RIVERSIDE

FLOOD DSS MEMORANDUM

TO: Carolyn Fritz, Chris Sturm - CWCB
FROM: Amy Volckens - Riverside
DATE: September 25, 2009
SUBJECT: Results from the User Needs Assessment

1.0 Introduction

Riverside conducted a series of interviews with CWCB personnel and external stakeholders (see Attachment 1) to solicit input on the layout, contents, and functionality to be included in the Flood DSS. Recognizing that the potential for useful data and functionality will exceed the available project resources, the needs assessment was also used to prioritize the implementation of system components. This memorandum presents a summary of the results from the user needs assessment and recommendations for proceeding with the data inventory task. The content of this memorandum represents a compilation of the user comments; not all input is recommended for immediate implementation in the Flood DSS.

2.0 Feedback on the Prototype Site

Riverside reviewed the Flood DSS prototype website with the interview candidates to elicit specific feedback about the site, including the contents, organization, and functionality. In general, the stakeholders were excited about the Flood DSS and its potential for centralizing data, linking various data types, and improving access for users that lack GIS software or personnel. The stakeholders felt that the prototype website has a good look and feel that was familiar to them, although several encouraged moving away from ArcIMS to ArcGIS Server.

Stakeholders felt that the prototype website might be overwhelming to beginning users who are not familiar with GIS data and functionality. This supports the recommendation from the evaluation of alternative technologies to develop the Flood DSS as one power user site and multiple simpler sites.

Stakeholders identified two perceived conceptual deficiencies in the prototype site:

- The prototype site is more of a data collection system than a decision support system. For example, the real-time data component supports event validation rather than forecasting. Users recognized that data collection is the first step, but felt that more real-time analysis (e.g., modeling, forecasting) could be required for decision support.
- The prototype site focuses on floodplain and emergency management. The Flood DSS has the potential to integrate mapping, assessment, mitigation, and planning, much like FEMA's RiskMAP program (http://www.fema.gov/plan/ffmm.shtm).

Specific requests for the Flood DSS included:

- Making background layers more transparent so data visibility improves
- Including zoom and pan functionality similar to Google Maps

- Labeling the map with the scale (e.g., 1 in = 100 miles)
- Adding major river basin boundaries

3.0 Flood DSS Site

A successful Flood DSS site will focus on user needs and the data required to make decisions. Flooding concerns vary across the state, requiring different lead times for warnings and flood outlook information. East slope users are more concerned with rainfall-driven events that develop in short periods of time (e.g., several hours); west slope users are more concerned with snowmelt-driven events that develop over longer periods of time (e.g., days).

The users of the Flood DSS were identified as CWCB personnel, floodplain managers, emergency managers, elected officials, utilities, recreationalists, the media, and the public.

During the user needs assessment, seven thematic components to the Flood DSS emerged, consisting of multiple data layers plus supporting base and background data. Each component is described in more detail in this memorandum:

3.1. Floodplain boundaries
3.2. Historical flood information
3.3. Real-time data and alerts
3.4. Multi-hazard
3.5. Weather modification
3.6. Watershed restoration
3.7. Community information

3.1 Floodplain Boundaries

The floodplain boundaries component is a high priority piece of the system that would include regulatory floodplain boundaries, non-regulatory floodplain boundaries, flood flows, and inundation areas. The main user groups of this system component include floodplain managers, planning personnel, and the public.

The use cases that have been identified for this component include:
- Reviewing preliminary DFIRMs (restricted to communities)
- Accessing information from effective DFIRMs
    - Identifying whether areas are within regulatory floodplain boundaries
    - Identifying differences between regulatory and non-regulatory floodplain boundaries
- Assessing changes to regulatory floodplain boundaries over time
    - Comparing FIRMs and DFIRMs
    - Accessing LOMR/CLOMR information

Table 1 contains a list of potential data layers for this component. From this list, spatial layers related to effective DFIRMs, preliminary DFIRMs, and non-regulatory floodplain boundaries were identified as needs. Additional layers related to flood flows and inundation areas were identified as “wants.” The data layers presented in Table 1 for the preliminary DFIRMs are the data layers typically provided with DFIRM databases. The data layers presented in Table 1 for the effective DFIRMs are the data layers included in FEMA’s National Flood Hazard Layer (NFHL) web

service. Data layers in the web service that appear repetitive are typically layers that are visible at different map scales.

