COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

StreamLines

VOLUME XXII, ISSUE 2
SPRING 2008

Quarterly Newsletter of the Office of the State Engineer

East Fork Landslide prompted Flood Hazard Study by Dam Safety Engineers

Matt Gavin, Division 7 Dam Safety Engineer, Durango, and Chris Brown, GIS Analyst, Denver

In May of 2008, the Dam Safety Branch of the Division of Water Resources was contacted by the Office of Emergency Management of Archuleta County regarding a landslide in progress on the East Fork of the San Juan River. Emergency management personnel recognized that the landslide could potentially form a natural dam on the East Fork River, which would pose a flooding hazard to downstream populations, including the City of Pagosa Springs. In response to the request for assistance, the Dam Safety Branch prepared a Potential Flood Hazard Study to provide emergency management personnel with a basis for assessing the threat as the situation develops.

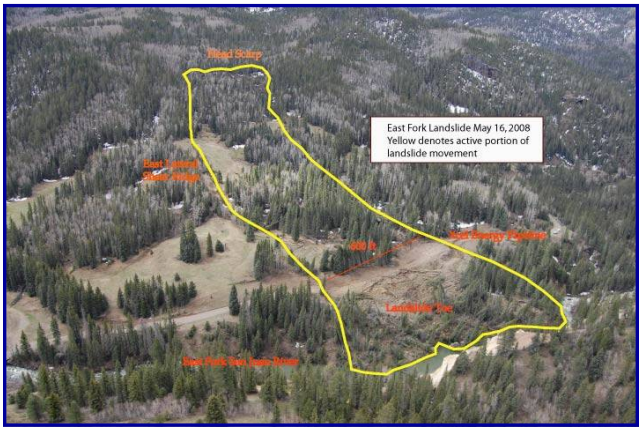

Figure 2

The slide is located approximately three river miles above the confluence with the West Fork of the San Juan River, and approximately 14 river miles upstream of Pagosa Springs (Figure 1). Shortly after the discovery, the slide was reportedly progressing into the river at a rate of approximately four feet per day (Figure 2).

Figure 1

On behalf of the Dam Safety Branch, Dam Safety Engineer (DSE) Bill McCormick organized the response to Archuleta County's request for information by identifying the steps necessary to perform a Critical Hazard Review of the situation. The first step was to establish the scenarios under which a dam could form. The first scenario considers a rapid acceleration/failure of the slide resulting in the immediate formation of a large obstruction in the river channel. The second scenario assumes that the slide will continue to progress into the river channel near the current rate. Under this scenario, gradual formation of the dam would begin at such time when spring runoff subsides to the point where the sediment carrying capacity of the river no longer exceeds the rate at which material is deposited by the slide.

Due to the unpredictable nature of landslides, it is not possible to accurately predict the height of a dam which

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East Fork Landslide *(cont.)*

may form from either a sudden rapid movement or from progressive slow movement. To address the uncertainty, engineers considered a wide range of dam heights and associated impoundment volumes for analysis. Paul Perri, DSE based in Denver, developed a stage-storage curve using the average end area method as applied to USGS quad sheets of the area above the landslide. The upper limit of dam heights considered is 210 feet. In addition, Paul estimated possible reservoir filling times using data from a historic DWR stream gage upstream of the landslide area (Figure 3).

