be a showing of practicably irrigable acreage. If, as a matter of law, sufficient indirect or circumstantial

evidence could be presented from which the arability of lands could be implied, the United States clearly failed to do so in the present case.

Although the United States relied on this type of circumstantial evidence for the unadjudicated in-use claims, at least with respect to a single point in time (1980), the adjudicated land evidence falls even short of this. Again, although there was evidence available from HKM studies indicating that at least a portion of these lands are in current use, no witness and no evidence was introduced to identify those lands. Tr. 12668 (Sostrom), Tr. 11011 (Sommers).

26-6 Failure to establish engineering element

The Court finds that the United States failed to establish engineering feasibility with regard to the adjudicated lands. The mere fact of certification of a water right does not, by itself, establish engineering feasibility. Nor was any evidence presented through Mr. Stetson or any other witness for the United States showing that irrigation systems still exist on the adjudicated lands and, if they do, that the systems are capable of delivering sufficient water to the lands. The mere fact that a system existed sometime in the past is insufficient to establish engineering feasibility today.

26-6 The United States' failure to establish the engineering for adjudicated lands is very similar to their failure to establish the engineering element of practicable irrigability for unadjudicated in-use lands. Other than observing that the parcel must have had a water delivery system on it at some point in time because it has a state-certificated water right, the United States performed no study and made no determination of the adequacy of supply and delivery systems even if such systems still exist.

At best, the fact that a state-certificated water right was awarded to a particular parcel shows that a delivery and supply system existed at one point in time. It indicates nothing about the continued viability of such system or its ability to deliver sufficient water to irrigate the parcel today.

This defect precludes the Court from awarding any federal reserved water right for these lands.

26-7 Failure to establish economic feasibility

The Court finds that neither the United States nor the Tribes conducted an economic analysis on the adjudicated lands. Neither can the economic feasibility of irrigating these lands be assumed merely because they have certificated water rights. Without such an analysis, these lands cannot properly be classified as practicably irrigable and thus no reserved water rights are decreed for these lands.

26-7 The concept of practicable irrigability requires the claimant of a federal reserved water right to establish that the systems needed to irrigate the lands in question can be designed, built, operated and maintained at costs which do not exceed the returns which will be realized by the sale of crops grown on the land. See Findings of Fact 15-1 et seq. This excess of returns over costs has been referred to through out the course of the hearings as "economic feasibility." Id.

The need for an economic analysis is not obviated by the fact that these lands were apparently in use at one point in time when the state water right was certificated. Mr. Christopulos' testimony, which was never refuted, clearly established that in certificating a water right, the Wyoming Board of Control makes no economic determinations. Tr. 2461 et seq. (Christopulos).

Mr. Stetson did not develop costs for the adjudicated lands (Tr. 5305-5306, 5489-5490 (Stetson)) because he was not requested to do so by counsel. There was no showing by the United

States that it is impossible or unreasonably expensive to develop engineering data for these lands. The fact that land was historically or is presently being irrigated is not probative of whether the costs of irrigation were or are reasonable. At least 6,510 acres of the adjudicated lands for which Mr. Stetson determined water requirements were classified by HKM Associates, the United States' experts, as Type VII (idle). Of all the adjudicated acres surveyed by the State by use of the HB-137 Map series, 56% of the land was classified by HKM as Type VII. Despite this, Mr. Stetson did not determine any costs for or perform any economic analysis of these lands. Tr. 5307-5321, 5376-5380 (Stetson).

The failure of the United States to present sufficient evidence of the economic feasibility of irrigating the adjudicated lands precludes the Court from awarding any quantity of water to those lands under a federal reserved water right. Absent a showing of economic feasibility, there can be no showing of practicable irrigability.

