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Water use surface water and water rights on the Flathead Indian Reservation Montana: A review

Laura Wunder

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WATER USE, SURFACE WATER, AND WATER RIGHTS
ON THE
FLATHEAD INDIAN RESERVATION, MONTANA
A Review

by
Laura Wunder
B.A., State University of New York at Binghamton, 1971
Presented in partial fulfillment of the requirements for the degree of Master of Science
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Approved by:

Chairman, Board of Examiners

Dean, Graduate School

Date
The following paper represents an attempt to compile and summarize available water resource information on the Flathead Indian Reservation of western Montana. It is not meant to be comprehensive. There are broad gaps in the published data on the Reservation, and the issue of Indian water rights is a tangled, and as yet, unresolved one. In addition, the report will be confined to a discussion of surface waters on the reservation only. Groundwater is an extensive topic in its own right and merits a more thorough treatment than was considered to be feasible within the limitations of this paper. Rather, it is hoped that this paper will provide a review of basic information useful in future planning on the reservation in the area of surface water resources; an indication of areas where further research is necessary; and a guide to the literature available on the subject, for those interested in pursuing the matter further.

It should be noted that, in some instances, reference has been made to areas outside the boundaries of the reservation itself. This has been done wherever it was felt that the information had either a direct bearing or effect upon the reservation, or where the data might help clarify situations existing on the reservation.
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CHAPTER I
DESCRIPTION OF THE STUDY AREA

Topography

The Flathead Indian Reservation is located in western Montana and includes most of Lake County as well as portions of Sanders, Missoula, and Flathead Counties. The reservation covers some 1,250,000 acres, and is bounded on three sides by mountain ranges. These are: the Mission Range to the east, the Cabinet Range to the west, and part of the Coeur D'Alene and Mission ranges to the south. The Salish (or Flathead) Range runs through the center of the reservation, while the Jocko Hills may be found in its southeast corner.

Most of the reservation is valley bottom, the most important valleys of which are the Lower Flathead and the Little Bitterroot. Both of these valleys run in a generally north-south direction.

Terrain on the reservation varies from gently rolling in the valley bottoms, to rugged mountain peaks, and represents a fairly typical example of the mountain-high intermontane valley topography so typical of western Montana as a whole.

The west slope of the Mission Range of the Rocky Mountains is included within the boundaries of the reservation. These mountains rise some 6,000 or 7,000 feet above the valley floor, with no real intervening foothills.

Elevations on the reservation vary from over 10,000 feet in the Mission Mountains, to about 2500 feet on the Flathead River near Dixon, decreasing to the west. Other representative elevations on
the reservation, in approximate order going from east to west are as follows: Arlee, 3094; St. Ignatius, 3006; Ronan, 3089; Polson, 2932; Moiese, 2592; Lonepine, 2875; and Hot Springs, 2763 (see map, Figure 1). Most of the irrigable lands on the reservation are found at an average elevation of about 3000 feet.

**Major Bodies of Water**

The major water course on the reservation is the Flathead River, into which all streams and rivers on the reservation eventually empty. The Flathead River is a part of the Clark Fork-Pend Oreille drainage of the Columbia River basin system, and has an average discharge at Polson of about 8,405,000 acre feet per year (11,610 cfs) (Montana State Engineers Office, 1963). Maximum discharge during the period of record (1907-1971) has been as great as 82,800 cfs (1938), and it is estimated that during the flood of 1894, discharge reached as high as 110,000 cfs. Highest flows on the Flathead River since the construction of Hungry Horse Dam in 1951, occurred during the floods of June, 1964. At that time, a maximum flow of 66,800 cfs was recorded for the Flathead River near Polson (Boner and Stermitz, 1967). Flows have probably been as low as 5 cfs (1938). (See Appendix III for more complete stream gaging records.) The river originates northeast of the reservation in British Columbia, and flows through the reservation, draining an area of some 9,000 square miles, 649 of which are in Canada. Just north of Flathead Lake, near the town of Kalispell, the Flathead River is joined by the Stillwater River, from whence it flows southeast into Flathead Lake, entering the lake in its northeast
Fig. 1

(Source: U.S. Dept. of Interior, Bureau of Indian Affairs)
corner. It emerges again from the southwest corner of the lake, near the town of Polson. The river runs in a generally north to south direction from Flathead Lake until it reaches the vicinity of Dixon, where it turns westward to join the Clark Fork River, about two miles outside the southwestern boundary of the reservation, near the town of Paradise.

Prior to the construction of Kerr Dam in 1938, the Flathead flowed quite rapidly along its course upon leaving Flathead Lake, with many rapids and falls. The outlet channel from the lake extended only two miles before turning into rapids, and the river fell about 240 feet in its first six miles. The river now flows through a five mile long channel, immediately upon leaving the lake, until it encounters Kerr Dam, built in a deep rock canyon cut by the river. This canyon is as much as 500 feet deep in places. The Flathead is still surrounded by high banks throughout much of its length, and at many points along its course, the river has cut through the glacial sediments left by the glacial Lake Missoula, exposing the bedrock, which consists of Belt Series quartzites and argillites, (US Army Engineer Division, 1958a). Numerous river meanders, occurring between Flathead Lake and the town of Dixon, result in a virtual doubling, in terms of actual channel length, of the straight-line distance of 26 miles between these two points (Clapp, 1932).

Other major water courses on the reservation include the Jocko River, which originates in the Mission Mountains and flows in a northwesterly direction, until it joins the Flathead near Dixon, and the Little Bitterroot River, which flows generally north to south.
through the western part of the reservation, eventually emptying into the Flathead River at Sloan. Some permanent streams of importance include, from north to south: Mud Creek, Crow Creek, Post Creek, Mission Creek, and Finley Creek, all of which originate in or near the Mission Range. Although a number of streams enter into the Little Bitterroot River from the west, these streams tend to be considerably smaller than those rising in the Missions, and originate at lower elevations than do the Mission streams, (US Bureau of Reclamation, 1923).

The reservation also encompasses the southern half of Flathead Lake. Flathead Lake is one of the largest freshwater lakes west of the Great Lakes, covering about 190 square miles, or 125,500 acres. It is some 30 miles long from north to south, approximately seven miles in width, and over 300 feet deep in parts. The lake is located about 77 miles above the point where the Flathead River joins the Clark Fork. The two main rivers draining into the lake are the Swan and Flathead Rivers, and the drainage area tributary to the lake is 7,086 square miles of extremely mountainous and sparsely settled area (US Army Engineer Division, 1958a). The lake is now artificially kept at an elevation between 2883 and 2893 feet by Kerr Dam on its southern outlet. Prior to the construction of Kerr Dam, the maximum lake elevation recorded at Somers was 2896.26 feet (1933), while the minimum elevation recorded was 2881.07 feet (1936). During the flood of 1894, the lake elevation probably reached its highest known elevation, of 2900 feet. Since the construction of Hungry Horse Dam in 1951 on the South Fork of the Flathead River, maximum elevation has not
A number of reservoirs used predominately for irrigation are also located on the reservation. A scattering of small, natural lakes are found in various parts of the reservation, but most of these are relatively inaccessible high mountain lakes. Numerous kettlehole ponds are found in the vicinity of Ninepipe, remnants of former glacial activity. These range in size from several feet to several hundred feet, with depths varying from one foot to 75 feet (DeYoung and Roberts, 1929).

**Climate**

The climate of the reservation area is of the modified continental type. Although generally continental in nature, there are interludes when Pacific Coast climatic influences prevail. These usually occur several times during the year, especially during the winter months, and they may last for several days. Temperatures in the area, on the whole, tend to be somewhat milder and less prone to extremes than those east of the Continental Divide, and the growing season tends to be longer as well. This is, for the most part, due to the moderating influence of the mountains, which tend to deflect the cold arctic air masses away from the Flathead Valley. Arctic air, however, occasionally does find its way into the valley.

The coldest temperature recorded at Lonepine, during the period 1919-1967 was minus 40 degrees Fahrenheit, while the highest temperature during the same period reached 105 degrees Fahrenheit. Average annual temperatures are around 45 degrees Fahrenheit in the Flathead area, and cooler in the mountains. Flathead Lake exerts some moderating
influence on the temperatures in the area immediately around its shores.
In the vicinity of the lake, temperatures generally do not fall much
below minus 20 degrees Fahrenheit. The lowest temperature recorded at
Polson, for the years 1907-1960, was minus 30 degrees Fahrenheit.

Flathead Lake only freezes over completely about once every seven
years. Some representative temperature data are given in Table 1.

| TABLE 1 |
| TEMPERATURE |
| (east to west) | Highest of Record | Lowest of Record | January Ave. | July Ave. | Annual Average |
| St. Ignatius | 103<sup>d</sup> | -36<sup>d</sup> | 25.1<sup>b</sup> | 67.6<sup>b</sup> | 46.0<sup>b</sup> |
| Polson | 104<sup>a</sup> | -30<sup>a</sup> | 25.1<sup>b</sup> | 67.4<sup>b</sup> | 45.5<sup>b</sup> |
| Polson<sup>c</sup> (Kerr Dam) | 104 | -23 | 25.9 | 68.1 | 46.2 |
| Lonepine | 105<sup>e</sup> | -40<sup>e</sup> | 23.0<sup>f</sup> | 67.4<sup>f</sup> | 45.2<sup>f</sup> |

<sup>a</sup>1907-1960  <sup>c</sup>1951-1960  <sup>e</sup>1919-1967
<sup>b</sup>1931-1960  <sup>d</sup>1909-1960  <sup>f</sup>1938-1967

The prevailing winds in the Flathead Valley tend to come from
the west and southwest, but are not often of great force (DeYoung
and Roberts, 1929).

The mountains receive a much greater quantity of precipitation
than does the valley and precipitation tends to decrease as one moves
west. Precipitation in the mountains is highest during the period
from October to March. Most of this precipitation falls in the form
of snow, which is stored in the mountains as heavy mountain snowpack.
Subsequent melting of the snowpack during spring and summer months produces the annual spring runoff and is a critical source of irrigation water late into the summer. The mountainous areas frequently receive as much as 60 inches of precipitation during the year, most of which falls as snow. In the valley area, conditions are quite arid and average annual precipitation usually ranges from 12 to 15 inches, making irrigation a necessity for dependable crop growth. Most of the valley precipitation (i.e. about 55-60%), falls during the months of April through September, which coincides with the growing season. High water for streams is generally reached in June and low flow months are usually August through October. Representative precipitation data is presented in Table 2.

**TABLE 2**

<table>
<thead>
<tr>
<th>Station</th>
<th>Total Yearly Av. (in.)</th>
<th>Growing Season Av. (in.)</th>
<th>% Falling in Growing Season</th>
<th>Wettest Year Amount (in.)</th>
<th>Driest Year Amount (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Ignatius</td>
<td>15.10b</td>
<td>9.31b</td>
<td>62d</td>
<td>25.15d</td>
<td>19168.77d</td>
</tr>
<tr>
<td>Polson</td>
<td>15.03a</td>
<td>8.53b</td>
<td>57a</td>
<td>21.90a</td>
<td>195810.17a</td>
</tr>
<tr>
<td>Polson (Kerr Dam)</td>
<td>15.28</td>
<td>8.81</td>
<td>58</td>
<td>19.93</td>
<td>195910.03</td>
</tr>
<tr>
<td>Round Butte</td>
<td>12.92</td>
<td>7.66</td>
<td>59</td>
<td>17.39</td>
<td>19487.46</td>
</tr>
<tr>
<td>Lonepine</td>
<td>11.83f</td>
<td>6.0f</td>
<td>51g</td>
<td>16.46f</td>
<td>19486.13f</td>
</tr>
</tbody>
</table>

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The growing season averages about 125 days. Table 3 shows some of the variation that exists in the duration of frost-free periods in different parts of the reservation:

**TABLE 3**

<table>
<thead>
<tr>
<th>Area</th>
<th>Elevation (feet)</th>
<th>Frost-Free Period</th>
<th>Length (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Ignatius</td>
<td>3006</td>
<td>5/21</td>
<td>9/23</td>
</tr>
<tr>
<td>Poison</td>
<td>2932</td>
<td>5/12</td>
<td>9/27</td>
</tr>
<tr>
<td>Lonepine</td>
<td>2875</td>
<td>5/22</td>
<td>9/19</td>
</tr>
</tbody>
</table>

On an annual basis, sunshine occurs only about 50% of the time. In July this percentage goes up to about 80%, while in December it falls as low as 25%.

From the preceding data, it is evident that in terms of moisture and growing season length, parts of the eastern, and Flathead Lake portions of the reservation are most favorable for agriculture.

**Vegetation**

Although forested areas occur east of Ronan, the predominant native vegetation form on the reservation is prairie. As one proceeds westward, the trend toward elevation and rainfall decrease, and temperatures increase. This is accompanied by changes of vegetation and soil.

Starting at the base of the Mission Mountains, the major vegetation types include wheatgrass and bluegrass, along with some balsam weed. Higher quantities of precipitation and cooler temperatures have produced a relatively thick vegetation cover in this region.
Moving westward, this is succeeded by an area dominated by fescues, wheatgrass, and some sagebrush, while around the Flathead River, the major vegetation type includes bunchgrass and a greater percentage of sagebrush. The Camas Valley area is a sagebrush dominated region, and along the Little Bitterroot River, some pines may be found, although the area as a whole is quite dry and barren. Much of the reservation interior consists of dry, rolling, treeless hills (US Army Engineer Division, 1958a).

Those forested areas that do occur (around the Mission Mountains and adjacent area), include various pines, larch, fir, and spruce as the major species. Logging has resulted in the proliferation of a heavy brush understory in this region, as well (DeYoung and Roberts, 1929).

Geology

Northwestern Montana is characterized by a series of nearly parallel mountain ranges separated by high valleys (Alden, 1953). The Flathead Valley occupies the southernmost part of the Rocky Mountain trench. This trench continues up into British Columbia, encompassing a distance of over 800 miles (Alt and Hyndman, 1972).

The Flathead Basin varies from five to twenty miles in width, with Flathead Lake occupying almost the entire width of the basin at the particular area in which the lake is located. The basin runs in a north-south direction and is some 80 miles long.

Most of the bedrock in the area consists of Precambrian sedimentary rocks of the Belt Series, composed for the most part, of sandstones and limestone (Alden, 1953). To the east of the Rocky Mountain
Trench lie the Mission Range of the Rocky Mountains, also made up predominantly of Precambrian sedimentary rock. The west side of the trench is bounded by the Salish Mountains, which are considerably less rugged than their eastern counterparts and, again, consist of Precambrian sedimentary rock.

Above the bedrock, both Pleistocene and possibly Tertiary deposits may be found, and are often of considerable thickness, (Alden, 1953).

During the Pleistocene, the entire Rocky Mountain trench was glaciated to the vicinity of St. Ignatius by a huge ice sheet originating in British Columbia. At that time, glacial ice succeeded in blocking the Clark Fork, resulting in the formation of a vast glacial lake (Lake Missoula). The blockage occurred at a point close to the present-day location of the Montana-Idaho border. The ice appears to have formed a dam some 2500 feet in height, and backed up the water for up to 250 miles. Throughout the glacial period, the water level of Lake Missoula apparently varied considerably, along with the vicissitudes of glaciation (Alden, 1953).

Many of the old beach lines of glacial Lake Missoula are still visible as narrow ridges on mountain slopes in the area. Tremendous quantities of glacial silt were deposited to great depths in the 3,300 square mile area covered by the lake.

Lake elevations reached as high as 4200 feet, while lake depths probably varied from a few feet to as much as 2,000 feet (Alden, 1953). Ice thicknesses somewhat north of the Clark Fork dam site have been estimated to have been as much as 5,000 feet (Alt and Hyndman, 1972).
The lake covered much of the reservation, occupying the lower Flathead, Jocko, Little Bitterroot, Camas Prairie, and Clark Fork valleys. This immense glacial lake was drained for the last time about 12,000 years ago by the bursting of the ice dam at Pend Oreille Lake. Tremendous water velocities were attained during the ensuing flood, as evidenced by the extensive scarring of some of the valley walls, (U.S. Army Engineer Division, 1958a). Water velocities in parts of the Flathead and Clark Fork River valleys at the time of draining have been estimated to have been about eight to ten cubic miles per hour, (Alt and Hyndman, 1972).

Other glacial remnants in the area of the reservation include the Poison and Mission moraines, as well as various moraines near the base of the Mission Mountains, left by smaller alpine glaciers. In the high Missions, where snow is present nearly year round, several small mountain glaciers may still be found today.

The Poison moraine is a large glacial deposit located just south of Polson and extending completely across the Flathead basin from the Mission Mountains to the Salish Range. The moraine is a terminal one and apparently dates from the last (Wisconsin) glacial advance (Alt and Hyndman, 1972). It was the Poison moraine that initially confined the waters of Flathead Lake. There is some evidence that during the pre-glacial period, the original drainage route of the Flathead River was through the Big Draw Valley, near Elmo. With the advent of glacial deposition, the route of the Flathead River was shifted to its present location, near Polson. The Big Draw today, is filled with glacial till to a depth of about 200 feet (Alt and Hyndman, 1972).
The Mission moraine and associated deposits, consist of an expanse of glacial till extending from an area south of the Polson moraine to a point slightly north of the Jocko River (Alden, 1953). The Mission moraine appears to be somewhat older than the Polson moraine and is covered and obscured to some extent by outwash from the latter. One glacial advance appears to have reached as far south as the Jocko Valley, and the Mission moraine seems to be a remnant from the retreat of this glacier (Alden, 1953). During the Wisconsin glacial advance, although glacial ice occupied the entire Flathead Lake basin, it failed to extend any farther south than the Polson moraine. Ice depths of this glacier varied from about 2,000 feet to several hundred feet in the south (Alden, 1953). In contrast to the rugged Missions, the lower Jocko Hills, located east of Arlee, remained unglaciated during the last glacial period and as a consequence are more smoothly rounded in appearance (Alt and Hyndman, 1972).

In sum then, the overall picture of the Flathead region is thus one of bedrock and glacially scarred mountains of Precambrian Belt sedimentary rocks, with valleys filled with Tertiary deposits and a large quantity of Pleistocene glacial (mainly lacustrine), deposits.

Soils

Intimately related to the geology and vegetation of any region, is, of course, its soil. Soil type affects a wide variety of factors, not the least of which are agriculture and water resources (i.e. water storage, and transmissal).

In the reservation region, the parent material, or base, for most of the soils is glacial till.
Soils on the reservation vary from light sandy loam to heavy clay. Much of the valley soil is underlain by clay, interspersed with rock fragments of glacial origin (U.S. Bureau of Reclamation, 1923).

Soil color also varies widely as one goes from east to west across the reservation. One factor on which soil color depends, is the organic content of the soils. This, in turn, is a product of precipitation, since heavier rainfall results in heavier vegetational ground cover, thus producing more humus. As one would expect, soils in the mountainous eastern section of the reservation, tend to be darker brown, while those in the lower elevation, western portion of the reservation, tend toward light brown or gray (DeYoung and Roberts, 1929).

The soils found along the base of the mountains are quite similar to the prairie soils of eastern Montana, but contain less organic material.

The major soil survey done on the Lower Flathead Valley was that of DeYoung and Roberts, completed in 1929. The descriptions contained in this survey are still considered to be basically valid, although the actual classification system has since been changed. (Some additional soils information is included in Appendix I.)

DeYoung and Roberts' (1929), five major soil classifications have been summarized as follows:

1. Well-developed soils having permeable and friable subsoils, with favorable subdrainage, including dark-colored grassland soils of the McDonald, Millville and Polson series; brown grassland soils of the Lonepine series. The dark grassland soils (McDonald, Millville and Polson) are prairie soils formed in areas of moderate precipitation.
These are good although sometimes stony agricultural soils, used mainly for wheat production (both irrigated and non-irrigated), grazing, and some alfalfa production. Lighter brown grassland soils are produced under even less precipitation and vegetation cover and alfalfa and grains tend to be the major crops on these soils. McDonald soils are found along the base of the mountains and receive a considerable amount of precipitation. Nitrogen and phosphorous contents are adequate.

2. Well-developed soils having tough compact subsoils and heavy-textured stratified substrata, with restricted subdrainage, including dark-colored grassland soils of the Post series; brown grassland soils of the Round Butte series; light-colored brushland soils (Round Butte silty clay, heavy phase), and light colored timbered soils of the Crow series. Due to the presence of a fairly impervious layer of clay in the subsoil of these soils, both surface and sub-surface drainage tend to be considerably poorer than soils in category one. 'The darker-colored grassland soils of this group are represented by the Post soils; the lighter-colored soils developed under lower rainfall and prairie and semidesert-land vegetation by the Round Butte soils; and the light-colored timbered soils by the Crow soils. The Post soils are extensive. Wheat, grown largely without irrigation under a system of summer fallow in alternate years and alfalfa, grown under irrigation, are the most important crops. Yields average somewhat lower than on the dark-colored soils of the first group. The Round Butte soils have somewhat less impervious and intractable sub-soils. These soils are of low organic matter and nitrogen content but are capable of improvement in this respect, under irrigation. The Crow soils are mainly timbered or include cut-over but unbroken areas, and they are used mainly for pasture. Post soils generally have fair quantities of nitrogen and phosphorous, but in some Post soils, there may be drainage and alkali accumulation problems.'

3. Well-developed soils having loose leachy sand and gravel subsoils and substrata with excessive subdrainage, including dark-colored grassland soils of the Flathead and Hyrum series; and brown grassland soils of the Moiese series. These soils are 'characterized by loose sandy and gravelly subsoils and substrata of low water-holding capacity ... They are of low value for dry-farmed crops but under irrigation are adapted to a wider range of crops than soils of the other two groups. Potatoes, sugar beets, alfalfa and truck crops are grown on these soils.'

4. Imperfectly developed alluvial soils, including dark-colored soils of the Corvallis series; light-colored soils (alluvial soils, undifferentiated). These soils 'consist of recently accumulated stratified stream-laid sediments. They are comparatively inextensive and unimportant. They consist of dark-colored soils ... used to a small extent for farming and a group of undifferentiated alluvial soils of light color and a variable texture, which are subject to overflow, are poorly drained and are utilized mainly for grazing.' Much of the material includes sand and gravel.

