

**WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
ABANDONED MINE LAND DIVISION**

A. COVER SHEET

This award application is respectfully submitted for consideration in the Year 2000 Abandoned Mine Land Awards sponsored by the United States Department of the Interior, Office of Surface Mining. This application summarizes the evaluation, design and construction of the Big Goose Creek Drop Structure in Sheridan, Wyoming.

1. Name and Location:

- A. Name: Big Goose Creek Drop Structure.
- B. Location: Sheridan, Wyoming.

2. Nomination By:

Evan J. Green, AML Administrator
Abandoned Mine Land Division
Wyoming Department of Environmental Quality
Herschler Building, 3rd Floor West
Cheyenne, WY 82002
Phone: (307) 777-6145

3. Construction Information:

- A. Project Start Date: The project construction was started mid December, 1994.
- B. Project Completion Date: March 3, 1995.
- C. Construction Costs: Completed construction costs were \$528,100.00.
- D. Organizations Responsible for Construction:

Wyoming Department of Environmental Quality
Abandoned Mine Land Division
Herschler Building, 3rd Floor West
Cheyenne, WY 82002
Phone: (307) 777-6145

Anderson Consulting Engineers
2900 South College Avenue, Suite 38
Fort Collins, CO 80525
Phone: (970) 226-0120

Larry's, Incorporated
2020 Schoonover Road
Gillette, WY 82716
Phone: (307) 686-0714

4. Submittal Date: March 13, 2000

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B. NARRATIVE

The Big Goose Creek Drop Structure is located within the city limits of Sheridan, Wyoming. It is bounded on the south by Mill Park and Dow Street with a private residence comprising the northern boundary. The Lewis Street Bridge is located immediately upstream (west) of the drop structure while the confluence of Big Goose Creek and Little Goose Creek is approximately 250 feet downstream (east) of the drop structure.

In 1934, the Secretary of War identified the need for flood control in the railroad and coal mining town of Sheridan, Wyoming. Damages resulting from the flooding of Big Goose Creek and Little Goose Creek were reported every two to three years. Consequently, by the late 1940's flood protection plans were being developed. Funding for the Sheridan Flood Protection Project was authorized by Congress in 1950. In 1963, work was completed on the initial stage of the Project by the Corps of Engineers, which included construction of a channel diversion and the Big Goose Creek Drop Structure. Upon completion of the construction in 1963, ownership of the drop structure was transferred to the City of Sheridan with the Corps of Engineers reserving the right to approve any changes to the original structure.

The original functions of the Big Goose Creek Drop Structure were to control flooding within Big Goose Creek, promote energy dissipation of the flow within the channel, and maintain channel stability. The water in Big Goose Creek was conveyed over a vertical, eight-foot concrete drop structure into a plunge pool/stilling basin that incorporated baffle blocks for additional energy dissipation (Slide 1). This structure, in conjunction with the channel improvements, performed very well as a flood control device, however, the nature of the energy dissipation within the plunge pool/stilling basin created a hazard to public safety, especially given the urban area surrounding the drop structure. This hazard has resulted in the death of two children and the unsuccessful attempts to rescue a child during a tragedy in June of 1987. Since the 1987 tragedy, the community increased its efforts to obtain funding for the modification or reconstruction of the Big Goose Creek Drop Structure. Efforts to obtain funding from the Corps of Engineers were unsuccessful since the original structure was not in disrepair and it continued to serve its flood control function.

During calendar year 1992, the Wyoming Department of Environmental Quality, Abandoned Mine Land Division (Wyoming AML) allowed communities impacted by coal and mineral mining to apply for funding for public facility projects. Under Wyoming's approved State Reclamation Plan, the Governor certified this Big Goose Creek Drop Structure Project (Project) because of the demonstrated threat to the public health and safety resulting in the loss of life. It was certain that another life could have been lost in the original structure.

Due to the loss of life attributable to the original drop structure, the primary goal of this Project was the mitigation of the health and safety hazard within the Big Goose Creek Drop Structure. Secondary goals involved maintenance of the flood protection, energy dissipation and channel stability functions of the original drop structure.