26-8 Failure to establish water availability

The Court finds that the United States failed to provide sufficient evidence that the quantities of water required for irrigation of the adjudicated lands were available. Mr. Stetson testified for the United States with respect to the engineering analysis performed for the adjudicated lands claimed by the United States as practicably irrigable acreage. Mr. Stetson was admitted as an expert in engineering, although previous to this case, he had no experience in determining irrigation water requirements in Wyoming.

26-8 Tr. 5208, 5220-5221, 5255 (Stetson).

26-9 United States' acreage and diversion requirement conclusions.

Mr. Stetson's conclusions with respect to acreage and water requirements for the adjudicated lands may be summarized as follows:

	Acreage	Diversion Requirements (acre-feet)
Adjudicated	17,411	97,404

26-9 Tr. 5247 (Stetson).

26-10 Calculation of water requirements

The Court adopts the assumptions listed in Finding of Fact 24-10 for calculating the water requirements of the adjudicated lands.

26-10 These assumptions concerning water requirements for unadjudicated in-use lands are equally applicable to adjudicated lands. There is no reason to increase efficiencies for future projects and still condone past inefficiency by quantifying reserved water rights based on past inefficiency. It is incumbent upon the Court to scrutinize the quantification of reserved water rights carefully and only grant the minimal amount of water necessary to fulfill the primary purposes of the Reservation. United States v. New Mexico, supra. It would violate this approach to quantify water rights based on past inefficiency. See also support for Finding of Fact 24-10.

26-11 Deletion of claimed adjudicated lands outside the Reservation

The Court finds that the United States can assert no claim for lands outside the boundaries of the Wind River Indian Reservation as those boundaries were stipulated to by the United States, the Tribes and the State.

Included in the United States' Amended Motion to Take Judicial Notice are 1,926.05 acres of lands which lie outside the stipulated boundaries of the Reservation. This acreage is therefore deleted from the United States' adjudicated lands claim.

26-11 On April 15, 1980 the United States, the Tribes and the State of Wyoming stipulated in writing to the boundaries of the Wind River Indian Reservation. See Stipulation Concerning the Boundaries of the Wind River Indian Reservation. It is clear from the face of the stipulation that all of the boundaries of the Reservation are within the Wind River Meridian. See id. at 1. The following lands have a legal description based upon the 6th rather than the Wind River Meridian and are, by definition, not part of the Reservation. Therefore, they cannot serve as the basis for a federal reserved water right. Tr. 1905, 1919-1922, 2188, 2917-2920 (Billstein); Tr. 12691, 12692 (Sostrom).

Permit Number	Proof Number	Ditch Name	Tract Number	Claimed Trust Acres
11707	14032	Typer No. 4	33-8C	64.0
6621	14024	Riggs	33-9C	27.0
Terr.	3526	Sliney and Mikkelson	34-1C	122.63
Terr.	3526	Sliney and Mikkelson	34-2C	32.0
Terr.	3527	Sliney and Mikkelson	34-3C	222.63
Terr.	3534	Padlock	34-4C	224.35
2306	6271	DeWitt	34-5C	17.0
4038	8350	Sliney No. 1	34-6C	160.0
4038	8351	Sliney No. 1	34-7C	160.0
2125E	15024	Rothwell Enlargement Enl. Sliney No. 1	$34\text{-}8C_1$	85.0
2125E	15024	Rothwell Enlargement Enl. Sliney No. 1	$34\text{-}8C_2$	233.0
Terr.	3533	Padlock	34-9C	252.0
Terr.	3534	Padlock	34-10C	41.0
Terr.	3534	Padlock	34-11C	285.44
		TOTAL		1,926.05

26-12 Errors in the motion to take judicial notice and Exhibit 304 Adj

Even if the Court were to agree in theory with the proposition that a state-awarded Certificate of Appropriation is prima facie evidence of irrigability, the Court is still unable to accept the list of water rights on the United States' Amended Motion to Take Judicial Notice or Exhibit 304-Adj because of the numerous errors and uncertainties in these two documents.

