

1996 COLORADO FLOOD REPORT

by

The Flood Control and Floodplain Management Section

Colorado Water Conservation Board

Colorado Department of Natural Resources



*James Lochhead, Executive Director
Colorado Department of Natural Resources*

*Daries C. Lile, Director
Colorado Water Conservation Board*

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I. EXECUTIVE SUMMARY

The potential for snowmelt flooding in Colorado heightened in January 1996 when an article in the Denver Post proclaimed "*January Snows Smashing Records*" - "*It's been snowing so hard at Steamboat Springs this month that officials have been tying helium balloons to the hats of kids in order to keep track of them.*" The average total snowfall for Colorado Ski Country USA's 21 members in January 1996 was 85.7 inches compared to 40.6 inches in January 1995 and 34.4 inches in January 1994. The amazing snowfall translated into more skiers on the slopes at resorts statewide.

In the April 30th edition of the Rocky Mountain News headlines shouted "*Streams May Be Ready To Rumble*". At this time the Colorado Flood Task Force listed its "Top Ten" flood threat locations as follows: 1) Colorado River above Grand Junction, 2) Gunnison River above Gunnison, 3) Arkansas River above Canon City, 4) Boulder Creek near Ward and Nederland, 5) Clear Creek near Silver Plume and Georgetown, 6) Blue River, Snake River and Tenmile Creek above Dillon Reservoir, 7) Eagle River basin, particularly near Gypsum, 8) Fraser River above Granby, 9) Roaring Fork River basin, particularly near Basalt, and 10) Yampa River above Steamboat Springs.

By May 24, Joe Garner of the Rocky Mountain News was writing "*the flood threat has ended on Colorado's major rivers, but four streams could still cause problems.*" Peak flows were predicted for around June 8, 1996 according to Larry Lang, Colorado Flood Task Force Chairman. At that point, the following streams could leave their banks: 1) the Yampa River near Steamboat Springs, 2) Tenmile Creek near Frisco, 3) the Blue River above Dillon Reservoir, and 4) Clear Creek near Georgetown.

On June 11, Joe Garner wrote "*five streams threaten to jump their banks in the next week before the risk from snowmelt flooding ends for the spring.*" In the same article Brian Hyde of the CWCB noted "*The snowfields that could cause problems will be gone by the end of the week*".

And so went the efforts of floodplain managers statewide as they tiptoed through a snowmelt flood season of high potential. The snowmelt flood threat became reality in only a few communities. The Roaring Fork River near Basalt caused streambank erosion damage with undermining of the abutments of the Emma Bridge. Low lying areas near Steamboat Springs were inundated but most lands were either parks or agricultural land. Georgetown and Silver Plume squeaked by without a repeat of 1995 but Clear Creek did experience erosion of streambanks.

Thunderstorm induced flooding was another story. Just ask the residents of Buffalo Creek following a fire in May and subsequent flood on July 12, 1996. So significant was this flood, that it's chronology has been tabulated in a separate document titled "*Preliminary Findings On The July 12, 1996, Buffalo Creek Flood Event*". Many other thunderstorm induced flood events occurred during the summer months of 1996. Canon City was particularly hard hit. And severe weather even caused a tornado to touch down in the mountains near Divide, Colorado. The following "1996 Flood Report" will chronicle the flood events which impacted so many Coloradans.

1996 The chronology

was realized 1 Until the middle of April it appeared that the state would experience less than average snowfall and that preparations would be needed for drier than average conditions. About two weeks later things had changed. By the middle of May, the State's Flood Task Force had held its second weekly meeting with Denver television and newspaper media in attendance. By the end of May heavy rains had caused flooding and storm drainage problems in several communities in the Front Range and Eastern Colorado. Shortly after the middle of June, the first significant snowmelt peak flows were experienced in many mountain and foothills communities as well as plains communities along the South Platte and Arkansas Rivers and some of their tributaries. In the middle of July, the second significant snowmelt peak flows were experienced on a few mountain and foothills streams.

In most affected communities flood frequencies ranged between a 10-year frequency (10% chance each year) and a 50-year frequency (2% chance each year). In a few communities, the flood frequency approached the 100-year frequency (1% chance each year). Some stream reaches experienced the flood of record or the second largest flood of record.

Sandbagging on South Clear Creek - Georgetown, CO

Damages were principally to agricultural land and crops and to public infrastructure. Through flood hazard mitigation work following the floods of 1983 and 1984 and the high runoff of 1993, through preparations undertaken primarily by state and local governmental agencies during May, June and July of 1995, through extensive media coverage of the flood threat, and

through a lot of LUCK, **serious damages were avoided**. There were twenty-one lives lost, but they were all a result of water recreationists failing to take proper precautions rather than travellers and building occupants being caught by flooding.

Since the flood event of 1993, the Colorado Water Conservation Board (CWCB) has increased its snowpack monitoring efforts. The experience with snowpack monitoring that was acquired in 1993 proved very useful in 1995. Interestingly enough, at the start of the 1995 snowpack monitoring effort, the state's snowpack, which had actually been below average until then, kept increasing at precisely the time when it actually should have been decreasing (late April and early May). As a result, the CWCB moved into action and formed the state's first Flood Task Force. The Task Force brought state and federal agencies, private entities and the media together on a weekly basis for 8 weeks so they could collectively share information about flood conditions and about their responses to those conditions. The Task Force's actions positively influenced the way governmental agencies respond to floods and how the public perceives them.

Statewide awareness of "Flood Threat 95" provided potential flood victims with opportunities to implement flood mitigation and preparedness measures. Through the efforts of the Colorado Flood Task Force, weekly forecasts were provided to the state's emergency and floodplain managers as well as the news media.

These forecasts were developed and prepared from real time data gathered from its 14-member agencies. The CWCB developed computerized planning tools for flood forecasting that gave state and local officials some ability to anticipate flood peaks and respond accordingly. The CWCB staff developed snowmelt flood forecast tools which utilized temperature and snowpack water equivalent to estimate runoff at 10 selected locations. These computerized tools proved useful in monitoring and identifying "hot spots" across the state's river basins. At this point the state's ability to predict the magnitude and timing of snowmelt flood peaks is not as well refined as many local officials would like. In a few locations the peak was overestimated or underestimated and/or the timing of the peak was different than what was predicted. By and large, in 1995 officials had more advance warning of the flood peaks that they could expect than they had ever had before.

When the flooding was over, the state visited the flooded communities to hold local flood hazard mitigation planning meetings. At these meetings, all of the counties and municipalities in a particular watershed were invited to consider preparing plans to identify problems experienced in 1995 and to develop strategies for reducing damages and inconvenience the next time similar flooding occurs. It is hoped that the Flood Event of 1995 will prompt some of Colorado's communities to make changes that will make them even better prepared the next time rain and/or snow bring more flooding.

The 1995 flood event demonstrated ^{worked with} the need for mitigation plans and projects. Many flood mitigation projects are needed across the state. Following the spring flood season, the CWCB has been ~~been contacted by~~ ^{the success and continued need} several communities which have an interest in preparing such a plan, ~~prior to the next flood event in their communities.~~ In early July, Clear Creek County, Georgetown, Idaho Springs and Silver Plume began developing a local flood hazard mitigation plan following a planning "kick-off" meeting conducted by CWCB staff. In addition, the communities of Pitkin County, Aspen, Basalt, Carbondale, ~~Glenwood Springs, Summit County, Frisco, Breckenridge, Silverthorne, Montezuma, Weld County, Logan County, Wiley and Grand Junction~~ have begun to seriously attempt to reduce future flood damages through the ~~implementation of flood hazard mitigation strategies.~~ Other communities in the Eagle River valley ^{are currently preparing plans and} are considering similar efforts. _{OC, LaS, SP, etc, Mather, Colbran}

especially in anticipation of the FEMA-funded Fed state-administered FMAP.