5. Rough mountainous areas, in which the soils are undifferentiated and are classed as rough mountainous land.
Most of the arable land areas have well-developed soils, while the imperfectly developed alluvial soils, although used to some extent for agriculture, are not of major importance and are restricted to stream valleys. The mountain soils are not used for agricultural purposes at all, except for some limited grazing (DeYoung and Roberts, 1929). The best, or most productive soils for agricultural and irrigation purposes are found in the northern and central regions of both the Mission and Camas valleys and in the southern part of the Jocko Valley. Less productive soils are found in the southern and peripheral parts of the Mission and Camas valleys and in the northern and more central portions of the Jocko Valley (U.S. Dept. of Interior, 1962).

Prior to the widespread use of irrigation on the reservation, most soils in the Lower Flathead Valley region maintained adequate drainage, except for those impermeable soils with a heavy-textured consistency. In the sandy soils, drainage is too great, so that these soils are often droughty, (DeYoung and Roberts, 1929).

Population

In 1973, total population for the reservation was about 16,000. The largest community on the reservation is the town of Polson, located on the south shore of Flathead Lake. Other major population centers include: Ronan and St. Ignatius, situated in the eastern part of the reservation, and Hot Springs, located in the western portion of the reservation. Population data for various communities, showing areas of expected growth, is given in Table 4.
TABLE 4

POPULATION ESTIMATES AND FORECAST
(from: Wirth and Assoc., 1970a)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arlee</td>
<td>300</td>
<td>100</td>
<td>100</td>
<td>125</td>
<td>170</td>
<td>200</td>
</tr>
<tr>
<td>Big Arm</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>135</td>
<td>175</td>
<td>200</td>
</tr>
<tr>
<td>Camas</td>
<td>100</td>
<td>50</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Charlo</td>
<td>310</td>
<td>150</td>
<td>180</td>
<td>195</td>
<td>225</td>
<td>270</td>
</tr>
<tr>
<td>Dayton</td>
<td>160</td>
<td>50</td>
<td>50</td>
<td>70</td>
<td>90</td>
<td>130</td>
</tr>
<tr>
<td>Dixon</td>
<td>150</td>
<td>140</td>
<td>120</td>
<td>125</td>
<td>130</td>
<td>145</td>
</tr>
<tr>
<td>Elmo</td>
<td>35</td>
<td>75</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>125</td>
</tr>
<tr>
<td>Hot Springs</td>
<td>733</td>
<td>585</td>
<td>600</td>
<td>640</td>
<td>680</td>
<td>790</td>
</tr>
<tr>
<td>Lonepine</td>
<td>n.a.</td>
<td>10</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Moise</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Niarada</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pablo</td>
<td>150</td>
<td>300</td>
<td>300</td>
<td>325</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td>Perma</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Polson</td>
<td>2280</td>
<td>2314</td>
<td>2450</td>
<td>2550</td>
<td>2850</td>
<td>3000</td>
</tr>
<tr>
<td>Ravalli</td>
<td>150</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>130</td>
<td>175</td>
</tr>
<tr>
<td>Ronan</td>
<td>1251</td>
<td>1334</td>
<td>1535</td>
<td>1650</td>
<td>1800</td>
<td>2150</td>
</tr>
</tbody>
</table>

Summer population figures are somewhat higher, especially in the area around Flathead Lake, where there are a large number of exclusively summer residences. These are occupied predominantly by non-Indians and include some 2000 persons (Moyer, 1973). Only about 20% of the reservation population are Indian, while the vast majority are non-Indian (Moyer, 1973). This disparity in numbers has been fostered by the tendency of the Indians to migrate off the reservation and non-Indians to migrate in. The result has been that the non-Indian population has been increasing at a rate nine times faster than that of the Indian population (Moyer, 1973). Indian vs. non-Indian population projections for the reservation are shown in Table 5.

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TABLE 5
INDIAN VS. NON-INDIAN POPULATION PROJECTIONS
(from: Moyer, 1973)

<table>
<thead>
<tr>
<th>Year</th>
<th>Indian</th>
<th>1980 High</th>
<th>1980 Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2,969</td>
<td>3,768</td>
<td>3,151</td>
</tr>
<tr>
<td>Non-Indian</td>
<td>12,525</td>
<td>16,064</td>
<td>13,706</td>
</tr>
<tr>
<td>Total</td>
<td>15,494</td>
<td>19,832</td>
<td>16,587</td>
</tr>
</tbody>
</table>

The distribution of the Indian population in different areas of the reservation, is indicated in Table 6. The highest Indian population density is found in the vicinity of Elmo, where Indians make up approximately 68% of the population.

TABLE 6
PERCENTAGES OF INDIAN RESIDENTS
(from: Moyer, 1973)

<table>
<thead>
<tr>
<th>Town</th>
<th>% Indian Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>West shore (Elmo-Dayton)</td>
<td>68</td>
</tr>
<tr>
<td>Arlee</td>
<td>62</td>
</tr>
<tr>
<td>St. Ignatius</td>
<td>46</td>
</tr>
<tr>
<td>Hot Springs</td>
<td>22</td>
</tr>
<tr>
<td>Ronan</td>
<td>21</td>
</tr>
<tr>
<td>Polson</td>
<td>11</td>
</tr>
<tr>
<td>Charlo</td>
<td>6</td>
</tr>
<tr>
<td>Entire reservation</td>
<td>19</td>
</tr>
</tbody>
</table>

Economy and Land Use

At the present time, the economic base of the reservation lies mainly in the areas of agriculture, lumbering, and recreation-associated activities. Hay and grain production for livestock are the most important agricultural crops.

Prior to the opening of the reservation to homesteading in 1904,
the major land use on the reservation was for open range grazing of livestock (DeYoung and Roberts, 1929). With the advent of homesteading, wheat became a major crop, in addition to livestock production. Since about 1918, however, acreage devoted to wheat has shrunk, and alfalfa hay has assumed predominance. Livestock production has continued to grow (DeYoung and Roberts, 1929).

Of primary importance at the present time are: beef cattle and dairy products, pasture, hay (grass and alfalfa), and various grains, including wheat, oats and barley. Of lesser importance are such cultivated crops as peas, potatoes, and fodder corn. Apples and cherries are grown in the vicinity of Flathead Lake. Both milk and cheese processing plants can also be found on the reservation. Many of the crops grown on the reservation are shipped as far away as Seattle and Spokane.

Perhaps the most vital factor in the economy of the reservation has been the development of the Flathead Indian Irrigation Project.

Construction of the Flathead Irrigation Project was begun in 1909, as a joint venture of the Bureau of Indian Affairs and the Bureau of Reclamation. It represented an effort to increase agricultural productivity on the reservation, by bringing water to previously dry lands. Prior to the initiation of the Flathead Project, irrigation was carried on only to a very limited extent, using relatively inefficient flooding techniques (Montana State Engineers Office, 1960).

The original Flathead Project plan, as put forth in 1910, called for the irrigation of some 152,000 acres of land. This figure has never been realized, and has since been revised downward to encompass
only about 140,000 acres. Irrigation was to have been accomplished via gravity flow through canals from streams originating in the Mission Mountains, supplemented by pumping from Flathead Lake, as required.

As originally envisioned, the Flathead Project would have included the following: 16 reservoirs, with a combined area of 117,556 acres, and a combined capacity of 1,949,970 acre-feet; a canal system including 14 miles of canal with a capability of handling over 300 cubic feet per second; 82 miles of canal capable of transporting 50 to 300 cubic feet per second; and 3,868 feet of tunnel (U.S. Bureau of Reclamation, 1923).

At the present time, the Flathead Project covers a total area of about 300,000 acres, of which, only approximately 138,000 acres are considered to be irrigable. It is divided up into three, relatively independent irrigation districts, known as the Mission, Jocko and Camas divisions. The Mission division is the largest of the three, and is located east of the Flathead River. The Camas division is located in the northern part of the reservation, immediately west of the Little Bitterroot River. The smallest of the three divisions is the Jocko division, situation in the southeastern corner of the reservation.

Not all of the potentially irrigable land on the Flathead Project is actually irrigated, and some dry-land farming still occurs. In 1976, only about 120,400 acres were actually being supplied with water from project facilities (U.S. Dept. Interior, 1976). A small, additional proportion of reservation lands are irrigated by privately owned facilities.
Crops grown on the Flathead Irrigation Project are shown in Table 7.

**TABLE 7**

**MAJOR CROPS RAISED ON THE FLATHEAD IRRIGATION PROJECT, 1976**


<table>
<thead>
<tr>
<th>Crop</th>
<th>% of Project Land Devoted to Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay</td>
<td>38</td>
</tr>
<tr>
<td>Pasture</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total Livestock Feed</strong></td>
<td><strong>82</strong></td>
</tr>
<tr>
<td>Wheat</td>
<td>3</td>
</tr>
<tr>
<td>Barley</td>
<td>9</td>
</tr>
<tr>
<td>Oats</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Grains</strong></td>
<td><strong>14</strong></td>
</tr>
<tr>
<td>Potatoes</td>
<td>2</td>
</tr>
<tr>
<td><strong>Fruit and Other Products</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

Examination of the above table shows that the major land use on the project was for livestock feed (82%). Alfalfa alone made up 25% of all crop land (U.S. Dept. Interior, 1976).

Some indication of the productivity of irrigated lands on the Flathead Project, is given in Table 8.

**TABLE 8**

**CROP YIELDS ON THE FLATHEAD IRRIGATION PROJECT, 1961**


<table>
<thead>
<tr>
<th>Crop</th>
<th>Unit</th>
<th>Class of Land</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Alfalfa Hay</td>
<td>ton/ac.</td>
<td>2.8</td>
</tr>
<tr>
<td>Mixed Hay</td>
<td>ton/ac.</td>
<td>1.7</td>
</tr>
<tr>
<td>Wheat</td>
<td>bu./ac.</td>
<td>38</td>
</tr>
<tr>
<td>Barley</td>
<td>bu./ac.</td>
<td>50</td>
</tr>
</tbody>
</table>

*Class 1 is the highest grade of agricultural land.*
Some areas on the Flathead Irrigation Project are now using sprinkler irrigation systems, and crop yields are generally higher from these lands. For example, in 1976, some 124,940 acres were cropped, producing crops valued at about 16.2 million dollars, or about $130.38 per acre. Sprinkler systems were used to irrigate 56,013 acres out of this total, and yielded crops valued at $9,926,308, or about $177.21 per acre (U.S. Dept. Interior, 1976). (See Appendix II for additional crop data.)

Types of livestock raised on the Flathead Project, are shown in Table 9.

TABLE 9

LIVESTOCK RAISED ON THE FLATHEAD IRRIGATION PROJECT, 1961

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Cattle</td>
<td>38,500</td>
</tr>
<tr>
<td>Sheep</td>
<td>13,400</td>
</tr>
<tr>
<td>Dairy Cattle</td>
<td>7,000</td>
</tr>
<tr>
<td>Pigs</td>
<td>3,000</td>
</tr>
</tbody>
</table>

Despite these evidences of productivity, the entire Flathead Reservation area was declared to be an economically depressed region, by the Redevelopment Act of 1961 (U.S. Dept. Interior, 1962). In fact, in addition to farming, at least one quarter of the farmers on the Flathead project also find it necessary to work at some other job as well, for at least part of the time. Since the numbers of jobs are limited, many people are forced to move off the reservation (U.S. Dept. Interior, 1962).
In recent years, the tendency on the reservation seems to have been toward the merging of small farms into larger ones. In 1962, the average farm size on the Flathead Project (irrigated only), was 190 acres, of which only 114 acres were actually irrigated (U.S. Dept. Interior, 1962).

**Indian vs. Non-Indian Land Use**

Since the very beginning of the Flathead Reservation, the trend has been toward a transfer of land out of Indian hands and into non-Indian ownership. Even today, this trend continues. At present, most of the irrigated land on the reservation is owned by non-Indians.

In 1962, Indian-owned irrigated farms numbered only 120, while non-Indian owned irrigated farms numbered 1,365 (U.S. Dept. Interior, 1962).

A comparison of 1962 and 1976 land use figures, as shown in Table 10, indicates that there was a marked decline in Indian ownership and use of Flathead Project lands, during that period.

**TABLE 10**

<table>
<thead>
<tr>
<th></th>
<th>1962</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Indian-operated acreage</td>
<td>12,947</td>
<td>8,539</td>
</tr>
<tr>
<td>Total Non-Indian operated acreage</td>
<td>97,563</td>
<td>116,401</td>
</tr>
<tr>
<td>Total Acreage</td>
<td>110,510</td>
<td>124,940</td>
</tr>
</tbody>
</table>

Reference to Table 10 shows that, over a 14-year period, Indian land use decreased by 4,408 acres, while non-Indian land use increased by 18,838 acres.
Broken down by Flathead Irrigation Project divisions, the amount of land farmed by Indians compared with that farmed by non-Indians is indicated in Table 11.

**TABLE 11**

<table>
<thead>
<tr>
<th>Division</th>
<th>Land Farmed by Indians (ac.)</th>
<th>Land Farmed by Non-Indians (ac.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camas</td>
<td>128</td>
<td>12,647</td>
</tr>
<tr>
<td>Jocko</td>
<td>2,414</td>
<td>8,329</td>
</tr>
<tr>
<td>Mission</td>
<td>5,997</td>
<td>95,425</td>
</tr>
<tr>
<td>Total</td>
<td>8,539</td>
<td>116,401</td>
</tr>
</tbody>
</table>

Although the Mission Division of the Flathead Project had the greatest Indian-operated acreage, the Jocko Division had the greatest actual number of Indian farmers.

As indicated by crop values, Indian lands on the Flathead Project also tend to be less productive than non-Indian run land. A comparison of crop values, based on land ownership, is shown in Table 12.

**TABLE 12**

<table>
<thead>
<tr>
<th></th>
<th>Average per ac.</th>
<th># ac. Farmed</th>
<th>Total Crop Value for Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian</td>
<td>$107</td>
<td>3,539</td>
<td>$918,282</td>
</tr>
<tr>
<td>Non-Indian</td>
<td>$132</td>
<td>116,401</td>
<td>$15,371,591</td>
</tr>
</tbody>
</table>

Several reasons have been advanced to explain this discrepancy. Olson (1963), concluded that the explanation lay in a difference in farm management input. However, analysis by the U.S. Department of Interior (1962), has shown that the typical 80 acre Indian land
allotment is really too small to make an efficient and profitable farm. In order to see why this 80 acre allotment is too small to farm successfully, it is interesting to look at the hypothetical farm budget shown in Table 13.

### TABLE 13

ESTIMATED BUDGET OF AN AVERAGE 80 ACRE INDIAN IRRIGATION ALLOTMENT  

<table>
<thead>
<tr>
<th>Item</th>
<th>Type of Farm: Beef Breeding Herd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 2 Land</td>
</tr>
<tr>
<td>Irrigable acreage</td>
<td>80</td>
</tr>
<tr>
<td>Irrigated acreage</td>
<td>77</td>
</tr>
<tr>
<td>Farmstead, etc. (ac.)</td>
<td>3</td>
</tr>
<tr>
<td>Man-hours of farm work</td>
<td></td>
</tr>
<tr>
<td>Operator</td>
<td>1,137</td>
</tr>
<tr>
<td>Hired</td>
<td>0</td>
</tr>
<tr>
<td>Investment</td>
<td>$32,175</td>
</tr>
<tr>
<td>Farm Income</td>
<td>$5,226</td>
</tr>
<tr>
<td>Farm Expense</td>
<td>$5,059</td>
</tr>
<tr>
<td>Net Farm Income</td>
<td>$167</td>
</tr>
<tr>
<td>Equity Allowance</td>
<td>$322</td>
</tr>
<tr>
<td>Available to Family</td>
<td>-$155</td>
</tr>
</tbody>
</table>

It can be seen from the above budget that a typical 80 acre farm, whether under Indian or non-Indian ownership, can be expected to lose some $155 per year.

It appears that if agricultural economic stability is to be achieved by the Indian population of the Flathead Indian Reservation, transfer of land out of Indian hands will have to be discouraged or reduced, and land allotments will have to be re-organized in such a manner as to make them of economically feasible size.
Most of the Flathead Indian Reservation is prairie-covered valley bottom.

Forested areas occur in the vicinity of the Mission Mountains, on the eastern boundary of the reservation.

The major drainage system is the Flathead River and its tributaries.

The climate on the reservation is modified continental, with precipitation averaging 12 to 15 inches per year.

Conditions of moisture, growing season length, and soil type, have resulted in the eastern portions of the reservation, as well as the area adjacent to Flathead Lake, being most suitable for agriculture.

Most of the valley land is filled with glacial deposits, which form the base for many of the soils.

The total population for the reservation is approximately 16,000, only 20% of which is Indian.

The non-Indian population is increasing at a greater rate than the Indian population.

Indians have been migrating off the reservation, while non-Indians have been migrating in.

The Flathead Lake area experiences a summer population increase.

The economy of the reservation is based on agriculture, lumbering, and recreation.

The most important agricultural crop is livestock feed.

One of the most important factors in the agricultural economy of the reservation is the Flathead Indian Irrigation Project. This
The project is run by the Bureau of Indian Affairs, and delivers critically needed water to much of the reservation's farm land.

The entire reservation area has been declared to be an economically depressed region. Many farmers are forced to seek additional, outside work, in order to maintain themselves. Out-migration is favored by the fact that jobs are unavailable on the reservation. This is particularly true of Indian farmers.

There is a continuing trend for land ownership to pass from Indians to non-Indians. Most irrigated land is now owned by non-Indians.

Indian land tends to be less productive than non-Indian land.

Indian land allotments are too small to be profitably farmed.
CHAPTER II
WATER USE

History of Water Use on the Flathead Reservation

The history of the reservation may be said to have begun with the signing of the Treaty of the Hellgate on July 16, 1855, between representatives of the U.S. government and representatives of the Flathead, Kootenai, and Upper Pend Oreille Indian tribes. Prior to the formation of the reservation, the Flatheads resided, for the most part, in the Bitterroot Valley, the Pend Oreilles ranged from Lake Pend Oreille all the way up and down the Clark Fork and Flathead Rivers, and the Kootenais ranged from southern British Columbia to northern Idaho and Montana (Hamilton, 1970).

The initial treaty was completed in Council Grove, not far from the present city of Missoula. Its major provisions included the setting up of a reservation for the Kootenais and Pend Oreilles on the Jocko, while the Flatheads were to remain in the Bitterroot Valley.

The major signers of the treaty included Issac I. Stevens, the then territorial governor, Victor, head chief of the Flatheads; Michelle, chief of the Kootenais; Alexander, chief of the Upper Pend Oreilles, and other delegates. The treaty was not officially ratified by the Senate and proclaimed by the president until 1859.

In 1871, the United States government, departing from the intent of the original treaty, decided to move the Flatheads from the Bitterroot up to the Jocko. This move was resisted for many years by the Flatheads, but was finally accomplished in 1891 when the 300 remaining Flatheads settled in the Jocko region.
The original treaty included some 1,500,000 acres of land (Hamilton, 1970). Within the context of the treaty, the U.S. government insisted on the right to build and allow the public to use roads across the reservation. In return for the lands ceded by the Indians, the U.S. government was to contribute $120,000 over a 20-year period to the construction of schools, homes, industries, agricultural improvements and other benefits. Not unexpectedly, most of this was never really honored (Burlingame, 1942). The treaty also stated that the reservation lands were guaranteed to be exclusively for tribal use, and that whites would be forbidden from living on the reservation without the consent of the tribes (Treaty of the Hellgate, 12 Stat. L 974 (1855)).

In 1854, Jesuit missionaries commenced to set up a mission at the present site of St. Ignatius. Their efforts to till and irrigate the land along Mission Creek marked the first recorded instance of the use of irrigation on the reservation. Prior to the advent of whites, the tribes relied exclusively upon hunting, fishing and gathering for their livelihood.

Early crops grown on the reservation under Mission supervision included, wheat, potatoes, cabbages, turnips and oats (Davis, 1954).

In 1877, Peter Ronan, a new Indian agent, arrived on the reservation. He reported irrigation to be essential for agricultural production over most of the reservation, and, some time in the late 1800's, managed to obtain funding for irrigation ditch building on the reservation. He appears to have constructed some sort of diversion from the Jocko River, which resulted in increased crop yields (Davis, 1954).
The passage of the Dawes, or General Allotment Act in 1887 (24 Stat. L. 388), effectively opened up Indian reservation lands to settlement by whites. This act provided for individual allotments of land to Indians residing on reservations. In theory, the best lands went to the Indians, while all "surplus" lands were to be sold to white homesteaders. The Act of April 23, 1904 (33 Stat. L. 302), opened the Flathead Reservation to homesteading, by specifically providing for the allotment of lands on the Flathead Reservation and the sale of any lands remaining after allotment.

The nominal purpose of these acts was to foster an interest in private property on the part of the Indians, at the expense of the tribal ties. This was believed to be a change in the interest of "civilization". The Act of April 23, 1904 also laid the foundation for the construction of the Flathead Irrigation Project, by providing for a preliminary survey of potentially irrigable lands on the reservation and the development of facilities to irrigate Indian land, and "incidentally", any white-owned 'surplus' lands on the reservation. It is interesting to note that although the project was only "incidentally" to service white-owned land, construction was only contemplated and begun after the opening of the reservation to white settlement.

The opening of the reservation to whites, resulted, at that time, in the following initial distribution of irrigable land: 60% was allotted to Indians, 4% went into state ownership, and the remainder went to white settlers (DeYoung and Roberts, 1929). By 1934, Indian ownership of reservation land had been reduced by some 610,000 acres as
a direct result of the opening up of the reservation to homesteading (Biggar, 1951).

