# Methodologies for Estimating and Projecting Urban (Municipal & Industrial) and Agricultural Demands and Environmental and Recreational Flows
## November 2003

The Colorado Water Conservation Board's (CWCB) Statewide Water Supply Initiative (SWSI) will prepare reconnaissance level basin estimates of municipal and industrial (M&I or urban) and agricultural water demands for the years 2000 and 2030. These water demands will be compared to future water supply estimates to determine if a gap will exist in each basin between future demands and supply. Environmental and recreational water demands will be based on the current Colorado Water Conservation Board (CWCB) decrees for instream flows and adjudicated recreational in-channel diversions. In addition, the geographic location of important resource management areas such as aquatic endangered species or state species of concern will be identified and considered during water resources alternatives development.

Preliminary methodologies were presented at the first roundtable technical meeting in each basin. Comments received during those meetings and during the subsequent comment period have been evaluated, and, where feasible, incorporated into the final methodologies.

## Methodology for Estimating Basin-Level Urban Water Demands

The objective of this methodology is to provide the SWSI with:

- A consistent methodology for all basins
- A comprehensive water demand estimate that includes publicly-supplied and self-supplied residential, commercial, and industrial water users
- A summary of current demands (estimated for year 2000) and a forecast of such water demands by basin for the year 2030

Note that this estimate of residential, commercial, and industrial water demand is identified as *urban* water use in the SWSI project to distinguish these water demands from agricultural water demand and environmental and recreational flows. This nomenclature of *urban* water demand is applicable to the residential, commercial, and industrial water demand in all counties in Colorado.

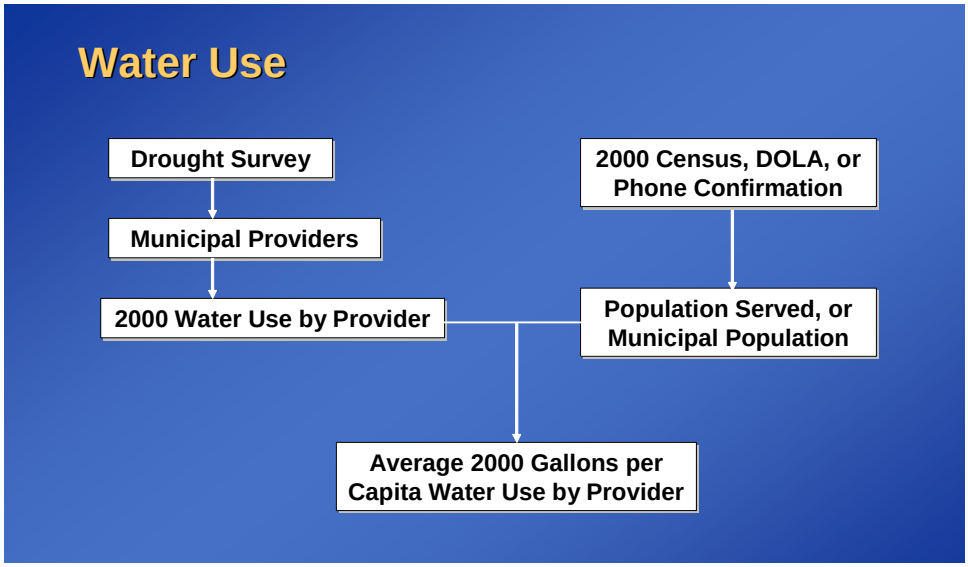
The estimation of urban water demand by county, basin, and the state is intended to provide a reconnaissance level of information for statewide analysis of water supply

