STATE OF NEVADA

DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES

Humboldt River Water Distribution

Part I–Problems

Part II–Priority Tables

By

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A Contribution of

The Division of Water Resources

Elmo J. DeRicco, State Engineer

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FOREWORD

Irrigation began on Humboldt River soon after the first emigrants passed through the area en route to California following the discovery of gold at Sutter Creek in 1848. The earliest use recognized by a priority is for the year 1861 and was on land situated in what was then known as Lassen Meadows. Developments proceeded rapidly during the next few years and many priorities of use were established by 1880.

Water continued to be diverted for irrigation of new lands during the nineties and the early years of the 1900's. Precipitation and runoff records indicate that a period of 15 to 20 years of rather plentiful precipitation and stream runoff began about 1890. The relatively good water supplies, plus a strong demand for hay for winter feeding of cattle, which was brought about by the hard winter of 1889–90, stimulated the demand for irrigation. Large areas of new lands were developed during the next several years.

A time of declining rainfall and stream runoff seems to have begun about 1910. The period of expanding irrigation tapered off and attention began to be directed toward the establishment and maintenance of water rights.

Proceedings were initiated by the State Engineer for an adjudication of the water rights of Humboldt River about 1903 and an order of determination was prepared by the State Engineer and filed with the court in 1925. The case was heard before Judge Bartlett, who filed his decree in 1931. The Bartlett Decree was protested, the case was reopened, and hearings were held by Judge Edwards. A number of changes were made in the Bartlett Decree which were incorporated in the Edwards Decree filed in 1935. Subsequently, efforts were made to reopen the suit but the Supreme Court refused to allow further protests and the case was declared closed in 1938.

Distribution of water in some sections on Humboldt River seems to have been initiated under the Order of Determination by the State Engineer about 1924, but the first supervising water commissioner for the entire stream system was employed in 1927. The first commissioner, J. A. Millar, served under State Engineer George W. Malone from 1927 to 1930. A. V. Tallman served under Malone from 1931 to 1933, and under State Engineer A. M. Smith in 1934 and 1935. In 1936, Millar again became supervising water commissioner under State Engineer A. M. Smith and served to 1946. He was followed by Chester Wood, who served in 1947. In

1948, George Hennen began a service which continued under State Engineers Smith, Hugh A. Shamberger, Edmund A. Muth, and Elmo J. DeRicco and continued until his appointment as Assistant State Engineer in 1963.

Each of these water commissioners has made contributions in the form of maps, charts, flow records, and experience to the problems of the distribution of the water of this river. Mr. Muth, while Assistant State Engineer, directed the preparation of the priority tables. Mr. Hennen has organized this accumulation of data and has developed a systematic and workable system of water distribution. This pamphlet and accompanying priority tables contain much of this information, and is presented to advance the understanding of the extremely complicated pattern of water rights and of the consequent problem of water distribution on Humboldt River. Such an understanding should facilitate the job of water distribution and is basic to the initiation of any broad program of development on the river.

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PART I

HUMBOLDT RIVER WATER DISTRIBUTION

By

GEORGE W. HENNEN[1]

INTRODUCTION

Description

Humboldt River, excluding Little Humboldt River and Reese River, has a drainage area above Palisade of 5,010 square miles and a drainage area below Palisade of 2,400 square miles for a total drainage area of 7,410 square miles or 4,742,000 acres. It has 30 main tributaries which, in turn, have approximately 75 tributaries. Humboldt River originates in the extreme northeastern part of the State, and runs southwesterly for a distance of approximately 1,000 miles as the stream flows in a tortuous course through, for the most part, almost level territory. Cultivated lands lie along the main stream and all of the tributaries, except where the narrow canyons or deep channels or unsuitable soils cause breaks in the irrigated areas. This is particularly notable between Lovelock and Winnemucca, between Beowawe and Carlin, and between Carlin and Elko.

The channel of the stream is deep and broad in the lower reaches and in the Battle Mountain basin. In the upper reaches of the river, the channel becomes shallow and narrow, the tributaries have considerable fall, and the water flows more rapidly than it does in the lower basin. The valleys of the tributaries, for the most part, are very shallow and narrow.

Altitude and climatic conditions vary greatly between the lower and upper reaches of Humboldt River. Also, there is a great difference in the altitude and exposure of the mountains which border the main stem of the river. This situation makes it extremely difficult to determine when the seasonal flow will begin. Runoff can begin at any time from the latter part of December to the first part of May. Also, because of the altitude and the location of the water sheds on Humboldt River there is always a second runoff which will begin between the latter part of April and the middle of May.