26-12 The facts which may be judically noticed by a Wyoming court are controlled by Wyoming Rules of Evidence 201. Pursuant to Rule 201, a judicially noticable fact must be "one not subject to reasonable dispute in that it is either (1) generally known within the territorial jurisdiction of the trial court, or (2) capable of accurate and ready determination by resort to sources whose accuracy cannot reasonably be questioned." Wyo. R. Evid. 201(b).

That the facts involved in the United States' Amended Motion are disputed is evidenced by the great amount of time and energy expended by the major parties in arguing the issue. See Motion to Take Judicial Notice (Mar. 9, 1981); Amended Motion to Take Judicial Notice (Mar. 16, 1981); Memorandum In Support of United States' Amended Motion to Take Judicial Notice and for Order That Adjudicated State Water Rights Are Prima Facie Evidence of Irrigability in Determining Reserved Water Rights (June 7, 1981); Wyoming's Motion to Strike the United States' Brief In Support of United States' Amended Motion to Take Judicial

Notice and For Order That Adjudicated State Water Rights are Prima Facie Evidence of Irrigability in Determining Reserved Water Rights (June 19, 1981); U.S Exh. WRIR C-303 Adj and 304 Adj ; Tr. 2469 et seq. (Christopulos); 7824 et seq. (Christopulos). See also discussions among counsel and the Master at Tr. 1886-91, 2443 et seq., 5146 et seq., 5191, 7752 et seq.

Far from being indisputably true, many of the facts the United States seeks to have the Court judicially notice are clearly erroneous based upon the documents in evidence, specifically the permits from the State Engineer's Office, as well as the testimony of George L. Christopulos.

The United States' Amended Motion contains numerous errors in the stream sources listed. Additionally, side-by-side comparison of the United States' Amended Motion to Take Judicial Notice and Exhibit WRIR 304-Adj reveals four categories of differences: (1) different number of acres for various permits, (2) different total number of acres, (3) inclusion of permits on

Exhibit 304-Adj that had been excluded from the Amended Motion, and (4) exclusion of permits on Exhibit 304-Adj that had been included in the Amended Motion. These inconsistencies are set forth in detail below:

1. Permits included in the United States Amended Motion to Take Judicial Notice, but excluded from U.S. Exh. WRIR 304 Adj:

Permit Number	Acreage
11,659	11.1
17,203	49.0
6,221	67.0
7,457	2.9
7,856	48.0
6,634	20.0
12,541	12.0
7,599	2.0
17,624	3.4
20,124	1.1
17,865	17.2
7,904	75.5
2,618E	35.0
8,242	239.33
2,943E	21.0
TOTAL	604.53 acres

2. Permits excluded from the United States Amended Motion to Take Judicial Notice, but included in U.S. Exh. WRIR 304 Adj:

Permit Number	Acreage
8,623	83.0
6,621	27.0
7,426	17.0
2,493E	21.0
8,533	70.0
8,482	239.33
13,431	10.9
2,168E	35.0
15,267	2.0
7,094	15.5
TOTAL	520.73 acres

3. Tabulation of Different Acreage Claims Between Amended Motion and U.S. Exh. 304-Adj:

Permit Number	Acres Claimed in Amended Motion	Acres Claimed in Exhibit 304-Adj.
6633-9080	50.9	346.8
6628	179.0	451.0
15697	615.3	555.93
7857	122.0	152.0
7856	48	0
12128	38	83.0
8866	81	108
12128	45	83
6588	372.2	411.9
6583	97.3	107.2
8913	87	100
16943	16.7	13
Terr.	376.26	377.26
2306	128	17
2125E	331	318
2187E	683	387.41
8721	464.41	185
12877	46	70.5

4. Differences in Acreage Totals Between the Amended Motion and U.S. Exh. 304-Adj:

In its original Motion requesting the Court to take judicial notice of state-awarded rights, the United States asserted reserved rights for a total of 16,448 adjudicated acres. In its Amended Motion, the United States asserted reserved rights for a total of 16,557.54 adjudicated acres. In Exhibit 304-Adj, the claimed acreages total 15,411.04 acres if each parcel is added separately. If, however, all of the subtotals are added, then the claim is for 17,411.04 adjudicated acres. Considering that