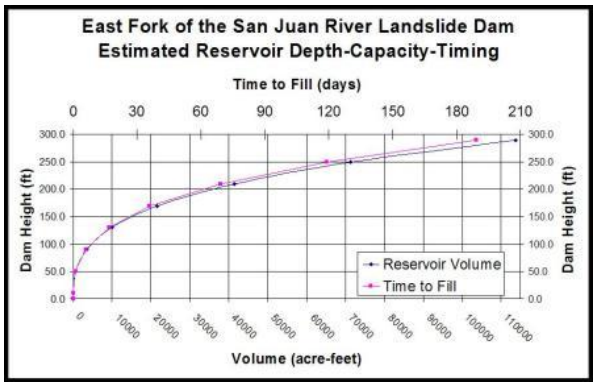

Figure 3

With the impoundment characteristics defined, the next step was to assess breach scenarios and estimate *potential* peak discharges associated with the various dam heights considered (Figure 4). To accomplish this, engineers used breach discharge prediction spreadsheets that were developed for engineered dams. It is noted that breach characteristics for a landslide dam are more nebulous than those for engineered structures due to the irregular geometry, heterogeneous mix of materials, and unknown compaction of the landslide deposit. A base-line flood of 15,000 cfs was modeled to approximate the 100-year flood in Pagosa Springs. As indicated in Table 1 (next page), the approximate 100-year flood is associated with a dam height of 50 feet. Including the 100-year approximation, a total of five peak discharge values were selected for steady flow analysis in the HEC-RAS model. The table gives the peak flows considered and the associated dam heights and storage volumes.

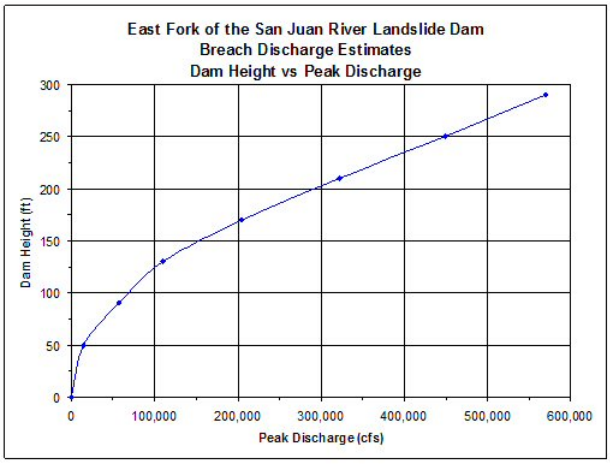

Figure 4

With the range of potential peak discharges defined, the next step was to generate hydraulic models and inundation mapping of the river below the dam. Matt Gavin, DSE based in Durango, and Chris Brown, GIS Analyst based in Denver, worked together to develop a HEC GeoRAS model for the study area. HEC GeoRAS provides an interface between the HEC-RAS and ArcGIS. Using HEC GeoRAS, river geometry was extracted from a 3D terrain model of the study area in ArcGIS and was exported to HEC-RAS. Hydraulic modeling was then executed in HEC-RAS, and the results were imported back into ArcGIS for automated floodplain delineation using HEC-GeoRAS. Inundation maps were developed depicting the inundation limits for the minimum and maximum discharge values considered (Figure 5). Tabular data was compiled for all five flood profiles to provide water surface elevations and inundation limits for the wide range of dam heights considered. The results were

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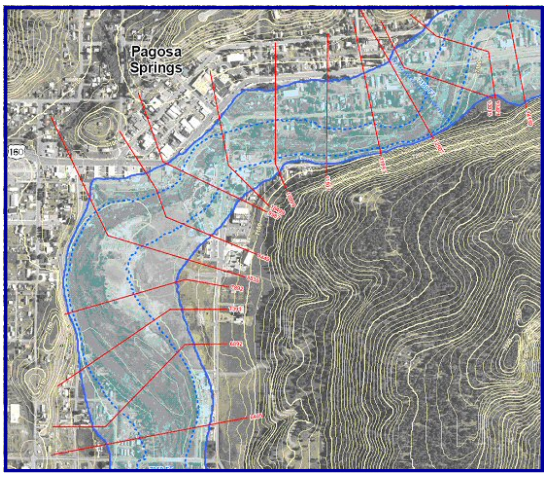


Figure 5

Toe of the landslide flow into the East Fork of the San Juan River constricting the river.