[1]Supervising water commissioner 1948 to 1963; presently Assistant State Engineer.

Available Water

The court has found that the water of the stream system is fully appropriated and that in the average year, as shown by the flow in the stream system, there is no surplus water for irrigation. The court makes no findings on the water available for storage in the nonirrigation season on the Humboldt River stream system. This finding is contained in Findings of Fact 44, Bartlett Decree, page 28 of the Compiled Edition, Humboldt River Adjudication.

Number of Owners and Amounts of Decreed and Permitted Water

At the beginning of the calendar year of 1963, there were 318 owners of 610 individual parcels of land that had decreed and permitted rights on the Humboldt River system. Of this total, 497 were decreed rights and 113 were permits issued by the State Engineer.

On the river below Palisade, there are about 277,027 acre-feet of decreed and permitted water on 117,428 acres of land. Of this total, Pershing County has 144,833 acre-feet of water on 40,884 acres of land from the Bartlett Decree, permits issued by the State Engineer, and from the purchase of water rights in the Battle Mountain section of the river. The Pershing County Water Conservancy District has 137,536 acre-feet of water rights on 37,086 acres of land. Under the Bartlett Decree and permits of the State Engineer, 33,300 acres were given water rights for 87,896 acre-feet of water. Subsequently, 867 acre-feet of water were transferred from 1,664 acres of land purchased for the Rye Patch reservoir site. Also, the district purchased 48,773 acre-feet of water from 32,182 acres of land in the Battle Mountain area. Except for a small amount, which is used on an acreage of land in the Battle Mountain area where physical conditions rendered transfer difficult, all of this water has been transferred to the Lovelock area.

There are in addition to the land and water in the Pershing County Water Conservancy District about 3,800 acres of land with decreed rights for about 7,300 acre-feet of water in Pershing County which receive no benefits from the water stored in Rye Patch Reservoir. About 2,500 acres of this land with decreed rights for about 3,600 acre-feet of water are located in the Imlay-Mill City area.

The following tabulation shows the acres of land with water rights and decreed and permitted acre-feet of water in the five counties in the lower river section. Usually the lower river section

is considered to be that part of the river and its tributaries below Palisade. In this tabulation, the area on the main stream and on Maggie Creek, which lies west of the Eureka-Elko County line is credited to the section below Palisade.

County	Acres of Land	Acre-feet of Water
Pershing	40,884	144,833
Humboldt	23,950	46,980
Lander	27,633	42,085
Eureka	20,235	34,427
Elko	4,726	8,702
Total	117,428	277,027

Details on the land and water rights in Pershing County are as follows:

County	Acres of Land	Acre-feet of Water
Pershing Co. Water Cons. Dist.	37,086	137,536
Other Land in Pershing Co.	3,798	7,297
Total in county	40,884	144,833

These data do not agree with the summarization of acres of land and acre-feet of water given in Findings of Fact 41 and 42, Bartlett Decree, on pages 27 and 28 of the Compiled Edition, Humboldt River Adjudication. Certain duplications in the decree increase the total of the decreed and permitted water, and some water covered by permits issued by the State Engineer is not included in the data given in the decree. Also, the transfer of water from the Battle Mountain district has resulted in a reduction in the acreage of irrigated land. Some land shown as located in the Winnemucca district in Humboldt County in the Order of Determination of the State Engineer was removed from this district and credited to Pershing County when this county was created.

Flows Required to Meet Priorities

Below Palisade: In the following tabulation are shown the flows of water required to meet the priorities for the three classes of water from Humboldt River and its tributaries below Palisade. These data do not include allowances for water for the land within Eureka County which is located on Maggie Creek and on the main stream above Palisade.