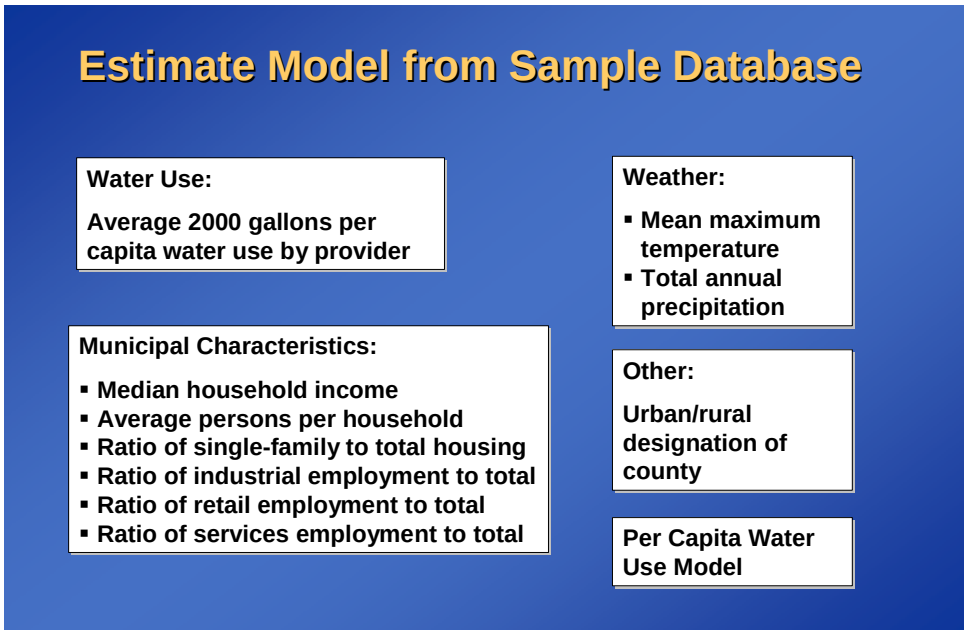
issues and needs. These estimates of future water demand are not being developed at the water provider level, nor are they intended to replace the planning efforts of individual water providers.

The originally proposed methodology for estimating urban water demand was based on the assumption that total urban water use data would be available for each county. The data source assumed to contain water use data that could be aggregated for each county was found to contain water use data for a limited number of water providers and not provide complete coverage for all counties. Thus, the methodology for estimating urban water demand has been revised as follows.

The recent CWCB Drought and Water Supply Assessment (DWSA) Survey database contains reported annual water use for the year 2000 for about 180 water providers. Service area population in the year 2000 will be obtained for as many of the 180 providers as feasible. Approximately 120 of these providers are municipalities for which the 2000 Census, as modified by the Colorado Department of Local Affairs (DOLA), municipal population may be used as a proxy for the service area population, if service area population cannot be obtained from the providers. The providers for which population can be identified will represent a sample of water use providers throughout the state and should include both large and small municipalities.

Given the year 2000 water use reported in the DWSA Survey and corresponding year 2000 municipal population, the per capita urban water use in year 2000 will be calculated for each of these providers. This calculated gallons per capita water use will represent a sample database.






To the extent that data are available from U.S. Census, Colorado Department of Local Affairs and others, municipal level characteristics will be identified for each of the providers in the sample database. Depending upon the availability of data, characteristics may include:

- Ratio of single-family housing to total households
- Median household income
- Average persons per household
- Ratio of industrial employment to total employment
- Ratio of retail employment to total employment
- Ratio of services employment to total employment
- Ratio of agricultural employment to total employment
- Annual mean daily maximum temperature
- Annual total precipitation
- Urban/rural designation of county located within

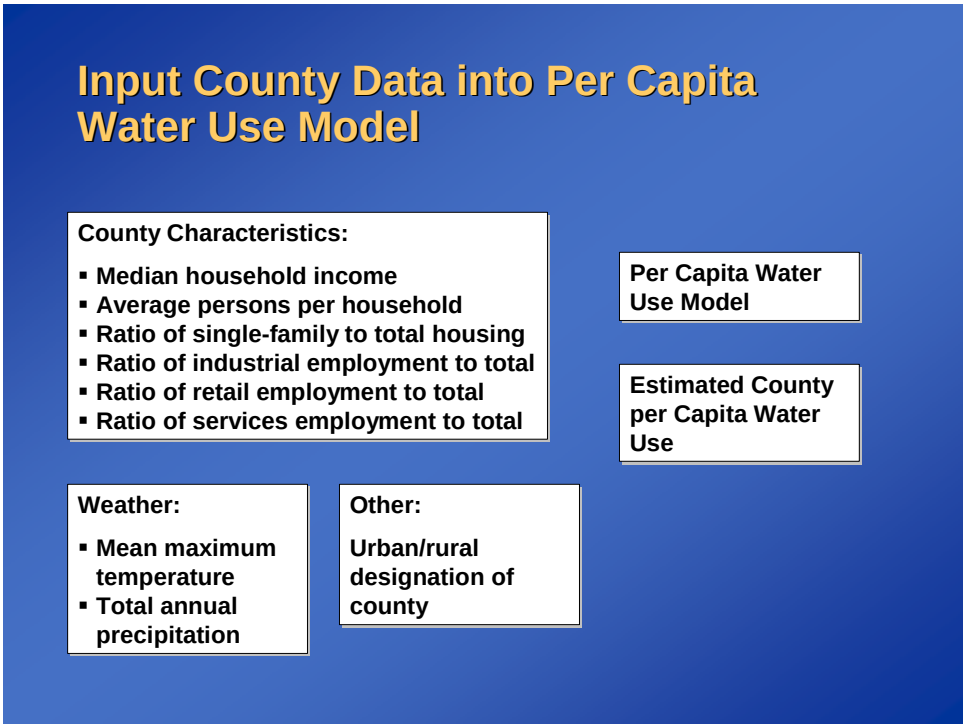
These characteristics will allow the identification of various factors, such as tourism or second homes, which may impact per capita water use. Regression analysis will be used to examine relationships between the municipal characteristics and municipal per capita water use. These relationships are quantified in coefficients, or elasticities, which indicate the percent change in per capita water use with a given change in the characteristic. That is, regression analysis assumes that the variation in per capita water use can be partially explained by the variation in associated characteristics. The analysis should result in a *model* of per capita water use.