Exhibit 304-Adj was represented to the Court as being merely a "housekeeping" exhibit, the fact that three different totals exist within these two documents is remarkable. The Court has been provided with no guidance directing it to one figure over another and should not be forced to guess or arbitrarily select one of the three figures. This is particularly true where, as here, the figure in dispute is one the United States seeks to have the Court judicially notice. Only those facts "not subject to reasonable dispute" may be judicially noticed. Wyo. R. Evid. 201(b). However, even the United States' own documents concerning this matter are in conflict. The result is that the Court has no basis for awarding a federal reserved right for a certain number of adjudicated acres. There is no such certain number in the record established by the United States.

Perhaps it was recognition of these numerous errors that caused the United States to omit references to stream source from U.S Exh. WRIR 304-Adj. Regardless of the reason for the

change, it is clear that not only are the facts the United States seeks the Court to judicially notice the wrong type of facts, and not only are the facts hotly disputed, but the permits in evidence show many of the facts to be incorrect.

26-13 The State's engineering experts

Mr. Sostrom and Mr. Bishop testified on behalf of the State with respect to their engineering analysis of the adjudicated lands. Mr. Sostrom was admitted as an expert in engineering design and construction, construction cost estimating and aerial photointerpretation and has many years of experience in all these fields in Wyoming. Mr. Bishop was admitted as an expert in water resources engineering and has an extensive background in determining water requirements for irrigated agriculture in Wyoming as a result of his working experience and years of service as the Wyoming State Engineer.

26-13 Tr. 13691-13693, 12152, 12134-12140 (Bishop); Wyo. Exh. WRIR HFB-1; Tr. 12611, 12576, 13253-13255 (Sostrom); Wyo. Exh. WRIR HSO-1.

26-14 State of Wyoming's acreage conclusion.

Based upon the State's analysis, the Court finds at most, 4,261.6 acres of adjudicated lands that are entitled to a federal reserved water right.

26-14 Mr. Sommers and Mr. Sostrom reviewed the adjudicated lands by means similar to the State's review of the United States' material regarding unadjudicated in-use lands. This analysis consisted of three steps and was based on HKM information regarding land type for irrigated land and arability classification for nonirrigated land. Tr. 11011 (Sommers).

The first step involved a review of the HKM information regarding land type and classification of adjudicated lands. Mr. Sommers reviewed Exhibits 303 Adj and 304 Adj, the United States' maps of adjudicated lands and the tabulation of those lands, respectively. He then examined the aerial photographs that had previously been admitted as Exhibits WRIR C-36 through 136 and C-227-1 through C-227-12. Finally, he reviewed a series of Mr. Waples' work maps obtained through discovery. Tr. 11011, 11017 (Sommers). Each adjudicated parcel was indexed by land type or classification per HKM testimony and exhibits.

According to the results of this first step, presented in Wyo. Exh. WRIR SS-2, none of the adjudicated lands were classified by the United States as Type I or III. The United States classified 5,011.9 acres or 28.8% of the total as Type II lands. The remainder of the adjudicated lands are in suspect categories:

1. The United States classified 12% of the total or 2,183.1 acres as Types IV, V and VI. These land types are marginal, at best, and are entitled only to partial service, if any.

2 17.4% or 2,888.0 acres were classified by the United States as Type VII lands of which about 800 acres were determined by HKM to be nonarable. Tr. 11019 (Sommers). If there is any presumption that may be derived from the fact that a parcel of land is in-use, these lands are clearly not entitled to it. Not only are the Type VII lands not presently in-use, but they were once in-use and have since been retired. The presumption with

these lands, if any, is that they were retired with good reason and are probably not irrigable.