FROM HUMBOLDT RIVER

Flow in c.f.s.	Season of Use
995.920	3/15–4/28
629.857	4/28–6/13
472.679	6/13–9/15

FROM ROCK CREEK

110.947	3/15–4/28
58.711	4/28–6/13
20.726	6/13–9/15

FROM BOULDER CREEK

36.173	3/15–4/28
8.869	4/28–6/13
6.043	6/13–9/15

FROM LITTLE ROCK CREEK AND POLE CREEK

9.963	3/15–4/28
9.372	4/28–6/13
9.360	6/13–9/15

FROM PINE CREEK

48.111	4/15–5/15
44.376	5/15–6/15
42.142	6/15–9/15

Above Palisade: On Humboldt River in the district above Palisade, which includes the area in Eureka County on Maggie Creek and on the main stream, there are 389,653 acre-feet of decreed and permitted water on 148,366 acres of land. To satisfy these rights would require flows of 1,835.313 c.f.s. from April 15 to May 15, 1,559.972 c.f.s. from May 15 to June 15, and 1,485.641 c.f.s. from June 15 to August 15.

The Basin: In the entire Humboldt River basin there are approximately 666,680 acre-feet of decreed and permitted water on about 265,791 acres of land. The above figures for acres of land and the acre-feet of water for neither the upper river section nor for the total basin agree with the summation of data in the Bartlett Decree for reasons previously discussed.

Characteristics of Flow and Resulting Problems

From the above figures one can see the enormity of the rights of appropriators and that great care has to be taken in the distribution between these rights and the setting of the priorities for the rights. In setting of the priorities, time and lag of flow is a great factor and has to be taken into consideration. Also, transportation losses must be considered. It takes approximately 21 days, depending on the flow, for a head of water to flow from Palisade to Imlay. Because of this, it is seldom that the same priority can be served at Imlay that is being served at Palisade.

Because of time lag, there is also some difference in the priorities being served on the tributaries and those being served at Palisade. The higher priority is reached first on the tributaries and approximately 7 days later at Palisade, then 21 days later at Imlay. However, at the final run of the water, Imlay will have a higher priority than Palisade or the tributaries, but care has to be taken that the higher priority will last as long at Imlay as it did at Palisade and on the tributaries. These conditions are the reason for the gages that have been established. Another condition that happens quite often is that the tributaries below Palisade will contribute to the stream system and allow higher priorities to be served below or at Palisade than can be served above. If this happens, then sometime during the season the rights above Palisade have to be compensated in their priorities. Distribution to individual appropriators is considered in Part II of this report.

DECREES

Differences

The stream system has two decrees which are known as the Bartlett Decree and the Edwards Decree. The Bartlett Decree applies to and is used in the distribution of water below Palisade and the Edwards Decree applies and is used above Palisade. The main differences between the Decrees are that the Bartlett Decree incorporates the doctrine of relation while the Edwards Decree does not, and the lengths of the irrigation season and rates of flow vary in the two decrees. The Edwards Decree is the exact duplicate of the Final Order of Determination with the exception of the new land classification of the bottom lands on Humboldt River in Elko County.

The decrees provide that the length of the irrigation season below Palisade shall be March 15 to September 15, and the length of the irrigation season above Palisade shall be April 15 to August 15. This gives a continuous flow of 0.81 c.f.s. for 100 acres of ground below Palisade, and 1.23 c.f.s. above Palisade.

Three different classes of land are common to both decrees. They are: harvest lands, meadow pasture, and diversified pasture. The harvest land is entitled to 3 acre-feet per season, the meadow pasture to 1½ acre-feet, and the diversified pasture to ¾ acre-feet. The lengths of the irrigation season for the different classes of land are approximately: harvest land, 180 days below Palisade and 120 days above; meadow pasture, 90 days below Palisade and 60 days above; diversified pasture, 45 days below Palisade and

30 days above. The corresponding dates for the irrigation seasons in the lower and upper sections are: harvest land, March 15 to September 15 and April 15 to August 15; meadow pasture, March 15 to June 13 and April 15 to June 15; diversified pasture, March 15 to April 28 and April 15 to May 15.

In most cases under the Bartlett Decree the water rights are appurtenant to the land and irrigation is confined to the land described in the decree. Under the Edwards Decree the water right lands are not specifically described, but the water rights are appurtenant to the lands included in groups of legal subdivisions. These lands are shown in the decree as enclosed by brackets and are commonly referred to as "bracketed" land. The rights are limited to the aggregate acreage of land and quantity of water indicated in the decree for each bracket. Some lands under the Bartlett Decree are bracketed and these lands are handled in the same manner as the lands under the Edwards Decree. Under both decrees, the measurement of the amounts of water diverted are to be made at the point where the main ditch enters or becomes adjacent to the land to be irrigated, or as near thereto as practicable.