East Fork Landslide *(cont.)*

TABLE 1			
Peak Breach Discharge (cfs)	Dam Height Associated with Peak Discharge (Feet)	Storage Volume Associated with Peak Discharge (AF)	Expected Attenuation at Pagosa Springs
15,000	50	695	25%
30,000	65	1500	10%
50,000	85	3000	5%
100,000	125	8500	0%
150,000	150	15000	0%

Upper portion of the landslide showing the scarp and tension cracking.

compiled in the Potential Flood Hazard Study and disseminated to emergency managers to assist with planning as the situation develops. Due to the size of this landslide, it is unlikely that man-made control will be possible to prevent future movement. It is likely that this landslide will remain active for some time into the future. The information provided in the study will remain applicable into the future and can be used as the behavior and impact of the landslide changes through time. ♦

Settlement Agreement Reached on Pioneer/Laird Water Rights Dispute

An agreement was reached between ground water users in the Northern High Plains Designated Ground Water Basin and numerous senior surface water right users on the North Fork of the Republican River. The dispute was set for a three-week trial before the Colorado Ground Water Commission's Hearing Officer, Joseph (Jody) Grantham. On June 6, Mr. Grantham signed an order vacating the proceedings pending completion of all necessary terms of the settlement. Non-compliance with the terms will result in the hearing being held in January/February 2009.

Mr. Dick Wolfe, State Engineer, indicated the parameters of the settlement are broad and incorporate most of the surface water right users on the North Fork. Some of those water users were not part of the case; however, in this manner, a long-term solution to the ongoing dispute between surface and ground water users in the area can better be served.

The case was initiated in 2005 when the Pioneer and Laird Ditch owners filed suit with the Ground Water Commission requesting ground water wells in the basin be shut down in order to provide water to what they deem to be "senior" surface water rights. The surface water right owners feel their rights are being injured by the junior wells and, therefore, the wells should be administered based on the *"first in time, first in right"* priority system, rather than a modified system as allowed for under the designation of the Northern High Plains ground water basin.

State Engineer Wolfe stated, "I am very pleased with all of the hard work of the parties in the case, as well as the willingness of the Republican River Water Conservation District and Yuma County Water Authority to step up and help. Without their support and creative thinking, we certainly were heading down a litigation path."

In general, the terms of the agreement call for a lease/buyout of the surface water rights for $20 million including a lease in 2008 of these water rights for $500,000. Funding is contingent on financing of approximately $5 million by the District for a 20-year lease and approval of up to $15 million bond issue by the voters this November. Yuma County Water Authority will be seeking approval of the bond.

Wolfe also indicated, "I understand it is a lot of money, however, the upside is that it will greatly assist the state in complying with the Republican River Compact by allowing that surface water to flow across the state line. This will lessen our debt to Kansas on a yearly basis and allow the farms and cities in this area to obtain the water they need to thrive." ♦

The Hydrography Team Improves the Accuracy of Stream Measurements

Measuring storm peaks has taken on a higher priority. Ditch companies who want recharge water are looking closely at the Kersey gage figures whenever it storms in Denver. With traffic flagging, a bridge measurement requires a minimum of four people. The Division 1 Office staff in Greeley are regularly drafted to assist hydrographers with measurements at Henderson and Kersey.

Hydrographer Patrick Tyler at Last Chance Ditch

Chatfield Reservoir accounting issues created a need for the best possible accuracy for figures from river gages at Waterton and below Chatfield and Strontia Springs Reservoirs.

The Chatfield spreadsheet has shown greatest inconsistencies when these gages require cable measurements. This could be due to flow timing, errors in the Chatfield capacity table, and problems with diversion figures as well as the measurement errors inherent in cable measurements. To help eliminate gages from the error investigation, the hydrography team has been taking steps to improve the accuracy of high water measurements.

This involved increasing the frequency of measurements. Next, the Division used rental equipment and contractors to remove the larger rocks beneath cable sections at the Chatfield and Waterton gages. The Division also successfully petitioned for the purchase of an ADCP instrument to use at these sites as a check on standard current meter techniques. Finally, the hydrography team is investigating the use of Denver's Conduit 20 diversion dam (below the Strontia gage), as a potential gaging site to verify flows recorded at the Strontia gage.

Notable USBR liaison activities in 2007 included assistance with installation of USBR-purchased SDR recorders at eight sites, assistance with DCP rewiring to facilitate the USBR's SCADA system operation, and numerous levels conducted as the USBR rebuilds the flume on the Big Thompson River above Lake Estes. Division 1 also conducted a day of cable measurements on a canal to assist with a USBR (Denver Lab) study.

