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***Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission***  
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# Buffalo Municipal Reservoir Project

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Level II - Phase I Evaluation

## Executive Summary

States West Water Resources Corporation

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Level II - Phase I Evaluation

## Executive Summary

Submitted to:

State of Wyoming  
Water Development Commission

Prepared by:

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Cheyenne, Wyoming

in association with  
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March, 1989

## **Buffalo Municipal Reservoir Project Executive Summary**

### **Project Concept**

The basic concept behind the Buffalo Municipal Reservoir Project involves development of a municipal supply storage reservoir in the Clear Creek basin to the west of Buffalo. Buffalo's existing water supply is diverted from Clear Creek about six miles west of town. After project completion, releases from the reservoir will supplement Clear Creek flow when the direct flow -- for legal or physical reasons -- cannot fulfill Buffalo's requirements. Buffalo can then use these increased flows at the town's diversion structure.

Buffalo can meet essentially all of its present water requirements with its direct flow diversion supply system. When demand is high during the summer irrigation season, pressure problems within Buffalo's distribution system have required watering restrictions. The institution of such watering restrictions has thus limited demand for Clear Creek water. Under such conditions, the direct diversion system is adequate for the community's water demands.

The existing direct diversion system, however, will be insufficient for Buffalo's water requirements after population growth, and some shortages likely will be suffered at the current population level if the pressure problem is solved. The present diversion pipeline can deliver a peak daily supply of about 10 cfs, enough for a population of slightly more than 9,100.

Upon completion of a reservoir fully meeting Buffalo's future demands, the limiting supply factor will be the carrying capacity of the existing diversion pipeline. Therefore, the reservoir project evaluation was conducted using that carrying capacity as the project's ultimate demand.

## Water Supply Reservoir

Previous Buffalo level I studies have indicated that the most practical way to meet Buffalo's future water requirements is through a water-supply reservoir located in the mountains west of Buffalo. The City of Buffalo has a temporary filing water right application (TF 13 6/246) dated October 18, 1933, which should allow the municipality to build a water supply reservoir to a capacity of 1642.03 (hereafter referred to as 1640) acre-feet. This filing, known as the Little Sourdough filing, is the most senior application for an unbuilt reservoir in the Powder River Basin. The application also predates in seniority several projects already built, including all of the water rights diverting from Clear Creek for Lake DeSmet Reservoir.

In addition to the 1,640 acre-feet of storage under the 1933 filing, a larger reservoir to meet other demands may be necessary. For example, environmental obligations must be met. Typically, certain environmental mitigation efforts must be undertaken to obtain the permits necessary for reservoir construction. Two of these mitigation measures generally required are allowance for a minimum reservoir pool and bypassing of a minimum flow through the reservoir. These provisions often necessitate an increase in the size of a reservoir over what is essential for project demands. Therefore, though the 1933 filing will be the keystone for the project, an additional filing may be needed to fully implement the project.

For the reservoir to have a capacity greater than 1,640 acre-feet, additional water rights must be acquired. Texaco has previously offered to allow Buffalo to store 1,000 acre-feet of Lake DeSmet Reservoir rights in an alternative reservoir to be built by the City of Buffalo. The transfer of 1,000 acre-feet of Lake DeSmet Reservoir storage to the project reservoir is an alternative investigated in this study. Additional storage could also be built by acquiring a current (1989) water right. The feasi-

bility of using a 1989 storage right for the project was also investigated.

### **Hydropower Generation**

Because of its substantial amount of head (pressure) and flow, Buffalo's existing water-supply pipeline has the potential to generate electricity. The installation of a hydropower unit at the pipeline terminus near town could provide power for Buffalo's own use and for sale to a power company. Revenue from the sale of power or cost savings from the City of Buffalo's lessened purchase of outside power could then be used toward reducing payments for the water-supply reservoir. The cost for installation of a hydropower generator will be dramatically reduced if it is housed within a future water treatment plant, since they could share some facilities.

### **Preliminary Site Selection**

Preliminary evaluations were conducted on two alternative dam sites near the Tie Hack Campground, located approximately fifteen miles west of Buffalo in the Bighorn National Forest. These evaluations used preliminary water supply estimates, feasibility-level cost estimates, reconnaissance-level geotechnical analyses, and a preliminary assessment of environmental effects. Selection of the lower Tie Hack site (Figure 1) for further study was recommended because of its lower costs, lesser geotechnical concerns, and greater water supply. This recommendation was reviewed by City of Buffalo and Water Development Commission personnel, and was adopted. Therefore, the upper Tie Hack site was dismissed from further study. The findings of the evaluation heavily favored the lower site.