Order of Right

The order of the right of the respective appropriators of the water of Humboldt River and its tributaries, and the order in which they are entitled to divert and use the water is according to the date of the relative priority of the right as set forth and determined in the decrees. The first in order of time according to the date of the relative priority is the first in order of right, and so on down from the date of the first to the date of the last priority. At all times the water diverted shall be beneficially, economically, and reasonably used without waste by those having a right to do so by reason of priority of their right.

Agreements between water right appropriators that are included in the two court decrees or that have been filed with the court in conformity with the decrees are treated as any other right included in the decrees. Agreements not mentioned in the decrees are recognized by the State Engineer if they do not hurt a third party.

ITEMS IN DECREES WHICH NEED COURT DETERMINATION

In the court decrees there are statements which raise questions and need court interpretation. Decisions on some of these questions could have far reaching effects on the water rights and land values of some appropriators. Adverse effects on the affected ranch properties could have a depressing influence on the economy not only of the counties concerned, but of the entire State.

Flash Streams

Need for Legal Determination: One particular point that needs court interpretation concerns flash or flush streams, which streams are given particular attention in the decrees. These are streams which have an early flush flow from melting snows, but have little runoff from the late snow melt. The decrees indicate that such streams are entitled to special consideration and should be permitted to accumulate the flow during the flush.

Flash flow streams are described in Findings of Fact 46, page 29, Compiled Edition, Humboldt River Adjudication, Bartlett Decree as modified by Edwards, Intervening Orders, page 9. "Flash streams" are streams that have a sudden flash flow or flush flow for a comparatively brief period of time, while such stream is draining the particular basin or source of supply fed by melting snows. Periods of flush flow in so-called flash streams are more particularly noted in Findings of Fact No. 38. The Bartlett Decree further states that "These flash streams in varying degrees are typical of the necessity of cumulating the flow during the flush for the particular rights to be served. When lands are entitled to irrigation from such flash streams, they must be served when the water is available." Findings of Fact 38, Bartlett Decree, page 23, Compiled Edition, Humboldt River Adjudication, lists and describes the characteristics of the flow of each tributary of the Humboldt River system.

In view of the court's description of a flash stream, appropriators on these streams want to use the water that is flowing in them at any time of the year regardless of the priority that is being served on the Humboldt River system. One can readily see, if this were allowed, what would happen to the water in Humboldt River available for delivery to earlier priorities.

Interpretations of State Engineer: The State Engineer has made an interpretation of the statement in the decree and has been handling flash streams in accordance with this interpretation. Court action on this interpretation to provide a permanent

ruling which could not be influenced by the changing of State Engineers would be desirable. Such action has been contemplated, but has not been taken. In his interpretation of flash streams, the State Engineer agrees that the water on a flash stream must be used when it is available in the stream. He maintains, however, that the water cannot be diverted unless the property to be served is in priority for water and is entitled to such water by priority. The State Engineer will allow users on the flash streams to use the water at any time of the year, if they are in priority with a priority that is being served on the stream system, but not otherwise.

The State Engineer maintains that the word "entitled" in the Bartlett Decree must be construed in its broadest sense. His position is that priorities are paramount and govern the distribution of all the water of the Humboldt River system including the so-called flash streams. He feels that the second paragraph of the Bartlett Decree given on page 241, Compiled Edition, Humboldt River Adjudication, is the controlling factor in water distribution. This paragraph reads as follows, "that the order of the rights of the respective appropriators of the water of said stream and its tributaries, and in which order they are entitled to divert and use the said water shall be and is according to the date of the relative priority of the right as herein set forth and determined, and the first in order of time according to the date of relative priority shall be and is the first in order of right, and so on, down to the date of the last priority, and those having prior rights are entitled to divert and use the waters of said stream and its tributaries when necessary for the beneficial use in connection with the irrigation of their respective lands, or other useful and beneficial purposes for which they are decreed a right of use, at all times and against those having subsequent rights, without hindrance, and whenever the water is not required by the appropriator having a prior right to its use for the purpose for which said water was appropriated, he must and shall permit it to flow down in the natural channel of the stream as it was wont to flow in its natural course, without hindrance or diversion thereof, and those having subsequent rights are entitled to the use of such water and to divert the same to the extent of their rights of appropriation, according to the order of their priority rights; and at all times the water diverted shall be beneficially, economically and reasonably used without waste by those having a right to do so by reason of the priority of their rights."