Hydrographer Russell Stroud developed a new spreadsheet tool which compares the data from an SDR log with the reported DCP record. The program highlights days on which the two data sets have any significant difference in mean, maximum or minimum values. For satellite gages with SDR encoders installed, the basic data check for records purposes is greatly facilitated. ♦

♦♦ *SAVE THE DATE* ♦♦
COLORADO WATER OFFICIALS ASSOCIATION ANNUAL CONFERENCE

The Colorado Water Officials Association (CWOA) will be holding its annual meeting and conference this year in Denver. The theme of this year's conference is ***"Effects of Climate Change on Colorado Water Administration."*** This is an appropriate subject given the changes in weather patterns experienced in Colorado in recent years. An array of speakers representing different viewpoints on the issues of climate and water have been assembled. The meeting will be held on the morning of October 2 at the REI conference center located at 1416 Platte Street, Denver. In addition, the traditional "Water Rodeo" event will be held in the afternoon at Confluence Park (next to REI).

On October 1, the CWOA hosts a golf tournament to raise money towards several scholarship programs. Money raised by the tournament is awarded to qualifying Colorado college students whose major course of study is related to water resources, civil engineering, environmental sciences or agricultural studies.

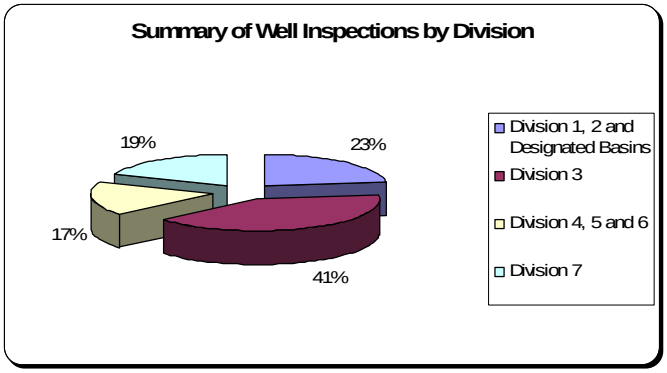
For further information, please check the website at http://www.coloradowaterofficials.com/.

Well Inspection Program

The well inspection program was instituted for the protection of ground water resources and public health through enforcement of the *Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction, 2 C.C.R. 402-2*. The staff's duties in this program include inspecting: water well construction and pump installation, monitoring or observation hole/well construction, well plugging and abandonment, and investigating complaints, providing education and outreach, and generally supporting the State Engineer and Board of Examiners.

A key focus of the well inspectors and the inspection program is to locate and initiate action against unlicensed contractors working illegally in the state. With regard to licensed contractors, the most frequent violation continues to be contractors drilling outside the distance limits allowed by the permit (usually 200 feet).

The well inspectors conducted more than 2300 inspections in 2007. As in previous years, nearly half of the inspections were conducted in Division 3. Well inspections were distributed across the state generally as shown in the graph.



As was anticipated, as the well inspection program continues to develop, the Staff sees a decrease in the proportion of violations discovered as a result of inspections. Since inception of the inspection program, it is evident that many licensed contractors are refining their well location and construction practices to ensure full compliance with the Board's Rules. ♦

Continuing Public Education Regarding the Administration and Enforcement of Well Permits

Scott Hummer, Water Commissioner, Water Division 5, District 36

The Colorado Division of Water Resources, Water Division 5 Office in Glenwood Springs, in cooperation with Colorado Mountain College is sponsoring a public education class regarding the continued need for enforcement of permitted well use and potential curtailment of wells for the "expanded use" of ground water not allowed by the terms and conditions of an exiting well permit.

The "well use enforcement" class will be held Tuesday, July 29, 2008 at the Colorado Mountain College building, Room 206, located in Breckenridge, from 6:30 – 8:30 p.m. Staff from the Water Division 5 office will present information on proper well use and be available to answer questions regarding previous, present, and future well enforcement activities in the Blue River Basin. The SYN number for pre-registration is 36590.

As was the case in the late summer and fall of 2007, once again this year during the same approximate timeframe, staff from Water Division 5 will conduct field inspections of well use in Summit County. Those wells found to be in violation of the permitted terms and conditions last year will be re-inspected for compliance. Wells that are re-inspected and still found to be out of compliance may be subject to curtailment. An additional 500 wells located in subdivisions located in the Upper Blue, Ten Mile, Snake River and Lower Blue Basins will be inspected this summer and fall as well.