In 1909, construction of the Flathead Indian Irrigation Project was begun. Construction got off to a slow start however, resulting in considerable hardship. Since land was allotted and opened up to homesteading prior to completion of most of the irrigation works, many Indians and white settlers found themselves in the position of owning dry land, with no prospects of receiving necessary irrigation water for at least several years. The land was not productive without water and allotted tracts were often too small to be effectively dry-farmed. Fairly heavy natural precipitation helped out to some extent during these early years, but not enough to prevent some homesteaders from giving up their farms entirely.

The remainder of the reservation lands were opened up to white settlement under the Homestead laws in 1910, and this resulted in another 21,000 acres passing out of Indian hands (Ketcham, 1915).

Land allotment sizes were fixed by the Act of June 25, 1910 (35 Stat. L. 855), at a limit of 40 acres for irrigable land, 80 acres for non-irrigable agricultural land, and 160 acres for grazing land. The eighty acre allotments were the most common. The allotment size stipulation was often gotten around by having several members of one family obtain allotments (DeYoung and Roberts, 1929).

The construction of the Flathead Irrigation Project was begun as a joint effort between the Bureau of Indian Affairs and the Bureau of Reclamation. The Bureau of Indian Affairs was responsible for the financial and managerial aspects of the project, while the Bureau of
Reclamation was responsible for the actual engineering work (U.S. Bureau of Reclamation, 1923). In 1924, the Reclamation Bureau ceased to be involved with even the engineering aspects of the project, and full responsibility, including responsibility for construction, was taken over by the Bureau of Indian Affairs. This is still the situation today. No water was available on the project until about 1911.

Due to the necessity of constructing reservoirs and power sites for the Flathead Project, some 50,000 acres of reservation land, of which about 7,000 acres had previously been allotted to Indians, was confiscated by the government. The displaced individuals were supposed to have been re-allotted other lands, of equal value elsewhere (U.S. Bureau of Reclamation, 1923).

It was with the construction of the Flathead Irrigation Project that agricultural, as opposed to grazing activities, began to assume increasing importance.

**Present Water Use**

At present, the major water uses on the reservation are for irrigation and power generation. Although there is some industrial, domestic, and municipal use of water, these uses are quite small in terms of total water use (Plunkett, 1952).

Plunkett (1952), in describing the entire Flathead basin, concluded that consumptive use of water for either irrigation or municipal purposes was minimal relative to the total annual run-off in the basin. He found that in 1946 only 1.4% of the approximately 8 million acre-feet of run-off per year, measured on the Flathead River near Polson, was
actually used in irrigation. Approximately 17% of this run-off was stored, predominantly in Flathead Lake (Plunkett, 1952).

Despite the apparent abundance of water, shortages can and do occur, and will be considered in great detail later in this paper.

In the following sections, each major water use will be considered separately.

Power

Most of the existing and potential hydroelectric sites located within the boundaries of the reservation are located on the Flathead River. The elevation of Flathead Lake was originally about 2800 feet, and the elevation of the Flathead River at its point of departure from the reservation is about 2470 feet. This means that initially there was a difference of about 330 feet available for power generation on the river. Population density is also quite low along most of the length of the river, within reservation boundaries, making it suitable for power projects in this respect.

Of the various possible power sites along the river, only the Kerr Dam site has actually been developed, thus far. Kerr Dam is located on the Flathead River, about five miles downstream from Flathead Lake, near the town of Polson. The dam was completed in 1938 by the Montana Power Company and is one of the largest in their power system, with a capacity of 180,000 kilowatts, (Montana State Engineers Office, 1963). It is used mainly for power generation and flood control. The site of the dam is owned by the Confederated Salish and Kootenai Tribes, and is leased by Montana Power (Confederated Salish and Kootenai Tribal Council, 1962). The dam is of the concrete arch
type and is 204 feet high, with an 800 foot crest length. Montana Power is required by the Federal Power Commission to maintain the elevation of Flathead Lake between 2883 and 2893 feet. This ten foot difference in elevation permits a storage capacity of 1,219,000 acre feet, in Flathead Lake. Every one foot change results in a difference in total storage capacity of the lake of about 120,000 acre feet (Boner and Stermitz, 1967).

Kerr Dam is used to regulate lake elevation in such a way that maximum elevation is maintained from early spring throughout the summer and into early fall, while drawdown occurs during the winter months, for the purpose of increasing power generation. Thus, minimum lake elevations are regulated to coincide with the beginning of the spring run-off (U.S. Army Engineer Division, 1958a).

Although Kerr Dam is the only completed power generation dam on the Flathead River at present, a small power plant run by the Flathead Irrigation Project is located on Big Creek as well. Several other sites on the reservation have been, and are being considered for possible dam construction, by such groups as the U.S. Army Corps of Engineers, Montana Power, and the Confederated Salish and Kootenai Tribes, although these dams have not yet materialized.

In the Army Corps of Engineers (1958a) evaluation of potential hydroelectric projects in this region, they concluded that three mutually exclusive, alternative projects were feasible, that were either located in, or would directly affect the reservation. These were: the Knowles project, the Paradise Dam project, and the projects at Buffalo Rapids. (See Figure 2 for location of these sites.) Each
Fig. 2. Location of Dam sites on the Lower Flathead River.  
(Adapted from: Soward, 1965).
project was to have been built in conjunction with one or more other projects, so that complete development of the Clark Fork basin would have been assured. The water plans proposed for the Clark Fork basin were as follows:

1. Paradise dam and Flathead Lake outlet improvement (i.e. channelization) project. The Paradise site was located just outside of the reservation boundary.

2. Knowles project (also located a few miles outside of the reservation), Flathead outlet improvement, and the Nine Mile Prairie project, (situated off the reservation on the Blackfoot River).

3. Buffalo Rapids project, Flathead outlet improvement, and the following projects, all located off the reservation: Ninemile Prairie (Blackfoot River), Spruce Park (on the Middle Fork of the Flathead River near Glacier Park), Quartz Creek (on the Clark Fork), and the Smokey Range Project (on the North Fork of the Flathead River).

A comparison of the three plans is shown in Table 14.

TABLE 14

ALTERNATIVE PLANS FOR THE CLARK FORK
(from: U.S. Army Engineer Division, 1958a)

<table>
<thead>
<tr>
<th></th>
<th>Plan 1</th>
<th>Plan 2</th>
<th>Plan 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total available storage (100 ac.ft.)</td>
<td>4770</td>
<td>4655</td>
<td>4253</td>
</tr>
<tr>
<td>Total usable flood control (1000 ac.ft.)</td>
<td>4770</td>
<td>4380</td>
<td>3978</td>
</tr>
<tr>
<td>Total initial power installation (1000 kw)</td>
<td>432</td>
<td>368</td>
<td>579</td>
</tr>
<tr>
<td>Total estimated construction cost (million dollars)</td>
<td>$498,429</td>
<td>$323,813</td>
<td>$372,977</td>
</tr>
<tr>
<td>Total annual costs</td>
<td>$20,840,800</td>
<td>$13,711,900</td>
<td>$16,000,300</td>
</tr>
</tbody>
</table>
Although Plan 1 would have provided the greatest storage potential, it would also have been the most expensive to build. Only by building all the other projects mentioned in Plan 3, in addition to Buffalo Rapids, could plan three have been made equal in scope to alternatives 1 or 2 (U.S. Army Engineer Division, 1958a). The Knowles Project (Plan 2), was the one most favored by the Corps, although both this plan and the Paradise Plan were eventually given up, due to strenuous objection on the part of the public.

The Knowles Project was originally to have been located on the Flathead River, about two miles above its junction with the Clark Fork and about five miles from the town of Paradise, between the towns of Perma and Paradise. Maximum stream flow at the project site is about 144,000 cfs and drainage area equals about 9,000 square miles (U.S. Army Engineer Division, 1958a). Valley width is about 1200 feet at the damsite. Basic data on the proposed dam are presented in Table 15.

<p>| TABLE 15 |
|-------------------|-------------------|</p>
<table>
<thead>
<tr>
<th>KNOWLES PROJECT</th>
<th>(from U.S. Army Engineer Division, 1958a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam type:</td>
<td>earthfill with concrete gravity intake</td>
</tr>
<tr>
<td>Dam height:</td>
<td>265 feet</td>
</tr>
<tr>
<td>Reservoir full pool capacity:</td>
<td>5,000,000 acre-feet</td>
</tr>
<tr>
<td>Maximum reservoir elevation:</td>
<td>2700 feet</td>
</tr>
<tr>
<td>Minimum reservoir elevation:</td>
<td>2620 feet</td>
</tr>
<tr>
<td>Usable storage (for flood control and power):</td>
<td>3,080,000 acre-feet</td>
</tr>
<tr>
<td>Drawdown:</td>
<td>80 feet</td>
</tr>
<tr>
<td>Reservoir full pool area:</td>
<td>51,554 acres</td>
</tr>
<tr>
<td>Initial power installation:</td>
<td>256,000 kw</td>
</tr>
<tr>
<td>Ultimate power installation:</td>
<td>512,000 kw</td>
</tr>
</tbody>
</table>
The reservoir would have extended up to Kerr Dam on the Flathead River, or a distance of about 69 miles. Some 45,600 acres of land would have been flooded. The towns of Dixon, Perma, Ravalli, Moiese and part of the National Bison Range would have been flooded by the dam in addition to some 47,000 acres of farmland and pasture. A total of 19,905 acres of Indian land would have been flooded, including the Buffalo Rapids power sites. Flooding by the dam would have also resulted in the destruction of many miles of telephone and power lines, roads and railroad track, and the evacuation, at that time, of about 1300 people. Building of the Knowles project would have precluded building of the Paradise project and vice versa.

The Paradise project was quite similar to the Knowles project in scope and was to have been located only a few miles downstream from it on the Clark Fork River at a point about four miles below its junction with the Flathead. Above the dam site the Clark Fork drains about 20,000 square miles. Usable storage was to have been 4,080,000 acre feet. The reservoir would have extended 72 miles up the Flathead River to Kerr Dam and 49 miles up the Clark Fork to the town of Superior. It would have covered 66,130 acres (103 sq. mi.) while varying in width from 1 to 6 miles. In addition to those towns and areas already mentioned, it would also have flooded the towns of Paradise, St. Regis and Superior, thus forcing the evacuation, at that time, of approximately 2,500 people. Close to 20,000 acres of Indian land would have been flooded by this project.
The Confederated Tribes strongly objected to construction of both the Knowles and Paradise projects on the grounds that the building of either project would have resulted in the flooding of the tribal power sites at Buffalo Rapids, valued at over $100,000,000. This in itself would have been illegal since by treaty, tribal power sites were reserved (Confederated Salish and Kootenai Tribal Council, 1962). In addition, the Knowles project would have resulted in excessive loss of tribal grazing lands and destruction of deer forage and bird breeding grounds. The tribe, therefore, favored the Buffalo Rapids site for development, since this project would have minimized destruction of Indian lands.

The Buffalo Rapids #4 site was the only one studied in detail by the Army Corps of Engineers. Due to its relatively smaller storage capacity of about 668,000 acre feet, it was not considered to be equivalent to either the Paradise (4,080,000 acre feet) or Knowles (3,080,000 acre feet) proposals, unless built in conjunction with the additional smaller projects already cited. However, it is the Buffalo Rapids site, among others, that is still being considered for construction. The Buffalo Rapids #4 site is located on the Flathead River, about 11 miles north of Dixon and about 36 miles from the Flathead-Clark Fort junction. Above the dam site, the Flathead River drains an area encompassing about 8,085 square miles. Construction of the dam would have formed a reservoir 36 miles long and extending all the way up to Kerr Dam, as well as along the Little Bitterroot Valley. At the dam site itself, the river valley attains a width of about 300 feet. Specifications for the proposed dam are presented in Table 16.
TABLE 16
BUFFALO RAPIDS #4 DAM
(from: U.S. Army Engineer Division, 1958a)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam type:</td>
<td>earthfill, with concrete gravity intake</td>
</tr>
<tr>
<td>Dam height:</td>
<td>160 feet</td>
</tr>
<tr>
<td>Usable storage:</td>
<td>668,000 acre-feet</td>
</tr>
<tr>
<td>Reservoir full pool area:</td>
<td>16,467 acres</td>
</tr>
<tr>
<td>Maximum reservoir elevation:</td>
<td>2700 feet</td>
</tr>
<tr>
<td>Power installation:</td>
<td>280,000 kw</td>
</tr>
</tbody>
</table>

The building of this project would have involved the flooding of 7,881 acres of private land, 8,633 acres of Indian land; and 187 acres of state land (U.S. Army Engineer Division, 1958a). However, no major towns, roads nor facilities would have been flooded and much of the land immediately bordering the river was of inferior agricultural quality (U.S. Army Engineer Division, 1958a).

In addition to storage and flood control, the Buffalo Rapids reservoir could also have been used to supply power for the pumping of irrigation water from the Flathead River (U.S. Army Engineer Division, 1958a).

In their evaluation of possible dam sites along the Flathead River, the Corps (1958a), concluded that development should be restricted to the upper portions of the Flathead River, above Moiese, where the affected population would be minimal. Within this region, they were able to find four possible dam sites, including: the Buffalo Rapids #1 site, located four miles below Kerr Dam; the Buffalo Rapids #2 site, 12 miles below Kerr Dam; the Oxbow site, located 11 miles below Kerr Dam; and the Buffalo Rapids #4 site, situated 16 miles below Kerr Dam. (See Figure 2 for locations.) The Corps favored the development of the
Buffalo Rapids #4 site, due to its potentially larger storage capacity and its more suitable topography. Although some individuals owning farmland in the Little Bitterroot Valley, that would have been flooded by this project, objected to it at public hearings held on the plan, this plan would still seem to have been less detrimental in terms of total area flooded, than either the Knowles or Paradise plans.

More recently, the Montana Power Co. has also expressed an interest in developing the Buffalo Rapids site. The Buffalo Rapids proposal, however, is not without potential for inflicting environmental damage.

The Fish and Wildlife Service (IN: U.S. Army Engineer Division, 1958b) predicted such adverse impacts as: flooding of trout spawning grounds, making stocking necessary; fluctuating water levels favoring rough fish over game fish; and reduction of game and pheasant habitat as well as goose nesting sites through flooding. Moreover, the National Park Service (IN: U.S. Army Engineer Division, 1958b), concluded that the reservoir created by the Buffalo Rapids Dam would have been inferior in terms of recreational potential to the Flathead River itself. They predicted that recreational use of the reservoir would be minimal, since the surrounding area was not very scenic, lacked trees, and there were many other more attractive natural areas nearby, including Flathead Lake.

Despite these factors, the development of these Buffalo Rapids sites is still favored by the Confederated Tribes. They have filed an application for the development of the Buffalo Rapids #2 and #4 sites with the Federal Power Commission, and are also considering the development of a site on the Flathead River near Dixon. Although Montana Power

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has also applied for a permit to develop these sites, this has been resisted by the tribes, who would like some assurance that they will receive compensation in the form of a block of power, before they will consider any outside development. The advantage of having a block of power would be that its value would tend to increase with time, and continuous income would be assured via the sale of low-cost power. This would avoid a boom and bust economy (Confederated Salish and Kootenai Tribal Council, 1962).

An engineer hired by the Tribal Council concluded that the projects at Buffalo Rapids #2 and #4 would be capable of producing power at a low enough cost to attract aluminum, wood pulp, and other industries to the reservation. As an alternative to the plans put forth by the Army Corps of Engineers, he suggested the following series of projects for the development of the Clark Fork-Flathead River basin (Confederated Salish and Kootenai Tribal Council, 1962):

1. A low head (35 ft. high) dam at Paradise, across the Clark Fork, one mile from its junction with the Flathead, with an installed capacity of 90,000 kw.
2. A low head (35 ft.) dam and powerhouse on the Flathead River at Dixon, with an installed capacity of 60,000 kw.
3. Low head (88 ft.) dams and powerhouse at Buffalo Rapids #2 and #4, with a capacity of 240,000 kw.
4. Dam (300 ft.), powerhouse, reservoir, etc. at Ninemile Prairie on the Blackfoot River, 42 miles east of Missoula, with 60,000 kw capacity and 885,000 acre feet storage.
5. Dam (370 ft.), powerhouse, and reservoir on the North Fork of the Flathead River, 62 miles upstream from Flathead Lake, with a capacity of 165,000 kw and 1,510,000 acre feet of storage.

Only projects two and three, in the above scheme, would have been actually located within the reservation boundaries. Although this series of projects would have provided less total storage than the Knowles Project, it would also have been capable of generating more power.
In addition to power generation, a major function of most of these dams is for flood control. Numerous other dams and reservoirs also exist on the reservation and are used almost exclusively for irrigation purposes. Most of these are run by the Indian Irrigation Service, but some smaller private dams and diversions also exist. Irrigation uses for dams will be discussed in greater detail in the section on irrigation.

**Municipal Water Use**

Municipal water needs are basically twofold, and include a supply of water for domestic and community use, and water for sewage purposes. Community water supply systems will be dealt with first.

Although Polson, Ronan, and St. Ignatius all make use of surface water in their water supply systems, in addition to groundwater, many towns on the reservation rely exclusively upon well water (either private or communal), or springs. Polson, Ronan, St. Ignatius, Charlo, Round Butte, Hot Springs, and several rural housing developments recently built by the Bureau of Indian Affairs and the Tribe, have community-wide water systems. Other towns on the reservation depend upon individual, private sources for their domestic and stock water, (Wirth and Assoc., 1970a,b; Hawkaluk, 1977). Table 17 represents a summary of information on community water supply systems, for most of the larger towns on the reservation.
<table>
<thead>
<tr>
<th>TOWN</th>
<th>WATER SUPPLY SOURCE</th>
<th>STORAGE</th>
<th>NO. PEOPLE SERVED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polson</td>
<td>450 gpm well, 500 gpm well, 1000 gpm from Hellroaring Dam and reservoir</td>
<td>500 gal. tank, two 250,000 gal. tanks</td>
<td>2450</td>
<td>System is community-wide; water supply and storage should be adequate through 1990. Expansion and improvement of distribution system may be necessary. Are considering abandoning supply line from Hellroaring Creek; line is 6 miles long and in good condition. If abandoned, an additional well could replace it. Between 1911-1919, water supply was pumped from Flathead Lake.</td>
</tr>
<tr>
<td>Ronan</td>
<td>415 gpm mountain stream, 300 gpm well, one well in progress (80 gpm free flow; 600 gpm pumping.)</td>
<td>None</td>
<td>1535</td>
<td>System is community-wide. Supply adequate at present, except during high demand summer months. New well or storage necessary to relieve summer shortages.</td>
</tr>
<tr>
<td>St. Ignatius</td>
<td>350 gpm well, 300 gpm from Mission Creek supply line from Mission Reservoir.</td>
<td>50,000 gal. wooden tank</td>
<td>1270</td>
<td>Community-wide; supply should be adequate through 1990. Supply line from Mission Creek is old, in poor condition, and leaks. It is 5 mi. long and needs replacement. Rest of wooden distribution system is in fair condition; wooden storage tank also in poor condition and leaks.</td>
</tr>
<tr>
<td>TOWN</td>
<td>WATER SUPPLY SOURCE</td>
<td>STORAGE</td>
<td>NO. PEOPLE SERVED</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------</td>
<td>---------</td>
<td>------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pablo</td>
<td>Individual private wells</td>
<td>None</td>
<td>300</td>
<td>Good water can be found at 30 ft. and is available in adequate amounts. Centralized community water system and storage necessary and being considered for construction.</td>
</tr>
<tr>
<td>Charlo</td>
<td>93 gpm well</td>
<td>None</td>
<td>180</td>
<td>Community-wide; supply adequate at present for most of year, but may have water shortages during summer. Water is distributed by means of a wooden pipeline, 25 yrs. old; some leakage. With population increase, will require additional well and replacement of pipeline.</td>
</tr>
<tr>
<td>Ravalli</td>
<td>Individual private wells</td>
<td>None</td>
<td>100</td>
<td>An adequate quantity of water is available, but some contamination of well water has been reported. Community water system and storage should be developed.</td>
</tr>
<tr>
<td>Arlee</td>
<td>Individual private wells</td>
<td>None</td>
<td>100</td>
<td>Water supply now adequate. Most wells at about 90 ft. in depth. Community system not necessary at present, but feasible in future.</td>
</tr>
<tr>
<td>Big Arm</td>
<td>Individual private wells</td>
<td>None</td>
<td>100 (higher in summer)</td>
<td>Should get central community supply and storage system in near future.</td>
</tr>
<tr>
<td>TOWN</td>
<td>WATER SUPPLY SOURCE</td>
<td>STORAGE</td>
<td>NO. PEOPLE SERVED</td>
<td>REMARKS</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------</td>
<td>-------------</td>
<td>-------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dayton</td>
<td>Individual private wells</td>
<td>None</td>
<td>50 (higher in summer)</td>
<td>Community system probably not necessary for 20 years. Present water supplies adequate.</td>
</tr>
<tr>
<td>Elmo</td>
<td>Individual private wells</td>
<td>None</td>
<td>50 (higher in summer)</td>
<td>Water supply adequate; community system not necessary for at least 20 years.</td>
</tr>
<tr>
<td>Round Butte</td>
<td>70 gpm artesian well</td>
<td>125,000 gal. concrete tank</td>
<td>450</td>
<td>Community-wide system. Distribution system consists of 42 mi. of pipeline. System adequate through 1990.</td>
</tr>
<tr>
<td>Hot Springs</td>
<td>200 gpm spring, two wells with combined capacity of 590 gpm (supplemental summer source)</td>
<td>200,000 gal. reservoir</td>
<td>600</td>
<td>Community-wide system; adequate through 1990; could also be used to supply nearby town of Camas. Pipeline from spring to reservoir is wooden; 4 in. diameter.</td>
</tr>
<tr>
<td>Camas</td>
<td>Private wells</td>
<td>None</td>
<td>35</td>
<td>Should obtain water from Hot Springs system. Population decreasing.</td>
</tr>
<tr>
<td>Dixon</td>
<td>Private wells</td>
<td>None</td>
<td>120</td>
<td>Adequate quantity of water, but quality poor. Central system and storage needed.</td>
</tr>
<tr>
<td>Perma</td>
<td>Individual private wells</td>
<td>None</td>
<td>20</td>
<td>Quantity and quality of water adequate through 1990. Central system not necessary.</td>
</tr>
<tr>
<td>Lonepine</td>
<td>Private wells</td>
<td>None</td>
<td>25</td>
<td>Water supply adequate. Houses too spread out to make community system practical.</td>
</tr>
</tbody>
</table>
The other major municipal water use on the reservation, is for sewage disposal. The towns of Polson, Ronan, St. Ignatius, Charlo, Hot Springs, Pablo, and the new Bureau of Indian Affairs rural housing developments have community-wide sewage facilities. Types of sewage disposal systems on the reservation are varied, and include sewage treatment plants, lagoons, and septic tanks or cesspools. One recent innovation at Lonepine has been the introduction of individual, small-size private lagoons (Lozeau, 1973). Table 18 represents a summary of community sewage systems for major towns on the reservation.