County-level values for the characteristics will be input into the model of per capita water use. Thus, per capita water use will be estimated for each county. This

estimation of county per capita water use assumes that *all* residences, businesses, and industries throughout the county (including the self-supplied users) use water at the same rate as the municipally-supplied residences, businesses, and industries, given similar demographic and climatic characteristics.

If future values of county characteristics are expected to change over time (e.g., the proportion of single-family to total housing, or average persons per household), then the estimated per capita water use rate for that county may change over time. The county per capita water use will be estimated for each county for 2000 and 2030 based on projected values of the county characteristics. The characteristics may be changed to reflect alternative growth scenarios.

The estimated future per capita water use rates of each county will be multiplied by the projected population of each county to estimate the urban water demand (i.e., the residential, commercial, and industrial water use) of each county. The population projections and future county characteristics will be obtained from the Colorado Department of Local Affairs (DOLA), Demography Section. A sample of the population projections from DOLA are shown in Table 1.




The use of the DOLA population projections will form the *baseline* water demand forecast for M&I demands in conjunction with the estimated per capita water use rate for each county. Since this estimate represents the total or gross per capita water use and there is a significant return flow component, an estimate of municipal and industrial consumptive use will also be included based on existing research.

Many water providers, either individually or as part of regional efforts, have conducted independent water demand forecasts that have been used in various regional water supply studies, such as the 1997 Metropolitan Water Supply Investigation and the 2003 Upper Colorado River Basin Phase II Study. Where available, these individual water demand forecasts will be reviewed and compared to the baseline water demand forecast.

Collectively, the baseline forecast and the independent forecasts will be utilized to develop the reconnaissance-level estimate of 2000 and projected 2030 water use for each county. Water demands will be estimated by county and summarized by basin and by selected major urban areas.