The "expanded" use of ground water causes injury to other water rights by reducing the amount of water available to the stream system. In order to prevent this injury, water must be added to the stream system. This protection against injury may be accomplished through a Plan for Augmentation.

Summit County Government and the Vidler Water Company have established such augmentation plans under decrees issued by the Division 5 Water Court. With the availability of these existing plans, all wells being used for purposes not allowed under the terms and conditions of an existing well permit are expected to seek coverage from either plan in order to operate legally or simply comply with the existing use limitation of the well. ♦

Arkansas River Basin Advisory Committee is Formed

State Engineer Dick Wolfe announced the selection of Advisory Committee Members who will be consulted in the development of rules and regulations concerning improvements to surface water irrigation systems in the Arkansas River Basin. The use of sprinklers and similar improvements can lead to an expansion of the historical consumptive use of the water right in some cases. In order to prevent this type of expansion, rules must be developed to provide a legal framework under which farmers can continue to irrigate their fields without violation of the Arkansas River Compact.

The formation of the Advisory Committee is a result of criticism concerning the original draft of the rules. Upon Wolfe's appointment as State Engineer, he decided to put together this Committee to assist him in the development of the rules that are necessary to ensure compliance with the Arkansas River Compact.

The Advisory Committee represents a diverse group of water users and interests throughout the basin, including water district managers, ranchers, irrigators, county commissioners, and attorneys.

The first meeting for the Committee will be held in Pueblo on July 9 from 1 to 4 p.m., in the Occhiatto University Center West Ballroom on the Colorado State University Campus. ♦

Greening of State Government Initiatives

Katie Radke, Program Manager

In April 2007, Governor Bill Ritter issued two Executive Orders to establish goals and objectives designed to reduce the environmental impact of state government. These orders enable state employees to take a proactive role in the Governor's New Energy Economy. The Greening Government goals for Colorado state governments are set to be implemented by June 30, 2012 and include a 20 percent reduction in energy and paper use, ten percent reduction in water consumption, and 25 percent volumetric reduction in state vehicle petroleum consumption. Each department will be charged with creating a system whereby their efforts are tracked and reported annually to the Governor.

The Greening of State Government Coordinating Council works in conjunction with the Governor's Energy Office to develop policies and programs of the Executive Orders. A representative for each department is required to be a part of the Council, managed by the Greening Government Program Manager. Additionally, a liaison is required for each agency. The Division of Water Resources' (DWR) Representative is Katie Radke, who coordinates greening goals and has opportunities to provide input to the Governor's Energy Office.

By 2012, energy consumption in state facilities must be reduced by 20 percent from state fiscal year 2005-06 baseline. All state-owned facilities must engage in performance contracting as defined in Executive Order. Where performance contracting is not feasible, state agencies shall strive to reduce energy use by ten percent. Performance contracting is not feasible for DWR because all 20 buildings occupied by DWR offices are leased.

Currently, DWR is in the process of revising and implementing an Energy Management Plan, dictating what steps and actions will be taken to assist the DNR in reducing energy use and water consumption. DWR will encourage and promote energy conservation by employees in their work and home offices by awareness and education, purchasing energy efficient equipment, and maintaining and enhancing energy conservation practices already in place. Additionally, DWR will estimate energy use

based on equipment use such as computers, printers, monitors, and IP phones per office and seek to reduce this number by ten percent by the year 2012. Associated electricity consumed by the equipment will be included as a baseline, which will be updated annually and posted on the intranet site for DWR. Employees will be encouraged to also maintain their own inventory lists and associated electricity use by utilizing an Employee Behavior Tracking System, which is forthcoming.

Future projects include creating and implementing a transportation plan to reduce petroleum use by 25 percent, developing an environmentally preferable purchasing plan aimed at reducing 20 percent paper waste, and developing department-wide green initiatives. ♦

HUMAN RESOURCES

New Employees

Lance Goss was hired to fill the Water Commissioner position in Lake City on May 5, 2008. His area of responsibility will be the Lake Fork of the Gunnison River and several other tributaries to the main stem of the Gunnison River. Lance served as a pilot in the U.S. Marine Corp for 20 years, has a small computer networking business in Lake City, and is also a mountain marathon runner. He comes to DWR with a broad background of experiences and abilities.