**Irrigation**

Something of the history of irrigation on the reservation has already been mentioned. Most of the irrigation facilities on the reservation are under the jurisdiction of the Flathead Indian Irrigation Project, although some small, privately run irrigation works do exist. The majority of the irrigated lands on the reservation, east of the Flathead River, are located along the Jocko River and Mission and Crow Creeks. West of the Flathead River, most of the irrigated lands are restricted to the areas adjacent to the Little Bitterroot River.

The Flathead Project is divided into three major and separate divisions, including the Mission, Jocko, and Camas (or Flathead) divisions. A court decree issued on August 26, 1926 officially organized these divisions as irrigation districts under Montana state law. Despite this creation of separate irrigation districts, all maintenance is still the responsibility of the Indian Irrigation Service. In 1962 there were a total of 73 actual water users in the Jocko Division, 227 in the
TABLE 18
COMMUNITY SEWAGE SYSTEMS
(from: Wirth & Assoc., 1970a; Plunkett, 1952; Denton & Lawrence, 1972; Hawkaluk, 1977)

<table>
<thead>
<tr>
<th>TOWN</th>
<th>SEWAGE SYSTEM</th>
<th>NO. PEOPLE SERVED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polson</td>
<td>Two cell 25 ac. lagoon</td>
<td>2400</td>
<td>Generally adequate; may require some expansion in future; has some interconnection between storm and domestic sewage, which should be changed. Sewage is discharged into Flathead Lake after treatment.</td>
</tr>
<tr>
<td>Ronan</td>
<td>Two cell 16 ac. lagoon</td>
<td>1532</td>
<td>Adequate</td>
</tr>
<tr>
<td>Pablo</td>
<td>Have recently built a community collection and treatment system; formerly used private septic tanks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charlo</td>
<td>2 ac. lagoon</td>
<td>180</td>
<td>Collection system uses 8&quot; pipe. System adequate, but will require some expansion with population growth.</td>
</tr>
<tr>
<td>Ravalli</td>
<td>Private septic tanks &amp; cesspools</td>
<td>100</td>
<td>System adequate; will probably require a community system by 1990.</td>
</tr>
<tr>
<td>Arlee</td>
<td>Private septic tanks &amp; cesspools</td>
<td>100</td>
<td>May require community system within five to ten years.</td>
</tr>
<tr>
<td>Big Arm</td>
<td>Private septic tanks &amp; cesspools</td>
<td>100*</td>
<td>May require community system within five to ten years.</td>
</tr>
<tr>
<td>Dayton</td>
<td>Private septic tanks &amp; cesspools</td>
<td>50</td>
<td>System adequate. Homes too widespread to make community system practical.</td>
</tr>
<tr>
<td>Elmo</td>
<td>Private septic tanks &amp; cesspools</td>
<td>50</td>
<td>System adequate. Homes too widespread to make central system practical.</td>
</tr>
<tr>
<td>Round Butte</td>
<td>Private septic tanks &amp; cesspools</td>
<td>450</td>
<td>System satisfactory; homes too widespread to make central system practical.</td>
</tr>
<tr>
<td>Hot Springs</td>
<td>Mechanical sewage treatment plant with secondary treatment</td>
<td>600</td>
<td>Community system adequate, and could also be used to serve Camas. Collection is via an 8&quot; sewer main and a 12&quot; outfall line carries sewage to treatment plant by gravity.</td>
</tr>
<tr>
<td>Camas</td>
<td>Private septic tanks, outhouses</td>
<td>35</td>
<td>Should pump sewage to Hot Springs treatment plant.</td>
</tr>
<tr>
<td>Dixon</td>
<td>Private septic tanks &amp; cesspools</td>
<td>120</td>
<td>System inadequate; central (lagoon), system necessary. Soil in area does not accept sewage effluents from septic tanks readily.</td>
</tr>
<tr>
<td>Perma</td>
<td>Private septic tanks, cesspools</td>
<td>20</td>
<td>System adequate.</td>
</tr>
<tr>
<td>TOWN</td>
<td>SEWAGE SYSTEM</td>
<td>NO. PEOPLE SERVED</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------</td>
<td>-------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lonepine</td>
<td>Private septic tanks, cesspools,</td>
<td>25</td>
<td>Houses too spread out for central facility to be practical.</td>
</tr>
<tr>
<td></td>
<td>individual lagoons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St. Ignatius</td>
<td>4 ac. lagoon; 5 ac. lagoon,</td>
<td>1200</td>
<td>Some untreated sewage is being discharged directly into Mission Creek.</td>
</tr>
<tr>
<td></td>
<td>septic tanks</td>
<td></td>
<td>Community system is adequate for those served, but not all households</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>are served. System should be expanded to serve all inhabitants. Most of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>collection done by 6&quot; pipes; need 8&quot; pipes. System will require</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>expansion in near future.</td>
</tr>
</tbody>
</table>

*Higher in summer.
Mission Division, and 1,040 in the Flathead Division (Montana State Engineers Office, 1963). In 1973, water users on the project numbered about 2500 (Moon, 1973). Each division is also divided up into smaller subdivisions. The major divisions are separated from each other by low mountains, and, in the case of the Camas division, the Flathead River acts as a natural boundary, as well. Each division, for the most part, has its own independent water sources and irrigation system. Lands served by these divisions are located in Missoula, Lake and Sanders counties. The Mission division, encompassing an area of approximately 320 square miles and located entirely within the confines of Lake county, is bounded on the north by Flathead Lake, extends as far south as the National Bison Range, and is bounded on the east and west by the Flathead River and the Mission Mountains, respectively. The towns of Polson, St. Ignatius and Ronan are all located within the confines of this division. Directly south of the Mission division lies the Jocko division. The Jocko division extends along the Jocko River in a northwesterly direction, from the neighborhood of Arlee, as far as the town of Dixon in Sanders County. It includes parts of Lake and Missoula Counties, as well. The Camas division is separated by some distance from the other two divisions and is located entirely within Sanders county, on the western side of the Flathead River. It extends along the lower part of the Little Bitterroot River and west to the Cabinet Range. Included in the Camas division are the towns of Hot Springs and Lonepine. (See Figure 3 for the location of these divisions.)
Fig. 3. Map showing approximate locations of subdivision on the Flathead Irrigation Project. (Adapted from: Johnson, 1930.)
Terrain in all three divisions is of a generally rolling nature, with most of the irrigable land at an elevation of about 3,000 feet above sea level. Elevational differences average about 130 feet throughout the Camas division, about 400 feet in the Mission division, and about 980 feet in the Jocko Valley (U.S. Dept. Interior, 1962).

Project Water Supplies

Jocko Division

Water sources for the Jocko division rely mainly upon the Jocko River and its tributaries. The most important of these tributaries are Finley, Agency and Big Knife Creeks. In addition to these sources, the division also utilizes water from one tributary of the Flathead River (i.e. Revaic Creek), and also diverts water from Placid Creek on the east side of the Mission Divide, over into the Jocko River system. Surface run-off is an important factor in maintaining adequate quantities of water for irrigation purposes. In the Jocko, run-off is generally sufficient until sometime around the middle of July, at which time it must be supplemented by additional water held in storage reservoirs.

Some basic data for the Jocko Division is provided in Table 19.
### TABLE 19

**JOCKO DIVISION WATER SUPPLY**  

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average divisional run-off</td>
<td>184,500 ac.ft./yr. (1954-61)</td>
</tr>
<tr>
<td>Quantity of water available during irrigating season</td>
<td>128,800 ac.ft.</td>
</tr>
<tr>
<td>Amount lost to division as uncontrolled run-off</td>
<td>72,000 ac.ft.</td>
</tr>
<tr>
<td>Quantity of water that must be diverted to meet divisional irrigation requirements (includes transmission losses)</td>
<td>54,700 ac.ft.</td>
</tr>
<tr>
<td>Quantity of water diverted, that is actually delivered to land</td>
<td>23,575 ac.ft.</td>
</tr>
<tr>
<td>Quantity of water diverted, that is lost in transit</td>
<td>31,136 ac.ft.</td>
</tr>
</tbody>
</table>

The rather high water diversion requirement for this division is due in part to the presence of rocky soils, as well as the high transmission loss (U.S. Dept. Interior, 1962).

For the year 1976, 35,308 acre-feet were delivered to a total acreage of 10,743 acres (or 2.87 acre feet per acre) in the Jocko Division. A minimum of 26,056 acre feet per year, or a flow of about 35.9 cfs, must be maintained in the Jocko River in order to meet downstream requirements, such as private irrigation rights (U.S. Dept. Interior, 1962; 1975).

Originally, storage for the Jocko Division consisted of the Upper and Lower Jocko Lakes reservoirs, with storage capacities, respectively, of approximately 4,000 acre-feet and 6,380 acre feet. In 1956, the natural dam in Upper Jocko Lake was washed out, thus removing this lake as a storage facility from the Jocko system. Subsequent to this wash-out, storage for several years was generally inadequate to insure...
sufficient water supplies for the Jocko division, beyond the beginning of August, until the construction of the Black Lake Dam (U.S. Dept. Interior, 1962).

The Lower Jocko Lake reservoir consists of a lake with a natural dam, through which a concrete lined tunnel has been constructed. A diversion from the North Fork of Placid Creek also feeds into this reservoir, and water from the reservoir flows into the Middle Fork of the Jocko River. The reservoir is plagued by a high seepage rate, thus making it suitable only for short term storage.

The Black Lake Reservoir, constructed in 1967, is the newest addition to the project storage system. It has a storage capacity of 5,000 acre feet. This reservoir is situated on the Middle Fork of the Jocko River, about 19 miles east of Arlee. A natural lake originally did exist at the site of the present reservoir, but was drained when the natural dam at one end broke. The lake was then re-excavated and dammed in 1967. It encompasses an area of about 260 acres. Here again, excessive seepage is a problem. Since the construction of this dam, about 20% of the necessary irrigation water can now be supplied by these reservoirs, while the rest must still come from run-off (U.S. Dept. Interior, 1962).

Mission Division

The Mission division is organized into three major subdivisions, known as the Mission, Post and Pablo subdivisions. Included in the Post subdivision is the Moiese area, in which the rocky nature of the soils require irrigation water in excess of that required by the rest of the Mission division. The Mission division is the only division
lacking a major river system, except for the Flathead River, which forms its boundary. Irrigation is therefore accomplished via the utilization of a number of smaller streams, all originating in the Mission Mountains. The most important of these are Mission Creek, Crow Creek, Post Creek, and Dry Creek. In addition to these streams, water is also diverted into the Mission Division from Falls Creek, and the North and Middle Forks of the Jocko River, all of which are located in the Jocko Division. The Tabor feeder canal serves to transport this water from the Jocko Division into St. Mary's Reservoir in the Mission Division. This Jocko Division water is surplus water not utilized by Jocko Division lands (U.S. Dept. Interior, 1962). The Moiese area, encompassing some 6,000 acres relies mainly on return flow from the Post and Pablo subdivisions, and on storage supplied by Crow Reservoir. Crow Reservoir receives water from Crow, Spring and Mud Creeks. The Hillside Reservoir also provides some storage for this area, (U.S. Dept. Interior, 1962).

Not all the arable land in this division is irrigated every year. About 12% of the land is either not used at all, is dry-farmed, or summer fallowed each year, thus cutting down on the irrigation water requirement.

Average run-off for the period April through August is about 137,000 acre feet (U.S. Dept. Interior, 1976). Peak spring run-off flows generally occur right at the beginning of June. The yearly figure for run-off is about 201,735 acre-feet. An additional 48,954 acre-feet is available to the Mission Division through diversions from outside the division, thus providing a total of about 250,689 acre-feet from
run-off, or about 275 cfs. Some 37,114 acre feet can also be supplied by the Flathead and Crow pumping systems, when they are utilized at their maximum capacity for the entire period between July 1st and September 15th. The greater the acreage irrigated, the greater must be the reliance on increased pumping to supplement run-off as a source of irrigation water. In addition to water required for irrigation of project lands, sufficient water must be maintained to meet private irrigation needs and other downstream uses. To keep streams viable below project diversions, an average minimum flow of about 20 cfs, or about 14,845 acre feet per year must be maintained, in addition to private water rights, amounting to about 24,715 acre feet per year. Thus a total of about 39,560 acre feet per year must be maintained in Mission Division streams in order to meet non-project needs. Project needs, based upon an estimated irrigated acreage of about 80,000 acres, amount to about 249,058 acre feet of water. This figure includes delivery losses, totalling approximately 132,600 acre feet per year. Total water needs for the Mission Division amount to about 288,648 acre feet per year, while run-off supplies only about 250,689 acre feet per year. The difference of 37,959 acre feet between these two figures must be made up by pumping, and by increased storage or canal delivery efficiency (U.S. Dept. Interior, 1962). Division efficiency is already increased somewhat by the re-use of waste water from upstream diversions in downstream ones. For the year 1976, 90,840 acres of land were irrigated by 94,939 acre feet of water, or about 1.05 acre-feet per acre (U.S. Dept. Interior, 1976). A summary of the above information is presented in Table 20.
TABLE 20
MISSION VALLEY WATER SUPPLY

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual run-off from snow and precipitation</td>
<td>250,689</td>
</tr>
<tr>
<td>Flathead and Crow pumping system</td>
<td>15,195</td>
</tr>
<tr>
<td>Waste and spill to keep streams alive because of limited canal and reservoir capacity</td>
<td>14,845</td>
</tr>
<tr>
<td>Private water rights</td>
<td>24,715</td>
</tr>
<tr>
<td>Diverted and controlled run-off</td>
<td>226,324</td>
</tr>
<tr>
<td>Delivered to land</td>
<td>93,723</td>
</tr>
<tr>
<td>Diversion and delivery loss</td>
<td>132,601</td>
</tr>
<tr>
<td>Acreage irrigated after completion (1967)</td>
<td>80,180</td>
</tr>
<tr>
<td>Acreage irrigated at present time (1962)</td>
<td>72,768</td>
</tr>
<tr>
<td>Net acreage gain</td>
<td>7,412</td>
</tr>
<tr>
<td>Composite delivery per acre</td>
<td>1.29 ac.ft.</td>
</tr>
<tr>
<td>Additional water needed at land</td>
<td>9,561</td>
</tr>
<tr>
<td>Pump delivery loss</td>
<td>58%</td>
</tr>
<tr>
<td>Net requirements at pumps for additional ac.</td>
<td>22,764</td>
</tr>
<tr>
<td>Net requirements at pumps, 10 yr. average</td>
<td>15,195</td>
</tr>
<tr>
<td>Total requirements at pumps after project completion</td>
<td>37,959</td>
</tr>
<tr>
<td>Amount that can be pumped during average season</td>
<td>37,114</td>
</tr>
<tr>
<td>Amount short of requirement</td>
<td>845</td>
</tr>
</tbody>
</table>

\(^{a}\) All figures in ac.-ft. and computed for 10 yr. average, 1951-60.

The Moiese area requires a significantly greater amount of water than the rest of the Mission division. In 1976, although only 6,335 acres were irrigated in Moiese, 20,202 acre feet of water were delivered, or 3.19 acre feet per acre. This was considerably more than the 1.05 acre feet per acre required by the Mission Division as a whole, (U.S. Dept. Interior, 1976). However, increased use of sprinkler irrigation in this area may help to reduce this discrepancy (U.S. Dept. Interior, 1962). For the Moiese area, over the ten year period of 1950-1960, out of 33,965 acre feet diverted to the land only 24,322 acre feet were actually delivered, signifying a delivery loss of 9,643 acre-feet (U.S. Dept. of Interior, 1962).
Storage for the Mission division is accomplished by means of some ten reservoirs of varying capacities, whose total combined storage capability amounts to 100,694 acre feet. Reservoirs serving the Mission Division include: St. Mary Lake, Mission, McDonald, Kicking Horse, Ninepipe, Lower Crow, Twin Lake, Pablo, Hillside and Horte. In general, reservoirs are kept at full capacity until after the beginning of July. A need for additional storage still exists in this division.

Camas Division

Water supplies for the Camas Division are completely independent of those supplying the Jocko and Mission Divisions. Water sources include the Little Bitterroot River and tributaries, as well as some water diverted from the Little Thompson River (U.S. Dept. Interior, 1962). Water from the Little Thompson is transported into the division by means of the Alder and McGinnis Creek feeder canals. Table 21 summarizes some of the more significant water supply data for the Camas Division.

Table 21

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total annual run-off for division</td>
<td>48,353 ac. ft.</td>
</tr>
<tr>
<td>Average quantity diverted (1956-60)</td>
<td>29,315 ac. ft.</td>
</tr>
<tr>
<td>Amount delivered to land</td>
<td>13,379 ac. ft.</td>
</tr>
<tr>
<td>Amount lost in transmission</td>
<td>15,936 ac. ft.</td>
</tr>
</tbody>
</table>

For the year 1976, total delivery of irrigation water to the lands in this division amounted to 12,525 acre feet. Some 12,484 acres were irrigated, or about one acre foot per acre.
In order to insure sufficient water for non-project uses, the Little Bitterroot River must be maintained at a flow of at least 2,200 acre feet and Dry Fork Creek must be maintained at 2,900 acre feet per year, for a total of 5,100 acre feet (U.S. Dept. Interior, 1962).

Storage for this division is provided by four reservoirs with a total storage capacity of 45,190 acre feet. These include: the Upper and Lower Dry Fork reservoirs, Little Bitterroot Lake, and Hubbart Reservoir. The latter two reservoirs are actually located outside the reservation boundary. Tables 22 and 23 summarize most of the data contained in this section.

**TABLE 22**

**SUMMARY OF ENTIRE FLATHEAD PROJECT**

<table>
<thead>
<tr>
<th>Water Divided to Land</th>
<th>Water Delivered to Land</th>
<th>Diversion Delivery</th>
<th>Irrigated Water</th>
<th>Composited Delivery</th>
<th>Waste Water</th>
<th>Private Water Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different to Different</td>
<td>Different to Very</td>
<td>Very</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mission (1951-60)</td>
<td>226,324</td>
<td>93,723</td>
<td>132,601</td>
<td>58.6</td>
<td>72,768</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14,845</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24,715</td>
</tr>
<tr>
<td>Moiese (1951-60)</td>
<td>33,965</td>
<td>24,322</td>
<td>9,643</td>
<td>28.4</td>
<td>4,932</td>
<td>4.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22,118</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Jocko (1954-60)</td>
<td>54,711</td>
<td>23,575</td>
<td>31,136</td>
<td>56.9</td>
<td>9,158</td>
<td>2.59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72,111</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>record</td>
</tr>
<tr>
<td>Camas (1956-60)</td>
<td>29,315</td>
<td>13,379</td>
<td>15,936</td>
<td>54.5</td>
<td>10,418</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25,304</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,297</td>
</tr>
<tr>
<td>Average for Project</td>
<td>344,315</td>
<td>154,999</td>
<td>189,316</td>
<td>55.0</td>
<td>97,276</td>
<td>1.59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134,378</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26,022</td>
</tr>
</tbody>
</table>

*All figures in acre feet.*
TABLE 23

FLATHEAD PROJECT WATER USE, 1976

<table>
<thead>
<tr>
<th>Project Division</th>
<th>Total Delivery (ac. ft.)</th>
<th>Acreage Irrigated</th>
<th>Delivered per acre (ac. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission Valley</td>
<td>94,939</td>
<td>90,840</td>
<td>1.05</td>
</tr>
<tr>
<td>Moiese</td>
<td>20,202</td>
<td>6,335</td>
<td>3.19</td>
</tr>
<tr>
<td>Camas</td>
<td>12,525</td>
<td>12,484</td>
<td>1.00</td>
</tr>
<tr>
<td>Jocko</td>
<td>35,308</td>
<td>10,743</td>
<td>2.87</td>
</tr>
<tr>
<td>Total for Project</td>
<td>162,974</td>
<td>120,402</td>
<td>2.03 (average)</td>
</tr>
</tbody>
</table>

In 1972, consumptive water use for project lands amounted to about 152,000 acre feet. For non-project lands on the reservation, this figure amounted to about 129,500 acre feet, or a total of 281,500 acre feet for the entire reservation (Clyde, Criddle, and Woodward, 1972). Only about 2/3 of the total reservation water requirements were being met by the Flathead Irrigation Project and normal precipitation. This was resulting in a water shortage, that was having a detrimental effect on crop yields.

Project operation and facilities

Project lands are classified into a number of categories, based upon irrigability. Irrigability is determined on the basis of such factors as topography, drainage, and soils. Lands in classes one through four are considered to be suitable for irrigation. Class one is the most suitable and productive, and class four is the least productive.

Most water is delivered to project lands under a quota system. All distribution is based upon need, rather than upon any principle of prior appropriation (Moon, 1973). In theory, at least, all water on the
project is equally distributed and without priorities.

For the most part, irrigation on the project is accomplished through gravity flow. A limited amount of water is also pumped, at greater cost, from the Flathead River, Jocko River, and other reservation streams. The use of sprinkler irrigation on the project is also increasing. In 1976, 56,013 acres were being irrigated by sprinklers (U.S. Dept. Interior, 1976).

