Preliminary Engineering Report

Project Location:

The project planning and service area is located on the Blackfeet Indian Reservation in Northwestern Montana and includes the majority of Glacier County and part of Pondera County. The area immediately served by this project is the Town of Browning, the surrounding Tribal Housing Projects and East Glacier. Browning is located in the West/Central portion of the Blackfeet Reservation, Township 32N, Range 11. East Glacier is located in the SW corner of the Blackfeet Reservation.

Figure 1 shows the project area of Browning and East Glacier. Major points of elevation include Lower Two Medicine Reservoir at 4882 feet, East Glacier from 4774 to 4840 feet and the overflow of the 100,000-gallon storage tank at 4979 feet. The Town of Browning is at approximately 4400 feet in elevation. The overflow elevation of the 1 million gallon storage tank in Browning is 4521 feet.

Problem Definition: Browning

Growth Areas and Population Trends:

The 2000 Census estimated the population of the Blackfeet Indian Reservation to be 10,100; of this 8,507 are American Indian/Alaskan Native. Enrollment information was also obtained from the Blackfeet Tribe. The total number of enrolled members living on the Blackfeet Indian Reservation is 8,326 as of April 5, 2001. Also, there are 4,215 descendents living on the Blackfeet Indian Reservation. From the 2000 Census data, there are 1,394 people of different races living on the Reservation. The total population of the Blackfeet Reservation based on the Blackfeet Tribe's enrollment and descendent data and the 2000 Census data is 13,935. It is estimated that 55% of the population on the Blackfeet Indian Reservation or 7,665 people live in Browning. For comparison, the Town of Browning currently has 1,926 commercial/residential water service connections and it is estimated that there are 4 people per service connection. Based on these numbers, there are 7,704 people living in Browning and the surrounding Housing Projects today. Based on current area trends, the population in Browning is expected to grow at a rate of 2.0% per year over the next 20 years. By the year 2010, it is estimated that the population of Browning will reach approximately 9,390 and 11,500 by the year 2020 based on the above growth rate. The 2000 Census data and the Blackfeet Tribe's enrollment and descendent data are given in **Appendix A.**

Evaluate condition of existing facilities.

A schematic layout of Browning's existing water system is given in **Figure 2a.** A detailed schematic of Browning's water distribution system is given in **Figure 2b.** However, this schematic does not include the outlying Blackfeet Tribal Housing subdivisions.

History:

The original water system for the Town of Browning was constructed in the mid 1950's. This site was located approximately 5 miles west of Town and was referred to as Flatiron Spring. This system consisted of a series of interconnected infiltration galleries. A pump then lifted the combined flow to a 250,000-gallon storage tank at what is known as the Parson's site. A chlorinator building was also constructed at this site. It was connected to the Flatiron site with approximately 9,450 feet of 8-inch Class 100 AC pipe. Chlorination was needed due to the shallow nature of the collection wells and possible surface contamination. The chlorinator was connected to the Town's distribution system with 16,450 feet of 10-inch pipe. An elevated 75,000-gallon storage tank was constructed in the center of Town.

In the 1960's, additional water capacity was added to the Flatiron Spring site. A 300,000-gallon storage tank was built at what is known as the Industrial site. An 8-inch pipe connected this tank to the Town's distribution system. In order to fill this storage tank a booster station was required.

From 1974 to 1980 improvements to Browning's water system were completed. Three 10-inch diameter community wells were drilled at the Flatiron Spring site. The wells were drilled to depths of 53 feet, 56 feet and 57 feet. A wet well collection system connected the three wells and a pump house with controls was also constructed at Flatiron. The original collection system was abandoned, probably due to surface water influence. A one million gallon storage tank was constructed on the southwest side of Town and a fluoride saturator was also connected to the system.

In 1988, 10 wells were drilled along Willow Creek north of the Northern Plains Indian Museum. These wells were drilled to increase the capacity of the existing system. The original quantity produced by the well field was 1100 gpm as evidenced by test pumping data. Two aquifers were tapped by these wells. The upper aquifer being a gravel layer and the lower aquifer being described as shattered rock. In 1998, after experiencing very low flow from the well field, the wells were video taped and acidized. The theory was that the high iron content had encrusted the screens therefore restricting the flow. In actuality, the upper aquifer is surface water dependent and controlled by the flow of Willow Creek. The upper aquifer is dry most of the year. Test pumping revealed that when the upper aquifer is dry, the well field could only produce 150 gpm. The production of this well field has since dropped to 100 gpm.

From 1994-1995, three test wells were drilled near the subdivision of Last Star just north of Browning. This area was identified as having potential for producing a large quantity of water. The first well drilled in 1994 was abandoned because it was a dry hole. The second well drilled in 1994 produced 10 gpm, but was abandoned because this was not a sufficient amount of water to warrant any further development. The third well drilled in 1995 produced 50 gpm and was also abandoned due to an insufficient amount of water. The well logs are provided in **Appendix B.**

On October 4-6, 1994, three wells were drilled near Starr School along Cut Bank Creek. The gravel layers extended from ground level to a depth of 33-35 feet. The well logs for these three wells are given in **Appendix B.** There is no test pumping data available for these wells and the landowner is asking for royalties on the water produced. According to the Clean Water Act's Ground Water Under the Direct Influence of Surface Water Rule, a water treatment plant may be required for this site because of the shallow nature of the wells. It is suspected that this site would not produce enough water to meet the anticipated growth of Browning.

In 1994, 2 wells were drilled at the Parson's site. When initially drilled, these wells were believed to produce 600 GPM. Only one well was operational until 1996. In 1996 a third well was drilled at this site and the problem with the pumping system for well #2 was fixed. In a 10-day period between drilling and test pumping well #3, the static water level in the other two wells dropped 20 feet. The situation was discussed with a hydrologist from the USGS. From this description, the hydrologist concluded the wells were drilled into a perched aquifer with a very slow recharge. It was then decided not to connect the third well to the system. Production of wells one and two have drastically decreased. The current flow available from these wells is approximately 250 gpm.

In 1999, renovations were completed at the Flatiron Springs site. Four new wells were drilled. The estimated production of this well field is 750 gpm. The original chemical analysis showed that the aquifer did not contain high levels of iron and manganese. Upon producing the aquifer, the levels of iron and manganese surpassed the secondary recommended maximum containment levels set by the EPA. The pH of the water produced is high and when oxidized, the iron and manganese precipitates out of solution and forms a sludge layer on the bottom of the pipes.

On May 25-26, 1999, after consultation with the USGS hydrologist who had completed an extensive study of the groundwater on the Blackfeet Indian Reservation, it was decided to drill wells along Cut Bank Creek approximately 5 miles northwest of Browning. These wells will be named the Community Test Wells for reference purposes and the location of these wells are shown in **Figure 7.** It was anticipated that the groundwater present would be found in shallow gravel aquifers under the direct influence of Cut Bank Creek. The hydrologist indicated that Cut Bank Creek has the most reliable flow in the Browning area. The gravel lenses were only 12 feet deep. The estimated production of these wells was 20-30 GPM per well. It was decided that this would not be an adequate source to meet the water demands for the rapidly growing community of Browning. The three test wells have since been abandoned. The well logs are given in **Appendix B.**

On June 12, 2000 Blackfeet Housing had another well drilled at the Evan's site approximately 7 miles northwest of Browning. The location of this well is shown in **Figure 7.** The well was drilled to a depth of 35 feet. The first 27 feet was composed of silt, sand, gravel and cobbles. The next 8 feet was composed of silty clay and gray shale. Water was present from 9-27 feet in depth. The estimated production of this well was 25 gpm and has since been abandoned. The well log is given in **Appendix B.**

Condition of Facilities:

Currently, the Town's water system just barely meets the peak water demands of the community. The peak water demand for Browning is 1,625,000 gpd. The current water supply utilized by the Town of Browning currently produces 1150 gpm. If the system is pumped continuously, 1,656,000 gpd of water can be supplied to the community. But this does not allow for pump down time and fire flow protection for the community cannot be met with the current system. The current system also does not allow for any growth in the community. Several times a year the residents of Browning must go without water for a day or two because the wells are not able to keep up with the demand of the community during high peak use. Therefore, the quantity of water supplied to the Town needs to be increased to meet peak use, allow for fire flow and to allow for growth. Browning's distribution system is in fair to good condition. The Town of Browning is in the process of replacing some of the older water mains. The water mains have accumulated quite a bit of sediment and iron and manganese precipitate over the years, which needs to be thoroughly flushed out of the distribution system.

Financial Status of Facilities:

Browning charges various rates based on the type and size of service connection. The rate schedule is given in **Appendix C**. In addition to the rates charged, Browning has recently added an additional monthly fee of $5.00 to each user. The revenue generated from this fee will be used to repair or replace the older water mains in the distribution system. Browning's operating revenues and operating expenses from 1996 to 1999 are also given in **Appendix C.** In 1998-1999 Browning generated $336,109.81 in revenue from their water system. Browning's water operating expenses were $275,889.36, and had a net operating income of $60,220.45.

Browning currently has an existing loan of $126,000 borrowed from the State Intercap Loan Fund.

Need for the Project

Health and Safety:
The Browning water supply has been historically inadequate in terms of quality and quantity to serve the community. This has been well documented. Water shortages have occurred several times in prior years. Browning currently relies on ground water as the source for its drinking water supply. The water supplied to the community has been tested over the years. It has been shown to not pose any health risks and the water currently meets EPA's Primary Drinking Water Standards. However, the water taken from the Flatiron Spring site has been found to contain high levels of iron and manganese. These two constituents have not been found to cause health problems, but they are cause for concern. Iron and manganese are precipitated out of the water when chlorine is introduced. This causes a build up of iron and manganese on the bottom of the pipes. When the system is flushed or breaks in the pipes occur, these sediments in the pipe are stirred up. The water users are then supplied water that is not aesthetically pleasing to drink because it is dark and cloudy. This situation also causes a high chlorine demand, which reduces chlorine residuals downstream. To maintain the proper chlorine residuals downstream more chlorine would need to be added thus raising the chlorine costs per year.

The major concern of the community is the lack of water. The Town's water supply has not been able to keep up with the demands of the growing community. Water shortages are a major concern especially for households with elders or young children. Browning typically experiences high water use in the summer and winter months. During the summer, lawns are watered and water consumption increases. Water shortages during the hot summer months can be a health risk, especially to the elders in the community. Water helps to cool down the body when it is extremely hot. If there is not enough water to drink, some residents may become dehydrated. During the winter months, water use is also high. Many households leave their water running to prevent their pipes from freezing during the cold winter months. Water shortages during the winter can be a

serious problem. If the residents cannot make it to the store for water, they must make due with what they have in the house, which may not be sufficient.

Many reports have been written about Browning's water supply problems. The Indian Health Service, Blackfeet Housing and the Blackfeet Tribe have assisted on many projects to increase the quantity of water supplied to Browning. In July of 1994, the Engineering Consulting firm Thomas, Dean & Hoskins, Inc. prepared a report for the Blackfeet Housing Authority. In the report they state, "The water supply for the Browning area has historically been inadequate to meet peak demand." In 1997 the US Geological Survey prepared a report on the Water Resources of the Browning/Starr School Area, Blackfeet Indian Reservation. This report also mentioned the problems Browning has had over the years trying to meet the water demands of the community.

The Town of Browning tried to alleviate this water shortage concern by renovating the Flatiron Springs well and infiltration gallery. The infiltration gallery was abandoned and in its place four wells were drilled. These renovations were completed and placed online in the Fall of 1999. The production of these four wells was originally estimated to produce 1000 gpm. But after the wells were put on line, they were found to produce only 750 gpm. However this is still the largest supply source for Browning. The water produced from these wells was also found to be high in iron and manganese. This project helped Browning to just barely meet the peak water needs of the community but was still not adequate to provide for fire protection and allow for the rapid growth of the community. The high levels of iron and manganese were also a major concern for the community. The residents of Browning were still being supplied dirty water when these two metals precipitate out of solution after chlorine is added.

System O&M:

Browning's water distribution system is maintenance intensive. The Town currently utilizes approximately 17 wells to supply water to the community. Each of these wells needs to be maintained, which increases the costs of operating the system. Some of the existing pipes in the distribution system were installed in the 1950's. Browning is currently in the process of replacing these old water mains. The water main breaks Browning has experienced over the past few years usually occur in these older sections of pipe. Most of the old asbestos-cement pipes have been replaced, but there are still a few in use. The two elevated tanks located in Browning have rusted and are full of holes and are no longer in use. There are three storage tanks currently in use. A 1 million-gallon storage tank located on the Southwest side of Browning is in good condition. The 250,000-gallon storage tank at the Parson's site has been recently repaired and repainted. The 300,000-gallon storage tank at the Industrial Site is currently being repaired and repainted.

The Town has been in the process of repairing the current water distribution system for some time. They have begun a program to flush the existing water mains to remove the sediment build-up within the system. The Town has repaired several water main breaks in recent years. Most of the distribution system is comprised of PVC pipe. However, some of the distribution system is comprised of old cast iron and AC pipe that have

deteriorated over time. Leaks are a concern for this system in the portions composed of the cast iron and AC pipe. The Town has recently completed a leak detection survey to identify the severity of the problem. However, the survey indicated minimal findings, with no major leaks detected. The Town of Browning has repaired a storage tank 4 miles west of Town at the Parson's site and will be repairing a leaking water tank 1 mile south of Town. IHS received a letter from William Morris, the Mayor of Browning, in which he listed the improvements and repairs to the water system that have been completed. Mr. Morris also stated that a $5.00 service charge would be billed each month to each user. The revenue generated from this service charge will only be used for repairing the water distribution system. Mr. Morris outlines his O & M plans in the letter that has been provided in **Appendix D.**

Growth:
Browning has a large potential for growth if an adequate supply of water can be supplied to the community. Between 1990 and 1997, Browning has grown at a rate of 5.4% per year and between 1997-2000 at a rate of 2.0%. Based on current trends, it is estimated that Browning will continue to grow at a rate of 2.0% per year. Blackfeet Housing has had to put construction of new housing projects on hold because there is not enough water to supply these new homes. The community desperately needs to build new housing for this growing community. Blackfeet Housing currently has a waiting list for 1000 new homes, but these homes cannot be built until the water situation is resolved. The Town of Browning has put a hold on new housing construction projects due to the inadequate water supply.

Water Use Data:

The Town of Browning has difficulty meeting the water demands of the community. The total amount of water required to meet peak demands for domestic use is 1,625,000 gpd. The current system is capable of producing 1,150 gpm or 1,656,000 gpd. This rate is achieved by pumping 24 hours per day. Therefore, during times of peak demand, any interruption in the system has the potential to cause a water shortage. Typically Normally storage can handle these interruptions, but only for a short period of time. The Town is in the process of improving the distribution system, which will stop most of the water loss. But even after the improvements to the system are completed, the water source will not be able to produce enough water for this rapidly growing community.

Browning currently has an estimated population of 7,704. The peak flow for the community is 1,625,000 gpd or 211 gpcd, which is considerably lower than the peak use per capita of other communities across the country. For comparison, Cut Bank has an average water use of 215 gpcd and a peak water use of approximately 400 gpcd. One reason for the low per capita water use is the lack of commercial businesses in Browning. Another reason for the low per capita use is the lack of an active flushing program due to the lack of water. However, once an adequate source of water is supplied to Browning, the per capita use is expected to increase. Typically the average water use is between 150-220 gpcd and the peak water use is between 300-440 gpcd. Since the residents of Browning have shown conservative water use and there are only a few commercial

businesses, the lower range of the average use will be applied to Browning. Based on these numbers, Browning would require 1.16 mgd for average use and 2.31 mgd for peak use. As stated above, the maximum amount of water that can be supplied to Browning is 1,656,000 gpd, if the supply wells are pumped 24 hours/day. The amount of water is still not adequate to provide fire protection or allow for growth of the community.

Based on the population trends discussed previously, it has been estimated that Browning's population will increase to 11,500 by the year 2020. A treatment plant to serve Browning will be designed taking into consideration the 2010 and 2020 water use projections. **Table 1** illustrates these projections. The plant will have an initial treatment capacity of 2.82 mgd or 1960 gpm and will have expansion capabilities to 3.45 mgd or 2400 gpm.