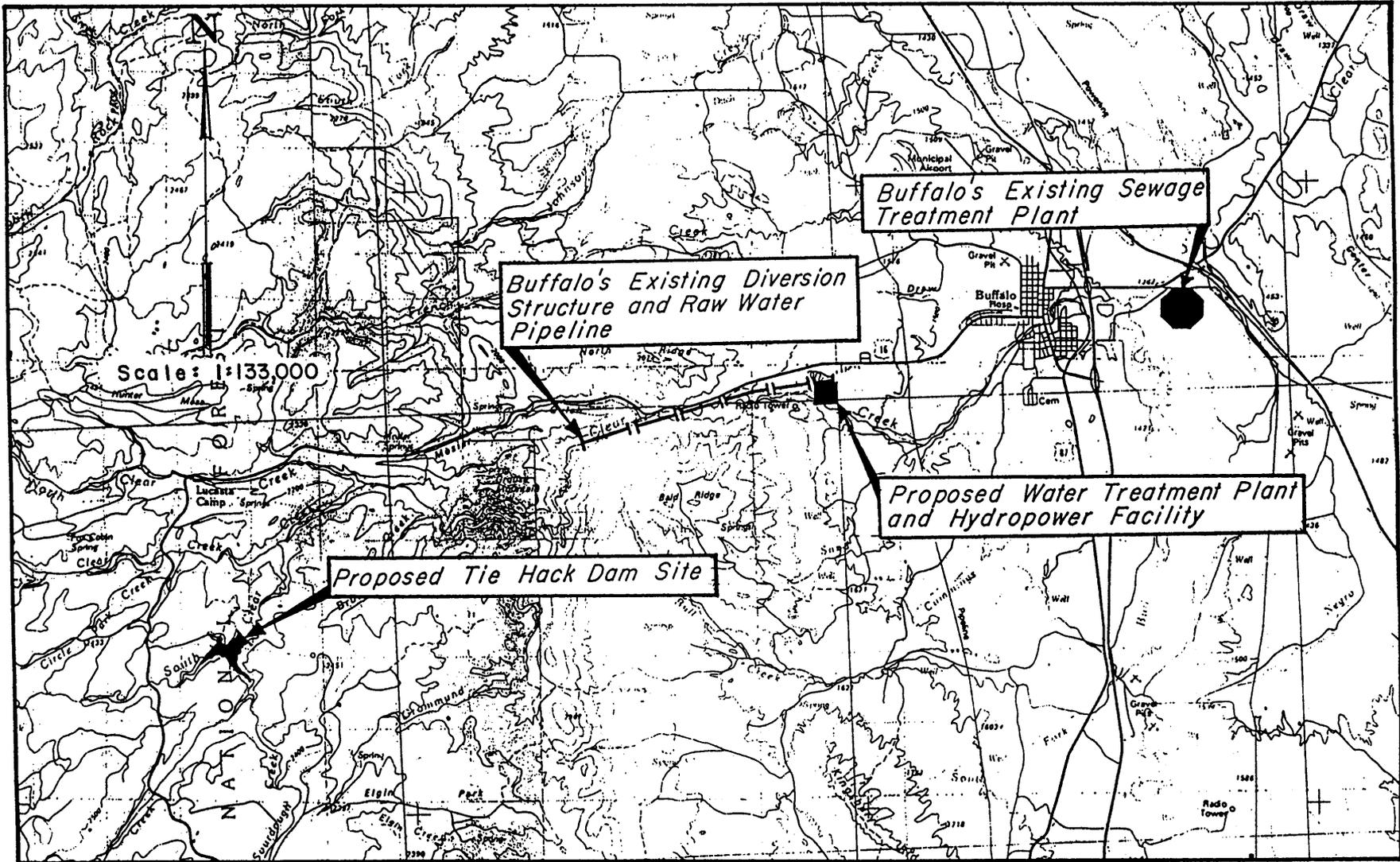


Figure 1: Location Map

## **Water-Supply Analyses**

The hydrology of the Clear Creek basin was studied to develop a simulation model for assessing operations of the proposed reservoir. Reservoir operation studies were conducted assuming the reservoir was in place for the 45-year period of 1943 to 1987. This time period contained several low-flow years and an extended drought from the mid-1950's through the early 1960's.

In order to simulate reservoir operations, it was necessary to model most of the Clear Creek basin. An assumed future industrial demand was placed on Lake DeSmet Reservoir to determine the ability of the project reservoir to store water with DeSmet fully operational. Incorporated in the model was the capability to operate two active storage pools with independent priorities, to implement instream flow requirements at three locations below the dam, and to operate with or without the State Engineer's one-fill rule. By conducting operation simulations with a wide variety of operation parameters, it was possible to evaluate the reliability of the project reservoir for meeting Buffalo's demands over a wide range of potential situations.