Water storage is provided by fifteen reservoirs, varying in size from 95 acre feet to 28,136 acre feet, and with a total storage capability of about 148,725 acre feet. Distribution of water is carried out via approximately 1,300 miles of main feeder and lateral irrigation canals. The major canals serving the project are as follows (U.S. Dept. Interior, 1962);

Jocko Division:

The two major canals of the Jocko division are known as the Jocko S and K canals. Both of these canals divert water from the Jocko River. The S canal has a capacity of 60 cfs at its intake and serves the southern Arlee area, while the larger K canal has a capacity of 231 cfs and furnishes water to the northern Arlee area.

Mission Division:

The Mission division is serviced by three major canals. These are the Tabor feeder canal, which transports some water from the Jocko division; the Pablo feeder canal and the Pablo A canal. The Tabor canal has a capacity of 200 cfs and empties into St. Mary's reservoir. The Pablo feeder canal diverts water from Dry Creek, has a capacity of 310 cfs and serves about two-thirds of the entire division. It
is about 42 miles long, with about five miles of concrete lining. The Pablo A canal, with a capacity of 511 cfs, draws water from the Pablo reservoir and serves the remaining one-third of the division.

Camas Division:

The Camas division also has three major canals, known as the Camas A, B, and C canals. The A canal, with a capacity of 89 cfs, supplies water diverted from the Little Bitterroot River to the B and C canals. The B canal has a capacity of 90 cfs. It transports water to about one-half of the entire division. The C canal, with a capacity of 75 cfs, originates at Lower Dry Fork Reservoir and supplies water to about 40 per cent of the division.

The Flathead project has three pumping facilities, in addition to its canal and reservoir system. These are: the Flathead pumping facility with a capacity of 216 cfs, the Crow facility, with a capacity of 24 cfs, and the Reavis facility, with a capacity of 10 cfs. The Flathead pumping plant is located on the Flathead River, in the Mission Division, just above Kerr Dam. At the present time, this pump operates mainly to supplement runoff. On a yearly basis, this averages about 24,120 acre feet per year, but may vary anywhere from zero to about 45,000 acre feet per year (Clyde, Criddle, Woodward, 1972). The pump should be capable of providing over 50,000 acre feet per year, however. Maximum output for one month was 13,221 acre feet and occurred in 1949. In general, pumps are only utilized for three or four months out of the year (Clyde, Criddle, Woodward, 1972). In 1972, the Flathead pump was operated only for the period July 12 to August 31 and supplied 17,686 acre feet of water during this time (U.S. Dept. Interior, 1972).
The Crow pumping facility is also located in the Mission Division and relies upon return flow for its water supply (U.S. Dept. Interior, 1962). The Revais pump is located in the Jocko Division and pumps about 2,000 acre feet per year. It derives water from the Jocko River via a supply canal. In 1972, this pump provided 1,248 acre feet to lands in the neighborhood of Dixon (U.S. Dept. Interior, 1972).

Table 24 summarizes the status of project facilities.

### TABLE 24

**FLATHEAD PROJECT FACILITIES**


<table>
<thead>
<tr>
<th>Major Supply Canals</th>
<th>Division</th>
<th>Total length (mi.)</th>
<th>Initial Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jocko</td>
<td>35.60</td>
<td>23-230</td>
<td></td>
</tr>
<tr>
<td>Mission</td>
<td>63.17</td>
<td>215-600</td>
<td></td>
</tr>
<tr>
<td>Camas</td>
<td>9.58</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td><strong>Project Total</strong></td>
<td><strong>108.35</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution Systems</th>
<th>Division</th>
<th>Total length (mi.)</th>
<th># Structures each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jocko</td>
<td>78.00</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Mission</td>
<td>894.</td>
<td>8100</td>
<td></td>
</tr>
<tr>
<td>Camas</td>
<td>104.</td>
<td>900</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,076.90</strong></td>
<td><strong>10,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pumping Plants</th>
<th>Name</th>
<th>Location</th>
<th>Water Supply</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flathead</td>
<td>Mission Division</td>
<td>Flathead River</td>
<td>216 cfs</td>
</tr>
<tr>
<td></td>
<td>Crow</td>
<td>Mission</td>
<td>return flow</td>
<td>24 cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>accumulations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Revais</td>
<td>Jocko</td>
<td>supply canal</td>
<td>10 cfs</td>
</tr>
</tbody>
</table>

A limited portion of some of the more important canals are concrete lined in order to reduce seepage water losses, but increased lining is necessary.
In addition to irrigation facilities, the Flathead Project also runs its own electric and power system. This system provides some power generation, via a 360 kw plant located on Big Creek, near Polson.

Private Irrigation

Private irrigation on the reservation is minimal. Clyde, Criddle and Woodward (1972) have found that some 26,000 acres on the reservation are served by means of private diversions. Many of these private diversions operated only during periods of high flow during the spring run-off.

Some conflict does exist between private and project water use. Some individuals apparently have state claims on what is actually project water. This water they put to private use, for which they are not assessed by the project.

Project Problems

One significant difficulty facing the Flathead Project is insufficient water supplies to meet increasing demands. These shortages, for the most part, are due to lack of storage and inefficiencies.

The Pacific Northwest River Basins Commission (1971), noted that for the Flathead Basin as a whole, water shortages tended to become most critical during the latter half of the summer, when water that had been stored during the spring run-off period was entirely used up. They concluded that although additional diversions were not necessary, increased storage was essential if water supplies were to last throughout the summer months. They predicted that in the event
of a drought, lands in the Flathead area might experience water shortages of up to 30%.

Even when water is available, it is sometimes difficult to get it to cropped lands at a reasonable cost, and local shortages may occur. For example, gravity flow is generally inadequate to transfer water from the Flathead River to most of the arable land in the area. Although pumping could be used in many cases instead, this is considerably more expensive. In the Jocko Division, the limiting factor appears to be not the total run-off, but rather the lack of possible storage sites. Only in the Camas Division do we find nearly all available water sources being fully utilized (Plunkett, 1952).

There are still water shortage problems in dry years, even when water is pumped, or when sprinkler, rather than gravity type irrigation is used. This problem will become magnified if more project land is classified as irrigable (Clyde, Criddle and Woodward, 1972).

One factor compounding water shortage problems is that of seepage and general project inefficiency. Although some canals are concrete lined, this is by no means extensive enough and much of the project is plagued by erosion of canal banks and water seepage. Some of the reservoirs also have high seepage rates. This is particularly true of the Jocko reservoir. Attempts at remedying the situation at the Jocko reservoir have, for the most part, failed (U.S. Dept. Interior, 1962). Some of the main canals in the Camas Division are also particularly beset by seepage problems.

Condition and size of canals and reservoirs all affect overall project efficiency. Clyde, Criddle and Woodward (1972), have found in
their study that overall project efficiency is quite low, accounting
to only about 18%, and that this has resulted in decreased crop
productivity.

Approximately 28% of the run-off available to the Flathead Project
is lost initially due to insufficient storage and canal capacity. On
the average, only some 45% of the total amount of water that is
successfully diverted by the Flathead Project, is actually delivered
to the land, while the remaining 55% is lost during distribution
(see Table 22). Delivery efficiencies range from as low as 25% in
areas served by open, sandy bottomed or heavily vegetated irrigation
ditches, to 95% in those areas with enclosed pipelines. Once the water
has been delivered to the farms, additional water losses occur. On-farm
water use efficiencies range from 15 to 60%, with an average value of
only 30 to 40%. Higher efficiencies are found on those farms using
sprinkler, rather than flood irrigation. Theoretically, 75% farm
efficiencies should be attainable with proper care (Clyde, Criddle
and Woodward, 1972). The fact that alfalfa has now taken precedence
over wheat production on the reservation is also of significance, since
it has resulted in an increased water demand. Alfalfa normally
requires considerably more irrigation water than does wheat (Monson,
et al., 1953).

Clyde, Criddle and Woodward (1972), found that another source of
inefficiency was that often, more water was being applied to the land
than was strictly necessary. They found that six to eight inches of
water were being applied to soils that had only a two to three inch
moisture deficit. Eliminating inefficiencies such as these would
permit more land to be irrigated. Some 9,568 acres of project land entitled to water do not receive it due to lack of water. If this land is to be irrigated, project efficiencies must be increased.

Although as early as 1929, DeYoung and Roberts noted that flood type irrigation caused some heavy soils to harden, the U.S. Department of Interior (1962), maintained that this was not a problem and that irrigation was neither adversely affecting project soils nor resulting in salt accumulations.

One other problem of significance is that of the equitability of water distribution. Although an attempt is made to distribute water equally, some users have complained that this is not really done, (Moon, 1973). Clyde, Criddle and Woodward (1972), also reported that there have been some complaints of inadequate water supply to Indian lands during dry years.

**Future status of the project**

The present use of project lands for the growing of hay and grain for livestock will probably not change in the foreseeable future. Water shortages will probably also plague the project for some time to come. Although the 1962 Plan for Completion (U.S. Dept. Interior, 1962), called for increased construction and irrigation, including the lining and repair of project canals to reduce seepage, many of these goals have not yet been met, due to lack of funds (Moon, 1977). Since the 1940's, the emphasis on the project has been on improving existing irrigation works, rather than on a great deal of expansion and increased construction. At the present time, little construction is going on, or is anticipated for the near future (Moon, 1977). At such time when further project construction does become possible, there are several
areas that might bear future development.

In the lower area of the Little Bitterroot River, an additional 20,000 acres that are not now receiving irrigation water might be suitable for irrigation. This is class three land; that is, lands with relatively poor soils that may limit crop productivity (Pacific Northwest River Basins Commission, 1971).

Another feasible project would involve utilizing water from the Flathead River to irrigate some lands along the west bank of the river. Some 100,000 acres might be included in such a project (Clyde, Criddle and Woodward, 1972). As has already been mentioned, the Jocko Division in particular is in need of increased storage facilities. One Jocko River tributary that might be suitable for building these facilities is Valley Creek. In the Mission Division, Yellow Bay Creek, Blue Bay Creek, and Boulder Creek are all probably too steep to make storage practical (Clyde, Criddle, and Woodward, 1972). In some instances lands are suitable for irrigation in terms of soil type, topography, etc., but water for irrigation is completely unavailable. Some 20,000 acres near Camas Prairie fall into this category.

An increase in project and on-farm efficiency, as well as storage, is essential if water shortages are to be avoided in the future.

Summary

At present, the major water uses on the reservation are for irrigation and power. Industrial, domestic and municipal water use are or secondary importance.
Most of the existing or potential power sites are located on the Flathead River.

Kerr Dam, run by Montana Power, and located on the Flathead River, is the major power facility on the reservation.

The development of the Buffalo Rapids power sites, on the Flathead River, would probably do the least damage, in terms of flooding of reservation land.

Municipal water uses include: water for domestic purposes and sewage disposal. Both surface and ground water are used domestically. Polson, Ronan, St. Ignatius, Charlo, Round Butte and Hot Springs have community-wide water systems. In some cases, these community systems need improvement in the form of increased storage or supplies for the summer months, and increased and improved distribution systems. Several communities without central water supply systems could use them, including: Pablo, Ravalli, Big Arm, and Dixon.

Sewage systems on the reservation include: treatment plants, lagoons, septic tanks and cesspools. Polson, Ronan, St. Ignatius, Pablo, Charlo, and Hot Springs, have community-wide sewage systems. Many of the towns without a community sewage system, could use one.

Irrigation is essential for agricultural production over most of the reservation.

Most of the irrigation is done by the Flathead Indian Irrigation Project, although some private irrigation exists as well.

The majority of irrigated lands are found east of the Flathead River or along the Jocko or Little Bitterroot Rivers.
Irrigation is accomplished via gravity flow, sprinklers, and pumping.

The Flathead Irrigation Project is divided up into three major divisions, known as the Jocko, Mission, and Camas divisions.

The Flathead Irrigation Project is not meeting all the demands placed upon it, and water shortages do occur. These shortages lower crop productivity. Project inefficiencies and insufficient storage and canal capacity are contributing to these shortages.

In the Jocko Division, much water is lost in the form of uncontrolled run-off, due to lack of storage. Many of the Jocko reservoirs are plagued by high seepage rates. Not many potentially suitable storage sites remain in the Jocko division. Instead of building new storage facilities, more effort should probably be spent on improving and enlarging existing facilities. Canal efficiencies in this division are also low. Transmission loss averages about 57%.

The Mission division also has inadequate storage and canal capacity, high canal and seepage rates, and inefficient pumping. Transmission loss for the Mission division averages 58%.

In the Camas division, most of the available water sources have been fully developed. Canal seepage loss is high, however. Transmission losses amount to about 54% in this division.

Delivery efficiencies range from 25% in open, sandy, or vegetation-choked canals, to close to 95% in enclosed pipelines.

Additional water is lost due to on-farm inefficiencies. On-farm water use efficiency is as low as 15-16% in some areas, with an average value of 30-40%.
Overall project efficiency is only about 18%.

The shift in land use away from wheat and in favor of alfalfa production, has placed some additional strain on Flathead project facilities. Alfalfa requires more irrigation water than does wheat.

Some conflict exists between private and project use of water, as well as over project distribution of water. These issues need to be clarified and resolved.

If project efficiencies are improved, some areas of expansion, in terms of irrigated acreage, may be possible.
CHAPTER III
WATER QUALITY

Water quality data for the Flathead Indian Reservation is quite limited and what does exist consists mainly of bacteriological studies. Extensive work covering additional aspects of water quality, as well, is an essential requirement for any future planning on the reservation.

Regulation and maintenance of water quality on the reservation is the responsibility of the Federal government, via the Bureau of Indian Affairs, rather than that of the state.

Water use classifications for streams on the Flathead Reservation are shown in Table 25.

TABLE 25
WATER USE CLASSIFICATIONS
(from: Montana Water Pollution Control Council, 1976)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-D&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Flathead River drainage (with certain exceptions)</td>
</tr>
<tr>
<td>A-open-D&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Flathead Lake and its tributaries except Flathead River above the lake, Swan River and a portion of Hellroaring Creek as listed below,</td>
</tr>
<tr>
<td>A-closed</td>
<td>Hellroaring Creek drainage to the Polson water supply intake</td>
</tr>
<tr>
<td>B-D&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Remainder of Hellroaring Creek drainage (the Flathead River below the highway bridge at Polson to Paradise is included in the B-D, classification of the Flathead River drainage listed above.)</td>
</tr>
<tr>
<td>B-D&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Crow Creek drainage to road crossing at Sect. 16, T20N, R20W about 2½ miles southwest of Ronan, except the portion of Second Creek listed below:</td>
</tr>
<tr>
<td>A-Closed</td>
<td>Second Creek drainage to the Ronan water supply intake</td>
</tr>
<tr>
<td>B-D&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Remainder of Second Creek drainage</td>
</tr>
</tbody>
</table>
TABLE 25 (continued)

<table>
<thead>
<tr>
<th>Description</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crow Creek (mainstem) from road crossing in S16, T20N, R20W to the Flathead River</td>
<td>B-D_2</td>
</tr>
<tr>
<td>Tributaries to Crow Creek from road crossing in S16 to the Flathead River</td>
<td>B-D_1</td>
</tr>
<tr>
<td>Little Bitterroot River Drainage to Hubbart Reservoir</td>
<td>B-D_1</td>
</tr>
<tr>
<td>Little Bitterroot River (mainstem) from Hubbart Reservoir to the Flathead River</td>
<td>B-D_2</td>
</tr>
<tr>
<td>Tributaries to the Little Bitterroot River from Hubbart Reservoir Dam to the Flathead River except Hot Springs Creek listed below:</td>
<td>B-D_1</td>
</tr>
<tr>
<td>Hot Springs Creek Drainage to the Hot Springs water supply intake</td>
<td>A-Closed</td>
</tr>
<tr>
<td>Hot Springs Creek (mainstem) from the Hot Springs water supply intake to the Little Bitterroot River</td>
<td>E</td>
</tr>
<tr>
<td>Tributaries to Hot Springs Creek (if any) from the Hot Springs water supply intake to the Little Bitterroot River</td>
<td>B-D_1</td>
</tr>
<tr>
<td>Mission Creek drainage to the St. Ignatius water supply intake</td>
<td>A-Open-D_1</td>
</tr>
<tr>
<td>Mission Creek drainage from the St. Ignatius water supply intake to U.S. Highway 93 crossing about one mile west of St. Ignatius</td>
<td>B-D_1</td>
</tr>
<tr>
<td>Mission Creek (mainstem) from U.S. Highway crossing to the Flathead River</td>
<td>B-D_2</td>
</tr>
<tr>
<td>Tributaries to Mission Creek from the U.S. Highway 93 crossing to the Flathead River</td>
<td>B-D_1</td>
</tr>
</tbody>
</table>

**KEY:**

- **A-closed:** Water supply for drinking, culinary and food processing purposes, suitable for use after simple disinfection.
- **A-open:** Water supply for drinking, culinary, and food processing purposes suitable for use after simple disinfection and removal of naturally present impurities.
- **B:** Water supply for drinking, culinary and food processing purposes suitable for use with adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any additional treatment necessary to remove naturally present impurities.
- **D_1:** Growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers.
A detailed explanation of State water use and water quality criteria may be found in Appendix IV. In 1959, the State Board of Health conducted the only really extensive study of water quality conditions on the Columbia River drainage as a whole. Their observations on the Flathead drainage are worthy of note, although, since that time, some of the problems they mention have been considerably alleviated, while others have worsened. Upgrading is particularly true of the towns of Ronan and Polson, both marked as major polluters in the 1959 study. The new sewage systems put into these towns since that date have greatly decreased their contribution of pollutants, although some pollution problems still exist. Other areas, such as Arlee and Evaro, were not problem areas in 1959, but now promise to become so. Where subdivisions are now being developed in areas with soils unsuitable for sewage drainfields, problems may be expected. In addition, increased recreational use of the Flathead area is beginning to create pollution problems that were not in evidence in 1959.

Each problem area will now be considered individually.

**Flathead Lake**

Flathead Lake has a distinct summer pollution problem. The reasons for this are twofold. One is that the tremendous influx of summer visitors and residents increases the sewage load on the lake, and the other is that people who reside on the lake only during the summer
months find it too costly to put in adequate sewage facilities (Lozeau, 1973). During the summer, motor boat use and overall recreational use of the lake also increase considerably.

Pollution levels on the lake as a whole are still low enough to warrant a Class A designation, although in a number of locations around the lake, where usage is high, the state standard of 50 coliforms per 100 milliliters of water for Class A waters, is exceeded (Spindler, 1966; Bauer, 1969). This is particularly significant since some residents in the area depend on lake water for their water supply.

Some of the more important trouble spots on the lake are described below.

**Big Arm**

The septic tanks used in this area appear to be permitting some seepage to reach the lake. Although the problem is not very great yet, it may become so (Wirth and Assoc., 1970a). Bauer (1969), reported an average total coliform count as high as 530/100 ml., for one location in the Big Arm area.

**Dayton and Elmo**

Both these areas also appear to have septic tank seepage and overflow going into the lake (Wirth and Assoc., 1970a). One count in Dayton yielded an average total coliform value of 140/100 ml., (Bauer, 1969).

**Blue Bay**

This area seems to be polluted, although some of the pollutants may be originating from the drainfield at Woods Bay. A lagoon treatment
system is being considered for the Blue Bay area, however (Lozeau, 1973). Bauer (1969) reported average coliform counts of up to 1,500/100 ml. for Blue Bay.

Yellow Bay

This area was experiencing pollution problems, presumably coming from the Yellow Bay State Park facility and the University of Montana Biological Station. The construction of a new sewage treatment plant has recently improved this situation (Hawkaluk, 1977). Bauer (1969), reported one average coliform value in this vicinity, of 8,300/100 ml.

Polson

Although little pollution is now getting into the lake from Polson, some areas in Polson Bay still have pollution problems. Bauer (1969), found some average coliform values to be as high as 300/100 ml.

Flathead River

The Montana State Board of Health (1959), found the reservation portion of the Flathead River drainage, with the exception of Spring Creek, which had a pH of 8.9, to be acceptable in terms of pH for all uses. They reported pH values ranging from 7.6 to 8.2, for other streams in the drainage.

Chlorides (with a range of 0 to 24 ppm), sulfates (with a range of 0 to 35 ppm), and phosphates (with a range of 0 to .24 ppm), were also found to be within acceptable levels. (See Appendix IV for Federal water quality standards.)
Two major areas of the Flathead River, one below Kerr Dam, and the other above its juncture with the Clark Fork, were found to have water temperatures sufficiently high to be potentially detrimental to trout. Temperatures of up to 68 degrees Farenheit were recorded, and the State Board of Health (1959), warned that the dumping of toxic wastes into these regions might be particularly hazardous, due to the potentially synergistic effect of high water temperatures.

Polson was found to be a major polluter on the river, and average MPN coliform values of 680/100 ml., were recorded below Kerr Dam. Although pollution from this source has been reduced since 1959, there is still some pollution downstream from Polson on the Flathead River (Lozeau, 1973).

Little Bitterroot River

The Montana State Board of Health (1959) found that one major problem on the Little Bitterroot River was a high degree of turbidity, exceeding, in the area of Hot Springs, the maximum standard of 10 ppm. The Little Bitterroot was also found to be contributing to high turbidity levels in the Flathead River, into which it drains. Turbidity levels in the Flathead were as high as 11 ppm, 22 miles downstream from the entrance of the Little Bitterroot. Turbidity levels of the Flathead above its juncture with the Little Bitterroot were only 7 ppm, (Montana State Board of Health, 1959).

In the area around Hot Springs, coliform counts were found to be high. Average coliform values of 19,000/100 ml., were recorded. Numbers of sewage intolerant benthic organisms were found to be low. Sewage
intolerant organisms were found to make up 77% of the benthic samples taken above Hot Springs, but only about 35% of the samples taken from below the town. Based upon this, the State Board of Health study (1959), concluded that this portion of the Little Bitterroot was suitable only for agricultural or industrial use. Lozeau (1973), maintained that while there was still some pollution on the Little Bitterroot in the neighborhood of Hot Springs, it was probably not coming from Hot Springs itself, which has a good sewage treatment plant, but rather from private septic tanks and drainfields along the river above Hot Springs. The Lonepine area was particularly suspect in this regard.