Table 1. Potential Data Layers – Floodplain Boundaries

General Data Descriptor	Data Layer	Priority
Preliminary DFIRMs	Base flood elevation lines on the printed DFIRM	Need
	Base map transportation line features	Need
	Coastal Barrier Resources System polygons	NA
	Coastal transect lines	N/A
	Cross section locations	Need
	DFIRM panel scheme polygons	Need
	Flood hazard zone lines	Need
	Flood hazard zone polygons	Need
	General study information	Need
	Hydraulic structures shown on DFIRM such as (levees, weirs, bridges, dams, culverts)	Need
	Leader lines for printed DFIRM labels	Need
	National Geodetic Survey (NGS) benchmark locations	Need
	Point location of printed DFIRM labels	Need
	Political boundary line	Need
	Political boundary polygon	Need
Preliminary DFIRMs (cont.)	Public Land Survey System (PLSS) township, range, and section lines	Need
	Public Land Suvey System (PLSS) section polygons	Need
	Raster base map tiling scheme	Need
	River Mile marker locations	Need
	Stream centerlines	Need
	Tabular data representing all affected communities	Need
	Tabular data representing cross section stationing origins	Need
	Tabular data representing FHBM revisions	Need
	Tabular data representing historic FIRM revisions	Need
	Tabular data representing Letters of Map Change (LOMC)	Need
	USGS 7.5 minute quadrangle boundaries	Need
	Water body polygons	Need
Effective DFIRMs	Base Flood Elevation	Need
	Bench Marks	Need
	CBRS and OPA Units	N/A
	Coastal Transects	N/A
	Cross Sections	Need
	DFIRM Data Availability	Need
	DFIRM Panels (detailed)	Need
	Flood Data Availability	Need
	Flood Hazard Zones (Detailed)	Need
	Flood Hazard Zones (General)	Need
	Flood Hazard Zones (General-lrg)	Need
	Flood Hazard Zones (General-med)	Need

General Data Descriptor	Data Layer	Priority
	Flood Hazard Zones (linear)	Need
	Flood Hazard Zones (mask)	Need
	Flood Hazards Zone Boundaries	Need
	Flood Map Availability	Need
	Flood Map Panels (national)	Need
	Floodways	Need
	Floodways (linear)	Need
	General Structures	Need
	Jurisdiction Boundaries	Need
	Jurisdiction Names	Need
	Jurisdiction Names 2	Need
	Limit of Floodway	Need
	LOMA and LOMR-F	Need
	LOMR's	Need
	No DFIRM mask	Need
	PLSS	Need
	Preliminary Maps Issued	Need
	Q3 Flood Hazards	Need
	Q3 Flood Hazards (red)	Need
	River Distance Markers	Need
	Streams	Need
Effective DFIRMs (cont.)	Streets (from DFIRM)	Need
	USGS Quads	Need
	Water Bodies	Need
	Watershed (HUC)	Need
Local (non-regulatory) Floodplains	To be determined from county data collection	Need
Flood Flows	100-yr flood flows from DFIRMs	Want
Inundation Areas	Dam break inundation areas	Want
Inundation Areas	Flood inundation mapping	Want
LOMR/CLOMR	LOMC Database	Want

The floodplain boundaries component should include links to the following documents in Laserfiche:

- Flood insurance studies
- FIRMs
- LOMR/CLOMR documents

This component should include external links to:

- CWCB Map Modernization website
- Community floodplain programs
- Community internet mapping applications
  - Boulder floodplain map
  - South Boulder Creek flood mapping study
  - UDFCD floodplain boundaries
- FEMA Map Service Center

    - DFIRMs
    - LOMR/CLOMR documents
- FEMA Mapping Information Platform
- Hydrologic and hydraulic models

The Phase I Flood DSS was not scoped to include an address search functionality. However, this was identified as a desirable feature, particularly for floodplain managers who require this functionality as part of their daily work process. Riverside will investigate the project impact of adding an address search functionality.

During the data inventory task, Riverside will confirm that all data layers have been identified that are required for communities to successfully review their preliminary DFIRMs. Several stakeholders that have in-house GIS applications indicated they would not likely use this function of the Flood DSS. Others indicated they may review the preliminary DFIRMs using the Flood DSS as long as the required background information is available.

Stakeholders identified the following issues related to floodplain mapping:
- There is a need to develop floodplain mapping in federal lands.
- The Flood DSS could serve as a methodological resource where people learn how to do things like floodplain mapping by gathering information from local entitles, consultants, and academic institutions. This idea has not been scoped into the design of the Flood DSS.

3.2 Historical Flood Information

The historical flood information component was identified as an important education tool for the media, elected officials, and the public and a planning tool for community officials developing mitigation plans. The Flood DSS should tell a story about the historical floods that have occurred in Colorado, including what happened, where it happened, and what actions were taken as a result. The challenge of this component is the amount of work that would be required to assemble and maintain a statewide data layer. However, this component could be a piece of the system that improves over time. Eventually, this component of the Flood DSS should serve as a comprehensive bibliography of community flood information.