## **Reservoir Size Recommendation**

A reservoir built at the proposed Tie Hack site could be a feasible means to supply Buffalo's future water requirements, provide a firmer yield for the proposed hydropower plant than could be achieved with natural streamflow, and meet instream flow requirements. However, the size of reservoir to be constructed will be a function of water rights regulations and the demands for instream flows. Until the reservoir project progresses and project requirements and restrictions are made by the various regulatory agencies, it is not possible to define a final project configuration.

The 1933 Little Sourdough filing for 1,640 acre-feet, if successfully transferred to the project reservoir site, will provide the basis for development of the reservoir project. This 1,640 acre-feet of storage could meet most project demands if instream flow requirements are not excessive. More storage could be achieved through the transfer of Lake DeSmet water to the reservoir or by application for storage with a 1989 priority. The most significant reason for increasing reservoir size would be increased instream flow demands. To maximize yield from the reservoir, the minimum pool would be established under a 1989 priority, so that the senior storage rights could be fully utilized.

Based upon water-supply analyses conducted to assess reservoir feasibility, we recommend that the project reservoir be developed with a total storage capacity of 2,425 acre-feet. Constructing this reservoir will require the movement of the place of storage for the Little Sourdough filing from Little Sourdough Creek to South Clear Creek. A new filing for 785 acre-feet will also be required for storage in the minimum pool. A reservoir built to this capacity could meet future municipal needs all the time and hydropower requirements 90 percent of the time, unless restrictive requirements are placed upon the project.

### **Preliminary Design and Cost Estimate**

Based upon the recommended reservoir size of 2,425 acre-feet at the Tie Hack site, a preliminary design was developed and the cost estimated. The design was done for a roller-compacted concrete (RCC) dam which was shown to be the least-expensive dam for the site conditions. Preliminary design for the dam and major appurtenances such as principal spillway and outlet works was done. Appurtenances such as access roads, recreational facilities, gaging stations, and remote control and monitoring were also analyzed. Figure 2 illustrates the reservoir project concept. Other issues such as stream diversion, pollution control, stream-inundation mitigation, terrestrial wildlife mitigation,