TABLE 1
PROJECTED WATER DEMAND FOR BROWNING

Year	Population	Peak Day (mgd)	Peak Day (gpm)	Average Day (mgd)
2000	7,704	2.31*	1604	1.16*
2010	9,390	2.82*	1960	1.41*
2020	11,500	3.45*	2400	1.73*

* Based on average use of 150 gpcd and peak use of 300 gpcd

Problem Definition: East Glacier

Growth Areas and Population Trends:

East Glacier is a resort community with approximately 400 year round residents, based on Census 2000 data. Of the 400 year round residents, 205 are American Indian/Alaskan Native. During the summer tourist season the transient population may exceed 1100 people. Blackfeet Housing has long-term projections to build 100 new homes that will house approximately 400 more residents. This brings the design year population to about 800 residents.

It is also anticipated that the new treatment plant would serve Glacier Park Inc. and would be a large consumer of treated water. GPI typically sees between 30,000 to 35,000 visitors through the months of June, July, August and September. The amount of water required to serve GPI is given below in the Water Use Data section.

Evaluate condition of existing facilities.

A schematic layout of East Glacier's existing water system is given in **Figure 3.**

History:
The water used to supply East Glacier is currently taken from Midvale Creek above a diversion dam approximately one mile west of town. A 12 to 14-inch raw water main, which is owned by Glacier Park Inc. (GPI), currently serves both East Glacier and GPI. Chlorination is the only means of treating the surface water supplied to the East Glacier Water and Sewer District users.

In 1980, East Glacier built an infiltration well and pump house three miles southwest of town along Railroad Creek just off the Blackfeet Reservation. The anticipated capacity of this well was 180 to 200 GPM. Also included in this system were a 100,000-gallon storage tank and a transmission main to East Glacier. The system was completed and placed on line in 1982. Unfortunately this system was abandoned within a year because the actual production of the infiltration well was only 110 gpm with constant pumping and high levels of iron were detected. The 100,000-gallon storage tank is currently full but it is not on line. The tank can only be filled with GPI's water treatment and pumping system. This tank can be put on-line with the turn of a valve to supply additional fire flow to the community. This information was obtained from a Design Report prepared by Neil Consultants in December of 1998. A schematic of this project is given in **Figure 3.**

Glacier Park Inc. built a pressure clarification and filtration system to serve GPI facilities in 1986, which has a rated capacity of 150 GPM. The system operates well most of the year except when the raw water turbidity levels are extremely high.

Condition of Facilities:
East Glacier's intake facilities are in poor condition. The diversion structure at the Midvale Creek reservoir is in need of repair. The existing sluice gate needs to be replaced and a new intake pipe and screen are needed. Sediment accumulates at the diversion dam and must be removed with a backhoe once or twice per year. This causes the water to become very turbid and since there is no method of treatment, the residents of East Glacier are supplied water that does not meet the requirements of the Safe Drinking Water Act. Because of this East Glacier has been issued a Boil Water Order. The raw water main is composed of 500 feet of 14-inch woodstave pipe, 1400 feet of 14-inch asbestos cement pipe and 6100 feet of 12-inch PVC pipe.

East Glacier's distribution system is thought to be in good condition. The distribution system west of Highway 2 was constructed in 1980-81 of PVC C-900 pipe and will last indefinitely. The distribution system east of US Highway 2 is constructed of cast iron and asbestos cement pipes and is also thought to be in good condition, however most of the breaks and problems occur here.

Financial Status of Facilities:

The East Glacier Water and Sewer District currently has an outstanding balance on a loan borrowed from USDA Rural Development Administration. This loan was taken out in 1982 to pay for water improvements. East Glacier currently has a balance of $778,273.30 with 22 years remaining on a 40-year note at 4.5% interest as of March 22, 2001. Steps are currently in place to resolve this debt with RDA. The Blackfeet Tribe has tentatively agreed to take over operation of the East Glacier Water & Sewer District (EGWSD). If the Tribe takes over the operation of this system, they will also assume the existing debt of the District. However, this debt will be written down to a present day value. Negotiations are underway to determine the exact amount the debt will be written down to. The Blackfeet Tribe will then have 22 years to pay off this debt.

Operation and maintenance costs and annual revenue were obtained from the East Glacier Water and Sewer District for 1998-2000 and are given in **Table 2** below. The District charges a flat rate of $20.00 for water and $13.00 for sewer to residential customers. Commercial rates vary based on the size of the business. As seen in the **Table 2**, the O&M costs exceed the revenue generated for the water system in 1999 and 2000. One reason for the lack of revenue is because the District has not actively pursued collections.

TABLE 2
OPERATION COSTS AND REVENUE FOR EGWSD

YEAR	WATER		SEWER	
	O&M	REVENUE	O&M	REVENUE
1998	$37,921.71	$49,985.13	$38,278.42	$43,372.55
1999	$55,242.66	$46,249.44	$43,874.99	$45,349.24
2000	$53,837.06	$45,688.45	$39,386.67	$40,872.49

Need for the Project

Health and Safety:

The water supplied to East Glacier is in direct violation of the Surface Water Treatment Rule of the Safe Drinking Water Act Amendments. A Notice of Violation was sent to the East Glacier Water and Sewer District on August 9, 1993. The District has been on a Boil Water Order since then. The residents of East Glacier may be exposed to health risks due to bacteria contamination, Giardia and other water-borne contaminants that may be present in the water supply. The Blackfeet Community Hospital has treated 48 patients for Giardia/Giardiasis since 1990. These cases are both presumptive and confirmed. The exact cause or source of these cases could not be determined; however having an untreated surface water source in the area is definitely a cause for concern. On September 28, 1998 a Microscopic Particulate Analysis was performed on water taken directly from Midvale Creek. The result of the MPA indicated that Giardia was present in the water. The turbidity levels of the water supplied to the community have exceeded the 1.0 NTU MCL set by the Surface Water Treatment Rule on several occasions. The results of the MPA, regulatory correspondence and Notice of Violations are given in **Appendix E.**

System O&M:

The existing water facilities do not permit the East Glacier Water and Sewer District to supply the community with water that meets the criteria set forth in the Safe Drinking Water Act. The construction of a water treatment plant will provide safe drinking water to the residents and businesses of East Glacier.

Growth:

There is potential for residential and commercial growth if safe drinking water can be supplied to East Glacier. The Blackfeet Housing has plans to build 100 new homes over the next few years. However, GPI currently has no plans for expansion. East Glacier will only be able to grow if safe drinking water is supplied to the community.

Water Use Data:

Water use data for East Glacier was obtained from a report prepared by MSE-HKM Engineering for the Blackfeet Nation on April 8, 1999. Water use data was gathered from 1994-1998 and is broken down between East Glacier and Glacier Park Inc. Water use was averaged over the 5 years of data available to determine the water use per year. From this data it was determined that on average East Glacier uses 36,000,000 gallons per year and GPI uses 13,400,000 gallons per year with a total use of 49,400,000 gallons per year or 94 gpm. However Montana DEQ requires that water treatment facilities be designed for maximum day demand and the design year. The peak month for East Glacier was July 1994 at 6,548,759 gallons, with an average day use of 211,250 gpd. The Design of Small Water Systems by Joseph A. Salvato, P.E. recommends a peaking factor of 1.5 to convert the average day of the peak month to the peak day demand. Therefore the peak day demand for East Glacier is 316,875 gpd or 220 gpm. The peak month for GPI was August of 1994 at 3,891,800 gallons with an average day use of

125,540 gpd. The peak day demand for GPI is 188,310 gpd or 130 gpm. The present demand of East Glacier and GPI would be 505,185 gpd or 350 gpm. The water use projections for 2010 and 2020 are based on a peak use of 300 gpcd and also an increase to account for commercial growth.

East Glacier's population fluctuates seasonally because it is a summer resort community and therefore per capita water use would not be used as the design criteria. The water use data for East Glacier and GPI are provided in **Appendix F.** The water use projections for East Glacier and GPI are given below in **Table 3.** As shown in **Table 3,** there is no future growth anticipated for GPI. The lodge in East Glacier owned by GPI operates at maximum capacity during most of the summer tourist season. There are no plans to expand the capacity of the lodge. Therefore, the water use should remain constant over the next 20 years.

TABLE 3
PROJECTED WATER DEMAND FOR EAST GLACIER & GPI

Year	Population	Peak Day (gpd)				Total Peak Day Demand	
		East Glacier		GPI		East Glacier & GPI	
		gpd	gpm	gpd	gpm	gpd	gpm
2000	400	316,875	220	188,310	130	505,185	350
2010	800	436,875	300	188,310	130	625,185	430
2020	900	466,875	325	188,310	130	655,185	455

Water Use: Browning and East Glacier

The following table shows the projected water use for Browning and East Glacier. These would be the design flows based on peak day use if a regional water system were selected as the preferred alternative. The total amount of water required to meet the current peak water demands of Browning and East Glacier is approximately 2,815,185 gpd or 1950 gpm. However, as stated above, Blackfeet Housing has an immediate need to build 1000 new homes. If there were 4 people per home that would add an additional 4000 people to the system. Because of the growth that is anticipated over the next few years the plant will be designed based on year 2010 water use estimates. The plant capacity will be 3.445 mgd with expansion capabilities to 4.105 mgd. Additional treatment capacity shall be added as needed based on the water demands of the communities. The estimated water use for Browning, East Glacier and GPI are given below in **Table 4.**

TABLE 4
PROJECTED PEAK WATER DEMAND FOR BROWNING, EAST GLACIER & GPI

Year	East Glacier	GPI	Browning	Total (gpd)	Total (gpm)
2000	316,875	188,310	2,310,000	2,815,185	1950
2010	436,875	188,310	2,820,000	3,445,185	2400
2020	466,875	188,310	3,450,000	4,105,185	2850

Treatment Alternatives

The Treatment Alternative section will investigate the various surface water treatment technologies available. A no treatment alternative has been included to discuss the effects on each community if there is no water treatment provided. The two water treatment alternatives discussed in this section are microfiltration and conventional package treatment. Each of these treatment technologies will be evaluated. The evaluation will focus on ease of operation, ability of treatment alternative to meet water quality regulations now and in the future, cost of each alternative and other criteria that will be discussed in this section. Based on the evaluation, a preferred treatment technology will be selected. The treatment technology selected will then be the only one considered for this project.

No Treatment:

Providing no water treatment for East Glacier is not an acceptable alternative. East Glacier's current water supply is in direct violation of EPA's Surface Water Treatment Rule under the Safe Drinking Water Act Amendments. Boil water orders have been issued to the East Glacier Water and Sewer District as have Notice of Violations. To date, there have been no fines assessed to the District. However, if a solution is not accepted shortly the EPA may start enforcing fines until the District comes into compliance. Suitable ground water sources are not available as demonstrated by the 1980-81 attempt to drill near Railroad Creek. IHS has also drilled several wells for individual homeowners near East Glacier. The wells drilled were low yielding and often contained high levels of iron and manganese. Therefore, a surface water treatment plant is required to bring East Glacier into compliance with the Safe Drinking Water Act.

Browning's situation is a little different. The ground water sources currently utilized by Browning just barely keep up with the demand of the community. However, not enough water is produced to allow for growth in the community. Over the past 20-30 years, more ground water sources have been sought after, but to no avail. IHS and Blackfeet Housing have made several attempts to find adequate ground water sources to provide more water to Browning. But all these attempts have failed to keep up with this rapidly growing community. Browning's current water supply does meet EPA's Primary water quality standards but does not meet the Secondary standards because of the high levels of iron and manganese. The lack of water is a major concern. The Indian Health Service has performed extensive well drilling on the Blackfeet Reservation. Many hundreds of wells for individual homes have been drilled, as have several community test wells. None of the wells have encountered an aquifer that could adequately supply water to the Town of Browning. Most of the wells drilled have produced a maximum of 20 gpm and many are surface water influenced. Because of the extensive amount of wells drilled, it has been decided that the ground water sources near Browning have been exhausted. The only other option to provide enough water to meet Browning's needs now and in the future would be to construct a surface water treatment plant.

Microfiltration:

Microfiltration uses a hollow fiber membrane to remove particles greater than 0.1 to 0.2 microns, depending on the membrane manufacturer, from the raw water feed stream. The goal of this treatment plant is to meet the water quality standards set forth by the Surface Water Treatment Rule of the Safe Drinking Water Act Amendments. Feed water, under pressure, flows from the outside of the membrane to the inside or inside to the outside, depending on the manufacturer. Only particles with diameters smaller than 0.1 to 0.2 microns can pass through the membrane. Giardia and Cryptosporidium typically have diameters between 5 and 14 microns, and therefore will not be allowed to pass through the membrane. Microfiltration provides an absolute barrier to Giardia and Cryptosporidium. The particles that do not pass through are deposited on the surface of the membrane. As the deposits on the membrane build up, the resistance to flow through the membrane increases. Once the resistance, measured as transmembrane pressure, reaches a pre-defined value the system performs a backwash to remove the deposits from the membrane. There is no addition of chemicals to aid in the filtration process, and therefore, no chemicals are present in the backwash water. A discharge permit will be required to discharge the backwash water into the river. Since no chemicals are used in treating the water, the discharge requirements are not as stringent. After a period of time, the transmembrane pressure cannot be restored by backwashing. At this point the filters need to be chemically cleaned. A clean-in-place (CIP) is then initiated. A chemical solution typically caustic soda, citric acid or both, is circulated through the filters. The chemical waste can either be stored in a detention pond or neutralized and discharged into the water source. The microfiltration treatment plant can be operated automatically or in manual mode. Microfiltration water treatment plants can be monitored and controlled from a remote computer. Because of this, a certified operator's presence at the treatment plant is not required at all times.

Plant costs: A 430 gpm microfiltration treatment plant would be required to provide water to East Glacier and GPI. A 1960 gpm microfiltration treatment plant would be required to serve Browning. A 2400 gpm microfiltration treatment plant would be required to serve as a regional plant to provide Browning, East Glacier and GPI with treated water. The cost of the microfiltration treatment equipment sized to treat 430 gpm, 1960 gpm and 2400 gpm are given in below **Table 5.** The estimates given in **Table 5** were based on extensive research of microfiltration water treatment plants that have been installed throughout the United States. These capital costs include everything required to operate the plant.

Building Size: The building sizes required to house the microfiltration equipment to produce 430 gpm, 1960 gpm and 2400 gpm with future expansion capabilities are given in **Table 5.** A metal, open bay style building will be constructed. The building will include an office, lavatory, equipment storage, laboratory, chemical storage and a chlorine dosing room. The building sizes are based on a US Filter/Memcor microfiltration water treatment plant. However, the manufacturer has not been selected at this time. The building costs are also given in **Table 5** and are based on $\$110.00/ft^2$.

This cost also includes the construction of a clearwell located below the treatment plant building. Schematics of the building layout are given in **Appendix G.**

Annual O&M Costs: Operating cost data was determined from a pilot study conducted by IHS. Operation and maintenance data from several microfiltration water treatment plants currently in operation was also reviewed. The operation and maintenance costs required to operate a 430 gpm, 1960 gpm and 2400 gpm microfiltration water treatment plant are given below in **Table 5.** This includes amortized membrane replacement costs, power and chemical costs, replacement parts cost, labor costs and a reserve fund to save for the cost of future plant expansion.

Conventional Treatment:

Conventional treatment is a multi-step process with a design goal of 2-3 log removal/inactivation of Giardia and viruses. The EPA will be initiating more requirements of conventional water treatment systems in the near future. The first step in the conventional treatment process is coagulation/flocculation. This process uses coagulants that reduce the repelling forces of suspended particles thus creating "flocs" or groups of particles that are heavy enough to settle out and to catch or drag suspended particles with them. The next process is sedimentation. The "flocs" are allowed to settle out of the water and the settled sludge is discharged to a holding pond. The settled water then passes through a filter consisting of graduated layers of different filter media. The filter media typically used is anthracite coal, silica sand, garnet sand and a gravel base for support. When this filter media becomes clogged, a backwash through the filter is initiated to remove particles trapped in the filter.