The use cases that have been identified for this component include:
- Educating users about flood risks
- Accessing archived information for historical flood events
- Identifying differences between regulatory floodplain boundaries and historical flood extents
- Providing information for events that occurred that were larger than the 100-yr flood event
- Updating hydrologic and hydraulic models, floodplain boundaries, hazard mitigation plans, and emergency response plans based on historical events
- Conducting emergency response exercises and flood studies

Table 2 lists the potential data layers that have been identified for the historical flood component.

Table 2. Potential Data Layers – Historical Flood Information

Data Layer	Priority	Comments
Statewide Historical flood layer	Need	Attributes would include: Date of event, precipitation totals, damaged areas, streams affected, deaths, damage estimates, links to available reports/video/photographs
Historical flood area delineations	Want	Could be multiple layers by flood event; could depend on county data collection activities
Historical flood damage zones	Want	
Historical flood isohyetals	Want	
Historical event precipitation time series by gage	Want	
Water mark surveys	Want	
Frequency of overtopping arterial ways	Want	
Largest flood of record by gage	Want	Layer of stream gages, with attribute of largest flood of record; may be available from NWS
High flow years	Want	Layer of stream gages, with linked tables of high flow years; may be available from NWS

The statewide historical flood layer generated a lot of interest from the stakeholders. The layer should include features on a statewide map indicating known locations of major flood events. Clicking on a feature would bring up a standard summary for an event that could include:

- Location of event (city, town, or nearest community)
- Streams affected
- Date of the event
- Damages
- Fatalities
- Peak flows
- Presidential Disaster Declaration #
- Links to photos, reports and related documents

This component should include links to annual flood reports and historical flood reports that are available in the Laserfiche system. In addition, this component should include external links to:

- Photograph and video documentation
- Other sources of historical flood information
    - NWS Noteworthy Colorado Floods
    - UDFCD Notes on Colorado's Flood History
    - Flood Safety website

3.3 Real-Time Data and Alerts

The primary objectives of the real-time data and alerts component are to identify areas of the state that are currently at risk for flooding, and providing users with sufficient information to monitor a storm event. This component would be primarily used by emergency managers and the public, including recreationalists.

The use cases that have been identified for this component include:

- Monitoring current weather conditions, either as part of a daily work process or in response to receiving an alert
- Identifying potential flood threats (e.g., forecasting, real-time modeling)

Table 3 lists the potential data layers that have been identified for this component. The highest priority layers include current streamflow conditions, observed precipitation (gage and radar), snowpack, NWS and Satellite Monitoring System Alert System (SMSAS) alerts, and HDR's flood outlook products. Some of the data elements, such as temperature, wind, and dew point, are most useful for anticipating flood threats. Stakeholders provided mixed input regarding whether they would use the Flood DSS to monitor weather conditions on a daily basis. Overall, most of the stakeholders rely upon the NWS or private meteorologists to issue an alert, at which point they begin to monitor current weather and flow conditions using their in-house data systems or external websites such as the NWS and USGS. Most users indicated they would use the real-time data and alerts component of the Flood DSS during a storm event.

Table 3a. Potential Data Layers – Real-Time Data and Alerts (Needs)

General Data Descriptor	Data Layer
Streamflow/Stage	Current conditions - Hydrobase
	Current conditions - USGS
Observed Precipitation	Radar - NWS
	Gaged - Hydrobase COOP & COAGM
	Precipitation Average (30-yr average)
Forecasted Precipitation	0-3 hours QPF
	6-hr QPF for Days 1-3 (NCEP; NDFD)
Temperature	Gaged - Hydrobase COOP
Snowpack	SNOTEL - Current SWE
	SNODAS SWE - Current SWE
Alerts	NWS Weather
	NWS Flow
	SMSAS Flow
	Flash Flood Alerts
Outlook	HDR Flood Threat Bulletin
	HDR Flood Outlook

Table 3b. Potential Data Layers – Real-Time Data and Alerts (Wants)

General Data Descriptor	Data Layer
Streamflow/Stage	Current conditions - UDFCD MADIS
Observed Precipitation	Radar - Weather channels
	Radar - Dept of Defense
	Radar - 24 hr (Hybrid) Derived QPE - NSSL
	Radar – Coverage or uncertainty maps
	Satellite - 24 hr Derived QPE - NSSL
	Gaged - COCORAHS
Forecasted Precipitation	24-hr QPF for Days 1-3 (NCEP)
Temperature	RUC Model Surface Temperature (NSSL)