Return Flow

Court Findings: Return flow was previously mentioned in the setting of priorities and is a point that is continuously arising between the State Engineer and the appropriators. The court states that the water commissioner shall take into consideration return flow in the distribution of the water. "The Court found and it has in mind the narrow valleys creating a condition whereunder the water is not taken to any considerable distance from the bed of the stream or its tributaries. It has in mind that under these conditions there is a greater portion of return flow, varying under the testimony from the State Engineer's own estimates of 40% to estimates of 70% to 80%. For this reason the major irrigation in the upper district results in great return flow to the main streams." Undoubtedly there is great return flow on the system. If there was not then the stream would be highly overappropriated.

Some appropriators, because of the language in the decree, feel that individual records of return flow from each ranch should be kept. Also, that the ranch should be credited with the measured return flow from the ranch and that the head of water being delivered to the ranch should be increased by the amount of return flow from the ranch. The State Engineer does recognize return flow, but in a different way than the appropriators want it recognized.

In his method there is no measurement made or record kept of the return flow from each individual ranch. The costs of determining such flows and keeping such a record would be prohibitive. However, the return flow from all ranches is in the inventory of the water available for distribution. If the inventory of water is raised by the return flow from the ranches, the priority being served on the entire system is raised. Thus each individual ranch comes in for more water in accordance with his priority and the number of acres of ground under the priority being served. If the water available for distribution is over 100 percent of all priorities on the system, then each individual ranch is allowed to divert over his 100 percent of right. We might assume, for example, that a ranch is diverting 150 c.f.s., which is less than the quantity permitted under its 100 percent priority, and at the same time is returning 100 c.f.s. to the stream system. Under the State Engineer's method, no credit is given this individual ranch for its return flow and it is not permitted to divert additional water because of the return flow from the ranch. Instead of individual

accounting of return flows, the return flows from all ranches are added to the natural flow of the stream and the priority of the entire stream system is set on the basis of the total quantity of flow thus obtained. The amount of water available for distribution from the records of natural stream flow plus return flow might be sufficient to permit setting priorities at 100 percent, or even more than 100 percent, of the total water rights. In this case, the ranch in this example, together with all other ranches on the stream system, would be allotted sufficient water to bring its diversion up to the quantity permitted under the established priority.

Administration of Tributaries

The policy of the State Engineer has been to separate a tributary from the Humboldt River system if its waters were not reaching the river in sufficient quantity to be of beneficial use to the users of the river system. Prior rights of appropriators on the main stream over the appropriators on the tributary are disregarded. The waters of a tributary, after separation, are distributed between appropriators according to their priorities.

Stock Water

The legal basis for the distribution of stock water to appropriators of irrigation water is laid in a section of the Bartlett Decree, found on page 243 of the Compiled Edition, Humboldt River Adjudication. This section reads as follows: "It is further ordered, adjudged and decreed that all claimants herein for water for irrigation shall be entitled to use such water for stock and domestic purposes; that the rights to the diversion and use of the water for stock and domestic purposes shall be continued by such claimants and such water users at any time during the year, and such diversion shall be according to the date of the priority of such claimants and such use shall be limited to the quantity of water reasonably necessary for domestic purposes. That during the irrigation season the amount of water diverted for irrigation purposes shall not be increased by any amount to be used for stock and domestic purposes but the quantity allowed and diverted for irrigation during the irrigation season includes the water for stock and domestic purposes."

Because of the above statement in the decree many appropriators feel that they are entitled to stock and domestic water at any time of the year, regardless of their priority.

The State Engineer has held that during the irrigation season if an appropriator is not in priority for irrigation water, he is not in priority for stock and domestic water. After the irrigation season the State Engineer has been distributing the stock water between the users on the tributaries according to their respective priorities.

One of the reasons that so many tributaries dry up so near their source at the present time is because of the distribution of stock water. It is felt that less than one-half of 1 percent of the water that is diverted for stock water and domestic purposes is actually used for that purpose.

DISTRIBUTION PROCEDURES AND PROBLEMS

Discharge Gaging Stations

Reasons: In order to inventory the waters of the stream system a number of gaging stations on both the main stream and tributaries have been installed. These stations not only record flows at the stations, but permit an estimation of return flows. This information is required in setting priorities.

Locations of Stations: Recorders on the main stem are installed at the following locations:

> Ryndon above Elko; Carlin Canyon; Palisade; Argenta; Battle Mountain; Comus; Rose Creek; Imlay; Rye Patch; and below Lovelock.