Plant Costs: A conventional water treatment plant designed to treat 2400 gpm is estimated to cost approximately $5-$6-Million. This cost includes everything required to construct a fully operational plant, including the building, sludge settling pond, clearwell and connecting pipes. A conventional pre-engineered package water treatment plant could also be utilized and would cost less. The plant would need to be designed with equipment redundancy built in. The plant is required to meet peak design capacity with one treatment train out of operation. For example, a conventional package plant designed to produce 2400 gpm would have three treatment trains, with each train able to produce 1200 GPM. The total plant treatment capacity would be 3600 gpm, but this allows for one train to be out of service and still produce 2400 gpm, meeting Browning and East Glacier's water demand. The cost estimates for a conventional package treatment plant capable of producing 430 gpm, 1960 gpm or 2400 gpm are given below in **Table 5.**

Building Size: The building size required to house the equipment to produce 430, 1960 or 2400 gpm using a conventional treatment package plant are given in **Table 5.** A metal, open bay plant building will be constructed. The building will also include an office, lavatory, equipment storage, laboratory, chemical storage and a chlorine dosing room. The building costs are also given in **Table 5** and are based on $110.00/ft^2. This cost also includes the construction of a clearwell located below the treatment plant building. Schematics of the building layout are given in **Appendix G.**

Annual O&M Costs: Operating cost data was gathered from two conventional treatment plants in Montana. The cities of Laurel and Hardin were contacted. The conventional treatment plant in Laurel currently treats 4 mgd, but has the capacity to treat 10 mgd. Their yearly budget for operation and maintenance is approximately $450,000 to $600,000. The operating and maintenance costs for this conventional treatment plant range from $0.30 to $0.41/1000 gallons. These operating and maintenance costs are expected to increase with more stringent EPA regulations.

The conventional treatment plant in Hardin, MT has the capacity to produce 2 mgd. Currently the plant produces 0.5 mgd during the winter months and 1.5 mgd in the summer. The operation and maintenance costs for this conventional treatment plant range from $83,000 to $106,000. Using an average of 1 mgd, the O&M costs are approximately $0.23 to $0.29/1000 gallons.

Operational data for a Trident pre-engineered package plant was obtained from a 1.7 mgd plant located on the Wind River Reservation, WY. Chemical costs ranged from $6,000-$7,000, power costs ranged from $13,000-$15,000, and miscellaneous costs were about $14,000. Based on the above data, it is anticipated that the annual O&M costs for a new conventional package water treatment plant sized to produce 2400 GPM with expansion capabilities to 3000 GPM would be approximately $170,000-$180,000/year. The estimated O & M costs for a conventional package plant are given in **Table 5** with treatment capacities ranging from 430 gpm to 2400 gpm.

Table 5: Explanation

The table is a comparison of a microfiltration water treatment plant versus a conventional package water treatment plant. The capital, building and O&M costs were discussed previously and are given in **Table 5.** The other items listed in the table will be used to compare how well a microfiltration plant operates versus a conventional package plant. Each item listed will be rated as excellent, good, fair or poor.

Ease of Operation: Low Turbidity

Microfiltration was rated as “excellent” in this category. This rating was based on how a microfiltration plant removes turbidity from raw water feed streams. Raw water under pressure is forced through a membrane. Particles larger than 0.1 to 0.2 microns are not able to pass through the membrane and are deposited on the surface of the membrane. As these deposits build up the pressure across the membrane increase. This pressure is referred to as Trans-Membrane Pressure or TMP. Once the TMP reaches a predefined value, the system performs a backwash. When treating a raw water source with low turbidity there a fewer particle in the water to be trapped on the membrane surface. It will take longer for the system to reach the TMP value that initiates a backwash. Therefore the interval between backwashes will be longer thus reducing the amount of backwash wastewater produced per day.

Conventional package treatment was rated as “fair” in this category. Conventional package treatment relies on chemicals to treat water. The chemicals reduce the repelling forces of particles suspended in water. Once these forces are reduced, the particles create “flocs” or groups of particles that are heavy enough to settle. As these “flocs” settle, they catch and drag other particles with them. If the water contains few particles suspended in the water, these “flocs” have more difficulty forming because the distance between the particles is much greater. Therefore the particles are not able to create large “flocs” and are more difficult to settle out of solution. The operator must determine the chemical feed rate based on the raw water quality.

Ease of Operation: High Turbidity

Microfiltration was rated as “good” in this category. The reason for this rating is that the system will have to backwash more frequently because there are more particles in the water that will be removed. The TMP will increase more rapidly, thus requiring more backwashes. There is no increased operator involvement when treating water with low turbidity as compared to a high turbidity raw water source.

Conventional package treatment was rated as “good” in this category. Conventional package treatment is more effective at treating water with higher turbidity than water with low turbidity. The reason for this is because there are more particles in the water to create large “flocs” and will more readily settle out of solution.

Ease of Operation: High Turbidity Spikes

High turbidity spikes usually occur during spring run-off or during storm events. These spikes can last for a few hours or a few days. Turbidity spikes over 2000 ntu’s have been recorded on Cut Bank Creek as well as Midvale Creek.

Microfiltration was rated as “excellent” in this category. The only change a microfiltration plant must deal with during a high turbidity spike is more frequent backwashes. The spikes typically last for a few hours to a few days. Therefore there is not a large increase in backwash waste. There is no increase in operator responsibilities.

Conventional package treatment was rated as “poor” in this category. High turbidity spikes can cause some problems for a conventional package plant. During a spike, the operator will need to adjust the chemical feed rates to properly treat the water. Often times the spike event occurs very quickly and the operator must rush to make the proper adjustments to the chemicals. If the dosing is not correct, the finished water may not meet the water treatment standards.

Compliance with Current Regulations:

Both microfiltration and conventional package treatment were rated as “excellent” in this category. The two treatment technologies will produce finished water that meets or exceeds the current regulations.

Compliance with Future Regulations:

Microfiltration was rated as “excellent” in this category. Microfiltration has proven that it can produce water that will meet future treatment regulations.

Conventional package treatment was rated as “fair” in this category. Conventional package treatment may have difficulties meeting future regulations.

Ease of Expanding Treatment Capacity:
Microfiltration was rated as “excellent” in this category. Adding additional treatment trains easily expands treatment capacity. The trains contain blocks of membrane filters, which easily attach the existing system. Only a small amount of additional space is required to add the trains.

Conventional package treatment was rated as “good” in this category. To expand capacity an additional treatment tank is required. A large amount of room would be required to add an additional tank.

Pre-Sedimentation Pond:
A pre-sedimentation pond would be required on water sources that experience prolonged periods of high turbidity. Most of the surface water sources on the Blackfeet Reservation are very pristine most of the year. During spring run-off, the waters in the area become extremely turbid. Turbidities exceeding 2000 ntu’s are common during run-off. To assist the treatment plant in handling these high turbidities a pre-sedimentation pond would be constructed.

Three surface water sources are discussed later in this report. They are Midvale Creek, Cut Bank Creek and Lower Two Medicine Reservoir. Midvale Creek and Cut Bank Creek both experience high turbidities during run-off. If either of these two water sources were to be utilized, a pre-sedimentation pond would be needed. Lower Two Medicine Reservoir is a large body of water primarily used for irrigation. This Reservoir acts as a large settling pond to control these high turbidity levels and a pre-sedimentation pond would not be needed.

The Ten State Standards recommends a minimum 3-hour detention time. However, a longer detention time may be required based on the settling characteristics of the particles present in the water. Because the engineering design of this system is still in the preliminary stages, a 4-hour detention time will be used to size the pre-sedimentation ponds. As stated above, two plant sites would require sedimentation ponds. The plant utilizing Midvale Creek would be designed to produce 430 gpm. Based on a 4-hour detention time, the pre-sedimentation pond would have a volume of 103,200 gallons or 13,800 ft^3. Three ponds would be built, with each pond capable of handling 50% of the flow. Therefore each pond would have a capacity to hold 6,900 ft^3. Each pond would be 10 feet deep, 15 feet wide and 46 feet in length. The estimated cost to construct all three ponds is $65,000.00. Land would need to be purchased from GPI to construct these ponds. However, in the past GPI has been reluctant to sell any land.

The same design standards will be applied to a plant utilizing Cut Bank Creek. The design flow for this plant is 1960 gpm. The volume of each pond would then be 235,200 gallons or 31,440 ft^3. Each pond would be 10 feet deep, 35 feet wide and 90 feet in length. The estimated cost to construct all three pre-sedimentation ponds is $150,000.00.

Waste Pond:
A microfiltration plant may require a waste pond to meet the discharge requirements for the backwash and CIP waste streams. The discharge waste is required to have a TSS less than 30 mg/L, contain 0.05 mg/L of chlorine or less depending on the flow rate of the receiving stream and a pH range between 6 and 9. The backwash water from a microfiltration plant will typically have a TSS greater than 30 mg/L. Therefore a small amount of settling time will be required before this waste can be discharged. There will be no chlorine present in the backwash water and the pH will be the same as the raw water since no chemicals have been added to affect the pH. Another option to dispose of this waste would be land application. Approval is required from the EPA, but this is a viable option. The membrane cleaning waste will also need some treatment before it can be discharged. The cleaning waste typically has a pH of 2 or 3 and TSS greater than 30 mg/L. Therefore the waste will need to be neutralized and allowed to settle for a short amount of time before it can be discharged. Land application would also be another disposal option after the cleaning waste solution is neutralized.

If the plant was located in East Glacier, the treatment plant waste could be discharged into the sewer system. It would cost approximately $4000.00/year to discharge the plant wastewater to East Glacier's sewer system. A plant constructed along Cut Bank Creek or the Lower Two Medicine Reservoir may require a waste pond if land application was not approved. A microfiltration treatment plant constructed along Cut Bank Creek would require a 12,000-gallon waste pond. The estimated cost to construct this waste pond is $5000.00. A microfiltration plant constructed near Lower Two Medicine Reservoir would require a 15,000-gallon waste pond. The estimated cost to construct this waste pond is $7000.00.

A conventional package treatment plant will require a waste pond at the Cut Bank Creek site or Lower Two Medicine Reservoir site. The waste from a conventional package treatment plant located in East Glacier could be discharged into the sewer system. It would cost approximately $5000.00/year to discharge the plant wastewater to East Glacier's sewer system. A conventional package treatment plant constructed along Cut Bank Creek would require a 15,000-gallon waste pond. The estimated cost to construct this waste pond is $7000.00. A conventional package treatment plant constructed near Lower Two Medicine Reservoir would require an 18,000-gallon waste pond. The estimated cost to construct this waste pond is $9000.00.

TABLE 5
Microfiltration versus Conventional Package Water Treatment

	Microfiltration Treatment Plant	Conventional Package Treatment Plant
Capital Cost		
430 GPM	$600,000	$250,000
1960 GPM	$1,250,000	$400,000
2400 GPM	$1,500,000	$500,000
Building Size (SF)		
430 GPM	1600 SF	2000 SF
1960 GPM	2600 SF	4000 SF
2400 GPM	3200 SF	5625 SF
Building Cost ($100/SF)		
430 GPM	$176,000	$220,000
1960 GPM	$286,000	$440,000
2400 GPM	$352,000	$618,640
O & M Annual Costs		
430 GPM	$ 95,000- $105,000	$ 80,000 - $ 90,000
1960 GPM	$150,000 - $160,000	$160,000 - $170,000
2400 GPM	$160,000 - $170,000	$170,000 - $180,000
Ease of Operation Low Turbidity	EXCELLENT	FAIR
Ease of Operation High Turbidity	GOOD	GOOD
Ease of Operation High Turbidity Spikes	EXCELLENT	POOR
Compliance with Current Regulations	EXCELLENT	EXCELLENT
Compliance with Future Regulations	EXCELLENT	FAIR
Ease of Expanding Treatment Capacity	EXCELLENT	GOOD
Pre-Sedimentation Pond		
430 gpm (Midvale Creek)	$65,000	$65,000
1960 gpm (Cut Bank Creek)	$150,000	$150,000
Sludge/Waste Pond		
1960 gpm (Cut Bank Creek)	$5000.00	$7000.00
2400 gpm (Lower Two Med)	$7000.00	$9000.00

Present Worth Analysis: Microfiltration

A present worth analysis was prepared for a 430 gpm, 1960 gpm and 2400 gpm microfiltration water treatment plant. Included in the analysis are the microfiltration equipment and building capital costs. Membrane replacement costs were also included. Most microfiltration manufacturers provide a 5 to 7 year warranty for the membrane filters. For the purpose of this analysis the membranes will be replaced twice during the 20-year life of the plant. Once at year six and a second time at year 13. The membrane present worth replacement costs were calculated at a 6% interest rate over 20 years. The present worth of the annual O & M costs over 20 years was also calculated. The annual amortized membrane replacement cost was not included in the annual O & M costs for this calculation, since it is already included in the membrane present worth cost.

430 GPM Microfiltration Plant

Microfiltration Equipment Cost	$	700,000.00	
Process Piping:	$	10,000.00	
Shipping:	$	3,750.00	
Building Size:		1600	sq. ft (40'x40')
Building Cost:	$	176,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**889,750.00**	
Total Number of Modules:		90	
Replacements During Project Life:		2	
Cost per Module:	$	650.00	(Year 6)
Cost per Module:	$	650.00	(Year 13)
Replacement #1 Cost:	$	58,500.00	(Year 6)
Replacement #2 Cost:	$	58,500.00	(Year 13)
Present Worth Replacement #1:	$	41,242.50	(Year 6, 6% Interest)
Present Worth Replacement #2:	$	27,424.80	(Year 13, 6% Interest)
Total Amortized Membrane Cost:	**$**	**3,639.37**	
Total Annual Power Costs:	**$**	**15,048.76**	
Total Annual Chemical Costs:	**$**	**2,130.59**	
Total Annual Parts Budget:	**$**	**12,000.00**	
Total Annual O & M Cost (No Labor)	**$**	**32,818.72**	
Total Labor Costs:			
Certified Plant Operator (2):	$	70,000.00	
Total Annual Labor Costs:	**$**	**70,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**102,818.72**	
Capital Cost:	$	889,750.00	
Membrane Present Worth:	$	68,667.30	
Annual Cost w/o Amortized Costs:	$	99,179.35	
Total Present Worth:	**$**	**2,433,958.09**	

1960 GPM Microfiltration Plant

Microfiltration Equipment Cost	$	1,200,000.00	
Process Piping:	$	40,000.00	
Shipping:	$	3,750.00	
Building Size:		2600	sq. ft (32.5'x80')
Building Cost:	$	286,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**1,529,750.00**	
Total Number of Modules:		400	
Replacements During Project Life:		2	
Cost per Module:	$	650.00	(Year 6)
Cost per Module:	$	650.00	(Year 13)
Replacement #1 Cost:	$	260,000.00	(Year 6)
Replacement #2 Cost:	$	260,000.00	(Year 13)
Present Worth Replacement #1:	$	183,300.00	(Year 6, 6% Interest)
Present Worth Replacement #2:	$	121,888.00	(Year 13, 6% Interest)
Total Amortized Membrane Cost:	**$**	**16,174.96**	
Total Annual Power Costs:	**$**	**36,741.10**	
Total Annual Chemical Costs:	**$**	**8,522.36**	
Total Annual Parts Budget:	**$**	**20,000.00**	
Total Annual O & M Cost (No Labor)	**$**	**81,438.42**	
Total Labor Costs:			
Certified Plant Operators (2):	$	70,000.00	
Total Annual Labor Costs:	**$**	**70,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**151,438.42**	
Capital Cost:	$	1,529,750.00	
Membrane Present Worth:	$	305,188.00	
Annual Cost w/o Amortized Costs:	$	135,263.46	
Total Present Worth:	**$**	**3,847,320.09**	

2400 GPM Microfiltration Plant

Microfiltration Equipment Cost	$	1,400,000.00	
Process Piping:	$	48,000.00	
Shipping:	$	3,750.00	
Building Size:		3200	sq. ft (33.3'x90')
Building Cost:	$	352,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**1,803,750.00**	
Total Number of Modules:		540	
Replacements During Project Life:		2	
Cost per Module:	$	650.00	(Year 6)
Cost per Module:	$	650.00	(Year 13)
Replacement #1 Cost:	$	351,000.00	(Year 6)
Replacement #2 Cost:	$	351,000.00	(Year 13)
Present Worth Replacement #1:	$	247,455.00	(Year 6, 6% Interest)
Present Worth Replacement #2:	$	164,548.80	(Year 13, 6% Interest)
Total Amortized Membrane Cost:	**$**	**21,836.20**	
Total Annual Power Costs:	**$**	**42,834.29**	
Total Annual Chemical Costs:	**$**	**10,312.05**	
Total Annual Parts Budget:	**$**	**20,000.00**	
Total Annual O & M Cost (No Labor)	**$**	**94,982.54**	
Total Labor Costs:			
Certified Plant Operators (2):	$	70,000.00	
Total Annual Labor Costs:	**$**	**70,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**164,982.54**	
Capital Cost:	$	1,803,750.00	
Membrane Present Worth:	$	412,003.80	
Annual Cost w/o Amortized Costs:	$	143,146.34	
Total Present Worth:	**$**	**4,345,413.44**	

Present Worth Analysis: Conventional Package Plant

A present worth analysis was prepared for a 430 gpm, 1960 gpm and 2400 gpm conventional package water treatment plant. Included in the analysis are the treatment equipment and building capital costs. The filter media replacement costs were also included. The life of the filter bed was assumed to be 15 years. The filter media present worth replacement costs were calculated at a 6% interest rate over 15 years. The present worth of the annual O & M costs over 20 years was also calculated. The annual amortized filter media replacement cost was not included in the annual O & M costs for this calculation, since it is already included in the filter media present worth cost.