General Data Descriptor	Data Layer
	Forecasted temperature Days 1-3 (NDFD)
Snowpack	NRCS Snow Courses - Current SWE
	SNODAS SWE - 24-hr Change in SWE
	SNODAS SWE - 7-day Change in SWE
	SNODAS SWE - 1-Month Change in SWE
Soil moisture	SNOTEL
Sublimation	SNODAS - cumulative WY sublimation loss
Snowmelt	SNODAS - 24-hr simulated snowmelt
Solar Radiation	Solar Radiation
Wind	Forecasted wind speed (NDFD)
Wind (cont.)	Forecasted wind direction (NDFD)
	Current wind speed
	Current wind direction
Dew point	Forecasted dew point temperature (NDFD)
	Dew point temperature
Evaporation	Hydrobase - Current conditions
	Evaporation Average (1956-1970)
Outlook	Flood Task Force Summary
	At-risk stream segments
	Significant River Flood Outlook (NCEP)
	Excessive rainfall forecasts (NCEP)
	Heat Index Forecasts (NCEP)
	Climate Outlook Probabilities (NDFD)
Water supply	Forecasted seasonal water supply

The real-time data and alerts component could include links to archived SNODAS and SNOTEL maps in the Laserfiche system. The component should also include external links to:

- Sources of real-time and forecasted information
    - Accuweather radar center
    - CBRFC SNOTEL plots
    - Climate Prediction Center
    - CoCoRAHS
    - College of DuPage weather
    - Colorado Avalanche Information Center
    - CRWCD Data site
    - CSU RAMS model
    - DWR Flow website
    - EMWIN (Emergency Managers Weather Information Network) Denver
    - Fire Weather by UDFCD
    - FSL MADIS Surface Data
    - Intellicast radar, precipitation
    - Local radar
    - Mesowest
    - National Several Storms Laboratory
    - NCAR/RAP
    - NCWCD Flows

    - NRCS Snow Summary
    - NWS 7-day weather forecast
    - NWS AHPS
    - NWS Pueblo WFO
    - NWS Radar
    - UDFCD Alert System
    - Unisys satellite imagery
    - USACE Albuquerque
    - USACE Missouri RB
    - USGS Real-Time Data
    - Weather Channel
    - Weather Underground
- Emergency management programs
    - Community contacts
    - Colorado Department of Emergency Management
- Sources of flood outlook
    - HDR Flood Outlook (if not included spatially)
    - HDR Flood Threat Bulletin (if not included spatially)

The stakeholders expressed a high level of interest in receiving alerts from the Flood DSS via pop-up messages within the Flood DSS, text messages, and e-mail messages. Stakeholders indicated that the flow thresholds used by the NWS and in SMSAS are not always reliable, for reasons that range from dynamic channel morphology to differences between flood thresholds and political or action thresholds. CWCB is currently updating its thresholds for SMSAS. Stakeholders indicated that they receive more alerts than truly require attention. This indicates the Flood DSS may need to include user preferences or filtering mechanisms to prevent excessive alert notifications.

Both the NWS and SMSAS alerts are available at point locations, but don't provide information about downstream impacts. Stakeholders expressed interest in developing routing tools that would serve to indicate whether flooding is impacting downstream locations. This functionality would improve the alert notifications by providing a larger watershed perspective. This functionality has not been scoped for the Flood DSS.

For real-time streamflow conditions, stakeholders expressed interest in being able to click on a stream gage to open a hydrograph that shows recent data, historical averages, and alert levels. This should function similarly to the DWR flow website, which allows the user to plot a hydrograph for periods ranging from a couple of days to the current water year.

Several potential data products were identified for the real-time component, including:
- Change in SWE conditions (past 24-hours, week, month)
- Daily snowpack conditions from SNODAS and SNOTEL (CWCB currently generates)
- SNODAS snow summary product (could include precipitation, current SWE, change in SWE, sublimation losses, snowmelt)
- Rainfall intensity, duration, and isohyetals

3.4 Multi-Hazard

The multi-hazard component integrates information from multiple hazards that can affect the

potential for flood risk. This component is intended primarily to support community officials for planning purposes.

The use cases that have been identified for this component include:

- Communities accessing hazard mitigation plans and projects to research what other communities are doing
- Users accessing flood area delineations to support planning and emergency management
- Users assessing changes in flood risks based on the multi-hazard information
- State agencies assessing relative risks between counties for planning purposes

Table 4 presents the data layers that have been identified for possible inclusion in the multi-hazard component. FEMA-approved hazard mitigation plan availability and wildfire risk for the Front Range were identified as necessary data layers.