These are all cooperative U.S.G.S. stations. We also have cooperative U.S.G.S. stations on the following tributaries:

> Marys River; North Fork; Lamoille Creek; South Fork; Huntington Creek; Rock Creek; and Pole Creek.

Besides the U.S.G.S. stations, the State Engineer has recorders installed on the following tributaries:

> Herder Creek; Ackler Creek; Left Boulder Creek; Right Boulder Creek; Thorpe Creek; Rabbit Creek; Talbot Creek; Maggie Creek; and Rattlesnake Creek.

Setting of Priorities

Different Schools of Thought Regarding Method to Be Used: There are different schools of thought on how the priorities should be set each year on Humboldt River. One idea is that the snow surveys should be taken as the basis for setting priorities.

Under this system, the amount of water forecast to pass Palisade would be used as the basis for setting priorities for the season for the entire stream system.

If, for example, the snow survey forecast a flow of 100,000 acre-feet at Palisade during the irrigation season and this flow would provide full service to lands with a priority of 1880, the State Engineer would set the priority at 1880 for the season. This would mean that regardless of the flow in the river, no right junior to 1880 would receive any water until the 1880 rights had received 100 percent of their decreed rights. This method possibly might work if the forecasts from snow surveys were accurate, but, with the deviation from the forecasts now being experienced it is impractical. The accuracy of forecasts from snow surveys could be improved by forecasting the runoff for each tributary, but the method would still be impractical. The manner in which distribution in the upper basin is carried out can distort the forecast of runoff at Palisade by as much as 40 percent. This method has been tried without success.

Method Used Currently by State Engineer: The other method of setting priorities, which is the one used by the present State Engineer, is to periodically set priorities according to the amount of water flowing in the stream. Under this method priorities may fluctuate from day to day, but more nearly from week to week. This method is fair and makes possible, if the flow is present, the distribution of some water to all priorities. Late priorities may have water for only a short period, older priorities may have water for a longer period, and real old rights may be served for the entire season. This method has been used for the past 16 years. Judging from the economic position of the appropriators and its general acceptance in the face of an unusual number of short water years, the method has been successful.

Accumulation by Rotation

Legal Basis: The Court recognized in the adjudication proceedings that irrigation in many cases with the permitted continuous flows would be difficult if not impossible. Provision, therefore, was made in the decrees whereby appropriators could accumulate their allotted water and receive the water in rotation.

This section, which is found on page 242 of the Compiled Edition, Humboldt River Adjudication, reads as follows: "It is further ordered, adjudged, and decreed that the claimants and the appropriators or their successors in interest will not be

required to take or use the amount of water allotted to them in a continuous flow, but may cumulate the same or any part thereof in a rotation or periodic turn within the seasonal limits with the approval of the Water Commissioner and subject to the control and direction of the State Engineer."

Importance and Dangers in Rotations: The right of accumulation by periodic turn is one of the better and more important points in the decree. This right is important because rotation undoubtedly is the best way to handle the water among appropriators in a short water year. However, this method has dangers for both the water commissioner and appropriators. This is true because one is continuously gambling on what the runoff of the stream system, or any one stream, is going to be from day to day. The records from the gaging stations have definitely established a large variation of flow from day to day and still greater variations of flow from week to week. Some streams have only a 30-day runoff period.

It is impossible for the water commissioners to include everyone on a stream in a rotation, let alone the entire system. There are many reasons why this cannot be done. For instance, the timing of the rotation is extremely important. Therefore, he cannot have too many in the rotation as the length of the rotation would be too great. The length of any rotation period should not exceed 20 days and in most instances not more than 14 days. He will also find many users with early priorities that refuse to rotate. This makes it necessary for him to keep sufficient water in the stream to serve these early priorities even if it means taking water from the amount he originally planned to use for the rotation. The only reason he will run short of water in his rotation, if set up properly, is if cold weather should set in for a few days and cause the stream to drop.

A drop of the flow of a stream due to cold weather may drop appropriators with late priority rights in a rotation out of priority before they receive any water. On the other hand later priorities, because of their position in a rotation, may receive water at the expense of appropriators with earlier priorities.