430 GPM Conventional Package Plant

Conventional Package Equipment Cost:	$	250,000.00	
Process Piping:	$	10,000.00	
Shipping:	$	3,750.00	
Building Size:		2000	sq. ft (40'x50')
Building Cost:	$	220,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**483,750.00**	
Filter Media Replacement During Project Life:		1	
Media Replacement Cost:	$	18,220.34	(Year 15)
Present Worth Replacement #1:	$	7,603.35	(Year 15, 6% Interest)
Total Amortized Media Replacement Cost:	**$**	**326.94**	
Total Annual Power Costs:	**$**	**4,992.37**	
Total Annual Chemical Costs:	**$**	**2,368.64**	
Total Annual Parts Budget:	**$**	**4,372.88**	
Total Annual O & M Cost (No Labor)	**$**	**12,060.84**	
Total Labor Costs:			
Certified Plant Operator (2):	$	70,000.00	
Total Annual Labor Costs:	**$**	**70,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**82,060.84**	
Capital Cost:	$	483,750.00	
Filter Media Present Worth:	$	7,603.35	
Annual Cost w/o Amortized Costs:	$	81,733.90	
Total Present Worth:	**$**	**1,707,349.42**	

1960 GPM Conventional Package Plant

Conventional Package Equipment Cost:	$	400,000.00	
Process Piping:	$	30,000.00	
Shipping:	$	3,750.00	
Building Size:		4000	sq. ft (50'x80')
Building Cost:	$	440,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**873,750.00**	
Filter Media Replacement During Project Life:		1	
Media Replacement Cost:	$	83,050.85	(Year 15)
Present Worth Replacement #1:	$	34,657.12	(Year 15, 6% Interest)
Total Amortized Media Replacement Cost:	**$**	**1,490.26**	
Total Annual Power Costs:	**$**	**22,755.93**	
Total Annual Chemical Costs:	**$**	**10,796.61**	
Total Annual Parts Budget:	**$**	**19,932.20**	
Total Annual O & M Cost (No Labor)	**$**	**54,975.00**	
Total Labor Costs:			
Certified Plant Operator (3):	$	105,000.00	
Total Annual Labor Costs:	**$**	**105,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**159,975.00**	
Capital Cost:	$	873,750.00	
Filter Media Present Worth:	$	34,657.12	
Annual Cost w/o Amortized Costs:	$	158,484.75	
Total Present Worth:	**$**	**3,266,263.92**	

2400 GPM Conventional Package Plant

Conventional Package Equipment Cost:	$	500,000.00	
Process Piping:	$	40,000.00	
Shipping:	$	3,750.00	
Building Size:		5625	sq. ft (75'x75')
Building Cost:	$	618,750.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**1,162,500.00**	
Filter Media Replacement During Project Life:		1	
Media Replacement Cost:	$	102,542.37	(Year 15)
Present Worth Replacement #1:	$	42,790.93	(Year 15, 6% Interest)
Total Amortized Media Replacement Cost:	**$**	**1,840.01**	
Total Annual Power Costs:	**$**	**28,096.61**	
Total Annual Chemical Costs:	**$**	**13,330.51**	
Total Annual Parts Budget:	**$**	**24,610.17**	
Total Annual O & M Cost (No Labor)	**$**	**67,877.30**	
Total Labor Costs:			
Certified Plant Operator (3):	$	105,000.00	
Total Annual Labor Costs:	**$**	**105,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**172,877.30**	
Capital Cost:	$	1,162,500.00	
Filter Media Present Worth:	$	42,790.93	
Annual Cost w/o Amortized Costs:	$	171,037.29	
Total Present Worth:	**$**	**3,749,898.19**	

Selection of Preferred Treatment Alternative:

The two treatment alternatives proposed are microfiltration and conventional package water treatment. Microfiltration is the preferred treatment alternative for this project. This treatment technology will consistently produce water that meets the requirements set forth in the Surface Water Treatment Rule (SWTR) of the Safe Drinking Water Act Amendments with minimal operator assistance. Microfiltration is a direct barrier water treatment method. The membranes used for microfiltration reject particles with diameters greater than 0.1 to 0.2 microns. Giardia cysts and Cryptosporidium oocysts fall in the size range of 5 to 14 microns and therefore will not pass through the membrane. With conventional package water treatment plants, operational or maintenance failures can lead to contamination of the finished water.

IHS conducted a pilot study from June 1999 to September 1999 to determine how effective microfiltration treated surface water. Midvale Creek was the raw water source for this pilot study. The microfiltration manufacturer's tested were Pall, US Filter/Memcor and Koch. Each of the pilot units produced water that met the SWTR requirements. A microscopic particulate analysis was done on the raw and finished water from the Pall and Memcor pilot units. The results of this analysis are given in **Appendix H.** Raw water turbidities ranged from 0.03 to 60.75 ntu. The Pall pilot unit produced finished water with turbidities ranging from 0.02 to 0.56 ntu, with an average of 0.07 ntu. The reading of 0.56 ntu is thought to be erroneous. The US Filter/Memcor pilot unit produced finished water with turbidities ranging from 0.02 to 0.16 ntu with an average of 0.06 ntu. Particle size removal efficiency is measured as log reductions. The log reductions ranged from 2.67 to 3.58 for the Pall pilot unit and 1.49 to 2.79 for the US Filter/Memcor pilot unit.

Microfiltration has proven that it will produce finished water that will meet current water quality requirements and can also meet the proposed future requirements. Finished water from a microfiltration plant, delivered to the community, should never exceed 0.2 ntu. Turbidity spikes will not be a problem as they could be with conventional treatment. When turbidity spikes occur during conventional treatment, the chemical dosing must be adjusted. The only change required for a microfiltration plant during turbidity spikes would be to decrease the backwash time interval. No changes in chemical feed rates are required. There were also several other factors that led to the selection of microfiltration as the preferred treatment alternative.

The building footprint of a microfiltration water treatment plant is typically about two-thirds of the footprint required for a conventional package water treatment plant to treat the same amount of water. This was an important requirement because the area surrounding the plant site is to be impacted as little as possible because of the natural surroundings. The smaller footprint also saves on material and construction costs.

Another benefit microfiltration has over conventional package treatment is that chemicals to assist in treatment are not required. Microfiltration works as a direct barrier to particles in water. Therefore no chemicals are required for coagulation or flocculation. Since chemicals are not used to treat the water, there are no chemicals present in the backwash water. This is important for the purpose of obtaining a permit to discharge the backwash water with little or no treatment. If chemicals were present in the backwash water, they would have to be removed before the water could be discharged. To meet the permit requirements, if no chemicals are present, the discharge water must have a pH between 6 and 9, have a TSS concentration less than 30 mg/L and have less than 0.05 mg/L of chlorine. The acceptable chlorine concentration level in the discharge water is determined by the lowest 7-day annual mean flow.

Another factor that influenced the decision to select this treatment technology was the input given by operators of microfiltration treatment plants. IHS Engineer's visited several microfiltration plants and interviewed the plant operators. The operators were very pleased with the operation and quality of finished water the microfiltration treatment

plants produced. The operators sited many benefits microfiltration had over conventional water treatment. One benefit was that chemicals were not needed to treat the water. They did not have to constantly change the chemical dosing if the raw water quality changed, as is required of conventional treatment. The only chemicals used in microfiltration are for the cleaning of the membranes during a Clean-In-Place (CIP). Chemicals are added automatically by the system when a CIP is required. The problems operators encountered with microfiltration water treatment plants were mechanical failures and were not related to chemical addition. Microfiltration plants are easily expanded by adding filter trains to provide for additional treatment capacity.

The one disadvantage to microfiltration is the high capital cost for the equipment. The equipment costs for microfiltration is 2 to 3 times greater than for a conventional packages plant. Based on the present worth analysis, a conventional package plant is more cost effective than microfiltration. The only difference being the capital costs. The costs to operate a microfiltration plant or a conventional package plant are very similar. However, the benefits that microfiltration offers over conventional package treatment outweighs the cost advantage of a conventional package plant.

Regional Water System Alternative

Plant Location: Lower Two Medicine Reservoir

This alternative would utilize water from Lower Two Medicine Reservoir to serve both East Glacier and Browning from one treatment plant. The Reservoir is fed by the Two Medicine drainage. Mountain springs and perennial snowmelt feed Upper Two Medicine Lake. Upper Two Medicine Lake is the water source for Two Medicine Lake, along with mountain streams and perennial snowmelt. The water from Two Medicine Lake then flows into Lower Two Medicine Reservoir.

The Bureau of Indian Affairs constructed the Lower Two Medicine Dam and Reservoir for irrigation purposes. It was decided to utilize the Reservoir for drinking water because of the large amount of storage that is available. The Reservoir has a total capacity of 25,120 acre-feet and an active capacity of 19,760 acre-feet. The active capacity of the Reservoir represents the water available for irrigation. This leaves 5,360 acre-feet or 1.75 billion gallons of inactive capacity. The inactive portion or dead pool of the Reservoir consists of the original lakebed, which is the portion that is not controlled by the dam. The intake structure for the treatment plant will make use of this inactive portion of the Reservoir. The treatment plant will initially be sized to treat 2400 gpm or 3,480,000 gpd with a future capacity of 3000 gpm or 4,320,000 gpd. However, the proposed treatment plant will not produce 2400 gpm 24-hours per day. The estimated average production of the treatment plant in 2020 will be approximately 2.33 mgd.

The top of the dead pool has an elevation of 4,861 feet. The top of the intake screen will be at an elevation of 4,855 feet. In the worst-case scenario, 6 feet of water above the screen in the dead pool will be available to supply water to the plant. To be conservative we will assume that 3 feet of water may be lost to evaporation or freezing. Therefore, 3 feet of water above the screen or 84.61 million gallons of water will be available to supply the plant with raw water. This condition would only be encountered in the most severe drought year. If the treatment plant produces an average of 2.33 mgd, and assuming no inflow or outflow, it would take 36 days to consume the 84.61 million gallons of water. However, for Lower Two Medicine Reservoir to receive no inflow, both the Upper Two Medicine and Two Medicine Lakes would have to dry up first. There are also mountain springs and perennial snowmelt that will supply water to the Lakes and Reservoir year round. The Reservoir capacity allocations are given in **Appendix I.**

Stream flow data from October 1998 to September 1999 for Two Medicine River was obtained from the USGS website and is given in **Appendix J.** The lowest monthly mean was November 1998, with a mean flow of 19.1 cfs. The historical lowest annual 7-day minimum was 13 cfs. On average, Lower Two Medicine Reservoir receives 244,800 acre-feet or 79.8 billion gallons of runoff per year. The amount of water available is more than adequate to supply East Glacier and Browning with treated water and still leave enough for irrigation since the water will be drawn from the inactive portion of the reservoir. Irrigation is typically done from May to September of each year, and these are

the months with the highest stream flows and available runoff. This source was selected for its location, water quality and quantity, which is more than adequate for the proposed project.

One advantage in using the Lower Two Medicine Reservoir is that the water turbidity levels in the Reservoir remain relatively constant. Large fluctuations in turbidity are not as drastic in the Reservoir as those seen in Midvale Creek or Cut Bank Creek. The Reservoir acts as a huge settling basin that helps control the turbidity spikes seen in streams and rivers during spring run-off. Turbidity spikes greater than 2000 ntu's have been observed in both Midvale Creek and Cut Bank Creek. These large fluctuations in turbidity can cause difficulties when treating the water. A water quality analysis was done on Midvale Creek and Two Medicine Reservoir in February. These results are given in **Appendix K.** This location also has the ability to be utilized as a regional treatment plant to serve both East Glacier and Browning. There is more than enough Tribal land and water available to construct a large treatment facility that could serve these two communities.

Alternative Site #1:

This site is located on Tribal Land, approximately 1 mile southeast of the Lower Two Medicine Dam. See **Figure 4a** and **4b** for the site location and proposed pipeline routes. This site was selected due to the fact that it is on Tribal Land. There is also an existing access road to this site. Minimum improvements to this road may be required, especially for access during the winter months. The Blackfeet Tribe will need to make the treatment plant access road a priority and it could then be done by the BIA Road Department. The treatment plant will be constructed just off the road. The plant will be located about 100 feet lower in elevation than the proposed 500,000-gallon storage tank. Therefore water will need to be pumped to the storage tank. Three-phase power is within 100 feet of the proposed plant site. There is also sufficient open land to construct a detention pond to handle process wastewater.

However there are some disadvantages to this site. To utilize this site to serve East Glacier, the Two Medicine River will need to be crossed twice. Once with the intake main and a second time with the main to supply East Glacier with treated water. To supply the treatment plant with raw water, the intake pumps will have to lift the water over 200 feet in elevation. This will increase the power consumption and raise operating costs.

Intake Facility:

The intake will draw water directly from Lower Two Medicine Reservoir, by placing an intake screen in the inactive portion of the Reservoir. The intake will be a USF Johnson Intake Screen or an approved equal. The preliminary design is for one tee-shaped intake screen having 0.07-inch slot openings and an open area of 50%. The intake screen will have a diameter of 27 inches with a capacity of 3200 gpm. The velocity of the water entering the screen will be 0.5 ft/second. At this low velocity aquatic life will not be

pulled into the intake or be trapped on the screens surface. The intake screen will be fitted with an air backwash system to allow for hand free cleaning of the screen.
The intake building will house the intake pumps that will supply the raw water to the treatment plant. The future design of the water treatment plant is 3000 gpm. However, the intake pumps will be designed to supply 2400 gpm to the treatment plant. Preliminary design of the intake pumps calls for four (4), 100-HP pumps with a capacity of 750 gpm each. The total production from the intake will be 3000 gpm. This will also enable the system to have some redundancy built in. If one pump is out, the intake will be able to supply 2,250 gpm to the treatment plant. These are preliminary designs and are subject to change once the final design is complete. Hydrometrics, Inc. provided the preliminary hydraulic calculations for this alternative and are given in **Appendix L**.

Clearwell:
The clearwell will be designed to provide for a small amount of finished water storage at the plant and for the addition of chlorine for disinfection. To provide the required contact time with a residual of 1.0 mg/L at a flow rate of 3000 gpm a 210,000-gallon clearwell would be required. However, the clearwell will have a design volume of 100,000 gallons that will provide 47.6% of the required contact time. The additional contact time will be achieved in the 500,000-gallon storage tank and the pipelines supplying both Browning and East Glacier. The water level in the clearwell would also control when the treatment plant starts up and stops.

Storage Facilities:
Browning currently utilizes three storage tanks. A one million-gallon storage tank is located approximately a ½-mile southwest of town. A 250,000-gallon storage tank is approximately 3 miles west of town at a site known as Parson's. The third tank is located about one-mile south of town and stores 300,000 gallons.