II. COLORADO FLOOD TASK FORCE

As Colorado's snowpack rapidly increased in ^{Jan 6} April 1998, federal, state and local officials began expressing concern about potential flooding. This prompted a number of actions to be undertaken. Beginning with leadership from Larry Lang, the state's ~~first~~ Flood Task Force was ~~formed on May 8, 1995~~. The Task Force is an interagency group that shared information related to the threat of snowmelt flooding. The intent of the Task Force's work was to guide those agencies and individuals who would be involved in preparing for the runoff and responding to it once it began. The Task Force consists of 14 state and federal agencies with expertise in floodplain management, flood forecasting, disaster response and flood damage. *convened for the second time*

The purpose of the ^{springtime} Monday meetings was to have experts present information for flood forecasting, flood emergency response, flood mitigation and the preparation of a weekly outlook report. After each Monday morning meeting of the Flood Task Force, the CWCB faxed the

"Weekly Flood Outlook Report" to 60 users. The major newspapers and television stations in Denver were present at the weekly meetings, also. Their assistance in getting the word out was appreciated.

Comprised primarily of state and federal agency personnel, the task force monitored the snowmelt and associated rising river levels. Task Force member and their roles are listed below:

<i>Colorado Governor's Office</i>	By proclamation, provides emergency assistance and makes emergency funds available.
<i>Colorado Water Conservation Board</i>	Development and leadership of the Colorado Flood Task Force. Snowpack monitoring and forecasting.
<i>Colorado Division of Water Resources</i>	Streamflow monitoring and forecasting. Dam safety assessment.
<i>Colorado Office of Emergency Mgmt.</i>	Flood preparedness activities. Flood damage assessment and reports.
<i>Colorado Dept. of Natural Resources</i>	Authorize flood preparation expenditures and future mitigation activities.
<i>Colorado Dept. of Local Affairs</i>	Authorize flood preparation expenditures and future mitigation activities. Coordinate efforts with Governor's Office.
<i>Colorado Dept. of Transportation</i>	Authorize flood response expenditures and equipment for future mitigation activities.
<i>Colorado Geological Survey</i>	Monitor landslide and mudflow potential.
<i>Natural Res. Conservation Service</i>	Monitor snowpack and issue reports.
<i>National Weather Service</i>	7-day weather reports and issuance of statements and warnings to the public.
<i>Federal Emergency Mgmt. Agency</i>	Flood insurance, recovery, preparedness and mitigation activities.
<i>U.S. Army Corps of Engineers</i>	Flood disaster response programs, technical assistance for preparedness and mitigation. Flood protection through reservoir operations.
<i>U.S. Geological Survey</i>	Monitor stream flow gaging stations in Colorado.
<i>U.S. Bureau of Reclamation</i>	Flood protection through reservoir operations.
<i>John Henz Meteorological Services</i>	30-day weather reports and issue statements and warnings to Colorado Flood Task Force.

During the months of May and June, the Flood Task Force met each Monday morning with briefings to the public and media about the flood threat status. Sometimes those briefings weren't that pleasant since high water contributed to twenty-one flood-related deaths. ~~Not when agricultural levees broke in Weld and Logan counties from Platteville to Sterling, inundating~~

thousands of acres of cropland. Nor when, despite a valiant sandbagging flood fight by Georgetown residents to reduce the impacts of high water on South Clear Creek, 14 homes received flood damage.

That's not to say there weren't damages and loss of life. Flood damages are estimated to be \$46.6 million. Many of the flood mitigation strategies which were implemented during the 1984, and 1993, flood seasons provided the necessary protection in such places like Redstone, Paonia, Hotchkiss, Grand Junction, Crested Butte, Gunnison and Delta, Routt, Mesa and Pitkin Counties.

and 1995

locations across the state.

III. 1995 SPRING/SUMMER FLOOD EVENTS

Introduction

Following record snowfalls ^{statewide} in January 1996,

the remainder of the snowfall season accumulated was close to average.

Flood Threat '95 was the title chosen by the Colorado Flood Task Force and television and radio stations alike as Colorado braced for what appeared to be the most serious flooding in 10 years (and possible record flooding statewide) from the melting of one of the state's largest recorded snowpacks. Colorado didn't have particularly unusual winter weather in 1994-95, at least until mid-April. At that point the snowpack was well on its way to being below average. There were concerns about possible drought. However, the wet spring that began in mid-April refused to leave the state until early to mid-June, causing an excess accumulation of wet snow in many of the state's river basins. At a time when the snow that was already on the ground should have been melting, not only was that snow remaining frozen, but new snow was accumulating on top of it which resulted in extremely high (1200%) snowpack percentages.

But we got lucky!! When our warmest temperatures of the snowmelt flood season occurred on June 14-16 (3 days in the 90's), cooler weather came to the rescue with a record low high temperature of 59 degrees at Grand Junction on June 17. This cooling trend moderated the snowmelt across Colorado. When hot weather returned in July, many of the state's mountain watersheds did not have enough snowpack left to cause serious flood problems. (Residents of the Roaring Fork River and Clear Creek valleys would certainly dispute that!)

Prior to the spring runoff season, the CWCB developed a model "Pre-Disaster Flood Hazard Mitigation Plan" for use by local governments. Buena Vista, Poncha Springs, Pitkin County, Frisco, and Summit County used parts of the plan prior to high water in their communities. A number of communities began their own efforts at preparing for the flooding

which they anticipated. Unfortunately other communities did not prepare quite as well as they should have.

1995 Flooding

During the entire period from mid-May to mid-July there was high water somewhere in each Colorado's four major river basins (South Platte, Arkansas, Rio Grande and Colorado). Depending on the time and on the specific stream reach, the high water was ^{mostly} attributable to thunderstorms, ~~general rainfall, snowmelt, rain on snow and failure of "dams" of snow and ice or debris.~~ There were flows ranging from minor nuisance flows of a 2-year frequency all the way to 100-year flows. ~~Small drainages that are normally dry and large rivers all experienced high water.~~

*primarily
in four basins 1),
2), 3)
4)*

desert from st. murray

The first flooding of the season was in the South Platte River basin. The Flood Task Force held its first meeting on May 8, 1995. Shortly after that meeting, the St. Vrain River watershed experienced enough rain to cause a 25-year flood at Lyons. The first flood of the season had, therefore, resulted from rainfall, not snowmelt. The rainfall amounts were not exceptionally heavy (about 2 - 3 inches), but the rain affected such a large percentage of the watershed that there was a large flow.

*Dry May 1996, the
Buffalo
Creek
watershed
experienced
a forest
fire which
consumed
12,000
acres.*

In the South Platte River Basin, rain in many portions of the watershed led to flows of about a 10-year frequency. Shortly before Memorial Day, the South Platte River left its banks for what proved to be a period of about 6 consecutive weeks, late May to early July. Unfortunately for those along the river, those flows seemed continuous. The first part of that six-week flood was caused by rain in the portion of the watershed downstream of Chatfield Reservoir.

Inundated Agricultural Land (background) - Weld County

As the rains continued, a mobile home park near Gilcrest suffered because the normally dry pond in which it was built was filled by a heavy rain - **6 inches in 3 hours**. Farmers whose low-lying land along the South Platte River was usually protected by their agricultural levees found out that a prolonged 10-year to 25-year flow on the river exceeded the capacity of those levees. State Highway 66 near Platteville was significantly damaged when it was under the South Platte for several days.

Rain in the Arkansas River basin led to flooding in the town of Wiley two weekends in a row, the most serious event occurring from 3 inches of rain in 2 hours. It also caused damage to flood control facilities at Las Animas. Meanwhile, the cool and wet weather was delaying the runoff of the heavy snowpack throughout the mountains.

Outflanked Agricultural Levee - Arkansas River, Prowers County

As time went on, the weather was adding new snow in the mountains. It was not until mid-June, two weeks after Memorial Day, that temperatures got high enough for heavy snowmelt runoff. Over the Father's Day weekend (June 16-18) most mountain streams peaked after 3 days of hot weather followed by rainstorms on Saturday. The Gunnison River at Gunnison, the North Fork of the Gunnison at Sommerset and Clear Creek at Lawson experienced flows between the 10-year and the 50-year frequency. The Blue River at Breckenridge and Tenmile Creek at Frisco experienced over 50-year flows. The Crystal River at Avalanche Creek (below Redstone) experienced just less than a 100-year flow. The Arkansas River at Wellsville (below Salida) had the flood of record, well above the computed 100-year level. Most other streams experienced 10-year flows. About 3 to 4 weeks later, during the week of July 10-14, a heat wave produced more high flows. In Clear Creek County flows were almost as high as they had been 4 weeks earlier. In the upper Roaring Fork River basin (Aspen and Basalt) flows were higher than in June, reaching near 50-year levels in Aspen and near 100-year levels in Basalt. The Colorado River from Glenwood Springs to the Colorado-Utah border was in flood stage as well.