3. Less than 1% of the lands were classified as Type VIII with no acres determined arable by HKM. Tr. 11020 (Sommers).

4. 14.6% of the lands were untyped, thereby leaving the Court with no basis for finding them to be arable.

5. The remaining 27% or 4788.3 acres were classified by the United States as nonarable, Class 6.

Therefore, even if adjudication of a water right were prima facie evidence of irrigability, that evidence is clearly and unequivocably refuted by the United States' own analysis, at least with regard to those lands they classified as nonarable.

In the second step of its review, the State took a closer look at those lands that were by definition marginal, such as Types IV, V, and VI. The result of this second stage is set forth

in Wyo. Exh. WRIR SS-1002. Seven parcels of Type IV or V land were acknowledged by the United States to be nonarable. Six of the seven were expressly recognized as nonarable and were classified as Class 6 lands. The seventh tract, number 16-3C, was classified Type IV, but the corresponding log indicates that the parcel had "been farmed years ago" and should have been classified Type VII. Therefore, the second stage of the State's analysis requires that another 360.5 acres must be deleted from the United States' claim for adjudicated lands.

The results of the third and final stage of the State's analysis were presented to the Court in Exh. HSO 7, 2nd Rev., during the testimony of Mr. Sostrom. Tr. 12679 (Sostrom). Exhibit HSO 7 2d Rev., is a tabulation of adjudicated trust land presently irrigated by Wyoming's evaluation. Only Types II, IV, V and VII were considered at this stage, all other types having been excluded as nonarable. Type IX and Class 6 are nonarable and there were no Type VI lands. Tr. 11019 (Sommers); U.S. Exh. WRIR C-226. Of the

remaining types (II, IV, V and VII) no evidence was presented regarding their engineering or economic feasibility. The only shred of evidence that might support an inference of engineering or economic feasibility of the land is evidence that the parcel is presently being irrigated. This, by definition, excludes all Type VII adjudicated lands. Therefore, if the United States is entitled to any reserved water rights for adjudicated lands, it is limited to those adjudicated lands that are presently irrigated. The number of presently irrigated adjudicated acres as tabulated in Exhibit WRIR HSO 7, 2d Rev., is approximately 4,300 acres.

26-15 Court's acreage and water requirements conclusions

The Court finds the following to be the irrigable acreage and water requirements for the adjudicated lands claimed as practicably irrigable by the United States:

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
1 & 37	Ray Unit	169	297.4	594.8
2	Coolidge Unit	65	115.1	230.2
3	Subagency Unit	0	0	0
4	Wind River 'A' Canal	0	0	0
5	Dinwoody Bench Area	387	766.3	1,532.6
6	Johnstown Unit	0	0	0
7	Lefthand Unit	0	0	0
8	Midvale Irrigation District	0	0	0
9	LeClair Irrigation District	0	0	0
10	E. Fork Wind River	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
11	Dinwoody Creek	0	0	0
12	Dry Creek	0	0	0
13	Bull Lake Creek	0	0	0
14	Meadow Creek	161	190.3	380.6
15	Dry Pasup Creek	537	501.2	1,002.4
16	Crow Creek	599	399.8	799.6
17	Willow Creek	0	0	0
38	Sand Draw	0	0	0
19	Wind River Main Stem	383	610.9	1,221.5
30	Main Stem Big Horn River	0	0	0
18	Cottonwood Creek	75	23.6	47.2
20	Muddy Creek	672	585.4	1,170.8
21	Five Mile Creek	3	0.9	1.8
22	N. Fork Little Wind River	285	378.4	756.8
23	S. Fork Little Wind River	42	24.8	49.6
24	Main Stem Little Wind River	0	0	0