East Glacier currently has a 100,000-gallon storage tank located about 1-mile south of town. The storage tank is currently off-line, because the only way to fill it is from the treatment plant and pumping facilities owned and operated by Glacier Park Inc. This storage tank will be utilized once the treatment plant is constructed.

A 500,000-gallon storage tank is proposed for alternative #1. From this tank, water will be pumped to supply both Browning and East Glacier with finished water.

Pumping Stations:
Preliminary design of the pumps required to supply East Glacier with treated water was done by Hydrometrics, Inc. and is provided in **Appendix L.** The pumping station will contain three (3), 20-HP pumps, each with a capacity of 250 gpm. This allows for one pump to be out of service and still provide East Glacier with a sufficient amount of water. These are preliminary designs and are subject to change once the final design is complete.

Preliminary design of the pumps required to supply Browning with treated water was done by Hydrometrics, Inc. and is provided in **Appendix L.** The pumping station will

contain three (3), 125-HP pumps, each with a capacity of 1250 gpm. This allows for one pump to be out of service and still provide Browning with a sufficient amount of water. These are preliminary designs and are subject to change once the final design is complete.

Distribution:
The new distribution pipes will be owned and operated by the Blackfeet Tribe. A 20-inch HDPE intake main 3 miles in length will supply raw water to the treatment plant. From the treatment plant, water will be pumped through a 16-inch PVC water main 2,640 feet in length to a 500,000-gallon storage tank. A 20-inch PVC water main approximately 11.2 miles in length will supply treated water to Browning and a 12-inch PVC water main 2.4 miles in length will supply East Glacier. Maps of the proposed distribution system for Alternative #1 are given in **Figures 4a and 4b.**

Alternative Site #2:

This site is located approximately 2 miles southeast of the Lower Two Medicine Dam. See **Figure 5a** and **5b** for site location and proposed pipeline routes. The treatment plant will be located on Tribal land. The plant will be approximately a ¼ mile off of Highway 49. An access road will need to be constructed, but this location will allow for easy access throughout the year. The Blackfeet Tribe will need to make the treatment plant access road a priority and it could then be done by the BIA Road Department. The plant elevation at this site is approximately 150 feet lower than the plant site in Alternative #1. Therefore the pumping costs will be lower in supplying raw water to the treatment plant. This site will utilize the same intake location as Alternative #1. Another advantage to this site is that the Two Medicine River will only be crossed once with the supply line to Browning, which will lower the capital costs for construction.

Intake Facility:
The intake will draw water directly from Lower Two Medicine Reservoir, by placing an intake screen in the inactive portion of the Reservoir. The intake will be a USF Johnson Intake Screen or an approved equal. The preliminary design is for one tee-shaped intake screen having 0.07-inch slot openings and an open area of 50%. The intake screen will have a diameter of 27 inches with a capacity of 3200 gpm. The velocity of the water entering the screen will be 0.5 ft/second. At this low velocity aquatic life will not be pulled into the intake or be trapped on the screens surface. The intake screen will be fitted with an air backwash system to allow for hand free cleaning of the screen.

The intake building will house the intake pumps that will supply the raw water to the treatment plant. The future design of the water treatment plant is 3000 gpm. However, the intake pumps will be designed to supply 2400 gpm to the treatment plant. Preliminary design of the intake pumps for alternative #2 calls for four (4), 50-HP pumps with a capacity of 750 gpm each. The total production from the intake will be 3000 gpm. This will also enable the system to have some redundancy built in. If one pump is out, the intake will be able to supply 2,250 gpm to the treatment plant. These are preliminary designs and are subject to change once the final design is complete. Hydrometrics, Inc.

provided the preliminary hydraulic calculations for this alternative and are given in **Appendix L**.

Clearwell:
The clearwell will be designed to provide for a small amount of finished water storage at the plant and for the addition of chlorine for disinfection. To provide the required contact time with a residual of 1.0 mg/L at a flow rate of 3000 gpm a 210,000-gallon clearwell would be required. However the clearwell will have a design volume of 100,000 gallons that will provide 47.6% of the required contact time. The additional contact time will be achieved in the pipelines supplying both Browning and East Glacier. The closest service connection on the 10-inch main to East Glacier would be located after the proposed 200,000-gallon storage tank. The closest service connection on the main to Browning would be a 1.3 miles from the plant to ensure the proper amount of disinfection/inactivation of Giardia and viruses. The water level in the clearwell would also control when the treatment plant starts up and stops.

Storage Facilities:
Browning currently utilizes three storage tanks. A one million-gallon storage tank is located approximately a ½-mile southwest of town. A 250,000-gallon storage tank is approximately 3 miles west of town at a site known as Parson's. The third tank is located about one-mile south of town and stores 300,000 gallons.

East Glacier currently has a 100,000 gallon storage tank located about 1-mile south of town.. The storage tank is currently off-line, because the only way to fill it is from the treatment plant and pumping facilities owned and operated by Glacier Park Inc. This storage tank will be utilized once the treatment plant is constructed.

A 200,000-gallon tank is proposed to increase the storage available to East Glacier if alternative site #2 is selected. The location of the tank is shown in **Figure 5a** and **5b.** Water will be pumped from the treatment plant to this 200,000-gallon storage tank. From the tank, water will then gravity flow into East Glacier's distribution system.

Pumping Stations:
Preliminary design of the pumps required to supply East Glacier with treated water was done by Hydrometrics, Inc. and is provided in **Appendix L.** The pumping station will contain three (3), 25-HP pumps, each with a capacity of 250 gpm. This allows for one pump to be out of service and still provide East Glacier with a sufficient amount of water. These are preliminary designs and are subject to change once the final design is complete.

Preliminary design of the pumps required to supply Browning with treated water was done by Hydrometrics, Inc. and is provided in **Appendix L.** The pumping station will contain three (3), 175-HP pumps, each with a capacity of 1250 gpm. This allows for one pump to be out of service and still provide East Glacier with a sufficient amount of water. These are preliminary designs and are subject to change once the final design is complete.

Distribution:

The new distribution pipes will be owned and operated by the Blackfeet Tribe. A 16-inch intake main 2.4 miles in length will supply raw water to the treatment plant. A 20-inch water main approximately 12 miles in length will supply treated water to Browning and a 10-inch water main 1.5 miles in length will supply East Glacier. Maps of the proposed distribution system for Alternative #2 are given in **Figure 5a and 5b.**

Other Site Alternatives:

Two other treatment plant site alternatives were mentioned in a previous Preliminary Engineering Report, prepared for this project by IHS. These two sites have since been abandoned as a result of a Geo-Technical Engineering study conducted by NTL Engineering. The two sites were located in an active landslide area. NTL Engineering decided these two sites would not be feasible locations for a water treatment plant. NTL Engineering's report is provided in **Appendix M**.

Schematic Layout:

A schematic layout of the proposed option for a microfiltration water treatment plant is shown in **Figure 6.**

Regulatory Compliance and Permits

Permit to use water from Lower Two Medicine Reservoir
Permit to operate treatment plant
NPDES Permit to discharge backwash water into water source
Permit to construct CIP water detention pond or discharge into water source
Permit to cut timber
Permit to cross streams

Land Requirements

The water treatment plant, intake structure and storage tank will be constructed on Blackfeet Tribal Land. A **right-of-way** from the Blackfeet Tribe is required prior to construction. The water main from the treatment plant to Browning and East Glacier crosses Tribal Land and also privately owned land. Permission from the state to use their Highway 49 and Highway 2 right-of-ways need to be obtained. An Agreement with the Blackfeet Tribe and the individual landowners is also needed before construction begins. A map of Blackfeet Surface Land Status is given in **Appendix N**.

Environmental Considerations

IHS prepared an Environmental Review for this project on January 22, 1998. From this review, it was determined that an Environmental Assessment will be required. Hydrometrics, Inc. is in the process of preparing an Environmental Assessment. The

Environmental Review prepared by IHS has been provided in **Appendix O**. The Uniform Environmental Checklist has also been included in **Appendix O**.
The Indian Health Service sent letters to Tribal, State, and Federal Agencies asking for any environmental concerns they may have with this project. Replies have been received from Phillip Melton of the State Historic Preservation Office, Marie Marshall Garsjo of the USDA and Dan Carney of the Blackfeet Tribe Fish and Game. Their response letters have been included in **Appendix O**.

Hydrometrics, Inc is preparing the Environmental Assessment required for this project. The EA will investigate the environmental impacts of each alternative. Hydrometrics, Inc. has also subcontracted Ethos Consultants to prepare a Cultural Assessment for the project. It is anticipated that both the EA and Cultural Assessment will be completed by May 25th if weather permits.

Some Environmental and Cultural concerns are listed below:

Indian burial or medicine grounds
Stream crossings
Timber removal
Impact of plant on surroundings (aesthetic impact)
Impact on aquatic life in Reservoir near intake structure & discharge
Threatened and Endangered Species
Reclamation Plan for grasslands and timbered areas

Construction Problems: Rocks/Water/Timber/Steep Slopes

There are a few concerns about what will be encountered when construction takes place. The U.S. Department of Agriculture Soil Conservation Service and the U.S. Department of the Interior, Bureau of Indian Affairs in cooperation with Montana Agricultural Experiment Station prepared a soil survey of Glacier County and part of Pondera County, Montana. The survey assisted in determining the types of soils that could be encountered during construction. The proposed alternatives for a regional water system cover a large area and therefore a wide range of soil types. The soil types encountered vary from sandy loam to bedrock. At this time no subsurface soil investigations have been completed to determine the soil conditions near the proposed treatment plant sites or along the proposed water main routes. Bedrock may become a problem near the mountain front and blasting may be required during construction of the treatment plant and water main.

Landslides or ground movement were a cause for concern in this area. Driving north of the Reservoir on Highway 49, evidence of landslides and ground movement can be observed. Because of this, a Geo-Technical Engineering firm was contracted with to determine what areas surrounding the Reservoir would be prone to landslides or ground movement. Based on the Geo-Technical Engineering report by NTL Engineering, the area directly east of Lower Two Medicine Reservoir is prone to landslides and this area will be avoided. Based on NTL Engineering's recommendations, we have selected

relatively flat areas for the potential treatment plant sites that should be safe from landslide activity and ground movement.

Cost Estimates

Project Costs: (administration, financial, engineering, construction)
The cost estimates for a Regional Water System utilizing Alternative Site #1 is shown below in **Table 6** and for Alternative Site #2 in **Table 7.**

Table 6: Cost Estimate for Regional Water System

Two Medicine Reservoir - Alternative #1

Regional Water System - Preliminary Cost Estimate

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Soil Borings- Drill Rig with crew	2	DAY	$ 1,700.00	$ 3,400.00
2.	Soil Pits	30	EA	$ 200.00	$ 6,000.00
3.	Tree Removal - Intake Main	12	ACRE	$ 5,000.00	$ 60,000.00
4.	Tree Removal - East Glacier Main	9	ACRE	$ 5,000.00	$ 45,000.00
5.	Rock Excavation	5,000	CY	$ 30.00	$ 150,000.00
6.	Intake Screen	1	LS	$ 50,000.00	$ 50,000.00
7.	16" HDPE Intake Main - Screen to Pump House	1,600	LF	$ 400.00	$ 640,000.00
8.	Intake Pump House	1	LS	$ 250,000.00	$ 250,000.00
9.	Intake Pumps	4	EA	$ 15,000.00	$ 60,000.00
10.	20" HDPE Intake Main - Pump House to Plant	15,500	LF	$ 60.00	$ 930,000.00
11.	20" Butterfly Valves	15	EA	$ 4,000.00	$ 60,000.00
12.	20" CI, MJ Bends	6	EA	$ 1,200.00	$ 7,200.00
13.	Flushing Hydrants	4	EA	$ 5,000.00	$ 20,000.00
14.	Microfiltration Equipment	1	LS	$ 1,400,000.00	$ 1,400,000.00
15.	Install Microfiltration Equipment	1	LS	$ 100,000.00	$ 100,000.00
16.	Treatment Plant Building & Clearwell	3,200	SF	$ 110.00	$ 352,000.00
17.	Back-up Generator	1	LS	$ 40,000.00	$ 40,000.00
18.	Plant Site Grading	7,500	SY	$ 2.00	$ 15,000.00
19.	Access Road	1	LS	$ 10,000.00	$ 10,000.00
20.	High Service Pumps - Plant to Tank	2	EA	$ 15,000.00	$ 30,000.00
22.	3-Phase Power to Plant	50	LF	$ 20.00	$ 1,000.00
23.	SCADA Controls	1	LS	$ 200,000.00	$ 200,000.00
24.	16" PVC Intake Main - Plant to Storage Tank	2,400	LF	$ 52.00	$ 124,800.00
25.	16" Gate Valves	2	EA	$ 4,000.00	$ 8,000.00
26.	500,000 Gallon Storage Tank	1	EA	$ 500,000.00	$ 500,000.00
27.	12" PVC Main - Plant to East Glacier	12,700	LF	$ 50.00	$ 635,000.00
28.	12" Gate Valves	12	EA	$ 3,000.00	$ 36,000.00
29.	12" CI, MJ Bends	10	EA	$ 1,200.00	$ 12,000.00
30.	Booster Pump Station (East Glacier)	1	LS	$ 75,000.00	$ 75,000.00
31.	20" PVC Main - Plant to Browning	58,400	LF	$ 60.00	$ 3,504,000.00
32.	20" Gate Valves	50	EA	$ 4,000.00	$ 200,000.00
33.	20" CI, MJ Bends	15	EA	$ 1,200.00	$ 18,000.00
34.	Booster Pump Station (Browning)	1	LS	$ 100,000.00	$ 100,000.00

35.	Two Medicine River Crossing (2 Crossings)	400	LF	$	400.00	$	160,000.00
36.	Railroad Boring (2 required)	200	LF	$	100.00	$	20,000.00
37.	Road Crossing (2 required)	300	LF	$	100.00	$	30,000.00
	PROJECT TOTAL - Bare Costs					**$**	**9,852,400.00**
	OVERHEAD & PROFIT				15.00%	$	1,477,860.00
	TERO TAX				2.00%	$	197,048.00
	ADMINISTRATION FEE				2.00%	$	197,048.00
	CONSTRUCTION TAX				3.00%	$	295,572.00
	BOND				2.00%	$	197,048.00
	ENGINEERING/INSPECTION				5.00%	$	492,620.00
	ESTIMATE CONTINGENCY				10.00%	$	985,240.00
	PROJECT TOTAL					**$**	**13,694,836.00**