The only safe way in which the water commissioner can set up a rotation is to have a thorough understanding with the appropriators in the rotation that they take all the responsibility in regard to the amount of water that is going to be available during the rotation period to serve the priorities set up in the rotation. Also, the cooperators in the rotation must thoroughly understand

that the rotation is on a time basis and each appropriator in the rotation will have the water for an exact number of days regardless of the amount of water available for the rotation at the time he is using it. This is a gamble the appropriators must take because if the water drops and the commissioner tries to extend the time factor of the rotation to make up for the water factor, he will extend the rotation period too long. This, in turn, will injure every appropriator in the rotation. In spite of the problems just mentioned in the setting up of a rotation on the Humboldt River system, rotations have been extremely successful. Many crops have been saved by the practice of accumulation and rotation during the short water years on the Humboldt that otherwise would have been lost.

Experience in Rotations: An old and successful rotation is that of the Winnemucca area and the Stanley Ellison White House ranch with the Lovelock area. Rye Patch Reservoir is the main contributing factor in this very successful rotation. The distance and the amount of water involved make it impossible to extend the rotation with Lovelock further up the river than Ellison's White House ranch. Upstream storage would add greatly to the successful operation of rotations which are so important to the system and yet at the present time so extremely dangerous.

Influence of Upstream Storage on Rotations: Upstream storage would undoubtedly take away almost all of the dangers that presently are involved in rotation. The removal of the dangers would be made possible because appropriators could accumulate their water in the proposed storages during peak flows which would give the commissioner a firm supply of water to work with which he does not have now. If handled properly for the accumulation of appropriators' water in the proposed reservoirs, the benefit to the appropriators above the dams would be as great, or even greater, than to the users below the dams. It would increase or firm up their water supply for a period when they need it most for irrigation by not having to take it from their tributaries at the time of need to serve early rights further down the stream.

The continuous flow of water of 0.81 to 1.23 c.f.s. per 100 acres of land allowed in the decrees is so low that in many cases the irrigator cannot get the water over his land. In order to effectively irrigate his land and efficiently utilize the available water supply, a larger head of water must be provided. This can be done only

through accumulation and rotation. Because of changing conditions on the river system, described later, the need for rotation is becoming increasingly important.

Change in the River Basin

Changes in Ownership of Water and Land: Many changes have occurred on Humboldt River since the decrees were entered. Practically all of the original appropriators have sold to new owners which makes the listing of the appropriators in the decrees largely obsolete.

The Pershing County Water Conservancy District has purchased rights in the Battle Mountain area and transferred the water to Lovelock. In order to get the transfer through without protest, the district gave certain water rights to appropriators in the Battle Mountain area. The district has also built a 179,000 acre-foot reservoir at Rye Patch to store winter water, and to accumulate decreed and transferred decreed water during the irrigation season. In transferring the water from the Battle Mountain area, the district stands the transportation loss from the point of purchase to Lovelock. The water is allotted and distributed to the different appropriators in Lovelock Valley by the Pershing County Water Conservancy District. The State of Nevada had measuring devices installed in all of the diversions from Humboldt River in Lovelock Valley, so that a record could be kept on the amount of water that was diverted to the conservancy district. The district operates the measuring devices during the irrigation season and the State inspects them for upkeep in the fall.

Changes in Culture: Because of the introduction of modern machinery, the present tax structure, range conditions, inflation, and other factors, the type of culture on the stream system is changing quite rapidly from the culture that was described at the time the decrees were issued.

For instance, large areas of diversified and meadow pasture land as described in the decrees and to which this class of water was decreed are now used as harvest lands. This probably would have no ill effects if the appropriators would accept the fact that these lands have less water decreed to them than the lands classed as harvest lands in the decrees, and that in dry years large amounts of this land will dry up because of the lack of sufficient water for irrigation to raise harvest crops. The true fact is that in dry years, probably they will be able to cut hay on the actual harvest ground to which they are decreed a harvest right, but

at the same time half or better of their now harvest ground will be burned up from the lack of water. This fact is probably one of the most difficult to explain to the appropriators at present. More than likely, because of many changes in ownership, they really do not know the number of acres on which they are entitled to the full supply of water for the production of harvest crops under the decrees.

Difficulty in Operating Under Decrees

Reasons: Efficient distribution of the water under the decrees is becoming more difficult each year. This is true because the decrees were based to a large extent on the concept of return flow. The evidence submitted and the testimony given in the adjudication proceedings on Humboldt River, indicates clearly that the concept of return flows received extended attention by the court. Under conditions at the time the decrees were issued any surplus from the water applied to the land found its way back to the river promptly and in significant amounts. Sloughs and depressions, for the most part, were not restricted by levees and dams and surplus waters had ready paths and returned to the stream system with little time lag.