Table 1 Draft DOLA Population Forecasts by County, 2000 to 2030

| Counties | CDS Est. July 2000 | CDS Proj. July 2005 | CDS Proj. July 2010 | CDS Proj. July 2015 | CDS Proj. July 2020 | CDS Proj. July 2025 | CDS Proj. July 2030 | Average Annual Percent Change | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 00-05 | 05-10 | 10-15 | 15-20 | 20-25 | 25-30 |
| COLORADO | 4,335,540 | 4,691,258 | 5,137,928 | 5,632,645 | 6,133,491 | 6,652,082 | 7,156,422 | 1.6% | 1.8% | 1.9% | 1.7% | 1.6% | 1.5% |
| Adams | 350,642 | 396,328 | 449,200 | 507,322 | 567,870 | 629,866 | 693,540 | 2.5% | 2.5% | 2.5% | 2.3% | 2.1% | 1.9% |
| Alamosa | 15,139 | 16,040 | 17,255 | 18,601 | 20,015 | 21,441 | 22,901 | 1.2% | 1.5% | 1.5% | 1.5% | 1.4% | 1.3% |
| Arapahoe | 491,143 | 526,537 | 560,698 | 592,442 | 621,884 | 645,827 | 666,262 | 1.4% | 1.3% | 1.1% | 1.0% | 0.8% | 0.6% |
| Archuleta | 10,028 | 12,100 | 14,449 | 16,934 | 19,813 | 23,140 | 27,048 | 3.8% | 3.6% | 3.2% | 3.2% | 3.2% | 3.2% |
| Baca | 4,516 | 4,234 | 4,085 | 3,954 | 3,849 | 3,775 | 3,709 | -1.3% | -0.7% | -0.6% | -0.5% | -0.4% | -0.4% |
| Bent | 5,971 | 6,158 | 6,308 | 6,492 | 6,617 | 6,727 | 6,750 | 0.6% | 0.5% | 0.6% | 0.4% | 0.3% | 0.1% |
| Boulder | 271,051 | 288,648 | 308,276 | 325,990 | 344,645 | 362,643 | 377,396 | 1.3% | 1.3% | 1.1% | 1.1% | 1.0% | 0.8% |
| Broomfield | 39,466 | 43,935 | 49,996 | 56,251 | 61,643 | 66,973 | 71,984 | 2.2% | 2.6% | 2.4% | 1.8% | 1.7% | 1.5% |
| Chaffee | 16,298 | 17,418 | 19,348 | 21,386 | 23,523 | 25,632 | 27,579 | 1.3% | 2.1% | 2.0% | 1.9% | 1.7% | 1.5% |
| Cheyenne | 2,230 | 2,144 | 2,064 | 2,010 | 1,969 | 1,925 | 1,881 | -0.8% | -0.8% | -0.5% | -0.4% | -0.5% | -0.5% |
| Clear Creek | 9,391 | 9,701 | 10,542 | 11,607 | 12,689 | 13,746 | 14,735 | 0.7% | 1.7% | 1.9% | 1.8% | 1.6% | 1.4% |
| Conejos | 8,400 | 8,498 | 8,804 | 9,185 | 9,485 | 9,766 | 9,990 | 0.2% | 0.7% | 0.9% | 0.6% | 0.6% | 0.5% |
| Costilla | 3,675 | 3,841 | 4,011 | 4,187 | 4,339 | 4,476 | 4,606 | 0.9% | 0.9% | 0.9% | 0.7% | 0.6% | 0.6% |
| Crowley | 5,513 | 5,755 | 5,711 | 5,699 | 5,693 | 5,716 | 5,687 | 0.9% | -0.2% | 0.0% | 0.0% | 0.1% | -0.1% |
| Custer | 3,540 | 4,062 | 4,797 | 5,638 | 6,530 | 7,409 | 8,239 | 2.8% | 3.4% | 3.3% | 3.0% | 2.6% | 2.1% |
| Delta | 28,009 | 30,830 | 34,405 | 38,273 | 42,325 | 46,400 | 50,215 | 1.9% | 2.2% | 2.2% | 2.0% | 1.9% | 1.6% |
| Denver | 555,782 | 574,317 | 606,161 | 639,473 | 674,105 | 716,760 | 753,720 | 0.7% | 1.1% | 1.1% | 1.1% | 1.2% | 1.0% |
| Dolores | 1,844 | 1,966 | 2,127 | 2,272 | 2,431 | 2,597 | 2,760 | 1.3% | 1.6% | 1.3% | 1.4% | 1.3% | 1.2% |

CDS/DOLA: Colorado Demography Section/ Department of Local Affairs

# Methodology for Estimating Agricultural Demands

## Introduction

Agricultural water demands will be characterized for current and future conditions in each of the eight major river basins in Colorado. Irrigated acreage, cropping patterns, and climatic data will be used to estimate crop irrigation water requirements, while diversion records and other studies will be used to estimate historic application amounts and consumptive use. A listing of terminology used in this discussion is included in Table 2.

Table 2 Agricultural Demand Terminology

| Term | Description | Primary Data Sources | CDSS[1] Tools |
|---|---|---|---|
| Historic Water Application (Surface Diversion and Groundwater Pumping) | Total water supply delivered to meet crop irrigation water requirement | * SEO diversion database<br>* Groundwater Pumping Estimates<br>* Basin Studies and Reports | * Hydrobase<br>* StateMod |
| Crop Irrigation Water Requirement (IWR) | Theoretical value based upon Blaney-Criddle procedure or other method | * GIS and other Land Use Studies<br>* Climatic Data<br>* Crop Characteristics | * Hydrobase<br>* StateCU |
| Crop Consumptive Use of Irrigation Water (CU) | Estimated value based upon expected system efficiency and available water supply | * Historic Water Application<br>* IWR | * StateCU<br>* StateMod |

[1] Colorado's Decision Support System

The Colorado, Gunnison, Yampa/White/Green, San Juan/Dolores, and the Rio Grande river basins have existing Colorado Decision Support System (CDSS) data sets and models. For these basins, the StateCU model and data will be used to estimate irrigation water requirements.