The Lonepine area has become increasingly a problem area. The difficulty appears to lie with the fact that while the area depends entirely upon the use of private septic tanks for its sewage disposal, the clay soil of the area is very unsuitable for septic tank use. The Indian Health Service has recently begun a new lagoon system in Lonepine, that appears to have excellent potential for solving the area's problems. In 1967, they began to install individual, private sewage treatment lagoons for area residents. These lagoons were found to be most effective when they were about 30 x 40 feet in size. The lagoons are not, apparently, excessively costly, unsightly, or odoriferous, and may be placed relatively near residences (Lozeau, 1973).

Spring Creek, Mission Creek and Others

Spring Creek

The State Board of Health (1959), found Spring Creek to be heavily
polluted in the vicinity of Ronan. Raw sewage was apparently being
dumped into the creek from Ronan at that time. Average coliform
values were found to be as high as 1,197/100 ml., and numbers of sewage
intolerant organisms were found to be low. The study concluded that
the stream was suitable only for agricultural or industrial use. The
stream was also found to have an excessively low pH. Since the time
of this study, a new sewage system in Ronan has considerably improved
this situation. Some pollutants from a Ronan dairy company are still
getting into Spring Creek, however (Lozeau, 1973).

Mission Creek

The Montana State Board of Health (1959), found evidence of fecal
pollution in Mission Creek, in the vicinity of St. Ignatius. Average
coliform values of 8,650/100 ml. were recorded. At the present time,
raw sewage is still being dumped into Mission Creek from St. Ignatius
(Hawlakul, 1977). Although St. Ignatius does have two sewage treatment
lagoons, there are several households in the town that are not served
by either of the lagoons, and use private septic tanks instead. These
households appear to be responsible for raw sewage getting into the
creek. Coliform counts also appeared to increase going downstream
from St. Ignatius. Denton and Lawrence (1972), pointed out that the
condition in Mission Creek did not pose an immediate health hazard,
since St. Ignatius derived its drinking water from Mission Reservoir,
located upstream from these sources of pollution. They also found some
evidence of inadequate sewage treatment in the lagoons themselves.
Improvement and expansion of the St. Ignatius sewage system to encompass all households, is still being contemplated. It appears that the water quality of Mission Creek and adjacent creeks is also being adversely affected by agricultural practices and irrigation return flows, in addition to sewage discharge (Hawkaluk, 1977).

**Finley Creek and Evaro**

Finley Creek, located above the town of Evaro, appears to be receiving fecal pollution from private septic tanks in the Evaro area. A trailer court may be established in the area, which may compound this problem. Development of a trailer court would increase subdivision and bring about a corresponding increase in septic tank and drainfield densities. Should pollution problems become excessive, a lagoon system may have to be installed in the area (Lozeau, 1973).

**Arlee**

Arlee also promises to become increasingly troublesome in terms of pollutants. This area has no central facility for sewage treatment, nor a community water system. Instead, the town relies upon a large number of individual septic tanks, all located within a small restricted area. The problem is compounded by the gravelly nature of the soil in the area. Thus far, at least three wells have been lost in the area due to fecal pollution. In one instance, a well was actually pumped out and refilled with clean water. Within a short period of time it became septic again. Dry well sewage disposal is no longer permitted in the Arlee area (Lozeau, 1973).
Ravalli

Ravalli has also had some problems with fecal pollution of well water in the past, but this situation is no longer thought to be serious (Wirth and Assoc., 1970a).

Dixon

This area relies upon septic tanks and is experiencing difficulties from having too many located in one area.

Black Lake

Although Black Lake is not a problem area in the same sense as the previous cases, it will be mentioned here simply because the Confederated Tribes have expressed some interest in developing it as a recreation area. Black Lake is located in the extreme north central part of the reservation, about five miles west of Dayton. It covers an area of about 61 acres and is completely enclosed, with no streams entering or leaving it. The water sources for the lake consist of precipitation, run-off, and intermittent springs. The lake has an unusual, but natural chemical make-up, which, unfortunately, makes it unsuitable for most recreational purposes, including fishing. It is extremely alkaline, with a pH near 9.5 (Noice and Scheltema, 1971). Hydrogen sulfide and ammonia are also present in the lake in extremely high concentrations, and appear to increase in concentration with increasing depth. At some depths, ammonia concentrations were found to be as high as 25 ppm (2.5 ppm is considered to be harmful to many organisms). Sulphate also exists in high concentrations in the lake, perhaps indicating the presence of sulphur springs (Noice and Scheltema,
1971). The chemical nature of the lake has placed a severe limitation on the number of living organisms capable of surviving in its waters. Murphy, et al. (1969) found fish and amphibians to be totally absent from the lake, and spotted only one turtle and a few water fowl on the lake during their entire study. The only life form found in any numbers in the lake is zooplankton (especially water mites), and even here there is a marked lack of species diversity (Murphy, et al., 1969). The number of species of aquatic plants and algae is also quite restricted (Noice and Scheltema, 1971). With the exception of bacteria, no life of any kind is present below 7½ meters in depth (Murphy, et al., 1969). The lake will never be suitable for stocking with fish, and is likely to remain undeveloped as a recreational area.

**Municipal Water Quality**

An analysis of the chemical content of water supplies serving most of the major communities on the reservation is shown in Table 26. Wells in Charlo, Polson, Ronan, Round Butte and St. Ignatius, all have extremely hard water. (See Appendix IV for water quality standards.) Wells in Round Butte and Hot Springs exceed standards for iron. All other municipal water sources meet Federal standards.
TABLE 26

MUNICIPAL WATER QUALITY\(^a\)
(from: Wirth and Assoc., 1970a)
\(^a\)All values in mg./liter.

<table>
<thead>
<tr>
<th>TOWN</th>
<th>CHARLO</th>
<th>POLSON</th>
<th>POLSON</th>
<th>RONAN</th>
<th>RONAN</th>
<th>ROUND BUTTE</th>
<th>ST. IGNATIUS</th>
<th>ST. IGNATIUS</th>
<th>HOT SPRINGS</th>
<th>HOT SPRINGS</th>
<th>HOT SPRINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>well</td>
<td>well</td>
<td>well</td>
<td>well</td>
<td>well</td>
<td>Mission Creek</td>
<td>well</td>
<td>Hot Springs</td>
<td>well 1</td>
<td>well 2</td>
<td></td>
</tr>
<tr>
<td>Total Solids</td>
<td>146</td>
<td>27</td>
<td>150</td>
<td>43</td>
<td>70</td>
<td>185</td>
<td>46</td>
<td>150</td>
<td>43</td>
<td>150</td>
<td>146</td>
</tr>
<tr>
<td>Hardness</td>
<td>198</td>
<td>21</td>
<td>177</td>
<td>50</td>
<td>110</td>
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<td>35</td>
<td>160</td>
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<td>100</td>
<td>71</td>
</tr>
<tr>
<td>Ca</td>
<td>40</td>
<td>8</td>
<td>33</td>
<td>11</td>
<td>22</td>
<td>32</td>
<td>12</td>
<td>34</td>
<td>5</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Mg</td>
<td>24</td>
<td>0</td>
<td>23</td>
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Areas of water quality work in which studies remain to be done in­clude: concentrations of pesticides, effects of agriculture and clear­cutting on water quality (i.e. whether or not silt loads are increased), and presence of radioactive materials. All of these areas will require that further research be initiated.

Additional water quality studies that are currently going on include some baseline sampling of lakes and streams in the Flathead drainage by the Flathead Drainage Project 208, in Kalispell, and some water quality work being done on Flathead Lake by the University of Montana Biological Station at Yellow Bay.

Summary

Flathead Lake has a summer pollution problem. This is due to an increased summer population, inadequate sewage facilities in summer residences and increased recreational use of the lake during the summer months. Particular trouble spots on Flathead Lake in the past have been Big Arm, Dayton, Elmo, Blue Bay, Yellow Bay, and Polson.

The Flathead River has some areas with high temperatures, some bacteriological pollution below Polson, and excessive turbidity below its junction with the Little Bitterroot River.

The Little Bitterroot River has generally high turbidity, and some fecal pollution in the vicinity of Hot Springs and Lonepine.

Spring Creek is receiving some contaminants from Ronan.

Mission Creek has some fecal pollution in the vicinity of St. Ignatius.

Finley Creek is apparently receiving some fecal pollutants from Evaro.
Arlee and Dixon are experiencing problems with fecal contamination of well water.

Black Lake is naturally highly alkaline and probably unsuitable for recreational purposes.

Municipal water quality on the reservation is generally within Federal standards. Charlo, Polson, Ronan, Round Butte and St. Ignatius, all have hard water. Round Butte and Hot Springs have excessive amounts of iron.
CHAPTER IV
WATER RIGHTS

The problem of Indian water rights is an extremely complex one. Unfortunately, many of the issues that might arise with respect to Indian water rights, have not yet come before, or been resolved by the courts. Thus, the full extent of Indian rights in this area is not really known and has not been fully defined. Even the Winter's Doctrine decision of 1908, which is the cornerstone of Indian water law, does not really quantify the amount of water involved and is sufficiently vague to be open to differing interpretations on some issues. Perforce, the treatment accorded the subject in this section will be only a superficial one. An attempt will be made, however, to provide some background information on both Montana and Indian water law, and some of the conflicts that have arisen between the two, as well as to consider some of the water rights problems on the Flathead Reservation.

Montana Water Law

Water law in the U.S. has, traditionally, been based on three main principles, that is, the doctrine of riparian rights, the doctrine of prior appropriation, and the permit system. The doctrine of riparian rights, originally of English origin, has been restricted in use for the most part, to the eastern part of the country, where water is plentiful. It states, in essence, that riparian owners are not allowed to significantly reduce the flow of a stream past their land (Wirth and Assoc., 1970a,b). This principle was well suited to the water-rich east, but was totally impractical for use in the arid west. In response
to the needs of mining and agriculture in the west, the law of prior appropriation came to be accepted instead. The basis of the law of prior appropriation, is, like that governing mining itself, first in time, first in right. Unlike the doctrine of riparian rights, non-riparian owners may appropriate water and stream flow may be reduced, with the earliest appropriators having priority for their claims.

In Montana water law, prior to 1973, beneficial use was the measure of the size of the water right. That is, water must have been actually diverted and put to use in order to establish a water right. The state retained ownership of the waters, while appropriators could only obtain use of the waters (Montana Water Res. Bd., 1968). Water rights were also considered to be property rights.

The first in time, first in right principle, was also taken to apply to ground water, as did the beneficial use concept of appropriation.

Streams could either be adjudicated (water rights determined by court decision), or unadjudicated. Procedures for appropriating water differed for each of these two situations.

Prior to 1973, Montana was one of two western states to still rely upon the doctrine of prior appropriation, rather than the permit system. In 1973, Montana finally did adopt a permit system. Under this system, water may not be appropriated without first applying to the state for a permit (Montana Water Use Act, 1973, R.C.M., 1947, Title 89, Ch. 8).

The permit system has the potential advantage of permitting water use planning at the state level, rather than completely random
development at the individual level. However, this state control can only be exercised over waters that have not yet been appropriated.

This system,

is an attempt to protect the public interest in unappropriated waters ... Under it no use of water can be initiated except upon application to state water officials for a permit, which may be denied if there is no unappropriated water or if the proposed use would conflict with the public interest ... Under this system, the water officials can do more than merely prevent over-development by over optimistic would-be appropriators who wish to undertake projects on already exhausted water sources, they also have the power to prevent underdevelopment, to insure total development by denying permits to small projects that might cut the heart out of large projects and make the remainder economically infeasible (Trelase IN Sheridan, 1968).

Under the new Montana Water Use Act of 1973 (R.C.M., 1947, Title 89, Ch. 8), permits are only issued if:

1. there are unappropriated waters in the source of supply
2. the rights of a prior appropriator will not be adversely affected
3. the proposed means of diversion or construction are adequate
4. the proposed use of water is a beneficial use
5. the proposed use will not interfere unreasonably with other planned uses or developments for which a permit has been issued or for which water has been reserved

Although under this system prior appropriation is still significant, other considerations are taken into account as well.

**Indian Water Law**

It is the concept of state ownership and control of the waters that comes into direct conflict with Indian water law. In the famous Winter's Doctrine decision, the Supreme Court ruled that the state did not have jurisdiction over Indian water, and that state laws governing appropriation did not apply to water thus reserved for Indian use.
The 1908 Winter's decision came as a result of a dispute over water rights on the Milk River, bordering the Ft. Belknap Indian Reservation in Montana. The United States, representing the Indians, maintained that the Indians had the right to have the river bordering their reservation flow past the reservation undiminished in quantity by upstream dams and diversions. The argument by the United States in support of this claim was essentially that the reservation was originally set up with the intent of converting the life style of the Indians from nomadism to sedentary agriculture. However, the arid nature of most of the reservation lands made it unsuitable for agriculture without water for irrigation. The U.S. maintained that all the waters of the river were necessary to fulfill the purpose of the reservation, and that all dams and diversions that had been built subsequent to the establishment of the reservation were in violation of the rights of the Indians:

The Indians did not thereby cede or relinquish to the U.S. the right to appropriate the waters of Milk River necessary to their use for agricultural and other purposes upon the reservation, but retained this right, as an appurtenance to the land which they retained, to the full extent in which it had been vested in them under former treaties, and thus retained and vested in them under the agreement of 1888, at a time when Montana was still a Territory of the United States, could not be divested under any subsequent legislation either of the Territory or of the State (Winters v. U.S., 207 US 564).

The upstream users, in return, argued that they had completely complied with the law in acquiring their lands under the Homestead Acts, and had followed Montana state law in appropriating the water necessary to irrigate these lands. In addition, their appropriation and use of these waters had preceded any appropriation and use by
Indians on the reservation. Without water for irrigation, their lands would become valueless and the tremendous investment that had been made not only in building dams, but in establishing communities in the area, would be lost. The defendants (i.e. the upstream water users) concluded that:

In the agreement with the Indians and the act of Congress, ratifying that agreement, there was no reservation of the waters of Milk River or its tributaries for use on the Ft. Belknap Indian Reservation. Nor can it be held that the Indians understood that there was any reservation of the waters of Milk River for use upon the Belknap Reservation, or that they ceded and relinquished to the government anything less than the absolute title to the lands and all waters thereon to that portion of the former reservation to which they relinquished their claims ... The appellants made valid appropriations of the waters of Milk River and its tributaries under the laws, customs and decisions of Montana, and the laws of Congress, and their rights as grantees of the government are superior to any rights which the Indians may have by reason of the agreement entered into between them and the government. The doctrine of riparian rights is not recognized, does not prevail and never was in force in Montana, and the rights of the parties to the use of the waters of Milk River and its tributaries must be construed according to the laws of this State (Winters v. US, 207 U.S. 564).

They also maintained that any reservation of waters on the river was lifted when Montana became a state.

The court, however, ruled in favor of the Indians and concluded that:

The power of the government to reserve the waters and exempt them from appropriation under the state laws is not denied, and could not be. That the government did reserve them we have decided, and for a use which would be necessarily continued through years. This was done May 1, 1888, and it would be extreme to believe that within a year Congress destroyed the reservation and took from the Indians the consideration of their grant, leaving them a barren waste - took from them the means of continuing their old habits, yet did not leave them the power to change to new ones (Winters vs. US 207, US 564).
The basic conclusion of the Winters decision, as expressed by Veeder (1965), was that:

Although not mentioned in the treaties, executive orders or other means used to establish the reservations, there is an implied reservation of rights to the use of the waters in streams which rise upon, traverse or border upon Indian reservations, which may be exercised in connection with Indian lands. Those rights to the use of water are withheld from appropriation by others subsequent to their reservation.

The rationale behind this was that the treaties resulting in the formation of reservations represented a cession of rights and land from the Indians to the U.S., rather than vice versa, and a reservation of land and all rights not specifically ceded. Only water rights established before the creation of a reservation would take precedence over Winters Doctrine rights.

For executive order reservations, the water rights are considered to be established from the day of the creation of the reservation. Where reservations have been established in the original area where particular Indian groups resided, their water right is considered to be the first on the river and has priority over all others. Even if this right to the water is not exercised until many years after the founding of a reservation, it is still considered to be a valid right with its priority date the date of the creation of the reservation (McDermott, 1973).

Several decisions subsequent to the Winter's decision have clarified and quantified the Winter's Doctrine to some extent, although by no means completely.
In the 1963 Arizona v. California decision, water rights were taken to encompass a sufficient quantity of water to meet both the present and future needs of the Indians. The quantity of water involved was further quantified to be the "quantity of water necessary to irrigate all practicably irrigable acreage on the reservations." (Arizona v. California, 373 US 546).

The Arizona vs. California decision arose as a result of a dispute between the states of Arizona, California and Nevada over the use of water from the Colorado River. In this decision, the Supreme Court ruled that:

We also agree with the Master's conclusion as to the quantity of water intended to be reserved. He found that the water was intended to satisfy the future as well as the present needs of the Indian reservation and ruled that enough water was reserved to irrigate all the practicably irrigable acreage on the reservations. Arizona, on the other hand, contends that the quantity of water reserved should be measured by the Indian "reasonably foreseeable needs," which, in fact, means by the numbers of Indians. How many Indians there will be and what their future uses will be can only be guessed. We have concluded, as did the Master, that the only feasible and fair way by which reserved water for the reservations can be measured is irrigable acreage (Arizona vs. California 373 U.S. 546).

Winter's doctrine rights are not restricted in their application to water used for irrigation purposes, but rather apply to any beneficial use that carries out the intent of the original treaty. (Veeder, 1965). Irrigable acreage is only a valid yardstick for water needs on those reservations devoted primarily to farming and ranching. Even in the case of the Arizona vs. California decision, where the irrigable acreage criteria was used, the intent of the decision was not to limit water use to agricultural purposes, but rather to meet
the needs of the Indians in the most beneficial way. On the Pyramid Lake Reservation in Nevada, an attempt is being made to retain water rights to a sufficient quantity of water to maintain a fishery in the lake. The Paiute Indians originally relied upon fishing the lake for their livelihood, but subsequent developers have been diverting most of the water from the lake.

Leaphart (1972), has summarized the essentials of the Winter's Doctrine, as it now stands, as follows:

1. The priority date of a water right on a federal reservation is the date the reservation was created. State water rights are subordinate.

2. Winters Doctrine rights, unlike appropriative rights, do not depend upon a diversion and an application to a beneficial use. The reserved rights arise when the reservation is established even though the water right is not exercised for decades thereafter. Also, non-use does not work a forfeiture or an abandonment of the water right.

3. Winters Doctrine rights need not be created or exercised in accordance with state law.

4. The quantity of water to be enjoyed under a Winters Doctrine right is measured by the quantity necessary to fulfill the purposes of the reservation, both present and future. In the Arizona case, the Court quantified this amount as the amount required to irrigate all the irrigable land on the reservation. This quantity represents the amount of water the Indians are entitled to for all time unless the reservation is enlarged in terms of irrigable acreage.

The questions of whether or not the Indians can use their quota of water for other than agricultural purposes, and whether they can lease water they are not using, remain unanswered by the case law.

Despite subsequent conflicts, Montana water law did recognize these Winters Doctrine rights again in the Crow Indian Reservation decision:

By the treaty of May 7, 1868, between the U.S. and the Crow Indians, establishing the Crow Indian Reservation, the Federal government impliedly reserved to itself the waters thereon for irrigation and other purposes for use by the Indians, hence, they were not subject to appropriation by others. The right to use
water appurtenant to lands on an Indian reservation and held by Indians under trust patents, is property of the U.S., and state courts are without jurisdiction to enter a decree affecting such right, but when Indian becomes seized of fee simple title after removal of trust patent, conveyance of land transfers the right to use of the water appurtenant to the land (Anderson v. Spear-Morgan Livestock Co., 107 M 18 in R.C.M., 1947, Title 89, Chapter 8, sect. 89-801).

Another rather complex aspect of Indian water law is the issue of transfer of water rights. In one court decision, (U.S. v. Hibner), dealing with the sale of land from an Indian allottee to a non-Indian, the court ruled that:

Purchasers of lands from Indians to whom water rights were granted and reserved ... acquire same character of water rights with equal priority for actual acreage under irrigation, when title passed and any increased acreage placed under irrigation by them with reasonable diligence, subject to general rules of law governing appropriation and use of public waters of state (U.S. v. Hibner, 27 F (2d) 909).

This was reaffirmed in U.S. vs. Powers:

waters arising, traversing or bordering a reservation were reserved for the equal benefit of tribal members and when allotments were made and thereafter conveyed in fee, the right to use some portion of tribal waters essential for cultivation passed to the owners (U.S. v. Powers 305 U.S. 527).

The result of these decisions was, in effect, to attach water rights to the land. This meant that when land was transferred from Indian to non-Indian ownership, so were the water rights. These decisions facilitated the alienation of the Indian water base, since many irrigated lands had passed out of Indian hands. The loss of water meant that the viability of many reservations was severely jeopardized (Hovis, Cockrill and Roy, 1973).

Hovis, Cockrill and Roy (1973), suggested two possible ways, with some legal precedent, of limiting excessive use by non-Indians of Indian water. They proposed that water used by non-Indians should be
restricted to the amount of water that was previously used by the Indian owner, and that Indian users should always receive first priority.

As can be seen from even this brief treatment of Indian water law, the potential for conflict between Indian and non-Indian use of water is high. In many instances, where Indians have never made full use of the water to which they are legally entitled, non-Indians have developed, invested in, and made use of this water. Should the Indians now make claim to the water to which they are entitled, these non-Indian developers will undergo a tremendous financial loss (McDermott, 1973). This situation is, in fact, one that is presently developing on the Flathead Indian Reservation, although it has not yet really reached the courts.

In many of these developing water confrontations, the Federal government itself is in a conflict of interest position. On the one hand, it is responsible for defending the rights of the Indians via the Department of Interior, while on the other hand, government water projects, via the Bureau of Reclamation are often responsible for usurping Indian water.