State Recreation Area Closed Due to Flooding - Colorado River, Mesa County

IV. CLIMATIC FACTORS AND HYDROLOGY

Weather of 1994-1995

During the "winter" portion (November - March) of the winter of 1994-95, Pacific and Arctic storm tracks provided the Colorado mountains with generally mild weather. Typical winter storms from the Pacific area moved infrequently across the southern and central Colorado mountains, causing a less than average snowpack to accumulate. Meanwhile, the central and northern mountains and the eastern high plains received little snow accumulation from Arctic storms from Canada and Alaska.

Then in April, particularly beginning in the middle of the month, it began snowing frequently in the mountains and along the Front Range. A series of persistent storms (snow and/or rain) began to occur with regularity. These storms deposited healthy accumulations of snow (and/or rain) every 4-5 days somewhere across the state. The storms lasted almost through the second week of June. As the snowpack rose, the moisture content of the snow rose faster, since spring snowstorms are characteristically "wetter" than winter storms.

The U.S.D.A. Natural Resources Conservation Service (NRCS) monitors snowpack in Colorado's mountain watershed through a network that includes automated sites and sites that require manual recording. At the beginning of each winter month the manual sites are visited and statewide and basinwide snowpack figures are computed. On April 1, 1995 the statewide and basinwide figures (the percent of the 20-year average) were low to slightly above normal, as shown below.

Table 1

Location	Percent of Average				
	April 1	May 1	June 1	June 15	
South Platte River Basin	77		122	374	657
Arkansas River Basin	112	183	338	628	
Rio Grande Basin	126		167	257	367
Upper Colorado River Basin	106		132	304	413
Gunnison River Basin	125	161	481	991	
Southwestern Colorado	125		159	334	405

The April 1st figures were not indicative of an impending snowmelt flood threat in any of the state's major watersheds. Then, approximately midway through April, things changed. The dry and mild weather that had prevailed through much of the winter was replaced by wetter and cooler weather. When the May 1, 1995 figures were calculated, there had been a considerable change. In fact, the increase in the basin figures from April 1 to May 1 led directly to the creation of the Flood Task Force and subsequently to all of the other preparatory measures taken by federal, state and local agencies and by private entities.

From about the middle of May through the first week in June, the Front Range and adjacent foothills, as well as portions of the Eastern Plains, experienced a lot of rain. In some locations rains were heavy enough to cause localized flooding.

By June 1, 1995 the basin figures were quite a bit worse than the figures on May 1. As the rains were affecting the lower elevation portions of the state's watersheds, the higher portions of those watersheds were experiencing two problems: 1) no melting of the snowpack and 2) the addition of more snow. Instead of slowly getting better each day in May and early June, the state's snowpack situation was getting worse each day. For the first and second week in June that trend continued. Almost at the middle of June the weather got hot. During the week following the Task Force's regular Monday meeting on June 12, 1995 stream levels in the mountains rose every day. They peaked on the weekend (June 17-18), partly because Sunday, June 18 was a very cold and rainy day (*a record cold day in Grand Junction*). After that weekend temperatures were not as hot for about three weeks, so much of the remaining snowpack melted slowly. Stream levels dropped because of this moderate weather.

Then another heat wave arrived after July 4. About July 12 the two watersheds with significant snowpack still remaining, the Roaring Fork River and Clear Creek, experienced peak flows again. After those peaks none of the state's watersheds had enough remaining snowpack combined with hot weather to produce significant flooding. There may have been more unusual weather after that, but it was no longer flood weather.

Basalt, Colorado would have experienced a flood exceeding the 100-year event if it hadn't been for the additional storage allocation in Reudi Reservoir. Attentive operational measures provided flood control at Basalt by reducing the flow 1,000 cfs.

Flood Hydrology

Although the snowpack produced by the winter and spring weather of 1994-1995 was very high, most of the snowmelt flooding that followed was not record flooding. Most snowmelt flood peaks fell between a 10-year and a 50-year frequency. On the Crystal River and on the Upper Arkansas River, frequencies were estimated at the 100-year level, but elsewhere the flows were smaller, relatively speaking. Because the heat wave in mid-June was stopped by record cold on June 17, the rate of melting (when there was still a lot of snow in the watersheds) dropped substantially. When the heat returned in early to mid-July, there was too little snow to sustain a heavy runoff except in a few locations.

Rain-induced floods were in the range of a 10-year to a 25-year frequency. Most rainfall amounts were about 2-3 inches, which is not record-breaking. There were some instances of larger rainfall amounts, but there were no rainfall floods of a 100-year or greater frequency.

The Board constructed river forecast models for ten river stations. These model were used to predict the approximate date of peak flooding and to estimate the peak flood discharge. These models were useful tools for flood forecasting and for flood damage prevention. Using past high runoff years as a guide, the models tracked snowpack, temperatures and streamflow for the ten stations on a daily basis starting on May 15, 1995. At the June 12, 1995 meeting of the Task force the models predicted flood peaks for the week of June 12-18, and over that weekend most streams did experience their 1995 snowmelt peak.

SUMMARY OF FLOOD EVENTS

<u>STREAM/LOCATION</u>	<u>FORECASTED FLOW</u>	<u>FLOW</u>	<u>ACTUAL DATE</u>
Cache la Poudre River at Fort Collins	6,000 cfs	5,240 cfs	June 16
Arkansas River at Wellsville	6,000 cfs	5,490 cfs	June 23
Roaring Fork at Glenwood Springs	13,000 cfs	12,100 cfs	June 17-18
Animas River at Durango	9,000 cfs	7,290 cfs	June 16 & 18
Gunnison River at Gunnison	6,500 cfs	7,560 cfs	June 18
N. Fk. Gunnison River at Sommerset	9,000 cfs	7,460 cfs	June 15
Dolores River at Dolores	5,000 cfs	4,730 cfs	June 18
Rio Grande at Del Norte	8,000 cfs	7,670 cfs	June 18
Clear Creek at Lawson	1,500 cfs	1,700 cfs	June 17
South Platte River near Kersey	17,000 cfs	21,000 cfs	June 1
Colorado River at Stateline	50,000 cfs	49,500 cfs	June 19
Gunnison River at Delta	16,000 cfs	15,100 cfs	June 14
Yampa River at Steamboat Springs	5,000 cfs	3,710 cfs	June 17

V. COLORADO FLOOD FORECAST MODEL

As snowpack conditions began to increase in late March 1995, CWCB staff began receiving calls from local floodplain administrators and elected officials about the spring flood threat. The phone calls were usually accompanied by requests to determine when peak snowmelt

runoff would occur. In response to these requests, the CWCB's Flood Section began exploring ways to provide improved snowmelt runoff prediction information to local government officials and emergency managers. Section staff agreed that by using 1) snowpack water content information, 2) daily temperature data, and 3) gaged stream flow data, it could reasonably predict when peak flows on given streams would most likely occur.

Temperature is an extremely important factor in the model. The CWCB has observed through years of snowmelt record keeping that when nighttime temperatures do not fall below freezing in a basin's headwater area, the peak snowmelt runoff begins. When a given snowpack does not freeze overnight, melting is continuous around the clock. Consequently, rivers and streams begin to rise more than normal.

This melting phenomena usually occurs at different elevations at different times. As a result, snowmelt is usually a gradual process and few serious problems occur. However, as an example, when a basin's headwaters area is 11,000 feet at its highest point, and the snowpack extends down to 9,500 feet there can be a considerable amount of snow to be melted once nighttime temperatures don't exceed freezing at 11,000 feet. Many times, it is the basins with elevations below 11,000 feet but with a high snowpack down to lower levels that can cause the most severe flooding on a given stream.