Table 4. Potential Data Layers – Multi-Hazard

Data Layer	Priority
FEMA-Approved Hazard Mitigation Plan Availability	Need
Wildfire Risk – Front Range Watershed Protection	Need
HAZUS Level I - Flood area delineation	Want
HAZUS Level I - relative risk ranking by county	Want
HAZUS Level I - damage estimates by county	Want
Hazard Mitigation Projects	Want
Pre-disaster mitigation projects	Want
Flood mitigation projects	Want
Convective outlook hazard probabilities (NDFD)	Want
Wildfire areas	Want
Wildfire risk - Statewide	Want
Wildfire risk - Sanborn / Colorado	Want
Geologic hazards	Want
2-D Debris modeling	Want
Marble	Want
Channel instability	Want
Erosion zones	Want
Tornado touchdowns	Want
Wildfire hazard	Want
COGCC Pits	Want
Earthquake (including folds, faults)	Want
Debris flow	Want
Landslide data	Want
Avalanche hazard data	Want
Beetle kill	Want

The multi-hazard component should include external links to:

- State of CO Natural Hazards Mitigation Plan
- County/regional hazard mitigation plans
    - Boulder draft multi-hazard mitigation plan
- FEMA HAZUS Level I Analysis Report
- Pre-disaster mitigation plans

- Spatial Hazard Events and Losses Database
- North Central All-Hazards Region

FEMA Region VIII expressed a willingness to share the HAZUS Level I analysis results with CWCB for the Flood DSS. At this time, information from HAZUS Level I will not be included in the Flood DSS. Information regarding the HAZUS Level I analysis is retained in this memorandum for documentation purposes.

Limitations of the HAZUS Level I data include:
- Structures that are not seen at the 30-m resolution used for the analysis
- Reaches that were excluded from analysis if the automated hydrology and hydraulics failed
- No results for Broomfield County because the analysis used 2000 Census data

FEMA Region VIII requested that the following activities be done if the HAZUS Level I results were included in the Flood DSS:
- The delineated flood areas should:
    - Be termed "risk areas" to avoid confusion with regulatory floodplain boundaries.
    - Not be shown where DFIRMs exist. (Note that Level II analyses could be shown.)
    - Not be shown at high resolutions that allow users to determine if specific locations are within the risk areas.
    - Be compared with available DFIRM data and physical elements to ensure the results make sense. If the results are reasonable, FEMA asks that a disclaimer be included (perhaps in the metadata) that describes the limitations and includes a link to the FEMA methodology report.
- CWCB should consider whether or not to show the depth grids and relative risk information. FEMA prefers to show the data qualitatively rather than quantitatively because of uncertainties in the analysis.
- A meeting should be scheduled between FEMA, CWCB, and the State Office of Emergency Management to discuss the proper use of the data.

3.5 Weather Modification

The weather modification component was identified as lower priority than floodplain boundaries, historical flood information, and real-time data and alerts. However, the component should be relatively easily to develop because much of the necessary information is available in spatial formats.

This component is primarily intended to support the CWCB flood section. However, external stakeholders did express some interest in knowing the location of cloud-seeding activities. The use cases that have been identified for this component include:
- Assessing whether cloud seeding activities can occur given current snowpack conditions
- Identifying target areas downwind of incoming storms by overlaying real-time weather data

Table 5 lists the potential data layers that were identified for this component.

Table 5. Potential Data Layers – Weather Modification

Data Layer	Priority
Generator locations	Need
Target areas	Need

Data Layer	Priority
Snowpack information – SNOTEL	Need
Snowpack information – SNODAS	Need
Avalanche conditions (CAIC)	Want
Avalanche hazard data	Want

External links should be included in this component to:
- Colorado Avalanche Information Center
- NRCS Snowpack Products
- NOHRSC SNODAS Snow Reports and Model Assimilation Information

3.6 Watershed restoration

The watershed restoration component would support planning activities and distribute information about planned and implemented projects. This component was identified as a lower priority than floodplain boundaries, historical flood information, and real-time data and alerts. However, the component should take relatively few resources to develop because much of the necessary information is available spatially.

This component is primarily intended to support the CWCB flood section and community officials responsible for planning or project identification. The use cases that have been identified for this component include:
- Communicating project information that is helpful to understand how the river is changing (e.g., locations, grant amounts, project types, objectives, benefits, success/failure).
- Overlaying project locations with wetland delineations to assess suitability of restoration.
- Overlaying project locations with real-time flow, flood of record, and bankfull stage data to identify potential damage to restored area.

Table 6 lists the potential data layers that were identified for this component.