Table 7: Cost Estimate for Regional Water System

Two Medicine Reservoir - Alternative #2

Regional Water System - Preliminary Cost Estimate

ITEM	DESCRIPTION	QUANTITY	UNIT		UNIT COST		TOTAL COST
1.	Soil Borings- Drill Rig with crew	2	DAY	$	1,700.00	$	3,400.00
2.	Soil Pits	30	EA	$	200.00	$	6,000.00
3.	Tree Removal - Intake Main	12	ACRE	$	5,000.00	$	60,000.00
4.	Tree Removal - East Glacier Main	9	ACRE	$	5,000.00	$	45,000.00
5.	Rock Excavation	5,000	CY	$	30.00	$	150,000.00
6.	Intake Screen	1	LS	$	50,000.00	$	50,000.00
7.	16" HDPE Intake Main - Screen to Pump House	1,600	LF	$	400.00	$	640,000.00
8.	Intake Pump House	1	LS	$	250,000.00	$	250,000.00
9.	Intake Pumps	4	EA	$	15,000.00	$	60,000.00
10.	16" HDPE Intake Main - Pump House to Plant	12,410	LF	$	52.00	$	645,320.00
11.	16" Gate Valves (Intake)	12	EA	$	4,000.00	$	48,000.00
12.	16" CI, MJ Bends (Intake)	6	EA	$	1,500.00	$	9,000.00
13.	Flushing Hydrants	4	EA	$	5,000.00	$	20,000.00
14.	Microfiltration Equipment	1	LS	$	1,400,000.00	$	1,400,000.00
15.	Install Microfiltration Equipment	1	LS	$	100,000.00	$	100,000.00
16.	Treatment Plant Building & Clearwell	3,200	SF	$	110.00	$	352,000.00
17.	Back-up Generator	1	LS	$	40,000.00	$	40,000.00
18.	Plant Site Grading	7,500	SY	$	2.00	$	15,000.00
19.	High Service Pumps - East Glacier	2	EA	$	12,000.00	$	24,000.00
20.	High service Pumps - Browning	3	EA	$	20,000.00	$	60,000.00
21.	3-Phase Power to Plant	2,110	LF	$	20.00	$	42,200.00
22.	SCADA Controls	1	LS	$	200,000.00	$	200,000.00
23.	10" PVC Main - Plant to East Glacier	7,300	LF	$	48.00	$	350,400.00
24.	10" Gate Valves (East Glacier)	7	EA	$	3,000.00	$	21,000.00
25.	10" CI, MJ Bends (East Glacier)	10	EA	$	1,200.00	$	12,000.00
26.	200,000 Gallon Storage Tank (East Glacier)	1	LS	$	200,000.00	$	200,000.00
27.	20" PVC Main - Plant to Browning	63,500	LF	$	60.00	$	3,810,000.00
28.	20" Butterfly Valves (Browning)	50	EA	$	4,000.00	$	200,000.00
29.	20" CI, MJ Bends (Browning)	15	EA	$	1,200.00	$	18,000.00
30.	Two Medicine River Crossing	200	LF	$	400.00	$	80,000.00
31.	Railroad Boring (2 required)	200	LF	$	100.00	$	20,000.00
32.	Road Crossing (2 required)	300	LF	$	100.00	$	30,000.00
	PROJECT TOTAL - Bare Costs					**$**	**8,961,320.00**
	OVERHEAD & PROFIT				15.00%	$	1,344,198.00
	TERO TAX				2.00%	$	179,226.40
	ADMINISTRATION FEE				2.00%	$	179,226.40
	CONSTRUCTION TAX				3.00%	$	268,839.60
	BOND				2.00%	$	179,226.40
	ENGINEERING/INSPECTION				5.00%	$	448,066.00
	ESTIMATE CONTINGENCY				10.00%	$	896,132.00
	PROJECT TOTAL					**$**	**12,456,234.80**

Browning Water System Alternative

The Lower Two Medicine Reservoir alternative discussed previously would be utilized as a regional water system. However, Cut Bank Creek is another water source that could be used to provide treated surface water to Browning. If this alternative were selected, another treatment plant would be required for East Glacier. A plant located on Cut Bank Creek could not be used to serve East Glacier. Two separate water treatment plants would be constructed to solve both Browning and East Glacier's water problems. The Browning Water System Alternative discusses alternatives to provide water to Browning only. The alternatives available to East Glacier are discussed in the next section.

Ground Water

Evans Site: On June 12, 2000 the Town of Browning and Blackfeet Housing developed a well approximately 7 miles northwest of Browning along Cut Bank Creek to determine the potential for groundwater yield. **See Figure 7** for site location. The test well indicated water was found in a layer of sand, gravel and cobbles from 9 to 27 feet. Based on the information given in the well log and an air pump test it was determined that the amount of water that could be produced from this well would be 25-30 gpm. This was not an adequate amount of water to warrant the development of this site any further. The well log is provided in **Appendix B.**

Community Test Well Site: On May 25-26, 1999 Blackfeet Housing had three (3) wells drilled to determine if enough groundwater was available to supply Browning with water. This site is located approximately a 5 miles northwest of Browning. See **Figure 7** for site location**.** The three wells were drilled approximately 100-200 feet north of Cut Bank Creek. Because of the close proximity to Cut Bank Creek and the shallow nature of the gravel layer, the ground water found would most likely be under the direct influence of surface water. This theory was confirmed based on the well log data, which is provided in **Appendix B**. Test well #1 was drilled to a depth of 17 feet. Water was found in a gravel layer from 0 to 11 feet. Gray shale was encountered after the gravel layer. This is typical of many of the wells drilled on the Blackfeet Reservation, and little water has been produced from these shale formations. Test well #2 was drilled to a depth of 21 feet. Water was found in a gravel layer from 0-12 feet and below that a shale formation. Test well #3 was similar, except it was drilled to a depth of 200 feet to determine how thick the shale formation was. Again water in a gravel formation was found from 0-12 feet. Most of the formations encountered below the gravel layer were some type of shale with little or no water present. A 1-foot thick layer of sandstone was encountered at 21 feet with an estimated water production rate of 6 gpm. From 118 feet to 200 feet was a shale formation with small seams of sandstone. This formation could produce water at an estimated rate of 30 gpm. Based on the well log data it was determined that each of these wells could produce 20-40 gpm. If this site were to be utilized, a surface water treatment plant and a river intake structure would be required since all three wells indicated that most water was found within 20 feet of ground surface.

Cut Bank Creek

A surface water treatment plant could be constructed at either the Evan's or Community Test Well site to supply Browning with water. However the Community Test Well site is the most logical choice to construct a water treatment plant for several reasons. One reason is that it is approximately 2 miles closer to Browning, which will reduce the construction costs by an estimated $630,000. Another reason this site would be selected is that the Blackfeet Tribe has sufficient land just to the north of Cut Bank Creek. There is also an existing dirt road that will provide access to this site year round.

However, IHS has some concerns about this raw water source. One concern is that there is no storage available to draw water from. A diversion dam would need to be constructed to allow for some raw water storage. This dam structure would also provide for a small amount of pre-settling. The construction of the diversion dam could potentially have some major environmental concerns.

The Cut Bank Water Treatment Plant utilizes Cut Bank Creek as a raw water source, and has experienced some problems over the years. In addition to the lack of raw water storage, another problem encountered are the extreme turbidity spikes during spring runoff. The operators have seen turbidity levels exceed 2000 ntu, which presents problems in treating the raw water. The plant operator's have also experienced problems with low stream flow several times during the life of the plant. Flow data has been obtained from the USGS web site and is given in **Appendix J**.

A treatment plant could be constructed at this location to supply Browning with treated water. Cut Bank Creek could meet Browning's current water needs, but may have trouble supplying enough water twenty years from now due to the estimated growth. If this site were to be utilized, the wells at Flatiron Spring that currently supply Browning's water would have to remain online in the event that not enough water were available from Cut Bank Creek to meet the community's demands.

Intake Facility:

To utilize water from Cut Bank Creek, a collection or infiltration gallery would be required. This gallery would consist of several horizontal screens placed under the creek bed in the gravel deposits. A header pipe would then connect the screens together. Intake pumps would draw raw water from Cut Bank Creek and then feed the raw water into a sedimentation basin. The sedimentation basin would be required to help control the extreme turbidity spikes observed during spring runoff and storm events. The sedimentation basin will also allow for a small amount of raw water storage. A coagulant may be required to assist in the sedimentation process. The settled water would then be pumped into the treatment plant.

Storage Facilities:

Browning currently utilizes three storage tanks. A one million-gallon storage tank is located approximately a ½-mile southwest of town. A 250,000-gallon storage tank is approximately 3 miles west of town at a site known as Parson's. The third tank is located about one-mile south of town and stores 300,000 gallons.

A 500,000-gallon storage tank would be constructed about 2 miles northwest of Browning. See **Figure 7** for tank location. The tank would be located on a hill just above a future Blackfeet Housing project that is currently in the planning stages. Blackfeet Housing has plans to construct 160 new homes at this site. The tank would provide storage and pressure to this Housing project as well as to the Town of Browning.

Clearwell:

The clearwell will be designed to provide for a small amount of finished water storage at the plant and for the addition of chlorine for disinfection. The Surface Water Treatment Rule established a 3-Log removal/inactivation for Giardia and 4-Log removal/inactivation for viruses. A Microfiltration water treatment plant is typically given a 2-Log credit for removal/inactivation of Giardia and a 1-Log credit for virus removal/inactivation. Disinfection with chlorine will need to provide 1-Log removal/inactivation of Giardia and 3-Log removal/inactivation of viruses. Based on CT values, a 1-Log removal/inactivation of Giardia will determine the required disinfection contact time. To provide the necessary contact time with a residual of 1.0 mg/L at a flow rate of 2400 gpm a 168,000-gallon clearwell would be required. The flow of 2400 gpm was used to take into consideration future growth in Browning. The water level in the clearwell would also control when the treatment plant starts up and stops.

Distribution:

The new distribution mains will be owned and operated by the Blackfeet Tribe. A 16-inch HDPE intake main 1600 feet in length will supply raw water to the treatment plant. A 16-inch PVC water main approximately 15,850 feet in length will supply treated water from the treatment plant to the proposed 500,000-gallon storage tank. A 16-inch PVC water main approximately 8,000 feet in length will supply treated water from the storage tank to Browning. A map of the proposed distribution system for the Browning Water System Alternative is given in **Figure 7.**

Schematic Layout:

A schematic layout of the proposed option for the water treatment plant utilizing Cut Bank Creek is shown in **Figure 8.**

Regulatory Compliance & Permits:

Permit to draw water from Cut Bank Creek

Permit to operate treatment plant
NPDES Permit to discharge backwash water into water source
Permit to construct CIP water detention pond or discharge into water source
Permit to cross Cut Bank Creek with 16-inch pipeline
Right-of-way across private land
Permit to construct diversion dam

Land Requirements:

The water treatment plant, intake structure and storage tank will be constructed on Blackfeet Tribal Land. A right-of-way from the Blackfeet Tribe is required prior to construction of these facilities. The water main from the treatment plant to Browning crosses Tribal Land as well as privately owned land. A right-of-way agreement with the Blackfeet Tribe and the individual landowners is required before construction begins.

Environmental Considerations:

Hydrometrics, Inc is currently preparing the Environmental Assessment required for this project. The EA will investigate the environmental impacts of each alternative. Hydrometrics, Inc. has also subcontracted Ethos Consultants to prepare a Cultural Assessment for this project. It is anticipated that both the EA and Cultural Assessment will be completed by May 25th if weather permits. Some Environmental and Cultural concerns are listed below:

Indian burial or medicine grounds
Stream crossings
Impact of plant on surroundings (aesthetic impact)
Impact on aquatic life in Cut Bank Creek intake structure & discharge
Reclamation Plan for grasslands
Diversion Dam

Construction Problems:

The U.S. Department of Agriculture Soil Conservation Service and the U.S. Department of the Interior, Bureau of Indian Affairs in cooperation with Montana Agricultural Experiment Station prepared a soil survey of Glacier County and part of Pondera County, Montana. The survey assisted in determining the types of soils that could be encountered during construction. The proposed alternative to construct a water treatment plant along Cut Bank Creek covers a large area and therefore a wide range of soil types. The soil types encountered vary from sandy loam to bedrock. At this time no subsurface soil investigations have been completed to determine the soil conditions near the proposed treatment plant sites or along the proposed water main routes. However, based on past construction experience in this area IHS engineers do not foresee any construction problems.

Cost Estimates:

Project Costs: (administration, financial, engineering, construction). The cost estimate for Browning's Water System is given below in **Table 8**.

Table 8
Cost Estimate for Browning Water System Alternative
Cut Bank Creek Alternative
Browning Water System - Preliminary Cost Estimate

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Soil Borings- Drill Rig with crew	2	DAY	$ 1,700.00	$ 3,400.00
2.	Soil Pits	20	EA	$ 200.00	$ 4,000.00
3.	Rock Excavation	3,000	CY	$ 30.00	$ 90,000.00
4.	Intake Structure - Infiltration Gallery	1	LS	$ 150,000.00	$ 150,000.00
5.	Diversion Dam	1	LS	$ 100,000.00	$ 100,000.00
6.	16" HDPE Intake Main - Screen to Pump House	1,200	LF	$ 250.00	$ 300,000.00
7.	16" Gate Valves	2	EA	$ 4,000.00	$ 8,000.00
8.	16" CI, MJ Bends	4	EA	$ 1,200.00	$ 4,800.00
9.	Intake Pumps	3	EA	$ 15,000.00	$ 45,000.00
10.	Intake Pump House	1	LS	$ 70,000.00	$ 70,000.00
11.	Sedimentation Basin	1	LS	$ 150,000.00	$ 150,000.00
12.	16" PVC Intake Main - Basin to Plant	400	LF	$ 52.00	$ 20,800.00
13.	16" Gate Valves	2	EA	$ 4,000.00	$ 8,000.00
14.	16" CI, MJ Bends	4	EA	$ 1,200.00	$ 4,800.00
15.	Intake Pumps	2	EA	$ 15,000.00	$ 30,000.00
16.	Microfiltration Equipment	1	LS	$ 1,200,000.00	$ 1,200,000.00
17.	Install Microfiltration Equipment	1	LS	$ 100,000.00	$ 100,000.00
18.	Treatment Plant Building & Clearwell	2,600	SF	$ 110.00	$ 286,000.00
19.	Backup Generator	1	LS	$ 40,000.00	$ 40,000.00
20.	Waste Pond	1	LS	$ 150,000.00	$ 150,000.00
22.	Plant Site Grading	7,500	SY	$ 2.00	$ 15,000.00
23.	Access Road	1	LS	$ 10,000.00	$ 10,000.00
24.	3-Phase Power to Plant	3,000	LF	$ 20.00	$ 60,000.00
25.	SCADA Controls	1	LS	$ 150,000.00	$ 150,000.00
26.	High Service Pumps - Plant to Tank	2	EA	$ 20,000.00	$ 40,000.00
27.	16" PVC Main - Plant to Storage Tank	15,850	LF	$ 52.00	$ 824,200.00
28.	16" Gate Valves	15	EA	$ 4,000.00	$ 60,000.00
29.	16" CI, MJ Bends	10	EA	$ 1,200.00	$ 12,000.00
30.	Cut Bank Creek Crossing	300	LF	$ 400.00	$ 120,000.00
31.	500,000 Gallon Storage Tank	1	EA	$ 500,000.00	$ 500,000.00
32.	16" PVC Main - Storage Tank to Browning	8,000	LF	$ 52.00	$ 416,000.00
33.	16" Gate Valves	8	EA	$ 4,000.00	$ 32,000.00
34.	16" CI, MJ Bends	10	EA	$ 1,200.00	$ 12,000.00
35.	Connect to Distribution System	1	EA	$ 2,500.00	$ 2,500.00
	PROJECT TOTAL - Bare Costs				**$ 5,018,500.00**
	OVERHEAD & PROFIT			15.00%	$ 752,775.00
	TERO TAX			2.00%	$ 100,370.00

ADMINISTRATION FEE	2.00%	$	100,370.00
CONSTRUCTION TAX	3.00%	$	150,555.00
BOND	2.00%	$	100,370.00
ENGINEERING/INSPECTION	5.00%	$	250,925.00
ESTIMATE CONTINGENCY	10.00%	$	501,850.00
PROJECT TOTAL		**$**	**6,975,715.00**

East Glacier Water System Alternative

The Lower Two Medicine Reservoir alternative and the Cut Bank Creek alternative's were discussed previously. The Two Medicine Reservoir would be utilized as a Regional water system to serve both Browning and East Glacier. The Cut Bank Creek alternative would only supply Browning with treated water. If the Cut Bank Creek alternative were selected, another treatment plant would be required to serve East Glacier. Two separate water treatment plants would need to be constructed to solve both Browning and East Glacier's water problems. The alternatives available to East Glacier are discussed below.

Ground Water:

Suitable ground water sources near East Glacier are not available. The 1980-81 attempt to drill near Railroad Creek proved this fact. The well drilled at Railroad Creek was anticipated to produce 180-200 gpm. However, the actual production of the well was only 110 gpm. The water produced from the well contained high levels of iron and manganese. IHS has also drilled several wells for individual homeowners near East Glacier. The wells drilled were low yielding and often contained high levels of iron and manganese. Therefore, a surface water treatment plant is required to bring East Glacier into compliance with the Safe Drinking Water Act.

Midvale Creek:

Midvale Creek is the water source currently used by East Glacier, but no water treatment system is in place at the present time. The only treatment provided is chlorination. Therefore East Glacier's water system is not in compliance with EPA's Surface Water Treatment Rule. The water quality of Midvale Creek changes seasonally. During the winter months, the quality of water is usually good but it is still in violation of the Surface Water Treatment Rule. During spring run-off and storm events the water becomes extremely turbid. This is a serious health concern since bacteria and other contaminants may be present in the water supply.