VI. STREAMFLOW DATA

Streamflow monitoring was an important work task during the 1995 flood season. The Satellite Monitoring System (SMS) allows the Colorado Division of Water Resources (a task force member) to collect, process, store and distribute any kind of environmental data transmitted from remote locations. The data set of interest to the Colorado Flood Task Force was the water level at rivers, streams, diversion structures and reservoirs. SMS provided real time and historic stream flow data from gaging stations across Colorado.

The State Engineer's Office began operating the SMS in 1985. The system has become one of the most important and integral tools for the administration and management of Colorado's water resources for the entire water user community.

Initially the state operated 150 remote gaging stations linked to the SMS. Through additional funding in 1991, 251 stations are now linked to the system. Federal agencies, water conservancy districts, municipalities and private entities own other stations in Colorado and neighboring states. The Division of Water Resources collects and uses the data from 179 of these stations operated by others.

Data collected from the remote stations converts raw water level values into several products of various use to "clients". The products range from raw data passed on to other computer systems to the official Hydrographic Records of mean daily stream flows.

It was the real time mean daily stream flow values which were used by the Colorado Water Conservation Board for the Flood Task Force to monitor snowmelt runoff conditions. The stream flow values were also used in conjunction with snowpack and temperature information to develop the Colorado Flood Forecast Model to monitor potential for snowmelt flooding.

The stream flow data is made available to Colorado water users through the Division of Water Resource's Water Talk user's network system for its seven water management divisions, statewide.

Stations Monitored During 1995 Flood Threat Season

- Roaring Fork at Glenwood Springs
- Rio Grande at Del Norte
- Arkansas River at Wellsville (Salida)
- Animas River at Durango
- North Fork of the Gunnison River at Somerset
- Colorado River at Utah Stateline
- Yampa River at Steamboat Springs
- Dolores River at Dolores
- Gunnison River at Delta
- Gunnison River at Gunnison

VII. GOVERNMENTAL ACTIONS AND RESPONSE

During the months of May, June and July in 1995 CWCB staff, the Colorado Flood Task Force and the Colorado Office of Emergency Management (OEM), in cooperation with local, state and federal agencies, spent a great deal of time monitoring snowpack levels, temperatures and streamflows. This was done to facilitate preparedness and response efforts related to the runoff season. Due to very heavy snows in April and May and June, the threat of snowmelt flooding was high. There was concern about the threat of flooding in many of Colorado's watersheds. That concern led to a substantial effort by CWCB staff during the 10 weeks from early May to mid-July.

The CWCB response, in cooperation with the Task Force, OEM and the State Engineer's Office included the following actions/activities:

- Statewide notice regarding the purchase of *Flood Insurance*
- Flood Forecast Measures including the weekly publication of "**Flood Outlook**"

- Monitoring and Documentation of Specific 1995 Flooding Events;
- Evaluation and Preparation of Flood Conveyance Systems
 - Advance Measures
 - Estimating Channel Capacities
 - Determination of the Role of Flood Control and Non Flood Control Reservoirs
 - Determination of the Role of Irrigation Diversions
- Requests for Assistance in the Preparation of Local Mitigation Plans

Flood Insurance and Community Participation

See Attachment No. V for News Release

Flood Conveyance Measures

In 1995 flood damages were prevented at many location due the mitigation measures that were constructed following the 1983, 1984, 1993 floods. In addition, many locations enjoyed flood control benefits because of the improved management of reservoirs in 1995. 1995 was also marked by better advance preparation by local governments. Through the efforts of the Colorado Flood Task Force, the word about the potential runoff got out to the flood-threatened areas. That word enabled the local governments to better implement "advance measures" to prepare for any flooding. The communities of Frisco, Summit County, Grand Junction, Delta, Delta County, Gunnison, Gunnison County, Georgetown, Clear Creek County, Routt County, Garfield County, Basalt, Pitkin County, Aspen and Redstone, the various communities in the Rio Grande Valley and other communities all implemented "advance measures". Those "advance measures" included prepositioning sandbags, mobilizing contractors for emergency work, reallocating funds for floodfighting, setting up floodcasting stations and implement mitigation plans.

Knowing the "channel capacities" was a very important piece of information in flood management and preparedness. By knowing the existing channel capacities and receiving a reasonably accurate floodcast, it was possible for the local government officials and property owners to determine what level of emergency flood protection was adequate. They could identify potential breakout points, critical bridges and culverts and buildings in need of special protection. The Division of water resources stream gaging network played a very important role in the monitoring of spring snowmelt flooding.

Reservoir Operations

Chatfield, Bear Creek, Reudi and the Colorado Storage Project

During the 1995 snowmelt runoff and spring flood, the flood control and "non-flood control" reservoirs played a role in the detention of floodwaters and the reduction of flood flows. This was evident is in the Gunnison and South Platte River basins. However, we learned that there is a need to better coordinate the operations and releases of the reservoir pools during the spring runoff season. The Board and Office of Emergency Management staffs are in communication with the Corps of Engineers, Bureau of Reclamation, Denver Water Board, and private reservoir companies regarding future operations.

Like reservoir operations and releases, irrigation company diversions, operations and "bypasses" can have a major effect on downstream flood flows and inundation of floodplain lands and property. On the Roaring Fork, Rio Grande, Cache La Poudre, North Fork of the South Platte, Lower South Platte and Upper, Blue, Colorado, and Lower Arkansas Rivers, the irrigation diversions assisted in the reduction of flood flows. State agencies have no jurisdiction over these private irrigation companies as to their flood protection responsibilities during flood. These flood protection benefits must be viewed as incidental. This flood protection can only be obtained through friendly negotiations and mutual agreements for securing flood control benefits. Local governments cannot take such flood protection for granted annually without implementing better management practices.

VIII. DAMAGE ASSESSMENT

Community infrastructure and agricultural lands suffered much damage. Roads were damaged, public and private bridges were washed out, water treatment plants were overwhelmed, sewer treatment plants suffered erosion and utility lines were broken. Approximately 100 houses and commercial building experienced water damage, most of it minor. Crop lands were inundated and/or eroded. Tourist dollars were lost. There were significant damages to Colorado recreational facilities and to fish populations.

In addition, the cool, wet spring weather pattern caused a major reduction in Colorado's overall agricultural crop production. The Colorado Department of Agriculture estimates over a 20-30% reduction in yield from 1994.

Nearly all of the mountainous areas of Colorado, the mountain valleys of the Western Slope, the San Luis Valley and the Front Range (South Platte and Arkansas River systems) experienced varying degrees of flood damage during the spring 1995 flood season. The following tabulation lists the communities and associated streamcourses which experienced high water.

<u>Community</u>	<u>Streamcourse</u>	<u>Community</u>	<u>Streamcourse</u>
Adams County	South Platte River	Pueblo County	Arkansas River
Logan County	South Platte River	Pueblo	Fountain Creek
Morgan County	South Platte River	Garfield County	Roaring Fork River Crystal River
Sedgwick County	South Platte River	Basalt	Roaring Fork River
		La Plata County	La Plata River Florida River
Weld County	South Platte River St. Vrain River Cache la Poudre River	Gunnison County	Ohio Creek Tomichi Creek Gunnison River East River
Bent County	Arkansas River	Durango	Animas River
Otero County	Arkansas River	Crested Butte	Coal Creek
Prowers County	Arkansas River	Grand County	Fraser River St. Louis Creek
Wiley	Unnamed Tributary		
El Paso County	Black Squirrel Creek	Gilpin County	N. Fk. Clear Creek
<u>Community</u>	<u>Streamcourse</u>	<u>Community</u>	<u>Streamcourse</u>
Mesa County	Colorado River	Boulder County	Boulder Creek
Collbran	Plateau Creek	Boulder	Boulder Creek
Grand Junction	Colorado River	Lyons	St. Vrain Creek
		Erie	Coal Creek
Delta County	Gunnison River	Summit County	Blue River