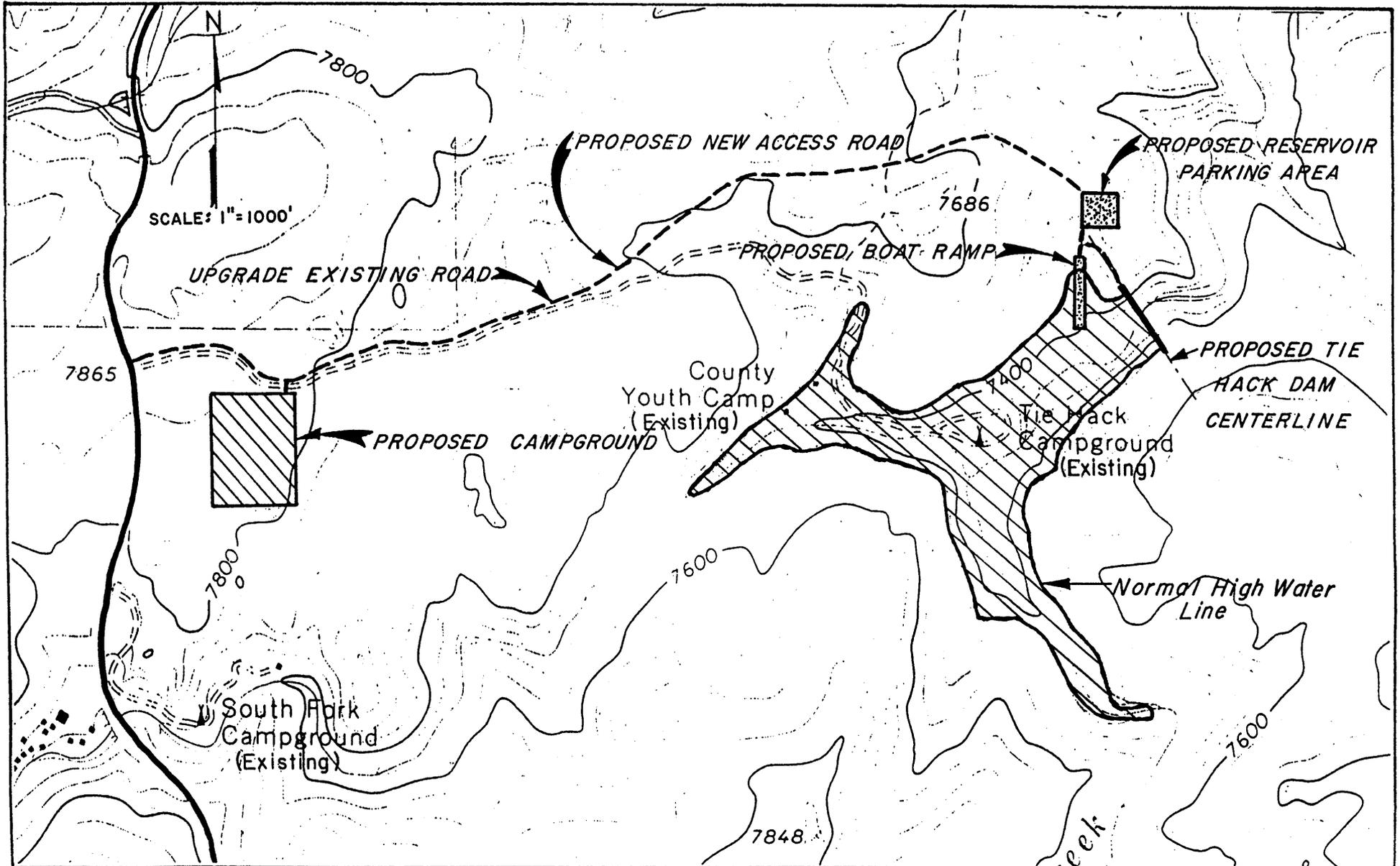


Figure 2: Map of Reservoir and Related Facilities

wetlands mitigation, and County Youth Camp relocation were addressed.

Based upon the information previously discussed, a more detailed cost estimate was developed for the proposed dam and reservoir. The estimated 1989 cost to construct the dam is \$6.3 million. Because construction is not scheduled to begin until 1992 or 1993, estimated costs were updated for projected inflation. The estimated reservoir cost in 1993 is \$7.6 million.

### **Hydropower Plant**

Installation of a hydropower plant on Buffalo's existing water supply pipeline will be economically advantageous for some circumstances, but a similar plant built at the project dam site does not show revenue benefits. Constructing a hydropower generating unit near the terminus of the water-supply pipeline and using the power at a future water treatment plant and at the existing sewage treatment plant will yield the greatest benefits. However, these assumptions are based upon benefit-cost ratios which are quite sensitive both to interest rates and to the rate of inflation of power costs. The inflated cost for the plant (1993) is \$1.1 million.

### **Environmental Obligations**

The proposed construction of the Tie Hack Reservoir will require the mitigation of negative impacts to the environment. Preliminary investigations indicate that mitigation of construction- and inundation-caused effects on fisheries, terrestrial wildlife, existing wetlands and stream quality may be necessary. At our present level of understanding, there appear to be no serious environmental problems that would terminate the project. However, if instream flow requirements become very high, then the project reservoir may need to be sized larger.

## **Preliminary Economic Analysis**

A complete project economic analysis and financing plan is not scheduled until Phase II of this investigation. However, in order to develop an initial indication of project feasibility, a preliminary economic analysis was performed for this study. Two project financing scenarios were investigated. In a worst-case scenario, the dam was financed with a standard Water Development Commission 67% grant/33% loan plan, and the hydropower plant was financed with a separate 100% loan. With this scenario, the City probably cannot afford the project. Under a best-case scenario, the dam and hydropower plant would be financed in one package, with a 67% grant and 33% loan at 4% for 50 years. Buffalo probably can afford this repayment plan. Under this plan, the WWDC would also share, in perpetuity, the hydropower revenues of the project on a ratio equal to the grant/loan split.

## **Recommendations**

If, on the basis of this phase I-level II study, the Wyoming Water Development Commission and the City of Buffalo plan to continue with development of the project, we suggest that the phase II study be subdivided into phase II and phase III investigations. As a result of the phase I investigations, we believe that the project is feasible. However, there still remain several major questions which must be answered before a final assessment of project feasibility and configuration can be made.

The issue of most concern is still the project's ability to provide a water supply to Buffalo. We have shown that with certain assumptions the project can provide a reliable water supply. Our most critical assumptions that could affect project feasibility dealt with potential storage limitations imposed by the Wyoming State Engineer and Board of Control and with instream flow requirements proposed by the Wyoming Game and Fish Department. The major component of a phase II investigation would be pursuit

of those activities to finalize the operation rules, regulations, and criteria that will be imposed on the project. With the final operating criteria established, simulations of reservoir operations will be conducted to establish reservoir feasibility and finalize reservoir size.

A financial analysis will also be conducted in phase II. As explained earlier, the economic analyses conducted during phase I were very preliminary. Phase II economic evaluations will be more detailed and provide more specific financing information based upon a project funding and repayment criteria to be established by the Water Development Commission.

At the completion of phase II, a "go" or "no go" decision would be made for continuing to phase III. phase III would contain the geotechnical investigations and development of a conceptual design. If the phase II investigations indicate that the project is not feasible because of water-supply or financing problems, the project could be terminated and phase III expenses saved.