In order to utilize Midvale Creek as a viable water source for East Glacier, a water treatment plant is required. The two treatment options considered are a conventional package treatment or a microfiltration treatment plant. However, based on the analysis in the Treatment Alternative section, microfiltration will be the preferred treatment alternative. The proposed site for the treatment plant is shown in **Figure 9.** A sedimentation basin will be required to help control the high turbidity spikes.

Intake Facility:

The existing diversion dam and intake structure was constructed in the early 1900's. The intake structure consists of a concrete dam with a flume 40 feet in length. A sluice gate 4 feet wide can be raised and lowered by a hand operated cable mechanism. A 14" intake pipe extends into the reservoir and is protected by a series of bar screens to prevent large debris from entering the intake pipe. Because the intake structure is extremely old and

has not been well maintained, it is in need of repair. The dam was constructed to provide for a small amount of raw water storage. Because of the high turbidities during run-off and storm events sediments build up behind the dam and the reservoir must be cleaned at least once per year to remove the sediment buildup. If the sediments are not removed, the storage capacity of the reservoir is diminished. The cleaning process requires the use of a backhoe to remove the sediments. The Blackfeet Water Resources Department has some concerns about the effects the cleaning process has on stream habitat. This cleaning process causes the water and sediments to be stirred up, causing muddy water downstream. Also with the backhoe in the water there is the possibility of contaminating the creek with diesel or other fluids leaking from the backhoe. Blackfeet Water Resources would like to abandon this intake structure. Therefore, if Midvale Creek is to be utilized as a water source for East Glacier permission from the Blackfeet Water Resources Department is required. The intake will need to be designed so that a backhoe is not required to remove the sediment buildup every year. This intake structure location is the only logical choice to maintain a sufficient pressure head to supply raw water to a treatment plant in East Glacier.

A sedimentation basin will be required to utilize Midvale Creek as a raw water source for East Glacier. During spring run-off and storm events, the water turbidity can exceed 2000 ntu. These high turbidities can cause problems during the treatment process. To alleviate these problems a sedimentation basin would be constructed. The sedimentation basin will be designed with a 4-hour detention time. The volume required at a flow rate of 500 gpm and a 4-hour detention time is 103,000 gallons. The flow rate of 500 gpm was used to account for future growth in the community. See **Figure 9** for proposed location of sedimentation basin.

Clearwell:

The clearwell will be designed to provide for a small amount of finished water storage at the plant and for the addition of chlorine for disinfection. The Surface Water Treatment Rule established a 3-Log removal/inactivation of Giardia and 4-Log removal/inactivation of viruses. A microfiltration water treatment plant is typically given a 2-Log credit for removal/inactivation of Giardia and a 1-Log credit for virus removal/inactivation. Disinfection with chlorine will need to provide 1-Log removal/inactivation of Giardia and 3-Log removal/inactivation of viruses. Based on CT values, a 1-Log removal/inactivation of Giardia will determine the required disinfection contact time. To provide the necessary contact time with a residual of 0.4 mg/L at a flow rate of 500 gpm an 81,000-gallon clearwell would be required. The flow of 500 gpm was used to take into consideration future growth in East Glacier. The water level in the clearwell would also control when the treatment plant starts up and shuts down.

Storage Facilities:

East Glacier currently has a 100,000-gallon storage tank, located about 1-mile south of town, which is currently connected to the distribution system. The storage tank is currently off-line, because the only way to fill it is from the treatment plant and pumping

system owned by Glacier Park Inc. This storage tank will be utilized once the treatment plant is constructed. See **Figure 9** for tank location.

The existing 100,000-gallon storage tank is capable of providing fire flow at a rate of 1000 gpm for 1 hour and 40 minutes. However, a more typical fire flow demand for East Glacier would be 2500 gpm based on the type and size of buildings in the community. The required duration for fire flows of 2,500 gpm and less is two hours according to AWWA M31: Distribution System Requirements for Fire Protection. To meet this fire flow demand and duration, 300,000 gallons of storage would be required. Therefore an additional 200,000 gallons of storage would need to be added to East Glacier's distribution system. This information was provided in a Preliminary Engineering Report (MSE/HKM 1999). Domestic water demand would also need to be met as well as fire flow demand. The treatment plant will be designed to produce 430 gpm and will meet East Glacier's peak daily water demand. A complete hydraulic model of the system would need to be prepared to determine if the existing distribution system can provide 2,500 gpm of fire flow. However, this is beyond the scope of this preliminary engineering report. The analysis would be done during final design of the system.

Distribution:

Glacier Park Inc. owns and maintains the existing raw water main. In 1991 GPI replaced all but approximately 500 feet of the existing 14-inch wooden raw water main with 12-inch C-900 PVC pipe. The remaining 500 feet of 14-inch wood stave pipe needs to be replaced. The raw water main will have to be extended approximately 2000 feet to the proposed water treatment plant. A 12-inch PVC finished water main approximately 500 feet in length will connect to East Glacier's existing distribution system. See **Figure 9** for proposed additions to East Glacier's distribution system.

Schematic Layout:

A schematic layout of the proposed option for a water treatment plant utilizing Midvale Creek is shown in **Figure 10.**

Regulatory Compliance & Permits:

Permit to operate treatment plant
NPDES Permit to discharge backwash water into water source
Permit to construct CIP water detention pond or discharge into water source
Right-of-way across private land
Permit to bore under railroad

Land Requirements:

The land for the proposed plant site as well as the sedimentation basins will need to be purchased from GPI. There is not enough room for the sedimentation basins at the treatment plant site. The most logical site to construct the basins would be along the raw

water intake. The proposed location for these basins is shown in **Figure 9.** In the past, GPI has been reluctant to sell any land. This could present a problem and other alternative plant sites would need to be evaluated. These alternative plant sites would increase the cost estimate to provide treated water to East Glacier if Midvale Creek is utilized. A right-of-way and a Deed of Trust for the land purchases from GPI is required prior to construction of the raw water main extension, sedimentation basins, treatment plant and finished water main.

Environmental Considerations:

Hydrometrics, Inc is preparing the Environmental Assessment required for this project. The EA will investigate the environmental impacts of each alternative. Hydrometrics, Inc. has also subcontracted Ethos Consultants to prepare a Cultural Assessment for the project. It is anticipated that both the EA and Cultural Assessment will be completed by May 25th if weather permits. Some Environmental and Cultural concerns are listed below:

Indian burial or medicine grounds
Stream crossings
Impact of plant on surroundings (aesthetic impact)
Impact on aquatic life in Cut Bank Creek intake structure & discharge

Construction Problems:

The U.S. Department of Agriculture Soil Conservation Service and the U.S. Department of the Interior, Bureau of Indian Affairs in cooperation with Montana Agricultural Experiment Station prepared a soil survey of Glacier County and part of Pondera County, Montana. The survey assisted in determining the types of soils that could be encountered during construction. The soil types encountered vary from sandy loam to bedrock. At this time no subsurface soil investigations have been completed to determine the soil conditions near the proposed treatment plant sites or along the proposed water main routes. However, based on past construction experience in this area IHS engineers do not foresee any construction problems.

Cost Estimates:

The cost estimate for East Glacier's Water System is given below in **Table 9**.

Table 9
Cost Estimate for East Glacier Water System
East Glacier Water System - Preliminary Cost Estimate

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Soil Borings- Drill Rig with crew	2	DAY	$ 1,700.00	$ 3,400.00
2.	Soil Pits	5	EA	$ 200.00	$ 1,000.00
3.	Rock Excavation	500	CY	$ 30.00	$ 15,000.00
4.	Intake Rehab	1	LS	$ 50,000.00	$ 50,000.00
5.	12" PVC Main - Extend Raw Water Main	2,000	LF	$ 52.00	$ 104,000.00

6.	12" Gate Valves	5	EA	$	3,000.00	$	15,000.00
7.	12" CI, MJ Bends	5	EA	$	1,200.00	$	6,000.00
8.	Flushing Hydrants	2	EA	$	5,000.00	$	10,000.00
9.	Purchase Land/Right-of-Ways	1	LS	$	50,000.00	$	50,000.00
10.	Sedimentation Pond	1	LS	$	80,000.00	$	80,000.00
11.	Microfiltration Equipment	1	LS	$	700,000.00	$	700,000.00
12.	Install Microfiltration Equipment	1	LS	$	70,000.00	$	70,000.00
13.	Treatment Plant Building & Clearwell	1,600	SF	$	110.00	$	176,000.00
14.	Neutralization Tank	1	LS	$	40,000.00	$	40,000.00
15.	200,000-Gallon Storage Tank	1	LS	$	200,000.00	$	200,000.00
16.	Plant Site Grading	4,000	SY	$	1.50	$	6,000.00
17.	Access Road	1	LS	$	10,000.00	$	10,000.00
18.	High Service Pumps - Plant to Storage Tank	2	EA	$	8,000.00	$	16,000.00
19.	3-Phase Power to Plant	500	LF	$	20.00	$	10,000.00
20.	SCADA Controls	1	LS	$	150,000.00	$	150,000.00
22.	Backup Generator	1	EA	$	30,000.00	$	30,000.00
23.	10" PVC Main - Plant to Distribution System	500	LF	$	48.00	$	24,000.00
24.	10" Gate Valves	2	EA	$	3,000.00	$	6,000.00
25.	10" CI, MJ Bends	4	EA	$	1,200.00	$	4,800.00
26.	Railroad Boring	200	LF	$	100.00	$	20,000.00
27.	Expansion of Wastewater Lagoon	1	LS	$	150,000.00	$	150,000.00
	PROJECT TOTAL - Bare Costs					**$**	**1,947,200.00**
	OVERHEAD & PROFIT				15.00%	$	292,080.00
	TERO TAX				2.00%	$	38,944.00
	ADMINISTRATION FEE				2.00%	$	38,944.00
	CONSTRUCTION TAX				3.00%	$	58,416.00
	BOND				2.00%	$	38,944.00
	ENGINEERING/INSPECTION				5.00%	$	97,360.00
	ESTIMATE CONTINGENCY				10.00%	$	194,720.00
	PROJECT TOTAL					**$**	**2,706,608.00**

Selection of Preferred Alternative

Selection of Site Location and Characteristics:

The Lower Two Medicine Reservoir was selected as the raw water source and the site for the microfiltration treatment plant. The water supply at this location is more than adequate to supply Browning and East Glacier with water. The plant will be located at alternative site #2, just off Highway 49 near the bridge crossing Two Medicine River. Site #2 was selected because the estimated construction costs were less than for site #1 and the hydraulics of the system were more favorable.

The Lower Two Medicine Reservoir alternative is the only location that will allow two communities to be served by one water treatment plant. This will keep the operation and maintenance costs low. The estimated annual costs to operate and maintain a microfiltration treatment plant designed to produce 2400 gpm is $165,000/year. If this cost increases by 2% every year for the 20-year life of the plant it would cost $4,009,000 to operate and maintain this plant for 20 years. The same calculation was done for a plant that would serve only Browning and one serving only East Glacier. To operate and maintain two plants, it would cost the Blackfeet Tribe $6,196,000 over twenty years as compared to $4,009,000 for one plant. This is a savings of $2,187,000 over 20 years. The reason for the savings is that two certified water treatment plant operators are required for one treatment plant. If two plants were built, at least four certified operators would be required to keep the two plants in operation 7 days a week. Therefore, an additional $80,000 to $100,000 for the added operator salaries is required.

The estimated cost of Alternative # 2 utilizing Lower Two Medicine Reservoir is $12,456,200. The estimated cost to operate one microfiltration plant for 20 years is $4,009,000. The total cost of this project over 20 years would then be $16,465,200. The estimated cost to construct a treatment plant for East Glacier utilizing Midvale Creek is $2,706,608 and to construct a plant for Browning utilizing Cut Bank Creek is $6,975,700. The total estimated cost to construct these two plants is $9,682,300. The estimated cost to operate two plants over 20 years is $6,196,000. The total cost of these two plants over 20 years would be $15,878,300. Constructing 2 plants would save the Blackfeet Tribe $586,900 over 20 years. However, it was decided that the benefits of utilizing Lower Two Medicine Reservoir and operating only one treatment plant outweighs the cost savings of constructing two treatment plants.

More sampling and water testing will be required under future water treatment requirements. The Disinfectant By-Product Rule has added more regulations for finished water quality. These proposed regulations would increase the cost to operate the plant. If two plants were in operation, twice as many samples and water quality analyses would need to be performed to meet future regulations. This essentially doubles the sampling and laboratory costs for the Tribe. Chemicals and supplies would only need to be delivered to one site if the Lower Two Medicine site is selected.

Another benefit to the Lower Two Medicine Reservoir site is the amount of raw water storage that exists in the Reservoir. There is more than enough water to meet both Browning and East Glacier's water demands now and in the future. The Reservoir also helps to control the high turbidity spikes seen in the streams and rivers during spring run-off. Cut Bank Creek or Midvale Creek do not provide a large amount of raw water storage. A raw water storage reservoir and/or a sedimentation basin will need to be constructed at these two sites. The turbidity spikes during spring run-off have exceeded 2000 ntu's on several occasions in both Cut Bank Creek and Midvale Creek.

Operational Requirements:

Three-phase power is required for operation of the microfiltration treatment plant. The local utility company has been contacted and has assured IHS three-phase power can be supplied to the proposed plant site.

Certified water treatment plant operators will be required to operate and maintain the treatment plant. The Blackfeet Utilities Commission currently has no staff member with the certification requirements to operate a microfiltration water treatment plant. However it is anticipated that the Blackfeet Utilities Commission will have a certified operator within the next year. The EPA and IHS have funding available to provide training to Blackfeet Utility employee's to obtain a treatment plant certification.

Impact on Existing Facilities:

Browning and East Glacier currently have no water treatment facilities. The only impact on their systems will be the increased amount of drinking water supplied to the communities.

Design Criteria:

Water Supply:
The water source selected for this project is the Lower Two Medicine Reservoir. This source was selected for its location, water quality and the quantity of water. The quantity of water stored in the Reservoir is more than adequate to supply Browning and East Glacier with treated water and also continue to meet the irrigation needs.

Treatment:
The treatment technology selected for this project will be Microfiltration and was discussed previously in the Selection of Preferred Treatment Alternative section on Page 25.

Storage:
Additional storage will be available from the proposed 100,000-gallon clearwell, the proposed 200,000-gallon storage tank serving East Glacier and in the water mains supplying water to Browning and East Glacier. The volume of water stored in the 20-

inch PVC main to Browning is 1,036,000 gallons. The volume of water stored in the 10-inch PVC main serving East Glacier is 30,000 gallons.

Intake Pumping Station:
The Montana Department of Environmental Quality has redundancy requirements for water treatment systems. MDEQ requires at least two pumps be installed in the event that one must be repaired or replaced. Each pump must be able to handle the design flow rate. The proposed intake pumping station will have the capacity to pump 2,400 gpm to supply the water treatment plant with raw water. East Glacier will need to be supplied with 430 gpm of water to meet their water demands now and in the future. Browning will require 1,960 gpm of finished water to meet the water demands of the community now and in the future. Therefore, the intake pumps will supply raw water to the treatment plant at a rate of 2,400 gpm.

Distribution Layout:
The only change to East Glacier's distribution system will be the water main to supply water from the treatment plant to East Glacier. The proposed water main will be 10-inch C-900 PVC. The proposed water main to Browning will be 20-inch C-905 PVC. Hydrometrics, Inc. prepared the preliminary sizing for these water mains. Their report is given in **Appendix L.**

Fire Protection:
Fire flow can be made available from the 100,000-gallon storage tank and also the proposed 200,000-gallon storage tank. The AWWA M31: Distribution System Requirements for Fire Protection recommend providing fire flow at a rate of 2,500 gpm for a period of 2-hours (MSE/HKM 1999). The treatment plant will be capable of meeting East Glacier's peak daily demand. Additional calculations are required to determine if East Glacier's distribution system can provide fire flow at a rate of 2500 gpm.

Browning currently has 1,550,000 gallons of storage available. An additional 1,036,000 gallons of storage would be available in the proposed 20-inch water main supplying Browning with treated water. The total amount of storage available to Browning for fire protection and domestic use would be 2,586,000 gallons. Browning will need to determine the amount of fire protection their system requires.