Table 6. Potential Data Layers – Watershed Restoration

Data Layer	Priority
Restoration Projects - CWCB Watershed Restoration Program	Need
Restoration Projects - CWCB Healthy River Fund	Need
Wetlands	Need
Watershed Plans	Need
Restoration Projects - Other Funding Sources	Want
Bankfull stage	Want
Streamflows for various return periods (e.g., 2-, 5-, 10-, and 100-yr events)	Want
Habitat	Want
Conservation and protective species data (includes riparian areas)	Want
CO Division of Wildlife, Habitat Section Colorado Gap Analysis Land Cover Maps	Want

The watershed restoration component should include links to watershed plans and basin studies and reports that are in the Laserfiche system. In addition, external links should be included to the following sites:
- Basin studies not available from CWCB
- USGS Reconfigured Channel Monitoring and Assessment Program

In addition, streamflow alerts should be added for the 5-year and 10-year flood events to notify the CWCB flood section that surrounding projects may need be evaluated.

3.7 Community information

The community information component was identified as a tool for CWCB to disseminate information to communities. This component is also intended to foster communication between communities. The use cases that have been identified for this component include:

- Information exchange within CWCB about community visits
- Information exchange between communities about program contacts and activities related to current ratings
- Centralized public access to community ratings

Table 7 lists the potential data layers that were identified for inclusion in this component.

Table 7. Potential Data Layers – Community Information

Data Layer	Priority
NFIP Community Status - City	Need
NFIP Community Status - County	Need
Community Rating System Status	Need
Community Rating and supporting information	Need
Community Contacts	Need
Community issues (violations, sanctions, audit, compliance)	Want
Cost savings	Want
CWCB visit information	Want
Repetitive losses by community	Want

The community information component should include links to compliance reports that are available in the Laserfiche system. However, access to these documents should be restricted to CWCB personnel. In addition, external links should be included to the following sites:

- Community contacts
- Community stormwater programs
    - City of Grand Junction Stormwater
    - Mesa County Stormwater
- Regional entities
    - UDFCD
    - 5-2-1 Drainage Authority
    - Grand Valley Drainage District
- Educational and safety websites
    - Boulder Flood information links
    - Flood Safety information

4.0 Base Data

Base data includes line, polygon, and point data that are drawn on top of background layers (e.g., hydrography, basin boundaries, structures, and political boundaries; see Table 8).

Table 8. Potential Data Layers – Base Data

Data Layer	Priority
Cities	Need
Counties	Need
Critical Infrastructure - CDOT	Need
Critical Infrastructure - Local	Need
Customized NHD (Major rivers)	Need
Dams - DWR	Need
Dams - NID	Need
Districts	Need
Divisions	Need
High-resolution NHD (Rivers)	Need
Highways	Need
HUC8	Need
HUC10	Need
HUC12	Need
Lakes and Reservoirs	Need
Levees - certified	Need
Main Lakes and Reservoirs	Need
Major river basins	Need
Townships	Need
Diversions	Not needed?
Bridges	Want
CO DPHE ambulance, health department offices, trauma centers	Want
Critical Infrastructure - HAZUS	Want
Flash flood basin delineations	Want
Levees - not certified	Want
Levees - PAL (Provisionally Accredited Levee)	Want
Management districts	Want
Municipal/district boundaries	Want
Parcel	Want

5.0 Background Data

Background layers are drawn first on maps, with other layers drawn on top. Table 9 lists the potential background data layers that have been identified for inclusion in the Flood DSS.

Table 9. Potential Data Layers – Background Data

Data Layer	Priority
Shaded Relief	Need
Land cover	Need
Aerial photography (NAIP)	Need
Topography - 24K	Need
Topography - 100K	Need
Topography - 250K	Need
Elevation	Need

Data Layer	Priority
Elevation (high resolution)	Need
Satellite imagery	Want

6.0 Additional System Features

In addition to the spatial data identified in Section 3, stakeholders identified a number of features that could enhance the Flood DSS:

- Calendar of upcoming events
- Announcements (could include current alert information)
- Community visit bulletin board (restricted to CWCB)
- Clearinghouse of flood regulations and ordinances
- Frequently Asked Questions
- Help
- Glossary
- On-line feedback tool

Stakeholders also requested the following functionality:
- A data download tool
- The ability to capture and print maps or export maps as PDF documents from the Flood DSS
- The ability to search by water feature to avoid dealing with jurisdictional boundaries

The user needs assessment validated the necessity of metadata for the data layers, including source, description, date of last update. In addition, stakeholders indicated that restricting access to some data layers was a requirement. In general, stakeholders indicated that communities could be allowed to access other communities' data; separate login information is not required.