	N. Fk. Gunnison R. Muddy Creek Minnesota Creek Hubbard Creek	Frisco Breckenridge	Tennile Creek Blue River
Paonia	N. Fk. Gunnison River	Clear Creek Cnty Georgetown	Clear Creek Leavenworth Creek
Chaffee County Buena Vista Poncha Springs	Arkansas River Cottonwood Creek Little Arkansas River	Eagle County Brush Creek	Eagle River Gypsum Creek
Pitkin County (Redstone) Aspen	Crystal River Roaring Fork River	Larimer County Rio Grande Cnty	Cache la Poudre River Rio Grande River
Park County	South Platte River	Archuleta Cnty	San Juan River
Alamosa County	Rio Grande River		
Conejos County	Rio San Antonio River Alamosa River Conejos River		
Costilla County	Culebra Creek Trinchera Creek		

Damage Overview

Damages were tabulated for most communities which experienced flood damage during the 1995 flood season. Damage ranged from impacts to residences in unincorporated Weld County (near Gilcrest) to significant loss of agricultural land in Morgan, Logan, Sedgwick and Weld Counties due to severe bank erosion. Also, nearly every flood-impacted community experienced damage to roads and bridges. This in fact, comprises the bulk of public damage figures. But beyond that, fisheries and wildlife habitat was impacted. 1995 is the first time these types of damages have been attempted to be accounted for. The following tabulation presents **public and private** damage estimates by type as of September 30, 1995:

<u>Type of Damage</u>	<u>Estimated Dollar Value</u>
Roadways, bridges, culverts	\$ 5.0 million *a
Irrigation systems	\$ 3.0 million *b
Agricultural land and repairs	\$25.0 million *c
Private residences	\$ 0.5 million *d
Public facilities (i.e. water & sewer plants)	\$ 1.0 million *e
Unbudgeted emergency services	\$ 0.1 million *f
Fisheries & tourism	\$10.0 million *g
State parks facilities	<u>\$ 2.0 million</u> *h
Total	\$46.6 million

*a Compiled from county road and bridge departments - Weld, Morgan, Logan, Boulder, Clear Creek Gilpin, El Paso, Pueblo, Otero, Bent, Prowers, Alamosa, Rio Grande, Mesa, Garfield, Eagle, Pitkin, La Plata, Archuleta, Delta, and Park Counties.

*b Irrigation systems damage was compiled from farmers in the South Platte and Arkansas River basins.

*c Compiled primarily from farmers and landowners in the South Platte and Arkansas River basins. \$15 million - South Platte River, \$5 million - Arkansas River, and \$5 million for the remainder, statewide.

*d Privately owned mobile homes in Weld County near Gilcrest, 8 homes in Wiley and 40 homes in Basalt and a statewide total of 100.

*e Obtained primarily from public works directors in Chaffee County.

*f Statewide estimate from county emergency services organizations.

*g Estimates from the Colorado Division of Wildlife and private sports entities.

*h Estimates from the Colorado Division of Outdoor Parks and Recreation.

IX. MITIGATION RECOMMENDATIONS

Mitigation Requests and Measures

There will be opportunities for flood mitigation plans and projects following the 1995 flood events. The Board and the Colorado Office of Emergency Management, in cooperation with the Department of Local Affairs and its divisions, will be meeting with flooded communities in an effort to develop viable flood hazard mitigation plans. These plans will examine a variety of measures from floodplain regulations and policies to structural flood protection projects. All of these measures would be examined with an eye as to how they could make things better for the next flood. Applications for funding for these measures will be submitted to State and federal agencies that have programs which can address the particular concern or area/regional problems. The Board staff in cooperation with OEM is presently assisting the following communities:

<u>Community</u>	<u>Type of Problem</u>
Weld County (Gilcrest) Weld County	Relocation of a floodprone subdivision/floodproofing measures Agricultural levees, overland flooding and update of floodplain information
Logan County (Merino) Logan County	Reconstruction of agricultural levees Reconstruction of roads and bridges
Lyons	Overland flooding and update floodplain information
Georgetown Idaho Springs	Overland flooding and restudy of their floodplain information Overland flooding, streambank erosion and water plant intake siltation
Silver Plume Clear Creek County	Overland flooding and restudy of floodplain information Bridge and culvert failures and overtopping, overland flooding, ongoing floodplain study

<u>Community</u>	<u>Type of Problem</u>
Wiley	Overland flooding, no floodplain regulations, no floodplain information
Las Animas	Levee damage
Rockvale	Stream protection and vulnerable utilities
Frisco	Overland and breaking out flooding and redefine floodplain
Blue River	Overland flooding, streambank erosion, no floodplain regulations and no floodplain information
Summit County	Bridge and culvert failure and overtopping, overland flooding and fire station subject to flooding
Gypsum	Overland flooding and restudy of their floodplain information
Aspen	Overland flooding
Basalt	Channel instability, river restoration plan and levee system
Redstone	New floodplain study
Pitkin County	Overland flooding and channel instability
Grand Junction (Riverside)	Design a levee system for the Riverside Area
Mesa County (Rosedale)	Relocation of a floodprone subdivision
Ouray	New floodplain study (for debris flow fans)
La Plata County	Streambank protection and new floodplain study
13 statewide requests	Stream protection projects

The State can anticipate additional requests for assistance as the full impact of the 1995 flood is assessed. For this reason, the Colorado Flood Task Force recommends that a mitigation funding component be added to the Governor's Executive Orders which are issued in the future as a result of flood events.

The Board has prepared "Scopes of Study" for Multi-Objective Floodplain Management Studies on 1) the Arkansas downstream of Pueblo, 2) the South Platte River downstream of Chatfield Reservoir, and 3) the Roaring Fork River downstream of Aspen.

X. ACKNOWLEDGEMENTS

The Colorado Flood Task Force and the Colorado Water Conservation Board would like to acknowledge the assistance and work provided by the following agencies and individuals during the response to the 1995 flood season. Without their cooperation, much of the assistance provided to communities would not have been possible.

Agency/Community

Type of Assistance

Colorado Water Conservation Board

*Larry Lang, Brian Hyde and
Mark Matulik* Flood threat assessment.
Advanced measures. Mitigation
recommendations and implementation.

Colorado Office of Emergency Mgmt.

*Tom Grier, Hal Knott, Fred Sibley
and Bob Kistner* Mitigation recommendations.

Colorado Flood Task Force Members

See Attachment No. 1

Town of Buena Vista

Roy Girton, Julia Hupper On-site mitigation
implementation and flood
fight.

Town of Poncha Springs

Mabel Hall and PW Director On-site mitigation
implementation.

Town of Lyons

Bob Freeman On-site mitigation
implementation.

Town of Paonia

John Norris On-site mitigation
implementation.

San Luis Valley communities, Rich Muniz

On-site mitigation
implementation.

Woodland Park

Joe Napoleon and David Dobbs

On-site mitigation
implementation.

XI. TECHNICAL ADDENDUM

The technical addendum for the 1995 Colorado flood report contains numerous sources of information which were used to 1) monitor, 2) prepare, and 3) respond to Colorado's flood threat. It has been prepared as a separate document and is available for photocopying from the Colorado Water Conservation Board. Its main parts are as follows:

- I. Colorado Flood Task Force Members and Work Task Participants
- II. Climatic Factors and Hydrology
- III. 1995 Stream Flow Data
- IV. 1995 Flood Season Newspaper Articles
- V. 1995 Special Reports
- VI. Governmental Actions and Response
- VII. Damage Assessment

XII. REFERENCES

1. Rocky Mountain News.
2. Denver Post.
3. CASFM Newsletter.
4. Colorado Climate. Colorado State University, August 1994.

XIII. ATTACHMENTS

- Attachment No. 1Colorado Flood Task Force Members and Work Task Participants
- Attachment No. 2Climatic Factors and Hydrology
- Attachment No. 3Colorado Flood Forecast Model Output
- Attachment No. 4Stream Flow Data
- Attachment No. 5Government Actions and Response
- Attachment No. 6Damage Assessment

1995 Flood Report

Technical Addendum

I. Colorado Flood Task Force Members

and Work Task Participants

- II. Climatic Factors and Hydrology
- III. 1995 Stream Flow Data
- IV. 1995 Flood Season Newspaper Articles
- V. 1995 Special Reports
- VI. Governmental Actions and Response
- VII. Damage Assessment

Floodplain Encroachment on South Clear Creek - Georgetown, CO

Rerouted Floodwaters of South Clear Creek - Georgetown, CO

Attachment No. 1
Colorado Flood Task Force Members
and
Work Task Participants

Attachment No. 2
Climatic Factors and Hydrology

Attachment No. 3
Colorado Flood Forecast Model Output

Attachment No. 4
Stream Flow Data

Attachment No. 5
Government Actions and Response

Attachment No. 6

Damage Assessment

Inundated Agricultural Land - Cache la Poudre River, Weld County

Floodplain Encroachment - South Clear Creek in Georgetown, Colorado

WEEKLY FLOOD OUTLOOK - APRIL 29, 1996

The Weekly Flood Outlook presents the findings of the Colorado Flood Task Force regarding the 1996 snowmelt flood threat. This Flood Outlook represents a summary of the first meeting of the Colorado Flood Task Force for 1996.