Since the advent of modern machinery, many of these sloughs and depressions have been leveled or solidly dammed off, and the flow of water back to the main stem of the stream is greatly restricted. Much more water is carried by ditches away from the stream and essentially lost as return flow than was the case when the decrees were issued. For these reasons, return flows in the Humboldt River basin are steadily declining. At the same time, the operators find that they cannot successfully irrigate unleveled river bottom land with water delivered at the rate of 1 cubic foot per second or less per 100 acres of land. With diminishing return flows, the problems attendant on distribution of the water of the river under the decrees become more difficult and appropriators must be held near to, or exactly to, their decreed continuous flows. As a result many appropriators are able to irrigate only a portion of the ground which they are entitled to irrigate under the decrees.

Suggested Remedial Measures: The practice of rotating the use of water is permitted under the decrees and rotation systems can be designed to operate in many situations without interfering with priorities. This method of water distribution can give larger heads for shorter periods of time, with resultant increases in irrigation efficiency and lower operating costs. However, under

present conditions on the river, it can result in the delivery of water to late priorities at the expense of earlier priorities. An effective rotation system which would make possible an equitable distribution of water would be possible only if such facilities for the control of the waters of the river as canals, river channelization and reservoirs were developed. A comprehensive system of rotation for the stream system might include also the conjunctive use of both surface and underground reservoirs. The presence of very large quantities of water only a few feet below the land surface in the Winnemucca and the Boulder Flat areas, which has been revealed by recent studies of the Department of Conservation and Natural Resources, would appear to make such conjunctive use possible.

One very practical suggestion would be to restrict irrigation of diversified pasture to those periods when there was a surplus of water in the stream system. The language in the decree, while not clearly definitive, seems to imply that such a restriction was intended. The Bartlett Decree, as cited on page 243 of the Compiled Edition, Humboldt River Adjudication, states: "Diversified pasture Class C, includes all lands from which the brush has not been cleared but which are artificially irrigated to some extent for the production of grasses for forage. These lands **shall be** watered only when the stream is in flood or when there is excess water above the needs of higher class culture. Also, this classification includes those areas in the irrigated fields which are grown up with willows, and the depressions or other acres covered with tules and flag, if there is grass amongst them. While these latter areas generally receive as much or more water than is required for the higher class of culture, the excess water cannot be considered as being used beneficially, hence the right to divert it is not recognized."

In the Bartlett Decree, the words "shall be" were interlined in pen and ink. In the intervening Orders, cited on page 7, Section 2, Compiled Edition, Humboldt River Adjudication, Judge Edwards modified the above in the following language: "It is further ordered: that such Decree, at page 245 (page 243, Compiled Edition) hereinbefore quoted, be, and the same hereby is, amended, changed and corrected, by striking the words 'shall be' and inserting in lieu thereof, the words 'are usually,' so as to make said sentence, on page 245 of said Findings of Fact, Conclusions of Law and Decree, read as follows: 'These lands are usually watered only when the stream is in flood or when there is excess water above the needs of higher class culture.' "

An increase in precipitation on the watershed of Humboldt River through the operation of a weather modification program with a consequent increase in stream flow might do much toward solving the water problems of the river. The possibility of artificially inducing such an increase in precipitation is the main objective of a 5-year project now in the 3d year of operation in this watershed by the Department of Conservation and Natural Resources and the Desert Research Institute of the University of Nevada.

Personnel Needed for Operation of System

Number: For a good operation of the river there should be eight water commissioners and one supervising water commissioner. A problem that develops with the water commissioners is that five out of the eight commissioners are part-time employees that work for a period of approximately 4 months. This short tenure makes training to obtain any degree of efficiency from their work practically impossible.

Limit of Distribution Cost: In operating the Humboldt River distribution system, the supervising water commissioner has to be very careful of expenses. By law he is limited to 6 cents per acre-foot for distribution costs.

PART II

PRIORITY TABLES

Part II of this report consists of a series of tables which show the priority, land classification, and the amount of water decreed to each individual appropriator on the Humboldt River system. In the case of the Pershing County Water Conservation District, the tables show this information for the lands within the district according to the Bartlett Decree and the transfers of decreed water to the district, but does not show how the water presently delivered to the district is distributed to landowners by the district.