7.0 Usability Considerations

Stakeholders were very concerned about the usability aspects of the Flood DSS. It was important to them that the website organization be driven by user needs. In general, the key words were simple, efficient, fast, familiar and flexible. Stakeholders requested that we:

- Be mindful of the technological experience of the users. The range of skills represented by the stakeholders varied from beginning to highly advanced. Stakeholders suggested we try to use familiar technology (e.g., internet browser, Google Maps) and consistent interfaces so users can focus on the data rather than learning a new technology.
- Avoid making users wade through information they don't care about. Users will want to quickly see the data they are interested in for the area they are interested in. Allow users to save a configuration or include dropdown menus that allow users to zoom to their area of interest.
- Be mindful that all users may not have high speed connections. If performance is an issue, include a disclaimer about the required network connection speeds to avoid frustration with the website.
- Be aware that one of the main benefits of the Flood DSS is its ability to centralize information. A goal should be to minimize the number of web searches that users perform to

find data.
- Recognize that the organization and format of the data will affect how users rely on the system. Consider identifying external beta testers during system development.

The current system design recommendation calls for a power user site plus simpler thematic pages, which fits well with the above considerations. Most stakeholders indicated they were likely to use the Flood DSS, although the extent of their use will depend upon the contents and functionality.

8.0 Risk Areas and Concerns

Table 10 contains a summary of concerns and risk areas raised during the user needs assessment, as well as the current strategy for mitigating those risks.

Table 10. Risk Areas and Mitigation Strategies

Concern	Mitigation Approach
Properly restricting data access	▪ Data sharing agreements from the county data collection ▪ This will be an attribute during the data inventory task
Protecting CWCB against liability issues	▪ Including disclaimers on the Flood DSS website as appropriate ▪ Restricting access to alerts and warnings
Keeping data current	▪ Linking to data sources that are rapidly evolving rather than using a copy of the data ▪ Developing the administrator's manual with update procedures
Data storage size	▪ Using web services and external links where available and appropriate
Showing local floodplains	▪ If local floodplain data are collected that conflict with the regulatory boundaries, Riverside will request that CWCB evaluate the potential legal ramifications
Stitching together county data	▪ Documenting county data with sufficient metadata ▪ Keeping disparate data layers separate
Laserfiche performance	▪ Discuss with CWCB to evaluate possible mitigation strategies
Soliciting sufficient representative user input	▪ Discuss with CWCB to determine if this is a concern
Performance for slow connections	▪ Rely on industry tools, cache content, and provide simple sites where appropriate

9.0 Training

All stakeholders agree that CWCB should host or provide training on the operational Flood DSS site. Responses were mixed regarding whether organizations would send personnel to Denver for the training based on distance and skill level. Alternate suggestions included on-site training, development of a training CD or website, and conducting webinars. The benefit of a training CD or website is that stakeholders could conduct internal trainings after they become trained. In addition, stakeholders suggested developing training modules or a quick-start guide that is available electronically. Stakeholders viewed the training workshops as an opportunity to solicit input from the people being trained.

10.0 Future Functionality for the Flood DSS

Currently, the Flood DSS is not scoped to include real-time modeling or forecasting. However, several stakeholders have experience or have done work in this area that could benefit the Flood DSS in the future.

FEMA Region VIII offered to demonstrate the Red River Decision Support Tool to CWCB as an example of an operational decision support tool that allows users to place sandbags in the model and review the impact on flooding.

UDFCD is developing an operational data management and flash flood modeling system in ArcGIS Server. This system will replace their current ALERT system. As part of this effort, UDFCD has done a significant amount of work to develop a database that collects real-time data on a 5-minute interval, including data from MADIS and other data sources of interest to the CWCB. Future work on the Flood DSS may be able to utilize this information. UDFCD offered to host a one-day meeting with CWCB and Riverside to demonstrate the system's capabilities and assess whether the Flood DSS could utilize any of its components.

Douglas County has developed a desktop GIS application called the Colorado Flood Hazard Inventory Tool (FHIT). The objectives of the application include developing an inventory of flood hazards for that area, identifying structures at risk during a storm event, and providing input to emergency responders. The system is being migrated to an internet application between now and March 2010. Douglas County has offered to give Riverside access to the restricted internet site.

11.0 Summary of User Needs Assessment

In summary:

- The results from the user needs assessment validate the current approach of developing one power user site and multiple simpler sites. All proposed components will be developed in some form. However, development work for the lower priority components will be limited to including GIS data that are readily available.
- The prototype site was well received but could be expanded in scope.
- In the floodplain boundaries component
    - Preliminary DFIRMs should be hosted on a restricted site for communities to