For those basins without developed CDSS data sets (i.e., the Arkansas, South Platte, and North Platte), information for irrigated acreage and cropping patterns will be gathered from existing sources and studies. A statewide StateCU climate data set is scheduled to be prepared by the State and consultants within the coming months. If available, these sources should provide sufficient information to apply StateCU for these basins in a more general fashion.

Annual average crop irrigation water requirements will be estimated for representative wet, dry, and normal hydrologic periods. The State's StateMod CDSS data sets and HydroBase will be queried to estimate historic diversions and pumped groundwater for agricultural use by river basin. Other data sources will be consulted to supplement data deficiencies where possible. Table 3 is an example of how the summary data may be presented. To illustrate the variability of demands for key structures (e.g., the largest ditch in a basin), a summary of key ditches may be listed.

Table 3 Summary Table with Preliminary Data for the Colorado River Basin

| River Basin | Irrigated Acreage[1] (acres) | Irrigation Water Requirement (IWR)[2] (acre-feet) | Average Historic Diversions for Irrigation[3] (acre-feet) | Average Historic Groundwater for Irrigation[4] (acre-feet) | Estimated Crop Consumptive Use - Supply Limited[5] (acre-feet) |
|---|---|---|---|---|---|
| Colorado | 266,446 | 409,890 | 1,719,475 | 9,000 | 356,893 |

Data Sources:
(1) StateCU model input data sets
(2) StateCU simulated values
(3) State Engineer's Office (SEO) database/ Hydrobase
(4) Estimated from SEO wells database
(5) StateCU simulated values

Selected river basins might be subdivided into subregions based upon special administrative considerations or hydrologic topology with the appropriate demand summary per region. This will be evaluated as the project evolves. These values could be summarized from existing CDSS data sets at various levels of resolution.

Unless directed otherwise by the basin advisors and technical committee, existing and year 2030 irrigated acreage will be assumed to remain constant with the latest available estimates of actual irrigated acreage. As such, the existing StateCU data sets are suitable, without modification, for calculating future crop demands for the year 2030. In the event that irrigated acreage is expected to change, total diversions will be compared to total irrigation water requirements to calculate unit agricultural-use coefficients. The unit agricultural-use coefficient can then be applied to the expected 2030 irrigated lands forecast to predict future agricultural water demands.

## Methodology for Basins with Existing CDSS Data Sets

CDSS datasets have been developed for the **Colorado**, **Gunnison**, **Yampa/White/ Green**, **San Juan/Dolores**, and **Rio Grande** River Basins. Irrigated acreage and crop types have been tabulated for all explicitly represented diversion structures and aggregated diversion structures. The StateCU model data sets contain all necessary climate data to generate monthly crop irrigation water requirement based upon crop type. Irrigation water requirement values at diversion structures will be summed to arrive at a total annual irrigation water requirement value by basin or region by processing the generated datasets and incorporating existing reports using CDSS tools.

The standard method for calculating irrigation water requirements is based upon the modified Blaney-Criddle procedure. In some basins, locally calibrated coefficients for Blaney-Criddle have been developed and will be used when available in StateCU data sets. StateCU includes features to calculate demands using the Penman-Montieth method, but lack of adequate climate data usually limits its applicability in all but specific regions of the State.

The StateCU model provides the functionality to estimate a supply limited crop consumptive use amount based upon historic diversions and soil moisture carryover.

This analysis is performed by diversion structure and will be summed to arrive at a total annual crop consumptive use value by basin or region.

## Methodology for Basins without Existing CDSS Data Sets

A StateCU statewide climate station data set is being developed as part of the CDSS project and may be completed in early 2004. This dataset will provide the means to calculate unit crop irrigation water requirements at selected climatic stations throughout the state. In other words, at climate station A, for 1 acre of crop B, the irrigation water requirement is N. These "unit crop use coefficients," once established, can be multiplied by the irrigated acreage from surrounding service areas to calculate the crop irrigation water requirements. Therefore, the main effort for these basins would be estimating the irrigated acreage and crop distributions.

If the statewide climate station data set is not available in time for SWSI requirements, then the Blaney-Criddle procedure for estimating crop irrigation water requirements in non-CDSS basins cannot be applied. Therefore a different approach will have to be used for estimating irrigation water requirements. Historic diversions and groundwater pumping estimates will be used to estimate the historic water application using average system efficiencies. The application amounts per unit area can be compared to the developed unit crop coefficients from the CDSS basins to arrive at estimates for expected irrigation water requirements and consumptive use amounts.