Until such time as these legal issues are resolved water rights of both Indians and non-Indians in many areas will remain exceedingly confused and uncertain.

In some areas, the Bureau of Indian Affairs has put forth tentative proposals whose aim is to clarify water rights and resolve some of these conflicts and uncertainties existing between Indian and non-Indian water users. (See Appendix V for details.) For example, the Portland Area Office of the B.I.A. recently came out with a tentative proposal for a modified permit system to regulate water use on Indian reservations:
Any person owning land or having other interests within the exterior boundaries of Indian reservations having a right to the beneficial use of Federally reserved water must file with the Secretary a declaration of use for present uses or an 'application for a water use permit' for contemplated uses. However filing for a particular use or several types of uses does not bar the tribe of any Indian water user or the B.I.A. on behalf of one or more Indian users from filing a claim for other uses within the federal reserved right. Beneficial use shall be the measure, extent and limit of the right to the use of reserved water and only on this basis will a permit be granted. The amount of water granted in a permit shall be based upon a just and equal distribution of the available water supply among all users actual or potential and shall be subject to change as the available water supply or the number of users or uses change from time to time. The Secretary reserves the right at any time during the time the permit is in force and effect to reduce the water allocated in the permit if in his judgment such action is necessary in order to avoid causing undue hardship upon any tribe, individual Indian, or Indian group residing upon the reservation...


Water Rights on the Flathead Reservation

Indian water rights on the Flathead Reservation are dated from the Hellgate treaty of 1855. Thus, Indian water rights are superior to any rights claimed after this date. This treaty, in addition to giving the Indians rights to waters flowing through or bordering their lands, also gave them exclusive fishing rights on the reservation. Water power sites, and reservoir and irrigation sites were reserved under the Act of June 25, 1910 (35 Stat. L 855).

In some of the early legislation affecting the Flathead Reservation, attempts were made, in theory, to insure the protection of Indian water rights. For example, the Act of June 21, 1906 (34 Stat. L. 354), asserted that Indian rights to water for irrigation and domestic purposes would be protected.
However, the opening of the reservation to homesteading by whites and the construction of the Flathead Indian Irrigation Project, actually resulted in a substantial loss of Indian water and power rights (Davis, 1954). This erosion of water rights was facilitated by the fact that the Indians had chosen most of their allotments along streams and had neglected to legally record their water appropriations. The Flathead Irrigation Project was thus able to divert water from Indian lands to dry lands allotted to non-Indians (Davis, 1954). In fact, the Indians apparently never did approve of the Flathead Irrigation Project, since it served so few Indians (Confederated Salish and Kootenai Tribes, 1962). Although nominally an Indian irrigation project, non-Indians far outnumber Indians on the Flathead Project today.

Clyde, Criddle and Woodward (1972), maintained that Indians on the reservation actually used only about 25% of the water to which they were entitled under the Winter's Doctrine. Rather than improving, this situation was becoming exacerbated by the fact that non-Indians were continuing to put more land under irrigation than were Indians.

In recent years, the tribes have begun to lay claim to their Winter's Doctrine water. The most obvious result of this has been the furor over water rights on the southern part of Flathead Lake. This is an exceedingly hot issue at present, and reflects similar conflicts occurring elsewhere throughout the country over non-Indian use of, and investment in, Indian water.
In particular, the dispute over Flathead Lake had its origins in the Allotment Act of 1910, in which Indians were allotted pieces of land and the surplus lands were opened up to white settlement. This included the lands bordering on Flathead Lake (Haddon, 1965).

The dispute over Flathead Lake revolved around an assertion by the Indians that the original Hellgate treaty of 1855 gave them the ownership of the lake bed and shores of Flathead Lake up to the high water mark, and that this was still true, regardless of who presently owned lake shore property. On this basis, the Confederated Tribes were proposing to charge fees for the use of the lake shore and lake waters. The particular test case that had come up, involved the owner of a boat marine in Polson, who had made extensive use of the lake shore and bed for the building of his docks. The tribe maintained that this was trespass and that the docks should be removed. One previous court decision made in 1942 (Montana Power v. Rochester, 127F (2d) 189), had already ruled in favor of the Indians. In this case the court concluded that:

Under Indian treaty creating Flathead Reservation which included one half of Lake, the U.S. intended to hold the entire reservation, submerged lands no less than uplands, in trust for Indians, rather than for the future state of Montana ... It is inadmissible to suppose that the U.S. having agreed to hold this area in trust for the exclusive and benefit of the Indian tribes, intended to put the tribes at the mercy of the future state, the policy of which was necessarily unknown at the time of the treaty ... For by adoption of a proprietary policy the state might substantially interfere with if not foreclose use of the shores by the Indians in the conduct of their fishing operations. There is ... nothing ... in the treaty ... or in subsequent legislation, suggestive of an intent that the ownership of lands in the reservation below the line of ordinary high water was to be at the disposal of the state ... The patent ... conveyed title to high water mark only, and that title to land below that mark and beneath the lake is in the U.S. in trust for the Confederated Tribes.
Haddon (1965) maintained that this might have been an erroneous decision on the part of the court. According to Montana state law, riparian owners do possess title to the low water mark. Haddon maintained that jurisdiction over the lake bed did in this case, rest with the state rather than with the U.S., on the basis that:

The submerged lands below navigable water within the territories were deemed to be held in trust for future states ... As a general rule once a state is admitted to the union, the Federal government holds no interest in the submerged lands beneath navigable waters of the state, beyond the limitations of regulation of commerce (Haddon, 1965).

In addition, any title to the lake bed the U.S. may have held was extinguished upon allotment of the lands. Haddon (1965) concluded that:

The riparian owners on Flathead Lake possess full access and wharfage rights which cannot be destroyed or infringed upon without compensation. This conclusion is based upon either of two alternate approaches. 1) The U.S. as trustee for the Confederated Tribes has no interest in the lands below high water mark because either the lands were never held in trust for the Indians or because any title which the U.S. did undertake to hold was extinguished upon the allotment and sale of the reservation lands and by implication passed to the State of Montana and ultimately to the riparian owners. 2) Even if the title to the lake bed is still held in trust for the Confederated Tribes, the U.S. would recognize the rights of the riparian owners to access and wharfage.

At the present time, the case is still being appealed in the courts (Haddon, 1977).

Some 2,000 lake shore residents, with investments totalling in the millions will ultimately be affected by the outcome of this case (Missoulian, Mar. 18, 1974). Many of these residents have banded together to fight the tribal action, by forming a "Flathead Defense Fund."

Although newspaper accounts are often unreliable, they were the only source available at the time.
Lake shore owners have also expressed fear of the Tribes laying claim to the waters of the Flathead Lake (Missoulian, April 19, 1974).

At the present time, the tribes have already asserted their rights to lake water to the extent of requiring non-Indian prospective lake fishermen and boaters to first obtain a tribal permit before making use of the lake.

Conflict over water rights has also been going on in Ronan, although the issue has not yet reached the courts. In this case, the conflict was over ground water rights, and involved an application for a permit to dig a new well by the city of Ronan. Although Ronan directed its permit application to the State, the Tribes maintained that only they have jurisdiction over ground water on the reservation, not the state.

One water rights problem, prevalent on the Reservation as well as elsewhere in Montana, is that of over-appropriation of stream waters. This situation has come about by virtue of the nature of the old system of Montana water law. Under this system, water appropriators were not required to file notices of completion of their water claims. Thus, in many instances, more water was claimed on paper, by a number of different appropriators, than actually existed in the stream. Disputes over water rights in such streams have to be settled by adjudication. Mission Creek is a prime example of this situation. In 1963, 30,151 cfs of water had been officially appropriated from Mission Creek, although the creek only maintains an average flow of 71.7 cfs (Wirth & Assoc., 1970a). To compound the problem, relatively few streams in the area have actually been subject to adjudication (Wirth & Assoc., 1970a).
Some water rights conflicts are also occurring on the Flathead Irrigation Project. All water for the Flathead Project was originally appropriated by the U.S. However, disputes over use of project water between non-Indian users and Tribal lawyers have occurred (Moon, 1973). Montana water law, of course, does not apply to the project. The Tribe is now attempting to assert ownership of all water being used by the Flathead project, based on the fact that no formal, legal agreement was ever signed between the Tribe and the U.S. giving the U.S. rights to the water. If successful in their efforts, the Tribe will be in a position to rent the water to the Project. Again, the situation has not yet come to the courts (Haddon, 1974).

Thus, a number of legal battles between Indian and non-Indian water users, are being waged at present and are shaping up for the future, as the Tribes increasingly attempt to assert their long neglected water rights. However, few of these have yet been tested in the courts, and until they are, water rights on, and in, the vicinity of the Flathead Reservation will remain unclear.

Summary

The concept of state control over water has come into conflict with Indian water law.

The Winter's Doctrine decision of 1908 ruled that states did not have jurisdiction over Indian reserved water, and that state laws were inapplicable.

The 1963 Arizona vs. California decision proclaimed that the reserved water was to include a quantity sufficient to meet all
present and future needs of the Indians, or the amount required to
irrigate all irrigable acreage on the reservations.

In many cases, Indians have not utilized all the water to which
they are entitled, and non-Indians have developed this water, often
investing huge sums of money. A considerable potential for conflict
exists, as Indians lay claim to this developed water.

On the Flathead Reservation, the Tribes only use about 25% of
their Winter's Doctrine water. They are now beginning to make some
claims upon it, including: parts of Flathead Lake (lake bed and
shore), ground water on the reservation, and water for the Flathead
Irrigation Project. Legal battles over some of these claims are now
materializing.
CHAPTER V
SUMMARY AND CONCLUSIONS

Data is sorely lacking on almost every aspect dealing with water resources on the Flathead Indian Reservation. Most of the studies concerned with water resources in western Montana have dealt only peripherally, if at all, with conditions on the reservation. This is probably a result of two factors; that is, a general lack of concern with the situation existing on Indian reservations that has had a long historical precedent, and the political independence of the reservations, which has tended to discourage any investment or intervention on the part of state and local organizations in reservation problems. Whatever the cause, the fact of the matter is that virtually no studies have been made that concentrate exclusively on the reservation, in the area of water resources.

Although an attempt has been made in this paper to gather the material that does exist, there remains a critical need for some basic research data. One of the aspects of water resources where the most glaring informational deficiencies exist, lies in the area of water quality. The reservation is in need of a complete and thorough study in this area, covering the entire reservation region.

Currently available water quality data indicate that Flathead Lake has a summer pollution problem. This problem might be alleviated by:

1. insuring that summer residents have adequate sewage facilities in their homes, and
2. by providing central sewage treatment facilities for some of
the larger communities around the lake, such as Big Arm.

Water quality is also being adversely affected in some communities on the reservation where soils are unsuitable for sewage drainfields, or where subdivisions are being developed. Arlee, Dixon, and St. Ignatius have all been experiencing fecal contamination problems and are in need of either centralized sewage treatment systems, or expansion of their current systems.

Additional water quality studies are needed to determine the effects of animal and land use, and the effects of clear-cutting in the Mission Mountains. More specifically, further work is needed to assess the concentrations of pesticides, nitrates, phosphates, trace metals, radiochemical compounds and sediment, as well as to determine the silt and nutrient load from irrigation. Studies currently being carried on by the Flathead Drainage Project 208, may provide some insight into these problems.

The Confederated Tribes, like many other groups throughout the country, are now faced with the classic conflict between economic and environmental considerations. Some of the situations over which this may arise include:

1. Clear-cutting and lumbering

Lumbering is an important part of the reservation economy, but may adversely affect water quality and increase erosion. If overdone, lumbering might limit forest regrowth and the recreational potential of the area.

2. Hydroelectric development

Power site development would probably produce considerable income for the reservation, but might have undesirable consequences
from an environmental and social standpoint. If the Tribes do opt for power site development, development of one of the Buffalo Rapids sites on the Flathead River would probably minimize the undesirable consequences. Building of the Buffalo Rapids dam would probably result in:

a. increased income, in the form of leased power
b. attraction of various industries to the reservation, and
c. power for the pumping of irrigation water.

Negative effects would include:

a. an extensive area of land would be flooded
b. fish, other wildlife, and water quality would probably be adversely affected; both directly, by the building of the dam itself, and secondarily, by any industries or increased population attracted to the area.
c. recreational potential of the dam site would probably be low.

Detailed impact studies dealing with both the issues of lumbering and power development should be made.

Most of the Flathead Reservation is relatively arid, and water is a critical resource. Water shortages do occur, particularly during the latter half of the summer, and result in reduced agricultural productivity. These shortages might be alleviated by improving the reservation's irrigation system, and by more conservative on-farm irrigation practices. Increased irrigation water storage, and concrete lining of distribution canals to prevent seepage, are required.

On-farm water use efficiency might be increased by:
1. using sprinkler, rather than flood irrigation
2. planting crops that require less water, and
3. not applying more water to the soil than is strictly necessary.

Further increases in irrigated acreage should be avoided until some of these problems are resolved.

Should water eventually become available, some currently unirrigated areas along the lower Little Bitterroot River and along the west bank of the Flathead River, might be suitable for development.

Indian water rights on the reservation have become an important and thorny issue.

Historically, the allotment system resulted in the partitioning of reservation land in such a manner as to make it difficult or impossible to farm profitably, especially without water for irrigation. It facilitated the erosion of the Indian land and water base, both directly and indirectly by:

1. allotting former Indian lands to non-Indians, and
2. making the reservation unstable economically so that Indians were encouraged to sell their lands and migrate off the reservation.

Since water rights were, in effect, attached to these allotments, the loss of land meant an accompanying loss of water.

The net result of this has been that control over most of the reservation land and water, has passed out of Indian hands, and the non-Indian population on the reservation now greatly exceeds the Indian population.

If the Flathead Reservation is to retain its integrity and social and economic viability, further alienation of the Indian land and water base will have to be minimized. In addition, land and water use
will have to be reorganized in such a manner as to make farming economically feasible.

One approach to the problem of alienation of Indian water rights, would be for the Tribes to lay claim to their Winter's Doctrine water. They would then be able to regulate water use via some sort of a permit system. A permit system would facilitate reservation-wide water planning and the most efficient utilization of water resources. It could be used to insure priority of Indian water rights, while at the same time permitting some strictly regulated non-Indian water use. In addition, limits could be placed on the water rights transferred to non-Indian purchasers of Indian land.

There have been some indications in other parts of the country, that it may be legally permissible for Indians to lease their water. If this should prove to be the case, then leasing may become another potential source of revenue for the Tribe.

If the Tribe does obtain control over reservation water, it will probably have to consider setting up some sort of water resource board of its own, to take over the equivalent regulatory function of the state agency. Assertion of independence from the state water agency, without setting up an equivalent control, might well prove to be chaotic. That is, it is highly doubtful whether Tribal courts at present, are equipped for dealing with a multiplicity of water rights/water use arbitrations, as well as with water quality control and regulation, in addition to their other functions.
Water rights for both Indians and non-Indians on the reservation are still clouded. There has been some evidence that private use of Flathead Indian Irrigation Project water has occurred. In addition, there have been some complaints of inequitable distribution of Flathead Project water to Indian land. These situations need to be investigated and clarified.

Ultimately, a reservation-wide water plan will have to be developed, that will take into account the environmental costs of water use and development, and that can be integrated into region-wide water use planning, without compromising the water rights of the Tribes. In the years to come, the water resources of the Flathead Indian Reservation, and their manner of utilization, will play an increasingly critical role in the social and economic stability of the entire reservation region.
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APPENDIX I

Soils

Most of the agricultural lands on the Flathead Reservation are located in Lake and Sanders Counties. Major soil types found on the reservation in these two counties are described below. All descriptions are from Wirth and Associates (1970a). Detailed soils information and maps are available in unpublished form at the Soil Conservation Service, Polson, Montana.

Reservation Soils: Lake County

   This association consists of grassland soils occupying steep bedrock areas. It is dominated by well and somewhat excessively drained, very shallow to deep soils containing a high percentage of rock fragments. Elevations range from 3,100 to 5,000 feet. The mean annual precipitation is from 14 to 20 inches and the frost free season is 90 to 120 days ... Susceptibility to surface-water run-off is mainly during seasons in which the surface is frozen.

   This association consists of forest soils occupying steep mountainous areas. It is dominated by soils developed in materials weathered from mainly quartzite bedrock. The soils are well to somewhat excessively drained, very shallow to deep and contain a high percent of rock fragments. Elevations range from 3,300 to 7,000 feet. The mean annual precipitation is from sixteen to thirty inches and the frost free season is sixty to one hundred days ... Although the soils are moderate or somewhat rapid in permeability, they are susceptible to surface water runoff.

   This association consists of shallow and moderately deep soils developed in gravelly outwash. Slopes range from zero to about five percent with the exception of a few narrow terrace edges. Elevations range from 2,500 to 3,200 feet. The mean annual precipitation is fourteen to eighteen inches and the frost free season is from one hundred to 130 days ... The high porosity of these gravel deposits create a susceptibility of pollution to shallow domestic water supplies and streams.

   This association consists of deep, well drained silty soils having a claypan subsoil and alkaline substrata. Slopes are zero to about five percent except along the deeply entrenched West Miller coulee. Elevations range from 2,900 to 3,200. The mean annual precipitation is about fifteen inches and the frost free season is about 120 days ... These soils are slowly permeable and are thus susceptible to surface runoff and stream pollution ...
   This association consists of steep, light colored, thin silty and clayey soils. It occupies the breaks into the Flathead River. Elevation ranges from 2,550 feet to 3,200 feet. The mean annual precipitation is thirteen to fifteen inches and the frost free season is 110 to 130 days ... Grass production is low, water erosion is a severe hazard ...

   This association consists of well drained, dark colored coarse silty to sandy soils developed in glaciofluvial deposits. Slopes are mostly in the zero to seven percent range. Elevation ranged from 2,700 to 3,200 feet. The mean annual precipitation is from thirteen to seventeen inches and the frost free season is about 120 days ... These soils, having a moderate to rapid permeability, are only slightly susceptible to surface water runoff. The rapid permeability of the Blanchard and Jocko soils could create a pollution problem to shallow domestic water supplies and streams ...

   This soil association consists of well drained, grassland-timber soils developed in clayey glacial till. The principal soils have loamy surfaces but clayey subsoils and substrata. Slopes range from one to about fifteen percent and elevations range from 3,100 to 4,000 feet. The mean annual precipitation is sixteen to twenty inches and the frost free season is ninety to 120 days ... These soils have moderate to slow permeability and are, therefore, susceptible to surface water run-off. The materials are suitable and sites are available for water storage reservoirs ...

   This soil association consists of deep, well drained silty soils developed in varved lake sediments. Slopes range from zero to about eight percent and elevations range from 2,900 to 3,200 feet. The mean annual precipitation is fourteen to sixteen inches and the frost free season is about 120 days ... These soils are used mainly for irrigated pasture, hay and small grains, and dryland small grains. These soils are moderately permeable but are susceptible to surface water runoff ...

   This soil association consists of well drained, dark colored loamy soils developed in glacial till. Slopes are irregular and range from one to twenty percent and elevations vary from 3,000 to 3,500 feet. The mean annual precipitation is thirteen to sixteen inches and the frost free season is about 120 days ... These soils are moderately permeable but are susceptible to surface water runoff ...
APPENDIX I (continued)

   This soil association consists of well drained, very slowly
   permeable claypan soils developed in varved clayey lake bed sediments.
   Slopes range from zero to about eight percent with elevations varying
   from 2,600 to 3,200 feet. The mean annual precipitation is from
   thirteen to sixteen inches and the frost free season is about 120 days ...
   The very slow permeability of these soils makes them susceptible to
   surface water runoff ... The materials are well suited for water
   reservoir areas.

11. Round Butte Soil Association Areas.
   This soil association comprises light colored, slowly permeable
   claypan soils developed in varved clayey lake bed sediments. Slopes
   are mainly zero to nine percent with elevations ranging from 2,600 to
   3,100 feet. The mean annual precipitation is thirteen to fifteen
   inches and the frost free season is about 120 days ... The slow per­
   meability makes these soils susceptible to surface water runoff ... 

   This soil association consists of well drained coarse silty to
   sandy soils developed under a forest cover. Slopes range from zero to
   ten percent with elevations ranging from 3,100 to 3,300 feet. The
   mean annual precipitation is fifteen to eighteen inches and the frost
   free season is 100 to 120 days ...

   This soil association consists of deep forest soils developed
   mainly from loamy glacial till. Slopes range from zero to thirty
   percent with elevations varying from 2,900 to 4,500 feet. The mean
   annual precipitation is from sixteen to twenty four inches and the
   frost free season is seventy to 120 days ...

   This association consists of steep rocky mountainous areas with
   elevations ranging from 5,500 to 10,000 feet. Rock outcrops and talus
   dominate the areas.

Reservation Soils: Sanders County

1. Forested Soils on Steep Bedrock Mountains.
   This general soil area is dominated by soils on steep and very
   steep mountainous slopes. These soils developed mainly in loamy
   material weathered from hardrock and usually contain high percentages
   of rock fragments. The soils range from very shallow to deep and from
   well to excessively drained. Rock outcrops and talus are common, especially
   at higher elevations and along the deeper entrenched drainages. Soils developed in deep glacial till and valley fill
   deposits occur in many of the narrow glaciated valleys.
   Elevation ranges from 4,000 to over 7,000 feet. The main land
   uses are woodland and recreation with some areas suited only for
   wildlife and recreation ...
APPENDIX I (continued)

2. Grassland Soils on Fine Textured Glaciolacustrine Deposits.

This general soil area is dominated by deep, well drained soils developed on nearly level to sloping silty and clayey sediments. These soils have light colored silt loam and silty clay loam surfaces, moderately slow and slowly permeable silty clay loam and clay subsoils, and unweathered varved or stratified clay and silt substratum. Soils having dark silty surfaces with clay subsoils occur locally at Dixon in the southern and western part of Camas Prairie and north facing slopings of the valley fringes. Soils with silty clay and clay surfaces occur in some areas and are especially prominent in Camas Prairie. Deep fine sandy loam and silty loam soils occur in the northern part of the area and other small localized areas. Steep, light colored, thin silty and clayey soils occupy the edges of dissecting drainageways and are especially prominent on the breaks into the Flathead River. Somewhat poorly drained and saline-alkali soils occur along major drainages.

