EXECUTIVE SUMMARY

The Wyoming Legislature has authorized the Water Development Commission (WWDC) to conduct a Level II Feasibility Study of the Horse Creek Reservoir Project. The proposed project is located in Goshen County approximately 12 miles south of Torrington in eastern Wyoming.

The reservoir would serve as a re-regulating reservoir to meet downstream commitments, while storing excess flows from Horse Creek, the Goshen Irrigation District (GID) canals, and possibly the Laramie River. The study was designed to establish the cost associated with, and the resultant benefits of, a reservoir on Horse Creek on a Level II feasibility study basis.

The study included four major phases:

Phase A: Hydrology
Phase B: Dam Site Selection
Phase C: Feasibility Analysis
Phase D: Economic Analysis

While these phases were generally sequential, considerable iteration was necessary in developing the final recommendations.

PHASE A: HYDROLOGY

The determination of potential flows available for storage included natural streamflow, historically "wasted" flow, and flow gains attributed to irrigation return flows. The development of potential flows consisted of using correlation techniques to improve gaged streamflow data, obtaining GID records of flow diversions, and obtaining state records of water rights of the GID within the Horse Creek Basin. Flows attributed to stream gains and losses between reaches were determined using pro-rating techniques.

Several sites were identified as potential reservoir sites. These sites, to be referred to as alternative sites, are shown on Figure 1. They include four locations on Horse Creek and two locations off-stream, one located on Dry Creek which is not shown on Figure 1.
The reservoir operation model was developed to evaluate yield possibilities and to study optional reservoir sizes and regulating scenarios at the alternative sites. A final reservoir site or size was not selected during this phase of the study. The operations model incorporated the following features:

- Wyoming water rights priority system.

- Diversions, and return flows, as determined from the study of potential flows.

- Reservoir evaporation and seepage.

- Reservoir filling from natural flow on a once-per-year basis as per the regulations of the State Engineer.

- A 34-year historical period of operations.

Inflow design hydrographs for the alternative sites were developed for evaluating spillway sizes and costs. The 50-year and 100-year peak discharges at the alternative sites were evaluated using standard frequency methods based on the flood records at gaged locations. The Probable Maximum Flood (PMF) and the one-half PMF flood hydrographs were generated using an event simulation model on the entire Horse Creek basin above the alternative sites.

The expected rate of reservoir sediment accumulation was estimated to determine the dead storage requirements over the selected life expectancy. This estimate was based upon the sediment accumulation in Hawk Springs and Oliver Reservoirs, as well as a technical literature review.

PHASE B: DAM SITE SELECTION

The study developed the criteria to evaluate alternative sites, resulting in the selection of the most feasible sites. Detailed feasibility studies were conducted on these sites.

The factors used for evaluation of the alternative sites included:

- Reservoir yield.

- Embankment volume.
- Foundation conditions.
- Emergency spillway site.
- Borrow source.
- Diversion locations.
- Relocations.
- Rights-of-way.

Hydraulic routings of the design floods, using several normal pool elevations at each alternative site, various riser and conduit sizes for optimizing the principal spillway and various widths of unlined excavated channels to optimize the emergency spillway were performed.

Itemized cost estimates of the alternative sites were prepared to determine the relative costs for each site. Construction quantities, land acquisition, and required relocations were included in the estimate. Estimates of foundation treatment and borrow sources were made from previously published geological reports.

PHASE C: FEASIBILITY ANALYSIS

Based on the evaluation of alternative sites, two sites were selected for detailed feasibility investigation: the Upper Bureau Dam site and the Lower Bureau Dam site. Figure 2 shows the plan of the Upper Bureau Dam site, including spillway layout and relocations. Figure 3 shows the plan of the Lower Bureau Dam site, including spillway layout and relocations.

The detailed feasibility investigation included geologic field investigations involving field explorations and laboratory testing of foundation and potential embankment material.

Surveys were performed to establish monuments and dam site cross-sections. Emphasis in the preliminary design was to identify, analyze and quantify the major factors that affect the performance and cost of the project, including:

- Stability analyses.
- Settlement analyses.
- Seepage control.
- Embankment geometry.
- Materials usage and availability.
- Erosion protection.
- Spillway and outlet works hydraulics.
- Relocations of roadways, farms and utilities.

The feasibility investigation resulted in a probable construction cost of $12.7 million for the Upper Bureau Dam site, and a probable construction cost of $11.1 million for the Lower Bureau Dam site. The Lower Bureau Dam site is recommended for the following reasons:

- Exposed silt soils in the proposed emergency spillway at the Upper Bureau Dam site will require extensive protection.

- Core material for the Upper Bureau Dam site will need to be imported from an off-site location.

- The right abutment of the Upper Bureau Dam site may result in seepage problems.

- The Upper Bureau Dam site poses additional environmental concerns in comparison to the Lower Bureau Dam site (Game and Fish Department reservoirs).

- The probable cost of the Upper Bureau Dam site is greater than the Lower Bureau Dam site ($12.7 million vs. $11.1 million in 1986 dollars).

- The Upper Bureau Dam site provides 8,350 AF of storage and the Lower Bureau site provides the desired 11,000 AF as recommended in the operations model.

PHASE D: ECONOMIC ANALYSIS

An economic analysis was also performed. This involved the probable construction cost estimates and an economic and financial analyses. The construction cost estimates were generated to reflect total construction costs for the dam and reservoir. The economic and financial analyses provides an overall picture of the economic consequences of the project, including identification of potential public and private
benefits and an analysis of the agricultural sector's ability-to-pay for additional water. The overall scope of the analysis included the following activities:

- Quantification of agricultural benefits; and

- assessment of the agricultural sector's ability-to-pay for the proposed project.

The study estimated the Lower Bureau Dam site would yield $3,935,000 (in 1986 dollars) in direct agricultural benefits over its design life. The direct agriculture benefits are approximately 36 percent of the probable construction cost of $11.1 million.
UPPER BUREAU DAM
Top Of Dam EL: 4168.3
Normal Pool EL: 4143.0
Max. Pool EL: 4198.3

LEGEND

Acquisition
Proposed Roadway
Bridge
Existing Ponds
Relocated U.S. Army Communications Cable

FIGURE 2
Horse Creek Reservoir Study

LOWER BUREAU SITE MAP/RELOCATIONS

LOWER BUREAU DAM
Top Of Dam El. 4187.4
Normal Pool El. 4135.2
Max. Pool El. 4192.4

LEGEND
Acquisition
Proposed Roadway
Bridge
Existing Ponds

FIGURE 3