Stream No.	Description	Acreage	Net Irrigation Requirement (Acre-Feet)	Diversion Requirement (Acre-Feet)
25	Sage Creek	56	26.1	51.8
26	Crooked Creek	0	0	0
27	Trout Creek	0	0	0
28	Spring Creek	0	0	0
29	Big Horn Draw	0	0	0
37	Mill Creek	0	0	0
31	N. Fork Popo Agie River	230	365.1	730.2
32	Main Stem Popo Agie River	26	38.8	77.6
34	Main Stem Owl Creek	153.6	111.4	222.8
33 & 36	S. Fork Owl Crk & Tribs	234	218.6	437
35	Mud Creek	184	168.7	337.4
36	Red Creek	0	0	0
	Totals	4,261.6	4,822.8	9,644.7

26-15 Mr. Stetson relied on the state-awarded permits and certificates in performing his engineering analysis for the adjudicated lands. Tr. 5226-5228 (Stetson). Mr. Sostrom prepared tabulations indicating those acres within the adjudicated lands which the State's soils experts determined to be arable. Wyo. Exhs. WRIR HSO-7, HSO-9, HFB-5A.

The determination of water requirements was based upon use of the assumptions in Finding of Fact 24-10 as applied to the State arable land base located within the adjudicated lands. Wyo. Exh. WRIR HFB-3; Tr. 13693-13696 (Bishop). Some of the figures for acreage and water requirements in Finding of Fact 26-15 do not coincide with the values listed in Wyoming Exhibits WRIR HSO 7, HSO 9 and HFB 5A. Generally, these changes reflect clerical or mathematical errors and round-off in the original exhibits. Any additional changes will be reflected in Appendix 11 which details changes in exhibits and the reasons for those changes.

In addition to the reasons listed in support of Finding of Fact 24-10, there are additional problems with Mr. Stetson's analysis of water requirements:

1. Mr. Stetson relied on the climatic data used by Dr. Mesghinna on the future lands engineering analysis. Tr. 5294-5298 (Stetson). The questionable accuracy of this data makes Mr. Stetson's water demand values suspect. See Findings of Fact 18-17 and 18-18 and the reasons in support thereof.

2. Mr. Stetson made none of the assumptions listed in Finding of Fact 24-10. In fact, he assumed full service even on those lands which he knows were historically and are presently partial service. Tr. 5443-5447 (Stetson).

3. In calculating historic water duty, Mr. Stetson included waste water in his determinations. Tr. 5352-5358 (Stetson). Mr. Stetson assumed full service throughout the season for water-short areas. Tr. 5511-5513 (Stetson).

4. Mr. Stetson relied on incomplete historic records and only used the period from 1938 to 1949. Tr. 5258, 5352 (Stetson). Mr. Stetson used overall efficiencies of 16.2% to 39.5% for adjudicated lands within the federal irrigation projects and a figure of 35% for non-project lands. Tr. 5238, 5258 (Stetson).

These figures are unrealistically low in light of the real need for increased efficiency in the use of water in areas where water is so vital to economic survival. Mr. Bishop's 50% figure is more in line with the necessity for water conservation.

26-16 State water right dates binding on federal reserved water right

To the extent the United States or the Tribes are entitled to a water right based upon the award of a state water right for a particular parcel of land, the United States or the Tribes are also bound by the date assigned to the state right as the priority date of any such reserved right.

26-16 While attempting to rely on state-certificated water rights as prima facie evidence of irrigability, the United States seeks to remove itself from the state priority system. In essence, what the United States is attempting to do is to avail itself of the benefits of Wyoming state law while avoiding the restrictions that go along with it. In its Motion for Judicial Notice, the United States argues that the Board of Control determines irrigability and that it is a binding determination. When it comes to priority dates, however, the United States argues that the Board of Control's determination is not binding. The United States has provided no support for its implied assertion that it can pick and choose when it is bound by state law and the Court must therefore deny this assertion. If the United States is to be allowed to avail itself of any presumptions that might arise from Wyoming state water law, it must also be confined by the limitations of Wyoming law, including priority dates. See discussion among counsel and the Master at tr. 5150, 5151, 5153.