Modifications to the structure were screened to first and foremost address the goals of mitigating the current health and safety problems, while maintaining the flood protection, energy dissipation and channel stability functions of the original structure. Redesign and reconstruction of the drop structure included compliance with the requirements of the Wyoming AML and the U.S. Army Corps of Engineers as well as the interests of the City of Sheridan and the residents of Sheridan, particularly those residents adjacent to the drop structure. Anderson Consulting Engineers (Anderson) served as the design engineer for this Project. Anderson was responsible for the development and evaluation of design alternatives, preparation of final design plans and specifications, and continuous observation and inspection during construction of the Project. During the evaluation of design alternatives, other considerations included incorporating recreational use into the design of the structure, addressing the concerns of adjacent landowners as well as planning, zoning and environmental issues, and being conscientious and sensitive to capital construction and operation and maintenance costs.

Due to the location of the Project in an urbanized setting, additional complications were identified and addressed. These included routing traffic to other streets for the duration of construction, emergency vehicle access to those streets impacted by the traffic detours, safety hazards created by the location of a middle school near the construction zone, and communication and coordination with residents located adjacent to the construction in Big Goose Creek.

In addition to the health and safety concern of the death trap of the original drop structure, the drop structure served as a barrier for the upstream migration of aquatic habitat or fish from the confluence of Big Goose Creek and Little Goose Creek (Slide 1). Further, given the location of the drop structures adjacent to Mill Park, it was important to the City of Sheridan to construct a project that would be aesthetically pleasing from a visual standpoint.

The Project involved a multitude of complex issues that needed to be addressed prior to or during construction. Initially, accomplishment of the primary and secondary project goals were seemingly at odds with each other. Providing a safer structure that continued to provide the same level of flood protection, energy dissipation and channel stability was a difficult task. Utilization of a series of four grouted sloping drop structures provided a mechanism to meet both the primary and secondary goals. During the design, the hydraulic analysis of the drop structures involved a complex, detailed technical investigation of both subcritical and supercritical flow conditions; the results of this analysis were incorporated into the design considerations for the drop structures. From an administration standpoint, the interests of several entities had to be considered. The City was primarily interested in a reduction in safety hazards while the Corps of Engineers was specifically interested in flood control, energy dissipation and channel stability.

This Project emphasized placement of four structures that would blend into the river environment. Existing techniques associated with the placement of the more typical concrete structures were replaced with design criteria that were specifically established to accomplish the Project goals while being environmentally sensitive and aesthetically pleasing. Man's knowledge of the river and channel hydraulics was utilized to develop criteria and design guidelines that culminated in the construction of a structure that mirrors those that occur naturally in the river.

Larry's, Incorporated (Larry's) of Gillette, Wyoming was hired as the contractor for the construction of the Project. As the general contractor, Larry's was responsible for ensuring that the intent of the final plans and specifications were constructed within the approved bid amount. Due to the nature of the work and the location within Big Goose Creek, the timing of construction required a season where floods were infrequent and normal flows were reasonably low. Consequently, construction was planned for late fall and early winter. The contract time was set at seventy-five days with an original starting date of October 1, 1994. Due to conflicts with relocation of an existing waterline within Big Goose Creek, the contract time did not begin until the middle of December. Even though the construction was completed during the most severe winter weather conditions, Larry's completed the Project within the seventy-five day construction period.

During construction of the Project, individual placement of the rock was necessary to obtain the desired flow hydraulics and promote energy dissipation. The grout mixture was modified to facilitate placement of the grout with the grout pump and pipelines. This modification resulted in exceeding the specified strength requirements of the grout. Placement of the grouted rock structures was further complicated by the location of the structures in the creek and a heating system was required to thaw the frozen ground before placing the grout (Slide 2). Throughout the construction, dewatering operations were maintained and consisted of a diversion pipe for the flows within Big Goose Creek and sump pumps to remove water within the construction area (Slide 3). The 36-inch diversion pipeline was abandoned in-place following construction and resulted in substantial savings to the Wyoming AML. Special precautions were made to promote the stability of the channel in the area where the diversion pipeline was abandoned.

The location of the Project within Big Goose Creek increased the complexity of the construction. Although the construction was scheduled for a season where the likelihood of high flows in the creek was reduced, no assurance could be given that a high flow event would not occur. The diversion pipeline was capable of diverting the normal flows but an unusually high flow would overtop the diversion facilities and be conveyed through the project. During construction in January 1995, an unusual warming trend created a condition of extremely high flows (estimated to be in excess of the ten-year flood event) within Big Goose Creek (Slide 4). Due to the efforts of the contractor, only minor damages were sustained to the completed facilities and no additional costs were incurred by the Wyoming AML.