1) MAJOR BASIN SNOWPACK AS OF APRIL 29, 1996

Based on SNOTEL readings on April 29, 1996 the snowpack in Colorado's major river basins, as a percent of average snowpack, is presented in table 1.

Table 1

WATERSHED	Feb 1	Mar 1	Apr 1	Apr 29	Apr 29 Water Equivalent (inches)
MISSISSIPPI/MISSOURI RIVER BASIN					
North Platte/Laramie Rivers	142%	136%	129%	133%	34.6
South Platte River	165%	162%	155%	155%	23.9
Arkansas River	111%	112%	93%	106%	12.4
COLORADO RIVER BASIN	136%	138%	120%	137%	31.0
Yampa/White Rivers	131%	134%	128%	138%	21.3
Upper Colorado River	102%	114%	101%	113%	17.2
Gunnison River	64%	70%	68%	61%	12.1
Southwestern Colorado					
RIO GRANDE BASIN					
Rio Grande	52%	66%	59%	49%	9.3

2) WEATHER FORECAST

A. 7-10 day forecast

The National Weather Service (NWS) provided a short-term weather forecast for the next 7 to 10 days. The NWS is predicting maximum daily temperatures in the 60's during the early part of this week. Temperatures should be in the 70's from Wednesday, May 1 through Sunday, May 5. Precipitation for this week should be below normal.

B. 30 day forecast

Henz Meteorological Services provided a weather forecast for the next month or so. The general forecast is presented in table 2.

Table 2

Week #	Dates	Weather Conditions	Comments
1	4/29-5/5	Warm and dry	
2	5/6-5/12	Cool and wet early, hot and dry later	5 days of hot and dry
3	5/13-5/19	Cool and wet early, hot and dry later	7 days of hot and dry
4	5/20-5/26	Mild and possibly wet early, cool and wet later	Memorial Wknd Begins 5/25

3) STREAMFLOW MEASUREMENTS

Streamflow measurements are being monitored by the State of Colorado's Division of Water Resources (DWR) and the USGS. The DWR's "Water Talk" phone number is (303) 831-7135. The DWR also has streamflow information on the Worldwide Web at <http://www.yampa.com/resources/water/index.html>. The Colorado District of the USGS also provides streamflow information on the Worldwide Web. Their Home Page is located at <http://webservice.cr.usgs.gov/home.html>.

4) SUBBASINS UNDER WATCH

Within the major drainage basins listed in table 1 above, there are 10 subbasins with sufficient snowmelt flood risk that they are being specifically monitored. Those subbasins are listed in Table 3, along with potentially affected communities.

Table 3
SUBBASINS THAT ARE UNDER WATCH FOR SNOWMELT FLOOD RISK

MAJOR RIVER BASIN	SPECIFIC SUBBASIN	AFFECTED COMMUNITIES
SOUTH PLATTE RIVER BASIN	Clear Creek	<i>Silver Plume, Georgetown, Idaho Springs, Clear Creek County</i>
	Boulder Creek	<i>Nederland, Boulder, Boulder County</i>
ARKANSAS RIVER BASIN	Upper Arkansas River	<i>Lake County, Buena Vista, Poncha Springs, Salida, Chaffee County</i>
COLORADO RIVER BASIN (Northern portion of basin)	Yampa River	<i>Yampa, Oak Creek, Steamboat Springs, Routt County</i>
	Fraser River	<i>Winter Park, Fraser, Granby, Grand County</i>
	Blue River	<i>Blue River, Breckenridge, Frisco, Silverthorne, Montezuma, Summit County</i>
	Eagle River	<i>Vail, Red Cliff, Minturn, Avon, Eagle, Gypsum, Eagle County</i>
	Roaring Fork River	<i>Aspen, Snowmass Village, Basalt, Pitkin County, Eagle County, Carbondale, Glenwood Springs, Garfield County</i>
	Upper Gunnison River	<i>Crested Butte, Mt. Crested Butte, Gunnison County</i>
	Colorado River Mainstem	<i>Eagle County, Glenwood Springs, New Castle, Silt, Rifle, Parachute, Garfield County, DeBeque, Palisade, Grand Junction, Fruita, Mesa County</i>

5) NECESSARY ACTIONS

1. Local officials should review flood impacts and response plans from previous years (1983, 1984, 1993, 1995), and make revisions as necessary for this year's runoff season.
2. Property owners and local officials should be familiar with their community's flood prone areas, and identify specific trouble spots.
3. Local officials should obtain snowpack, temperature, and streamflow information on their own or through the Flood Task Force. Stay informed, especially if you are in one of the **Subbasins Under Watch**.
4. Citizens and local officials may contact local emergency managers or Fred Sibley (273-1775) regarding sandbag availability.
5. The threat of landslides and mudflows is being monitored by the CGS. Contact Vicki Cowart (303-866-2611) for further information.
6. In Colorado, snowmelt flood events usually occur between May 15 and June 30. Occasionally, snowmelt flooding can occur as late as July 15.
7. Property owners should check to see if they need flood insurance. (Only 20% of Colorado's flood prone structures carry flood insurance). There is now a 30 day waiting period before flood insurance coverage becomes effective.
8. Be aware that many reservoirs and irrigation diversions will not have an effect on flood flows during the peak runoff.

Next Task Force meeting is Monday, May 13, 1996 at 10:00 AM.

Location: NRCS Building

655 Parfet, 3rd Floor

(Same Location as the 1995 Task Force meetings)

6) SNOWMELT RUNOFF MODEL

The CWCB, in cooperation with NRCS, NWS and SEO, developed a snowmelt runoff and river level prediction model during the 1995 flood season. The use of the model for the 1996 runoff season will be discussed during the May 13, 1996 Flood Task Force meeting. streams and locations.

7) LIST OF FLOOD TASK FORCE MEMBERS

The list of the 1996 Flood Task Force members was provided with the meeting agenda. For specific flood information, it is recommended that you contact the appropriate Flood Task Force member for your concern.

Information in this report is a compilation of materials from presentations of the "The Colorado Task Force", Larry Lang, Chair. The Task Force is made up of NRCS, NWS, FEMA, DOLA, OEM, DWR, CWCB, DNR, CGS and John Henz.

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WEEKLY FLOOD OUTLOOK - MAY 28, 1996

The Weekly Flood Outlook presents the findings of the Colorado Flood Task Force regarding the 1996 snowmelt flood threat. This Flood Outlook represents a summary of the first meeting of the Colorado Flood Task Force for 1996.

1) MAJOR BASIN SNOWPACK AS OF MAY 28, 1996

Based on SNOTEL readings on May 28, 1996 the snowpack in Colorado's major river basins, as a percent of average snowpack, is presented in Table 1.

Table 1

WATERSHED	Mar 1	Apr 1	Apr 29	May 28	May 28 Ave. Water Equiv. (inches)
MISSISSIPPI/MISSOURI RIVER BASIN					
North Platte/Laramie Rivers	136%	129%	133%	111%	21.1
South Platte River	162%	155%	155%	156%	13.0
Arkansas River	112%	93%	106%	106%	5.3
COLORADO RIVER BASIN					
Yampa/White Rivers	138%	120%	137%	116%	17.5
Upper Colorado River	134%	128%	138%	99%	8.2
Gunnison River	114%	101%	113%	57%	3.2
Southwestern Colorado	70%	68%	61%	1%	0.1
RIO GRANDE BASIN					
Rio Grande	66%	59%	49%	1%	0.0

2) WEATHER FORECAST

A. 7-10 day forecast

The National Weather Service (NWS) provided a short-term weather forecast for the next 7 to 10 days. The NWS is predicting maximum daily temperatures in the high 70's and low 80's during the next week or so for Denver and Grand Junction. Precipitation for the week should be minimal, but there is a chance of showers during the week.