Elevation ranges from 2,500 to 3,100 feet. The mean annual precipitation is ten to fifteen inches. The frost free season is ninety to 120 days. In the Lonepine, Hot Springs, Dixon and a few other scattered areas these soils are used mainly for irrigated hay and pasture with some small grains. Dryland alfalfa, small grain, and improved pasture along with range are the uses on the remainder of the area ...


This general soil area is dominated by somewhat excessively to well drained soils that occupy hilly to very steep bedrock areas. These soils have dark colored loamy surfaces and lighter colored loamy subsoils. Soil depth ranges from shallow over bedrock to deep soils that contain thirty five to eighty percent coarse fragments mixed with the loamy materials. Soil surface layers have various amounts and sizes of coarse fragments. Sloping and rolling coalescing fans in Camas Prairie are included along with similar small areas in other locations. Rock outcrops are common and very shallow soils dominate a few localized areas. Minor inclusions are deep loamy soils developed in glacial till and valley fill deposits, and dark colored silt loam soil with clay subsoils on glaciolacustrine remnants.

Elevation ranges from 2,500 to 4,500 feet. The mean annual precipitation is fourteen to nineteen inches. The frost free season is ninety to 120 days. These soils are used mainly for range.
APPENDIX II

Flathead Indian Irrigation Project Crop Report
1976

<table>
<thead>
<tr>
<th></th>
<th>Unit Ac.</th>
<th>Yld. Ac.</th>
<th>Total Ac.</th>
<th>Unit Acre Value</th>
<th>Total Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa Hay Ton</td>
<td>1623</td>
<td>4904</td>
<td>2126</td>
<td>93270</td>
<td>$4,146,525</td>
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<tr>
<td>Grass Hay Ton</td>
<td>1376</td>
<td>2112</td>
<td>3488</td>
<td>30836</td>
<td>$1,143,320</td>
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<tr>
<td>Ann. Pasture Ac.</td>
<td>2746</td>
<td>9561</td>
<td>12305</td>
<td>54123</td>
<td>$4,059,225</td>
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<tr>
<td>Fall Pasture Ac.</td>
<td>3193</td>
<td>562</td>
<td>3755</td>
<td>53451</td>
<td>$1,069,020</td>
</tr>
<tr>
<td>Yng. All. &amp; U. Clover Ac.</td>
<td>111</td>
<td>1230</td>
<td>1341</td>
<td>1600</td>
<td>$638,220</td>
</tr>
<tr>
<td>Silage Ton</td>
<td>316</td>
<td>8600</td>
<td>1176</td>
<td>3141</td>
<td>$411,628</td>
</tr>
<tr>
<td>Wheat Bu.</td>
<td>128</td>
<td>6560</td>
<td>784</td>
<td>182748</td>
<td>$348,800</td>
</tr>
<tr>
<td>Barley Bu.</td>
<td>611</td>
<td>35250</td>
<td>6136</td>
<td>621160</td>
<td>$1,087,030</td>
</tr>
<tr>
<td>Garden Ac.</td>
<td>11</td>
<td>2460</td>
<td>35</td>
<td>6000</td>
<td>$24,600</td>
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<tr>
<td>Apples Lbs.</td>
<td>138</td>
<td>36850</td>
<td>1516</td>
<td>695912</td>
<td>$2,956,125</td>
</tr>
<tr>
<td>Peas Lbs.</td>
<td>125</td>
<td>3470</td>
<td>35</td>
<td>35000</td>
<td>$1,284,380</td>
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<tr>
<td>Total Acres</td>
<td>10242</td>
<td>1971</td>
<td>12312</td>
<td>171122</td>
<td>$16,289,873</td>
</tr>
</tbody>
</table>

A. Total Cropped 10242

B. - Dip. Cropped 3193

C. Eql. Net Grpd. 7049

D. - Grpd. Not Irrg. 540

E. & S. Grpd. Not Irrg. 14

F. Eql. Net Irrg. 6523

G. & S. Eql. Net Irrg. 17

H. - Summer Fallow 50

I. Plus 2B. Above 540

J. Assessable Ac. 7080

Land Farmed by (Line C) Acres Crop Value Per Acre

Indian 7080 $ 797,136 $112.00

Indian Leases 1459 121,146 $83.03

Non-Indian Leases 3216 344,663 $107.17

Others 113185 15,026,928 $132.76

Total 124940 16,289,873 $130.38

1. Lists types of Crops (incl. irrig. pasture lands)
3. 4 & 5. Indian-owned lands
6. Non-Indian-Owned (incl. areas irrig. and farmed by schools and agencies)
## APPENDIX III

**Stream Gaging Records**

<table>
<thead>
<tr>
<th>Station</th>
<th>Years of Record</th>
<th>Drainage Area</th>
<th>Average Annual Runoff C.F.S.</th>
<th>Average Annual Runoff A.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hell Roaring Big) Creek</td>
<td>15</td>
<td>6.41</td>
<td>6.64</td>
<td>4,800</td>
</tr>
<tr>
<td>Flathead River - Polson</td>
<td>63</td>
<td>7,096</td>
<td>10,890</td>
<td>8,469,000</td>
</tr>
<tr>
<td>Little Bitterroot River</td>
<td>2</td>
<td>223</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Mud Creek</td>
<td>1</td>
<td>30.4</td>
<td>6.81</td>
<td>4,930</td>
</tr>
<tr>
<td>Crow Creek</td>
<td>2</td>
<td>139.0</td>
<td>84.0</td>
<td>61,000</td>
</tr>
<tr>
<td>Dry Creek</td>
<td>4</td>
<td>19.5</td>
<td>11.5</td>
<td>8,300</td>
</tr>
<tr>
<td>Mission Creek</td>
<td>9</td>
<td>74.8</td>
<td>71.7</td>
<td>52,500</td>
</tr>
<tr>
<td>Post Creek</td>
<td></td>
<td>47.6</td>
<td>88.3</td>
<td>64,000</td>
</tr>
<tr>
<td>M. F. Jocko River</td>
<td>4</td>
<td>14.9</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>S. F. Jocko River</td>
<td>4</td>
<td>72.3</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>N. F. Jocko River</td>
<td>4</td>
<td>19.5</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Falls Creek</td>
<td>4</td>
<td>3.57</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Big Knife Creek</td>
<td>2</td>
<td>7.44</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Agency Creek</td>
<td>7</td>
<td>4.0</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>E. Finley Creek</td>
<td>7</td>
<td>5.48</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Finley Creek</td>
<td>1</td>
<td>36.7</td>
<td>25.7</td>
<td>18,700</td>
</tr>
<tr>
<td>Valley Creek</td>
<td>1</td>
<td>64.1</td>
<td>Seasonal</td>
<td></td>
</tr>
<tr>
<td>Jocko River</td>
<td>3</td>
<td>348.0</td>
<td>366.0</td>
<td>265,000</td>
</tr>
<tr>
<td>Revais Creek</td>
<td>5</td>
<td>35.0</td>
<td>36.1</td>
<td>26,180</td>
</tr>
</tbody>
</table>
APPENDIX IV

Water Use and Water Quality Criteria

Water use classifications assigned to the Columbia and Missouri Basin and the Hudson Bay drainage in Montana are described as follows:

"A-Closed" --- Water supply for drinking, culinary, and food processing purposes, suitable for use after simple disinfection. Public access and activities such as livestock grazing and timber harvest should be strictly controlled under conditions prescribed by the State Board of Health.

The Council has classified as "A-Closed" only those waters on which access is presently controlled by the utility owner. If other uses are permitted by the utility owner, these waters shall be reclassified "A-Open-D₁" or lower.

"A-Open-D₁" --- Water supply for drinking, culinary, and food processing purposes suitable for use after simple disinfection and removal of naturally present impurities. Water quality shall also be maintained suitable for the use of these waters for bathing, swimming, and recreation (where these waters are used for swimming and other water contact sports, a higher degree of treatment may be required for potable water use); growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, these waters shall be held suitable for "A-Open", "C", "D", "E", and "F" uses but may not necessarily be used for all such purposes.

Waters in this class, if shown to meet the "A-Closed" criteria, may be so classified by the Council at the request of the utility owner.

All waters within the boundaries of national parks and nationally designated wilderness, wild, or primitive areas in Montana are classified "A-Open-D₁" except those adjacent to developed areas such as Synder Creek through the community of Lake McDonald and Swiftcurrent Creek below the Many Glacier Chalet, both in Glacier National Park. Also, Georgetown, Flathead, and Whitefish Lakes and Lake Mary Ronan are classified as "A-Open-D₁" as are some streams presently used for domestic water supply.
"B-D₁" ------- The quality of these waters shall be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any additional treatment necessary to remove naturally present impurities; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "B-D₁" equals "B", "C", "D₁", "E", and "F".

"B-D₂" ------- The quality of these waters shall be maintained suitable for the uses described for "B-D₁" waters except that the fisheries use shall be described as follows: "Growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers." Therefore, "B-D₂" equals "B", "C", "D₂", "E", and "F".

"B-D₃" ------- The quality of these waters shall be maintained suitable for the uses described for "B-D₁" waters except that the fisheries use shall be described as follows: "Growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers." Therefore, "B-D₃" equals "B", "C", "D₃", "E", and "F".

"C-D₂" ------- The quality of these waters shall be maintained suitable for bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "C-D₂" equals "C", "D₂", "E", and "F".

"D₂" ------- The quality of these waters shall be maintained for growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "D₂" equals "D₂", "E", and "F".

"E" ------- The quality of these waters shall be maintained for agricultural and industrial water supply uses and "E" shall equal "E" and "F" uses.

"F" The quality of these waters shall be maintained suitable for industrial water supply uses, other than food processing.
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Permissible Concentrations in Milligrams Per Liter</th>
<th>Objections to Concentrations Beyond Permissible Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Esthetic</td>
</tr>
<tr>
<td>Color</td>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Esthetic</td>
</tr>
<tr>
<td>Threshold Odor Number</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Esthetic</td>
</tr>
<tr>
<td>Alkyl Benzene Sulfonate (ABS)</td>
<td>0.5</td>
<td>Taste, Foaming, Indicator of Pollution</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>0.01</td>
<td>Toxic</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>250</td>
<td>Poss. Laxative Effect</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>1.0</td>
<td>Poss. Phys. Effect</td>
</tr>
<tr>
<td>Carbon Chloroform Extract (CCE)</td>
<td>0.2</td>
<td>Toxic</td>
</tr>
<tr>
<td>Cyanide (CN)</td>
<td>0.01</td>
<td>Toxic</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>See Below</td>
<td>Mottling of Teeth</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.3</td>
<td>Esthetic, Staining of Laundry</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.05</td>
<td>(same as above)</td>
</tr>
<tr>
<td>Nitrate</td>
<td>45</td>
<td>Methemoglobinemia</td>
</tr>
<tr>
<td>Phenols</td>
<td>0.0001</td>
<td>Taste</td>
</tr>
<tr>
<td>Sulfates</td>
<td>250</td>
<td>Poss. Laxative Effect</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>500&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Poss. Laxative Effect</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Poss. Laxative Effect</td>
</tr>
<tr>
<td>Radium-226</td>
<td>3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Radiation Damage</td>
</tr>
<tr>
<td>Strontium-90</td>
<td>10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Radiation Damage</td>
</tr>
<tr>
<td>Gross Beta Radioactivity</td>
<td>1,000&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Radiation Damage</td>
</tr>
</tbody>
</table>

Concentrations in excess of following should be re-examined before use (mg/l):

- Arsenic (As) 0.05
- Barium (Ba) 1.0
- Cadmium (Cd) 0.01
- Hexavalent Chromium (+6) 0.05
- Cyanide (CN) 0.2
- Lead (Pb) 0.05
- Selenium (Se) 0.01
- Silver (Ag) 0.05

**Hardness Standards for Water**

<table>
<thead>
<tr>
<th>Hardness in Milligrams per Liter</th>
<th>Degree of Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 35</td>
<td>Soft</td>
</tr>
<tr>
<td>36 – 100</td>
<td>Medium</td>
</tr>
<tr>
<td>100 – 150</td>
<td>Hard</td>
</tr>
<tr>
<td>Over 150</td>
<td>Extremely Hard</td>
</tr>
</tbody>
</table>

<sup>a</sup> Standard Units

<sup>b</sup> Pico-curies Per Liter.
Appendix V

Regulations for the Use of Waters on Indian Reservations

Located in Washington, Oregon and Idaho


600.1 PURPOSE

These regulations are adopted in order to protect and conserve the water supply reserved for the various Indian reservations, and to limit said reserved waters among all users having a right thereto in a just and equal manner. The regulations in this part set forth the policies and administrative procedures that will be adhered to in allocating a right to the use of the waters reserved for use upon and within Indian reservations located in the area subject to the Portland Area Office of the Bureau of Indian Affairs.

600.2 GENERAL

a. In order that the Secretary of the Interior can effectively carry out the authority delegated to him by the Congress in making a just and equal distribution of the federally reserved waters arising on, flowing through, or bordering the Indian reservations in the States of Washington, Oregon, and Idaho, administered by the Portland Area Office of the Bureau of Indian Affairs, effective immediately, any person owning land or having other interests, real or personal, within the exterior boundaries of Indian reservation having a right to the beneficial use of federally reserved water must file with the Secretary a declaration of use for present uses or an "application for a water use permit" for contemplated uses. Such application will be on an appropriate form provided by the Bureau of Indian Affairs. Permits issued pursuant to applications will authorize the diversion and use of water in such amounts, for such purposes, at such places and times as are set forth in the permit. However, filing for a particular use of several types of uses does not bar the tribe of any Indian water uses or the Bureau of Indian Affairs on behalf of one or more Indian users from filing a claim for other uses within the federal reserved right.

b. Beneficial use shall be the measure, extent and limit of the right to the use of reserved water and only on this basis will a permit be granted. The amount of water granted in a permit shall be based upon a just and equal distribution of the available water supply among all users actual or potential as the Secretary or his designated agent shall prescribe and shall be subject to change as the available water supply or the number of users or uses change from time to time.
APPENDIX V (continued)

c. The Secretary reserves the right at any time during the time the permit is in force and effect to reduce the water allocated in the permit if in his judgment such action is necessary in order to avoid causing undue hardship upon any tribe, individual Indian, or Indian group residing upon the reservation or to adequately carry out his responsibilities as prescribed by law.

d. Any person diverging water in amounts exceeding that set forth in his permit or using it for purposes or at places other than those so authorized will be considered as in violation of his permit and such act may be cause for cancellation as set forth hereafter.

e. The governing body of the affected reservation shall represent the interests of the tribe as a whole. It may file applications and shall be a party to all proceedings. All positions of the Tribal Council in support of or protest of any application will be incorporated as part of the record and shall be given all due weight considering the policy of the Secretary on Indian self determination.

601.4 WATER RESOURCE BOARD

a. The Secretary shall appoint a water resource board for each Agency having responsibility for one or more Indian reservation. Said board shall consist of three people selected from a slate of persons recommended jointly by the Tribal Council or Councils involved, and the Superintendent. Such board may call upon the Office of Trust Responsibilities to obtain the expert assistance it needs from the agencies of the Department of the Interior ...

c. Under the general supervision of the Superintendent the board will review all applications for water permits and hold public hearings, hear any protests or allegations of violations and shall make recommendations concerning the issuance of permits pursuant to all water-use applications or declarations of use and disputes concerning the same. Further, the board shall perform such other duties as required to administer and control the waters reserved for the benefit of the reservations, its tribal or allotted lands, or its inhabitants ...

600.5 DECLARATION OF USE

a. Any person or persons using waters of any of the Indian reservations in the Portland area on the date of the final publication of these regulations must file within 160 days a "Declaration of Use" with the Superintendent at the Agency responsible for that reservation.

b. While it is not the intent of this regulation to prevent the continued use of the water as declared in such filing, a determination will be made by the board of the amount of reserved water presently being used, the amount the user has a right to use and said facts shall
be established as a matter of record. However, the Secretary reserves
the right to reduce the amount of water being diverted if after due
investigation it is found that the water is not being beneficially
used or such reduction is necessary in order to provide a just and
equal distribution of the available water as required by law ...

600.6 APPLICATION FOR WATER USE PERMITS

a. Immediately upon the effective date of these regulations no
person or persons owning land or proposing to make use of reserved
water or water which will affect or diminish the amount of water
reserved within the boundaries of the Indian reservation in the Portland
area will be allowed to divert water from any reserved water source.
Except as provided in temporary permits under paragraph 600.7 (f), no
water right may be acquired until the water user has filed an applica-
tion in triplicate for a water-use permit with the affected Superin-
tendent, and a permit for the use of water has been approved by the
Secretary or his designated representative. Forms for such applications
and protests may be obtained from the office of the affected
Superintendent or the interested Tribal Council ...

c. The Water Resources Board will review the application, taking
into consideration the Tribal Council's comments, all protests, the
amount of reserved water available for development of reservation lands
and other water uses and the productive potential of the proposed use.
The board's recommendations may where necessary preserve minimum stream
flows for the preservation of an environment for fish and wildlife
and other environmental considerations. The board's recommendations
will be submitted to the Tribal Council for their comment, and then
transmitted to the Area Director by the Superintendent with his
comments. A copy of all actions taken with respect to the application
and the permit will be furnished to all parties to the action.

e. At the end of each five years from the date of approval of a
permit, it will be subject to review by the Water Resources Board. If
such a review discloses that an adjustment in the quantity of water
is required in order to carry out the intent of Congress in regards
to the distribution of the reserved waters, the board through the
Superintendent will serve notice on the permittee that his permit is
subject to review and adjustment within one (1) year from the date of
such notice. The results of any review and all proposed changes shall
be communicated in writing to the water user. Any person feeling
himself aggrieved by such proposal may in writing protest to the board
within 60 days for an examination and reversal of any such action.
Thereafter the matter shall be handled in the same manner as other
disputes.
APPENDIX V (continued)

600.7 PROTESTS

a. Upon receipt of an "Application for a Water Use Permit" or a "Declaration of Use", the board through the Superintendent will give public notice of the pertinent parts of the application by posting and publication for 15 days in a newspaper in general circulation in the county where the proposed use is located. The notice of publication will contain a statement that any interested party or parties who for valid reasons believe that approval of the permit will conflict with other legally established or contemplated uses of the water or otherwise detrimental to the best interests of the reservation and its inhabitants may file a protest with the Superintendent within thirty (30) days after the date of publication of such notice ...

f. Upon good cause shown the board, with the approval of the Tribal Council and the Superintendent, may issue a temporary water use permit for a period not to exceed one year, to the extent that water is available and granting of the permit will not seriously impair the rights of other water users ...

600.10 APPROVED PERMITS

a. Upon receipt of the conditional permit a federal water user will have two (2) years from that time to apply water to beneficial use and seven (7) years to complete the facilities required for the diversion and delivery of water. The permittee will give written notice to the Water Resources Board when such works have been completed.

b. In order to assist the board in determining the amount of water being diverted, to protect other water users and to maintain water use records, each permittee as a condition of his permit must also install and maintain a water control and measuring device or a meter at his diversion ...

600.12 CHANGES IN PLACE AND/OR NATURE OF USE OF WATER

a. Any permittee holding an approved water use permit in good standing desiring to change his point of diversion or the place or nature of use of the water, as approved in his permit, may file with the Water Resources Board through the Superintendent an application for an amendment to his permit and the same shall be granted to the extent it does not interfere with the water rights of other water users federal or otherwise ...
APPENDIX V (continued)

600.13 CANCELLATION OF PERMITS

Permits may be cancelled for violation or other good cause. However, revocation, suspension or withdrawal of a permit shall occur only after notice and hearing on such issue. Prior to the institution of such proceedings the board shall give ninety (90) days notice by mail to the permittee of the charges against him which initiated the action. The permittee shall be given the opportunity to rebut all charges or to show compliance with these regulations and the conditions of his permit. If the board finds the health, safety and welfare of any person or organization imperatively requires emergency action by the board and it incorporates a finding to that effect in its notice, summary suspension of the permit may be ordered, pending the proceedings for revocation or other action. Such proceedings shall be promptly instituted and determined.

600.14 APPOINTMENT AND DUTIES OF THE WATER MASTER

a. In order to provide adequate control, supervision and administration over the use of the waters of the various Indian reservations, the Tribal Council will select a Water Master who, upon the approval of the Secretary will act under the supervision of the Area Director as the Department's representative in all matters relating to enforcement of these regulations and the conditions set forth in all water-use permits. He will measure and record water diversions, and will promptly report to the board all violations or unauthorized uses of water ...

600.15 GROUND WATER

a. All ground water diversions are subject to these regulations. Mining of ground water will not be permitted except upon specific authorization by the board.

c. Domestic use of ground water shall have a preference over any other uses regardless of the dates on the various permits.

d. If at any time the board determines that the ground water table is being depleted because withdrawals exceed the rate of recharge or that the water table is approaching a critically low elevation, the board is authorized to limit the rate of pumping, adopt a rotation schedule or in case of an emergency situation immediately terminate any further pumping. In such situations all possible advance notice will be given to all affected water users as to a proposed plan of action.

e. Failure to comply with such notice to cease pumping shall be a misdemeanor and the violation will be subject to prosecution.
APPENDIX V (continued)

600.16 POLLUTION CONTROL

Upon receiving knowledge of, or complaints relating to, the discharge of pollutants in violation of the federal or state law into any of the waters of the reservation by individuals, municipalities, or industries, holding a federal water permit on, near or adjacent to any Indian reservation, the board will cause an immediate investigation to be made of such contamination. If the results of the investigation indicate that such pollution is occurring the board will, by order, serve a notice on the party or parties causing or permitting such pollution, advising them to correct the situation within a reasonable period of time. Failure to do so within the time prescribed will be cause for cancellation of a water permit and/or appropriate action before a court of competent jurisdiction.