This Project offers technical insight into solutions for hydraulic problems commonly encountered by engineers working within the river environment. The evaluation and design procedures undertaken by the design team were innovative and illustrated an in-depth understanding

of the channel hydraulics within Big Goose Creek. This understanding of channel hydraulics and hydraulic structures coupled with the goals of the Project resulted in a state-of-the-art design of the drop structures. The important design considerations for this Project included:

- Removal of the uniform roller wave located at the toe of the existing drop structures; the hydraulic forces within the rollers trapped both light objects and floating debris that inadvertently were conveyed through the drop structure, creating the hazard that caused the drowning deaths of children as well as the hazard to the rescue personnel trying to rescue the children. Removal of the roller wave was accomplished through placement of an irregular crest within the drop structure. The crest was crescent-shaped in plan view to force the flows to the center of the structure, irregular in shape due to the placement of grouted rock and sloped mildly toward the center of the structure.
- Replacement of the original one drop structure with four smaller drop structures to reduce the hydraulic forces that would tend to trap light or floating objects, to reduce the hazard of trapping people in the drop structure or the hazard to rescue personnel attempting to rescue people trapped in the forces of the drop structure.
- Placement of several drop structures less than or equal to three feet in height to promote the safety aspects of the Project. Two of the new drop structures were placed upstream of the original drop structure (Slide 5) and two of the new drop structures were placed downstream of the original drop structure (Slide 6).
- Large boulders or baffle blocks were not placed in the plunge pools, reducing the hazards associated with the hydraulic forces in the plunge pools.
- Utilization of grouted rock structures to facilitate the energy dissipation within the new drop structures to meet the original function of the flood control project.

This Project significantly improves the health, safety and welfare of the residents of the City of Sheridan. This is accomplished in several ways. First, the likelihood of an individual being trapped in a reverse roller wave is significantly reduced if not eliminated. Second, rescue operations are facilitated by promoting the flushing of individuals through the drop structures. Finally, through the integration of exit and access ramps in the project, an opportunity to exit the water prior to the drop structures is provided along with access for rescue operations. Consideration of all these aspects culminated in a design that met or exceeded the primary goals of the Project. The secondary goals of this Project were met or exceeded by the construction of the four new drop pools. Following construction, the flood levels within Big Goose Creek were reduced. Energy dissipation is provided in an equivalent manner by the new drop structures and channel stability is maintained.

From an economic standpoint, the costs to replace the existing drop structure were greatly outweighed by the benefits while tangible benefits were limited. The intangible benefits associated with the increase in public safety or potential reduction in loss of life were considered by the City of Sheridan and the Wyoming AML to far exceed the construction costs. Maintenance costs were included in considering the economics of this Project. In this regard, the maintenance costs associated with this Project as constructed are less than or equivalent to those costs associated with the original structure. Based on the final plans and specifications, the construction contract awarded to Larry's was for an amount not to exceed \$542,450. Through diligent efforts by Larry's, Anderson and the Wyoming AML, the final cost to construct the Project was held to \$528,100.

The City of Sheridan and the residents of Sheridan will benefit from the reconstruction of the drop structure. Due to the redesign of the drop structure and the resulting reduction of the safety hazard, the City of Sheridan will experience less liability in the future. Placement of the four revised drop structures limits that liability. The nature of the grouted rock drop structures promotes the migration of fish in Big Goose Creek and thereby increases its potential as a fishery. This was accomplished by placement of drop structures that more closely resembled those encountered in a natural river environment. Furthermore, the design resulted in a drop structure that is more friendly to the river environment and blends in aesthetically to reflect more natural conditions within Big Goose Creek.