B. 30 day forecast

Henz Meteorological Services provided a weather forecast for the next month or so. There appears to be an unsettled weather pattern that will move through the state causing thunderstorm activity. There is a chance of thunderstorm activity along the Front Range during the first 10 to 14 days of June, which could produce intense rainfall. There will be periods of warm and dry weather between the thunderstorms. The general forecast is presented in table 2.

Table 2

Week #	Dates	Weather Conditions
1	5/29-6/2	Warm and dry most of the week
2	6/3-6/9	Storm early, hot mid-week, storm at the end of the week
3	6/10-6/16	Storms early, hot at the end of the week
4	6/17-6/30	Hot some of the week, possible thunderstorms or general rain part of the week

3) STREAMFLOW MEASUREMENTS

Streamflow measurements are being monitored by the State of Colorado's Division of Water Resources (DWR) and the USGS. The DWR reported high stream flows (spikes) on the lower reaches of the South Platte and Arkansas Rivers due to rainfall runoff over the Memorial Day Weekend. The DWR's "Water Talk" phone number is (303) 831-7135. The DWR also has streamflow information on the Worldwide Web at <http://www.yampa.com/index2.html>. The Colorado District of the USGS also provides streamflow information on the Worldwide Web. Their Home Page is located at <http://webserver.cr.usgs.gov/home.html>. A summary of recent peak streamflows for selected streams is shown in the table 3 below:

**Table 3
PEAK FLOW SUMMARY THROUGH 5/27/96 FOR SELECTED STREAMS**

Stream Name	Location	Measured Flow (cfs)	Comment
Tenmile Creek	At Frisco	680	Flow within channel
Blue River	Above Dillon	645	Flow within channel
Yampa River	At Steamboat Springs	2840	Flow within channel
Clear Creek	At Lawson	500	Flow within channel
Eagle River	Near Gypsum	2890	Flow within channel

4) STREAMS UNDER WATCH

Within the major drainage basins listed in table 1 above, there are 5 stream basins with sufficient snowmelt flood risk that they are being specifically monitored. Those streams are listed in Table 4, along with potentially affected communities.

**Table 4
STREAMS THAT ARE UNDER WATCH FOR SNOWMELT FLOOD RISK**

MAJOR RIVER BASIN	SPECIFIC STREAM	AFFECTED COMMUNITIES
SOUTH PLATTE RIVER BASIN	Clear Creek and Chicago Creek	<i>Silver Plume, Georgetown, Idaho Springs, Clear Creek County</i>
COLORADO RIVER BASIN (Northern portion of basin)	Yampa River	<i>Yampa, Oak Creek, Steamboat Springs, Routt County</i>
	Blue River	<i>Blue River, Breckenridge, Frisco, Silverthorne, Montezuma, Summit County</i>
	Eagle River	<i>Eagle, Gypsum, Eagle County</i>
	Tenmile Creek	<i>Frisco and Summit County</i>

5) **SUMMARY INFORMATION**

1. There does not appear to be a general snowmelt flood threat in Colorado at this time. Flooding from the 1996 snowmelt runoff season may only be a problem for a few areas in the state. The streams under watch will be monitored over the next several weeks.
2. The snow line appears to be around 10,000 feet in the northern mountains, and around 11,000 feet in the southern mountains.
3. Denver Water is regulating Dillon Reservoir to help minimize downstream flooding problems. The reservoir outflow is kept to 1800 cfs or less when possible.
4. The volume of snowmelt runoff for 1996 seems to be much less than it was for 1995.
5. Property owners and local officials should be familiar with their community's flood prone areas, and identify specific trouble spots.
6. Local officials should obtain snowpack, temperature, and streamflow information on their own or through the Flood Task Force. Stay informed, especially if you are in one of the **Streams Under Watch**.
7. Citizens and local officials may contact local emergency managers or Fred Sibley (273-1775) regarding sandbag availability.
8. The threat of landslides and rockslides is being monitored by the CGS. There were some reported rockslides this past weekend due to the rainfall in the area. Contact Vicki Cowart (303-866-2611) for further information.
9. **Local officials and citizens should be aware that Colorado's most severe floods have historically been caused by thunderstorms and general rain, not by snowmelt runoff!**

Information in this report is a compilation of materials from presentations of the "The Colorado Task Force", Larry Lang, Chair. The Task Force is made up of NRCS, NWS, FEMA, DOLA, OEM, DWR, CWCB, DNR, CGS and John Henz.

Next Task Force meeting is Tuesday, June 18, 1996 at 1:00 PM.

IMPORTANT NOTE: The next meeting is at 1:00 PM instead of 10:00 AM

***Location: US F&WS Building
755 Parfet, 2nd Floor
(Same Location as the May 28, 1996 Task Force meeting)***

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WEEKLY FLOOD OUTLOOK - JUNE 7, 1996

The Weekly Flood Outlook presents the Colorado Flood Task Force's findings regarding the 1996 snowmelt flood threat. This Outlook was prepared because of hot weather expected for the next few days.

1) MAJOR BASIN SNOWPACK AS OF JUNE 7, 1996

Based on SNOTEL readings on June 7, 1996 the snowpack in Colorado's major river basins, as a percent of average snowpack, is presented in Table 1.

Table 1

WATERSHED	Apr 1	Apr 29	May 28	June 7	June 7 Ave. Water Equiv. (inches)
MISSISSIPPI/MISSOURI RIVER BASIN					
North Platte/Laramie Rivers	129%	133%	111%	117%	13.6
South Platte River	155%	155%	156%	135%	5.8
Arkansas River	93%	106%	106%	0%	0.0
COLORADO RIVER BASIN					
Yampa/White Rivers	120%	137%	116%	130%	10.5
Upper Colorado River	128%	138%	99%	78%	2.9
Gunnison River	101%	113%	57%	51%	1.3
Southwestern Colorado	68%	61%	1%	1%	0.1
RIO GRANDE BASIN					
Rio Grande	59%	49%	1%	0%	0.0

2) WEATHER FORECAST

A. 7-10 day forecast

The National Weather Service (NWS) provided a short-term weather forecast for the next 7 to 10 days. The NWS is predicting maximum daily temperatures in the high 80's and low 90's during the next week or so for Denver and Grand Junction. Precipitation for the week should be negligible, but there is a chance of very minor showers during the week.

B. 15 day forecast

Henz Meteorological Services provided a weather forecast for the next two weeks or so. There appears to be a very strong hot and dry weather pattern that will settle into the state causing rapid snowmelt. There is very little chance of thunderstorm activity or general rain in the mountain watersheds during the next 10 to 14 days. The general forecast is presented in table 2.

Table 2

Week #	Dates	Weather Conditions
1	6/8-6/14	Hot and dry
2	6/15-6/21	Hot and dry

After these two week of hot and dry weather, it is expected that most of the snowpack will have melted and that the threat of snowmelt flooding will largely have passed for 1996.

3) STREAMFLOW MEASUREMENTS

Streamflow measurements are being monitored by the State of Colorado's Division of Water Resources (DWR) and the USGS. The DWR reported moderate increases in stream flows at some locations this past week after warm days, but no flows that cause concern yet. The DWR's "Water Talk" phone number is (303) 831-7135. The DWR also has streamflow information on the Worldwide Web at <http://www.yampa/water/flow>. The Colorado District of the USGS also provides streamflow information on the Worldwide Web. Their Home Page is located at <http://webserver.cr.usgs.gov/home.html>. A summary of recent peak streamflows for selected streams is shown in the table 3 below:

**Table 3
PEAK FLOW SUMMARY THROUGH 6/7/96 FOR SELECTED STREAMS**

Stream Name	Location	Measured Flow (cfs)	Comment
Tenmile Creek	At Frisco	1240	Flow within channel
Blue River	Above Dillon	620	Flow within channel
Yampa River	At Steamboat Springs	3540	Flow within channel
Clear Creek	At Lawson	710	Flow within channel
Eagle River	Near Gypsum	3730	Flow within channel

4) STREAMS UNDER WATCH

Within the major drainage basins listed in table 1 above, there are 5 stream basins with sufficient snowmelt flood risk that they are being specifically monitored. Those streams are listed in Table 4, along with potentially affected communities.