Hydraulic Calculations:
Preliminary hydraulic calculations have been prepared by Hydrometrics, Inc. and are provided in **Appendix L.** A complete hydraulic analysis will be prepared during the final design stage of this project.

Cost Summary

Project Cost Estimate:
The project cost estimate to provide treated water to Browning and East Glacier, utilizing Lower Two Medicine Reservoir is $12,456,234.80. The project will be constructed in two phases. Phase 1 includes construction of the intake, intake main, treatment plant, the 10-inch water main and 200,000-gallon storage tank for East Glacier. Phase 2 includes the 20-inch water main to Browning. The cost estimate for each Phase is listed below in **Table 10**.

Table 10
Proposed Project Cost Estimate
Two Medicine Reservoir - Alternative #2
Regional Water System - Phase 1 and Phase 2 Cost Estimates

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
Phase 1: Intake, Treatment Plant, Main to East Glacier				
1. Soil Borings- Drill Rig with crew	2	DAY	$ 1,700.00	$ 3,400.00
2. Soil Pits	30	EA	$ 200.00	$ 6,000.00
3. Tree Removal - Intake Main	12	ACRE	$ 5,000.00	$ 60,000.00
4. Tree Removal - East Glacier Main	9	ACRE	$ 5,000.00	$ 45,000.00
5. Rock Excavation	5,000	CY	$ 30.00	$ 150,000.00
6. Intake Screen	1	LS	$ 50,000.00	$ 50,000.00
7. 16" Intake Main - Screen to Pump House	1,600	LF	$ 400.00	$ 640,000.00
8. Intake Pump House	1	LS	$ 250,000.00	$ 250,000.00
9. Intake Pumps	4	EA	$ 15,000.00	$ 60,000.00
10. 16" PE Intake Main - Pump House to Plant	12,410	LF	$ 52.00	$ 645,320.00
11. 16" Gate Valves (Intake)	12	EA	$ 4,000.00	$ 48,000.00
12. 16" CI, MJ Bends (Intake)	6	EA	$ 1,500.00	$ 9,000.00
13. Flushing Hydrants	4	EA	$ 5,000.00	$ 20,000.00
14. Microfiltration Equipment	1	LS	$ 1,400,000.00	$ 1,400,000.00
15. Install Microfiltration Equipment	1	LS	$ 100,000.00	$ 100,000.00
16. Treatment Plant Building & Clearwell	3,200	SF	$ 110.00	$ 352,000.00
17. Back-up Generator	1	LS	$ 40,000.00	$ 40,000.00
18. Plant Site Grading	7,500	SY	$ 2.00	$ 15,000.00
19. High Service Pumps - East Glacier	2	EA	$ 12,000.00	$ 24,000.00
20. High service Pumps - Browning	3	EA	$ 20,000.00	$ 60,000.00
21. 3-Phase Power to Plant	2,110	LF	$ 20.00	$ 42,200.00
22. SCADA Controls	1	LS	$ 200,000.00	$ 200,000.00
23. 10" PVC Main - Plant to East Glacier	7,300	LF	$ 48.00	$ 350,400.00
24. 10" Gate Valves (East Glacier)	7	EA	$ 3,000.00	$ 21,000.00
25. 10" CI, MJ Bends (East Glacier)	10	EA	$ 1,200.00	$ 12,000.00
26. 200,000 Gallon Storage Tank (East Glacier)	1	LS	$ 200,000.00	$ 200,000.00
Sub-Total Phase 1 Bare Costs				**$ 4,803,320.00**
OVERHEAD & PROFIT			15.00%	$ 720,498.00
TERO TAX			2.00%	$ 96,066.40
ADMINISTRATION FEE			2.00%	$ 96,066.40
CONSTRUCTION TAX			3.00%	$ 144,099.60

BOND				2.00%	$	96,066.40
ENGINEERING/INSPECTION				5.00%	$	240,166.00
ESTIMATE CONTINGENCY				10.00%	$	480,332.00
Total Cost - Phase 1					**$**	**6,676,614.80**

Phase 2: Main to Browning

1.	20" PVC Main - Plant to Browning	63,500	LF	$	60.00	$	3,810,000.00
2.	20" Butterfly Valves (Browning)	50	EA	$	4,000.00	$	200,000.00
3.	20" CI, MJ Bends (Browning)	15	EA	$	1,200.00	$	18,000.00
4.	Two Medicine River Crossing	200	LF	$	400.00	$	80,000.00
5.	Railroad Boring (2 required)	200	LF	$	100.00	$	20,000.00
6.	Road Crossing (2 required)	300	LF	$	100.00	$	30,000.00
	Sub-Total Phase 2 Bare Costs					**$**	**4,158,000.00**
	OVERHEAD & PROFIT				15.00%	$	623,700.00
	TERO TAX				2.00%	$	83,160.00
	ADMINISTRATION FEE				2.00%	$	83,160.00
	CONSTRUCTION TAX				3.00%	$	124,740.00
	BOND				2.00%	$	83,160.00
	ENGINEERING/INSPECTION				5.00%	$	207,900.00
	ESTIMATE CONTINGENCY				10.00%	$	415,800.00
	Total Cost - Phase 2					**$**	**5,779,620.00**
	Phase 1 Total Cost					**$**	**6,676,614.80**
	Phase 2 Total Cost					**$**	**5,779,620.00**
	Total Project Cost					**$**	**12,456,234.80**

Potential Funding for Project

The EPA has committed $720,000 to the Blackfeet Tribe for the purpose of providing East Glacier with safe drinking water. TSEP has also committed $307,000 to the East Glacier Water & Sewer District for the purpose of providing safe drinking water to East Glacier. TSEP has also awarded the Blackfeet Tribe and Browning with $500,000 each for this project. The Blackfeet Housing has committed $1,500,000 to construct a treatment plant to supply Browning with adequate drinking water. Rural Development has provided a $100,000 grant to the Blackfeet Tribe. IHS has committed $800,000 in Fiscal year 2001 for this project. A Memorandum of Agreement between the Blackfeet Tribe, Blackfeet Housing, IHS, East Glacier Water and Sewer District and Browning has been prepared. A copy of the MOA is included in **Appendix P**. Based on the funding plan proposed below, the total amount of grant money anticipated for this project is $10,886,426.10. The Blackfeet Tribe will then need to borrow $1,569,808.70 at an interest rate of 4.5% from USDA Rural Development. The Blackfeet Reservation has a 62.5% unemployment rate. The residents of Browning and East Glacier cannot afford a substantial increase in their water rates. Because of this fact every effort is being made to fund as much of this project with grant money as possible. The less the Blackfeet Tribe

has to borrow, the lower the rate increase will be. The proposed funding plan is given in **Table 11** below.

Table 11
PROPOSED PROJECT FUNDING PLAN

Proposed Funding Sources for Project	Type		Amount	Status	Date
Phase 1: Intake & Treatment Plant					
EPA	Grant	$	720,000.00	Awarded	1998
Rural Development	Grant	$	100,000.00	Awarded	2000
Blackfeet Housing	Grant	$	750,000.00	Committed	2000
TSEP - Browning	Grant	$	500,000.00	Awarded	2000
TSEP - East Glacier	Grant	$	307,000.00	Awarded	1995
TSEP - Blackfeet Tribe	Grant	$	500,000.00	Awarded	2000
IHS	SDS Funding	$	800,000.00	Committed	2001
Funding Available		$	3,677,000.00		
Phase 1 - Total Cost		$	6,676,614.80		
Funding Required		$	2,999,614.80		
RDA	Grant	$	2,249,711.10		2001
RDA	Loan	$	749,903.70		2001
Phase 2: 20" Main to Browning					
Blackfeet Housing	Grant	$	750,000.00	Committed	2000
EDA	Grant	$	500,000.00	Applying	2001
ICDBG	Grant	$	800,000.00	Applying	2001
Mt. CDBG - Browning	Grant	$	450,000.00	Applying	2001
Funding Available		$	2,500,000.00		
Phase 2 - Total Cost		$	5,779,620.00		
Funding Required		$	3,279,620.00		
RDA	Grant	$	2,459,715.00		2002
RDA	Loan	$	819,905.00		2002
Total Funding Committed		$	4,427,000.00		
Total Funding Still Pending		$	1,750,000.00		
Total Funding w/o RDA		$	6,177,000.00		
Total Funding Needed		$	6,279,234.80		

Annual Operating Budget:

Income: The Blackfeet Tribe will own the intake, the water treatment plant, the water main serving East Glacier and the water main serving Browning. The Blackfeet Utilities Commision will handle the operation and maintenance of the system. Negotiations are currently underway to determine how the existing debt East Glacier has with Rural Development will be handled. The plan is to have the debt written down to a present day worth value. The Blackfeet Tribe will then take over this existing debt. The East Glacier Water and Sewer District will be dissolved and operation of the water and sewer systems will be turned over to the Blackfeet Utilities Commission. The revenue required for the Blackfeet Utilities Commission to operate East Glacier's water and sewer systems would

be generated from the water users in East Glacier. The revenue required for the Blackfeet Tribe to pay back the existing debt with Rural Development will also be generated from the water users in East Glacier. The revenue required for the operation of the proposed water treatment plant and distribution system would be generated from the water users in Browning and East Glacier. As stated above, the Blackfeet Tribe will need to borrow $1,569,808.70 at an interest rate of 4.5% from USDA Rural Development to help pay for the construction of this new system. The revenue required to payoff this loan would be generated from the water users in Browning and East Glacier. **Table 12** shows the revenue required to: operate the new treatment plant and distribution system, pay the Rural Development loan back, operate East Glacier's water system, pay back the existing debt with Rural Development and operate and maintain Browning's water system.

Table 12
Projected Revenue Increase for Browning and East Glacier

Plant Capacity		2400	GPM
Microfiltration Plant Annual O & M	$	250,000.00	
RD Loan	$	1,569,808.70	
Annual RD Loan Payment	$	84,687.24	40 years @ 4.5%
Browning's Annual Water System Revenue	$	336,109.81	
Browning's Annual Water System O & M Costs	$	275,889.36	
Browning's Water Use		1960	GPM
% of Water Use		82.00%	
Share of Annual Plant O & M Cost	$	205,000.00	
Share of Annual RD Loan Payment	$	69,443.54	
Total Annual Revenue Required	**$**	**610,553.35**	
Total Increase Required	**$**	**274,443.54**	
East Glacier's Annual Revenue	$	43,710.00	
East Glacier's Annual O&M Costs	$	55,242.66	
Reserve Fund	$	20,000.00	
East Glacier's Water Use		430	GPM
% of Water Use		18.00%	
Share of Plant Annual O & M Cost	$	45,000.00	
Share of Annual RD Loan Payment	$	15,243.70	
RD Debt	$	200,000.00	(Not Finalized)
RD Debt Annual Payment	$	14,337.36	
Total Annual Revenue Required	**$**	**149,823.72**	
Total Increase Required	**$**	**106,113.72**	
Anticipated Average Daily Water Use		1,300,000	GPD
Anticipated Yearly Water Use		468,000,000	Gallons
1000 Gallons Used		468,000	
Tribe's Required Annual Revenue	$	334,687.24	
(Does not include existing debt with RD)			
Tribe's Rate per 1000 Gallons	$	0.72	

O&M Costs:
Once this project is complete the Blackfeet Utilities Commission will operate and maintain the new intake, water treatment plant, water main serving Browning, water main serving East Glacier and East Glacier's water and sewer systems. Operating cost data for a microfiltration water treatment plant was researched extensively from several plants currently in operation. The operating and maintenance costs were given in the Treatment Alternatives section. These costs include operation, maintenance, chemical, power and replacement parts of the treatment plant only. The cost per year to operate and maintain a microfiltration water treatment plant that produces 2400 gpm, based on the numbers given in the Treatment Alternative section, range from $160,000/year to $170,000/year. Not included in that cost are the operation and maintenance of the intake screen, intake pumps, intake main, water main serving East Glacier and water main serving Browning. The estimated cost for the Blackfeet Tribe to operate and maintain the entire system is $250,000.00/year. Based on anticipated water use, Browning water users will provide 82% of the operation and maintenance costs or $205,000year. The Browning Consolidated Utility Service will need to adjust their rates accordingly. East Glacier water users will provide 18% or $45,000/year.

To complete this project, the Blackfeet Tribe will need to borrow $1,569,808.70 at an interest rate of 4.5% from USDA Rural Development. The estimated annual loan payment is $84,687.24. The revenue required to make this payment will come from Browning and East Glacier. Based on anticipated water use, Browning water users will provide 82% of this payment or $69,443.54/year. The Browning Consolidated Utility Service will need to adjust their rates accordingly. East Glacier water users will provide 18% or $15,243.70/year.

The Blackfeet Utilities Commission will take over the operation and maintenance of East Glacier's water distribution system. The East Glacier Water and Sewer District currently requires $55,242.66/year to maintain the water system. Therefore, the Blackfeet Utilities Commission will also require this amount to operate and maintain the water system. In addition to the annual cost to operate the system, $20,000/year will be required as a reserve for replacement parts and any future system improvements. As stated previously, the East Glacier Water and Sewer District currently has an outstanding debt with Rural Development. The Blackfeet Tribe is currently in negotiations with Rural Development to assume this debt for the District. The exact amount the debt will be written down to has not been determined. However, to prepare this report it is estimated that the debt will be written down to approximately $200,000.00. The Blackfeet Tribe will then have 22 years to pay back this amount. The estimated annual payment is $14,337.36. The revenue required to make this annual payment will come from the water users in East Glacier. The total revenue the Blackfeet Utilities Commission requires from East Glacier to operate and maintain the new water system, East Glacier's water system and pay back the loan and existing debt with Rural Development is $149,823.72/year. This information is provided above in **Table 12.** The anticipated water rates are given in **Section E** of the Uniform Application.

The Browning Consolidated Utility Commission will also need to increase their water rates to help pay for the operation and maintenance of the new water system and pay back the loan taken out by the Blackfeet Tribe. The estimated increase in revenue to the Browning Consolidated Utility Commission to pay for the operation and maintenance of the new system and the loan will be approximately $274,443.54/year. The anticipated water rates are given in **Section E** of the Uniform Application.

Public Participation:

Several public meetings have been held to inform the residents of Browning and East Glacier about the proposed project. Two public meetings have been held in Browning and two have been held in East Glacier. There was little public attendance at these meetings. The major concern came from farmers and ranchers that utilize the water in Lower Two Medicine Reservoir for irrigation. They were concerned that this project would take water from irrigation users. They were informed that water would be taken from the dead pool of the Reservoir and the water used for irrigation purposes would not be affected.

Conclusions and Recommendations:

This project is desperately needed to supply East Glacier and Browning with a safe and adequate source of drinking water. Browning has shown time and time again that the groundwater present in the area is not available in sufficient amounts to meet the needs of this rapidly growing community. Every effort has been made to find an adequate groundwater source, but each effort has failed. The only alternative is to construct a surface water treatment plant and Lower Two Medicine Reservoir is the most reliable surface water source that is available to serve Browning.

East Glacier has also made efforts to supply the residents with safe drinking water. The ground water source East Glacier attempted to develop in 1980-81 failed. The East Glacier Water and Sewer District was forced to go back to Midvale Creek and could only provide chlorination as a means of treating and disinfecting the water. East Glacier will need the help of the Blackfeet Tribe to provide safe drinking water to the residents of East Glacier. East Glacier is a small community and could not afford to construct a surface water treatment plant. East Glacier would also have trouble borrowing money because of their past history with Rural Development. The Blackfeet Tribe is making every effort to assist East Glacier in providing safe drinking water to the community. The proposed regional water system will be extremely beneficial to both Browning and East Glacier.

The Blackfeet Tribe has reviewed the possible alternatives to supply both Browning and East Glacier with an adequate amount of safe drinking water. The Blackfeet Tribe, with assistance from the IHS Engineering staff, has selected the Lower Two Medicine Reservoir as the best alternative for East Glacier and Browning. Preliminary work for this project is currently underway. An Environmental Assessment and Cultural Assessment are currently being prepared for this project and are expected to be complete by May 25th. The right-of-ways required for the pipelines are currently being negotiated. Every effort is being made to begin construction on the Intake by the Fall of 2001.