Construction of this Project significantly reduced the safety and health hazard within Big Goose Creek. While recognizing that injury may still result from either intentional or accidental access to the creek, the potential for loss of life has been reduced. Recent recreational use of the structure following construction confirms that individuals are not trapped in the hydraulic forces previously experienced within the Big Goose Creek drop structure. In addition, the safety features afforded by the structures are further exemplified by the fact that fencing was originally included in the design drawings to restrict access to the creek, but following construction, the City of Sheridan determined fencing was not necessary due to the flow conditions, stable slopes created by the structures and the exit and access ramps built into the Project. The City of Sheridan and the residents of Sheridan were supportive of the Project throughout the design and construction phases. Their satisfaction with the Project is illustrated in the endorsement letters attached at the end of this section.

In summary, the successful completion of the Project required close coordination and communication among the local, state and federal agencies as well as the design engineer and contractor. This coordination was initiated by a partnering session at the beginning of the Project and close communications throughout the Project. In addition, this Project required the expertise of a design engineer with specific experience in river mechanics and innovative techniques for designing structures located within the river. Finally, the contractor was adept at working within the river environment and utilized his expertise to fulfill the design intent of the plan and specifications while keeping the Project within the time and budget constraints. This Project is a success, by eliminating the death trap hazard of the original drop structure while still maintaining the integrity of the flood control, energy dissipation and channel stability of the original structure.



"GATEWAY TO THE BIG HORNS"

P.O. BOX 848

55 E. GRINNELL
Ph. (307) 674-6483

SHERIDAN, WY 82801

October 23, 1995

Mr. Detmer R. "Abe" Knapp, P.E.
AML Project Officer
Department of Environmental Quality
3030 Energy Lane, Suite 200
Casper, Wyoming 82604

Dear Mr. Knapp:

As Mayor of Sheridan, Wyoming, I would like to thank you and all others in your department who were instrumental in the rebuilding of Big Goose Drop Structure. After viewing the drop structure site with the city engineer, I believe that area of Big Goose Creek is safer. And, if not safer, at least rescue efforts are now more achievable than before.

In addition to the safety factor, this area is now aesthetically pleasing. Especially, now that the "Old City Barn" was demolished (which was located across the street from the drop structure). This area will be used for parking and an additional green area.

Speaking for the citizens' of Sheridan, thank you for helping us solve a life-threatening problem, and turning that problem area into an asset for the community.

Sincerely,

Della Herbst
Mayor

DH:vb

January 4, 1996

Detmer Knapp
Department of Environmental Quality
Abandoned Mine Lands Division
3030 Energy Lane, Suite 200
Casper, WY 82604

Abe
Dear ~~Detmer,~~

It is my understanding that the Sheridan drop structure project that was completed in 1995 is being submitted as a possible award candidate. I would like to make a few comments in support of that project winning the award.

As you know, my son, Brett, drowned in the Big Goose Creek in Sheridan at the site of the drop structure. I am more than acutely aware of the dangers a structure of that nature, compounded by it's placement in the community, brought. It truly lived up to it's name, "drowning machine", and was destined to continue that legacy.

This past May, I had the opportunity to view the drop structure at it's near completion. It was a bittersweet experience for me, and I wept. I wept because of the losses experienced. I wept because the creek was so beautiful in it's natural state, as it should have been all along. And I felt joy and relief that no other parent would have to stand in my shoes.

Your project has been a success, both in terms of lives that have not been lost as well as in providing a natural looking creek that has a built-in erosion control system. I would like to commend AML and the architects for the work they have accomplished. From inception to completion, I have only praise for the quality of work I have witnessed, and gratitude for being included. Your professionalism has been surpassed only by the kindness I received.

Sincerely,

Nadine Wilson

Nadine M. Wilson

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C. SLIDE DESCRIPTIONS

Slides:

Slide 1

The original drop structure in Big Goose Creek. The structure consisted of a vertical 8 foot concrete drop structure with baffle blocks.

Slide 2

Placement of grouted rock drop structures during extreme weather conditions required the utilization of concrete blankets and tents supplied with propane heat.

Slide 3

Pipeline for diversion of stream flows during construction in the stream bed. The diversion pipeline was abandoned (in place) following construction.

Slide 4

Warm temperatures created unusually high runoff and ice flows during construction.

Slide 5

Big Goose Creek Drop Structure following construction, showing the two distilling pools placed upstream of the original drop structure location. Note the middle school on the hill above the construction site.

Slide 6

Big Goose Creek Drop Structure following construction, showing the two distilling pools placed downstream of the original drop structure location.