**Table 4
STREAMS THAT ARE UNDER WATCH FOR SNOWMELT FLOOD RISK**

MAJOR RIVER BASIN	SPECIFIC STREAM	AFFECTED COMMUNITIES
SOUTH PLATTE RIVER BASIN	Clear Creek and Chicago Creek	<i>Silver Plume, Georgetown, Idaho Springs, Clear Creek County</i>
COLORADO RIVER BASIN (Northern portion of basin)	Yampa River	<i>Yampa, Oak Creek, Steamboat Springs, Routt County</i>
	Blue River	<i>Blue River, Breckenridge, Frisco, Silverthorne, Montezuma, Summit County</i>
	Eagle River	<i>Eagle, Gypsum, Eagle County</i>
	Tenmile Creek	<i>Frisco and Summit County</i>

5) SUMMARY INFORMATION

1. There does not appear to be a general snowmelt flood threat in Colorado at this time. Flooding from the 1996 snowmelt runoff season may only be a problem for a few areas in the state. The streams under watch will be monitored over the next two weeks.
2. **The streams under watch (see Table 4) will experience peak flows during the next week or so, as the hot weather melts the remaining snowpack.**
3. The snow line appears to be around 10,000 feet in the northern mountains, and around 11,000 feet in the southern mountains.
4. Denver Water is regulating Dillon Reservoir to help minimize downstream flooding problems. The reservoir outflow is kept to 1800 cfs or less when possible.
5. The volume of snowmelt runoff for 1996 seems to be much less than it was for 1995.
6. Property owners and local officials should be familiar with their community's flood prone areas, and identify specific trouble spots.
7. Local officials should obtain snowpack, temperature, and streamflow information on their own or through the Flood Task Force. Stay informed, especially if you are in one of the **Streams Under Watch**.
8. Citizens and local officials may contact local emergency managers or Fred Sibley (273-1775) regarding sandbag availability.
9. The threat of landslides and rockslides is being monitored by the CGS. There were some reported rockslides two weekends ago due to the rainfall in the area. Contact Vicki Cowart (303-866-2611) for further information.
10. **Landowners located near the channels and floodplains of Tenmile Creek, the Blue River, the Yampa River, Clear Creek, and, to a lesser degree, the Eagle River, should be advised that those streams may experience flood peaks near 1995 levels about Tuesday, June 11, 1996, or Wednesday, June 12, 1996.**
11. **Local officials and citizens should be aware that Colorado's most severe floods have historically been caused by thunderstorms and general rain, not by snowmelt runoff!**

Information in this report is a compilation of materials from presentations of the "The Colorado Task Force", Larry Lang, Chair. The Task Force is made up of NRCS, NWS, FEMA, DOLA, OEM, DWR, CWCB, DNR, CGS and John Henz.

Next Task Force meeting is Tuesday, June 18, 1996 at 1:00 PM.

IMPORTANT NOTE: The next meeting is at 1:00 PM instead of 10:00 AM

***Location: US F&WS Building
755 Parfet, 2nd Floor
(Same Location as the May 28, 1996 Task Force meeting)***

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*** FLOOD OUTLOOK UPDATE- JUNE 10, 1996 ***

This Update was prepared after the past weekend of hot weather, and is an update to the June 7, 1996 Weekly Flood Outlook.

1) MAJOR BASIN SNOWPACK AS OF JUNE 10, 1996

Based on SNOTEL readings on June 10, 1996 the snowpack in Colorado's major river basins is decreasing at a fairly rapid rate due to the hot and dry weather.

2) WEATHER FORECAST

There is no significant change in the weather forecast (*see the June 7, 1996 Weekly Flood Outlook*).

3) STREAMFLOW MEASUREMENTS

Streamflow measurements are being monitored by the State of Colorado's Division of Water Resources (DWR) and the USGS. There were some moderate increases in stream flows at some locations, but no flows that cause concern. A summary of recent peak streamflows for selected streams is shown in the table below:

RECENT PEAK FLOW SUMMARY FOR SELECTED STREAMS

Stream Name	Location	Measured Flow (cfs)	Date of Measured Flow
Tenmile Creek	At Frisco	1240	June 5, 11:45 pm
Blue River	Above Dillon	630	June 9, 8:45 am
Yampa River	At Steamboat Springs	3620	June 9, 11:00 pm
Clear Creek	At Lawson	930	June 10, 2:00 am
Eagle River	Near Gypsum	3730	June 7, 7:00 am

4) STREAMS UNDER WATCH

There is no significant change to the Streams Under Watch at this time.

5) SUMMARY INFORMATION

1. For most of Colorado, there is no longer a snowmelt flood threat for the 1996 runoff season. Flooding from the 1996 snowmelt runoff may be a problem for a few specific areas in the state. The streams under watch will be monitored through the next week.
2. The streams under watch will continue to experience high flows during the next week or so, as the hot weather melts the remaining snowpack. The flows will begin to taper off as the available snowpack diminishes.
3. Landowners located near the channels and floodplains of Tenmile Creek, the Blue River, the Yampa River, Clear Creek, and the Eagle River, should be advised that those streams may experience high flows during this week. A review of the streamflows and snowpack for the past weekend indicates that it is unlikely that 1996 peaks will reach levels experienced in 1995.
4. Local officials should obtain snowpack, temperature, and streamflow information on their own or through the Flood Task Force. Stay informed, especially if you are in one of the Streams Under Watch.
5. **Local officials and citizens should be aware that Colorado's most severe floods have historically been caused by thunderstorms and general rain, not by snowmelt runoff!**

*** FLOOD OUTLOOK UPDATE- JUNE 19, 1996 ***

This Update was prepared after the last Flood Task Force meeting that was held on June 18, 1996. There will be no more Flood Task Force meetings held this year relating to snowmelt runoff. The Colorado Water Conservation Board would like to thank all of this year's participants in the Colorado Flood Task Force. Information from the NRCS, NWS, USGS, DWR, FEMA, John Henz, OEM, DOLA, CGS, and Denver Water was very helpful for the preparation of the 1996 flood outlook reports. These reports provided useful information to government agencies, communities, citizens, news media, and other interested parties.

1) MAJOR BASIN SNOWPACK AS OF JUNE 19, 1996

Based on SNOTEL readings on June 19, 1996 the snowpack in Colorado's major river basins has mostly melted away. The average snow water equivalent for Colorado's major drainage basins is quickly approaching zero. Southwest Colorado is very dry at this time. Fire danger is high in certain parts of the state!

2) WEATHER FORECAST

The weather should be mostly hot and dry throughout the next week, with scattered showers and thunderstorms.

3) STREAMFLOW MEASUREMENTS

Streamflow measurements are being monitored by the State of Colorado's Division of Water Resources (DWR) and the USGS. Most of the mountain area streamflows have stabilized or decreased in the last week or so. A summary of recent streamflows for selected streams is shown in the table below. These flows are less than the flows experienced during the previous week or so.

RECENT PEAK FLOW SUMMARY FOR SELECTED STREAMS

Stream Name	Location	Measured Flow (cfs)	Date of Measured Flow
Tenmile Creek	At Frisco	910	June 16, 1996
Blue River	Above Dillon	590	June 16, 1996
Yampa River	At Steamboat Springs	2780	June 16, 1996
Clear Creek	At Lawson	990	June 16, 1996
Eagle River	Near Gypsum	3590	June 16, 1996

4) SUMMARY INFORMATION

1. For most of Colorado, there is no longer a snowmelt flood threat for the 1996 runoff season. Selected streamflows will be monitored over the next week or two.
2. **Local officials and citizens should be aware that Colorado's most severe floods have historically been caused by thunderstorms and general rain, not by snowmelt runoff! Summer thunderstorms and rains can cause serious flooding problems with little time to prepare. Stay tuned to TV stations and radio stations to receive information about severe weather watches and warnings from the National Weather Service.**