review.
    - Effective DFIRMs should be brought into the public site using FEMA's NFHL web service.
    - Local floodplain boundaries will be hosted unless there is a conflict with the regulatory boundaries.
- The historical flood information is a valuable component that would require significant resources to create and populate a statewide data layer. A statewide historical flood layer is not specifically identified in the current scope, and therefore has no allotted resources. Riverside will provide a description of what can be done within the project scope that could provide a framework for future enhancement. In addition, because of the high level of interest in this theme Riverside will describe a more complete option and assess the project impacts.
- The highest priority elements in the real-time data and alerts component include current streamflow, gage precipitation, radar precipitation, HDR's flood outlook products, NWS alerts, and SMSAS alerts.
- Community officials would like access to the alerts.
- Additional real-time data types like temperature, wind, and dew point would facilitate flood forecasting.
- Although many of the stakeholders are mostly concerned with rainfall-driven events, it is still important to include snowpack information in the Flood DSS.
- The highest priority data elements in the multi-hazard component include a data layer indicating where FEMA-approved hazard mitigation plans have been developed as well as a data layer showing wildfire risk for the Front Range.
- The weather modification and watershed restoration components were identified as lower priorities than other system components. However, these components should be relatively easy to develop because much of the required data is available spatially.
- The community information component is primarily intended to improve communication.
- Stakeholders identified a number of additional features and functions that could enhance the Flood DSS. These features were not identified in the current project scope and have no specific allotted resources.
- Stakeholders were concerned about usability issues, and strongly suggest that the Flood DSS be simple, familiar, and efficient.
- Stakeholders suggested that CWCB identify external beta testers during system development.
- Stakeholders identified some risk or concern areas that Riverside will work with CWCB to address.
- All stakeholders thought that some form of training would be necessary.

12.0 Recommendations for Conducting Data Inventory

To transition from the user needs assessment to the data inventory task, Riverside suggests the following action items:

- Riverside will incorporate feedback from CWCB into the enumeration and prioritization of the system components, data layers, and system features.
- Riverside will use information from the user needs assessment to develop a prioritized list of functionality requirements.
- Riverside will use the information from the user needs assessment to begin the system design to organize the themes into simpler sites and a power user site.

- Riverside will conduct additional investigation as needed for each system component. For example:
    - Riverside and AMEC will make a recommendation about whether all DFIRM layers will be shown in the Flood DSS.
    - Riverside and AMEC will work with Thuy Patton at CWCB to confirm that the necessary data layers have been identified that would allow communities to review preliminary DFIRMs. This will require better understanding of the review process, as well as whether any functionality is required (e.g., an approval button).
    - Riverside and AMEC will work together to assess the local floodplain boundary data that have been collected. If local floodplain boundaries exist for the 100-yr flood that differ from the FEMA floodplain boundaries, Riverside will work with CWCB to determine whether it is appropriate to include this information in the Flood DSS, and whether access to the data layers should be restricted.
    - Riverside and AMEC will assess whether the background data layers that are bundled with DFIRMs should be displayed in that component of the Flood DSS rather than the base and background data layers that were identified in Sections 4.0 and 5.0 of this memorandum.
    - Riverside will investigate the project impact of including an address search functionality.
    - Riverside will work with HDR to determine if the flood outlook products will be available in spatial format beginning in April 2010. Riverside may require input from CWCB regarding whether HDR's contract will be extended beyond 2010. If not, it may not make sense to expend project resources to incorporate these products for one year.
    - Riverside will evaluate differences between the DWR dam layer and the National Inventory of Dams.
- Riverside and AMEC will work to combine the results from the user needs assessment and the county data collection process to modify the component and data layer priorities as needed.
- Riverside and AMEC will focus on conducting a more detailed data inventory and assessment of the resources required to integrate the highest priority data layers into the Flood DSS.
- Given the available information, Riverside and AMEC will develop a detailed prioritization for the data layers that specifies which layers should definitely be included in the Flood DSS, which layers should be incorporated as resources permit, and which layers should not be incorporated at this time. Riverside will present this to CWCB for review and approval.

RIVERSIDE

Attachment 1: Interviews Conducted for the User Needs Assessment

Name	Organization
Tom Browning	Colorado Water Conservation Board
Kevin Houck	Colorado Water Conservation Board
Thuy Patton	Colorado Water Conservation Board
Cristina Martinez	Colorado Water Conservation Board
Joe Busto	Colorado Water Conservation Board
Chris Sturm	Colorado Water Conservation Board
Ken Howard	NOAA National Severe Storms Laboratory
Kevin Stewart	Urban Drainage and Flood Control District
Jeff Arthur Bob Harberg	City of Boulder
Brad Anderson	Anderson Consulting Engineers
Jesse Ortiz	City of Colorado Springs
Eric Mende	5-2-1 Drainage Authority
Tim Condit	Pikes Peak Regional Building Department
Brian Hyde	Dewberry
Dave Kanzer Don Meyer Chris Treese	Colorado River Water Conservation District
Doug Bausch Jesse Rozelle	Federal Emergency Management Agency Region VIII

Riverside would like to thank these individuals for participating in the user needs assessment.