Janet Wolney started on April 17, 2008 as the new Water Commissioner in the Paradox area. Her main duties will be administering the Paradox Creek and Buckeye reservoir system. Even though she has limited water experience, she will do a great job in this remote location of the state.

Rege Leach has been appointed as the new Division Engineer for Water Division 7 in Durango and will assume his new duties on July 7, 2008. He will be replacing Mr. Bruce Whitehead who retired from the Division in October 2007. Mr. Leach is a Professional Engineer and comes from the Bureau of Reclamation. He is an alumnus from Pennsylvania State University as well as Colorado State University. One of his recent projects was the Navajo-Gallup Water Supply Project, a proposed municipal water supply in New Mexico. Leach has been involved in the operations and planning of the Navajo Dam and Reservoir, the Animas La Plata Project and many other Reclamation projects in the Four Corners Area. Rege has extensive knowledge in water resources as well as dam safety.

Retired Employees

Jack Byers, Deputy State Engineer, will be retiring on July 7 after nearly 12 years with the Division. Jack started with the Division in October 1996 as Assistant State Engineer. During his tenure, Jack was responsible for the leadership and management of the Engineering, Technology and Investigations Section, which consists of engineers, geologists, hydrologists, information technology professionals, budget and administrative support personnel. He also provided support to the Board of Examiners for Water Well Construction. Jack received the Annual Leadership Award in 1998 and 2006. Jack will be transitioning into the private consulting arena and corporate world.

Bob Becker is retiring on July 31 after serving as a Water Commissioner for Division Seven for 20 years. He started in Districts 71 and 69 in May of 1988 and then moved to District 34 in the drought year of 2002. Bob received the Water Commissioner of the Year award in 1998 for his dedication to Montezuma County. Bob has served on the CAPE (Colorado Association of Public Employees) Board for 14 Years, two years as President and is currently the Vice President. Bob is planning to travel after retirement, especially to watch the Rockies during spring training in Tucson. Bob's experience and leadership will be missed.

Other

*Message from **Ken Knox, Deputy State Engineer,** to DWR/DNR colleagues and Colorado water users:*

Thank you. Two simple words that fail to describe the depth of my appreciation for working with you and sharing our time, experience and energies in shepherding Colorado's water resources together for over 24 years. Beginning in April of 1984, I have enjoyed the blessing of working in many different disciplines throughout the state. For example, the Division has allowed me the opportunity to measure the Rio Grande in the remote canyon at the Colorado-New Mexico state line at dawn, conduct stream loss/gain studies in the alluvium of the lower Arkansas River, to receive daily renewal in valuing the expertise of water commissioners in the delicate balance of water allocation in the Gunnison River Basin, and culminating these professional challenges through interstate river compact negotiations in Denver and throughout the western United States.

Recently I received a gracious and challenging offer to pursue my professional interests to continue serving water users through employment with URS Corporation in water resources planning and engineering in the Rocky Mountain region with national and international opportunities.

Succinctly, thank you once again for sharing your talents, patience, and working with you. It has indeed been an honor. I eagerly look forward to continuing our collaborative efforts to optimize the use of precious water resources in a sustainable manner.

Best regards,

Ken Knox

CALENDAR OF EVENTS

July 22-23	Colorado Water Conservation Board Meeting, Cortez, Colorado; for more information, contact Lisa Barr at 303-866-2599
August 5	Colorado Board of Examiners of Water Well Construction and Pump Installation Contractors Meeting, Denver, Colorado; for more information, contact Gina DeArcos at 303-866-3581
August 15	Colorado Ground Water Commission Meeting, Inn at Silver Creek, Granby, Colorado; for more information, contact Rick Nielsen at 303-866-3581

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***STREAMLINES** is published by the Colorado Division of Water Resources on a quarterly basis. Subscriptions are available for $10 per year to cover the cost of printing and mailing.*