### *South Platte and North Platte Basins*

The State is currently developing the **South Platte** Decision Support System (SPDSS), including portions of the **North Platte** Basin. The SPDSS GIS component should have preliminary results delineating lands under irrigation by December 2003. Identification of crop type is not scheduled to be complete until December 2004. If available in sufficient time, the irrigated lands data will be reviewed for accuracy and completeness, and if considered acceptable, this data could be used as the estimate for total acreage being irrigated. Estimates for crop type will be based upon existing studies and reports such as Colorado Agricultural Statistics. For example, Agricultural Statistics will be used to prorate SPDSS irrigated acreage by crop.

Depending upon the availability of SPDSS data, it may be difficult in a reconnaissance-level study like SWSI to determine basin-wide estimates for crop water requirements at other than a coarse level. Therefore, rather than focusing on irrigation water requirements estimated from crops and acreage, it may be more appropriate to review historical diversion records from HydroBase and use existing State reports to estimate agricultural water demands. A more detailed study can be done in the future after the SPDSS effort implements basin models.

***Arkansas Basin***

Although the State has not begun developing a CDSS for the **Arkansas** basin, several engineering studies on water resources with the basin have been performed in recent years. Some of these studies included the development of hydrologic / water use models, such as the HI model, which was used in Arkansas River Compact discussions between Colorado and Kansas to evaluate irrigation demands along the Arkansas River mainstem from Pueblo Reservoir to the state line. Based upon discussion with DWR personnel, existing reports should be adequate for a reconnaissance level investigation to describe the agricultural practices in the basin.

Pre-processed data for the HI model includes irrigation water requirements estimated using the modified Blaney-Criddle procedure. This information should be available for irrigated lands below Pueblo Reservoir to the State line. Additional data sources will be needed to evaluate agricultural demands in the upper Arkansas basin and along Fountain Creek.

***Northern and Southern High Plains***

Irrigated lands and associated demands and supply for the Northern High Plains and Southern High Plains areas, including the **Republican** and **Purgatoire** River basins will not be studied since these basins are considered stand-alone. Existing data on irrigated acres and irrigation water use will be summarized, to the extent studies have been performed and these data are made available.

# Glossary

**Consumptive Use (acre-feet [AF]):** the actual amount of irrigation water that is consumptively used by the crop. This value can be no greater than the Crop Irrigation Water Requirement (IWR), and is a function of system efficiency and water availability.

**Crop Irrigation Water Requirement (AF)**: an on-farm crop consumptive use demand, typically based upon empirical equations such as the Blanney-Criddle or Penman Monteith methods. This value is measured as a depth and can be converted to a volume based on acreage. StateCU estimates the irrigation water requirement as potential evapotranspiration minus effective precipitation.

**Historic Water Application (AF)**: the total water supply provided from a source (such as a river or groundwater aquifer) to meet an irrigation water requirement. Unless limited by supply or decree, water application is a larger value than the irrigation water requirement due to system inefficiency. This value is measured as a volume.

**Unit Crop-Use Coefficient (AF/acre)**: the irrigation water requirement for a unit area of a single crop. This value can be multiplied by the total acreage for a crop to determine the irrigation water requirement for the total acres of the crop.

# Approach for Projecting Environmental and Recreational Flows

The CWCB has an existing program for appropriating, acquiring, and protecting instream flow water rights and natural lake levels. This stream and lake protection program is designed to "preserve and improve the natural environment…" The CWCB appropriates minimum stream flows or natural surface water levels or volumes for natural lakes to preserve the natural environment. The CWCB typically uses the "R2 Cross method" for determining minimum stream flow requirements for in-stream flows. The CWCB is also authorized "to acquire, by grant, purchase, donation, bequest, devise, lease, exchange, or other contractual agreement, from or with any person, including any governmental entity, such water, water rights or interests in water in such amount as the Board determines is appropriate for stream flows or natural surface water levels or volumes for natural lakes to preserve or improve the natural environment to a reasonable degree."

The CWCB protects these instream flow water rights both legally, by obtaining terms and conditions in water rights decrees filed by other water users, and by physically monitoring stream flows and assisting the State and Division Engineers is administering the prior appropriation system so that the CWCB's instream flow water rights are not injured. For the purposes of preparing a future baseline estimate of environmental in-stream flow water rights, the current decreed CWCB instream flows will be assumed to remain in place. In 2001, the General Assembly formally recognized a new type of water right, through the passage of Senate Bill 216—recreational in-channel diversions (RICDs). Prior to the effective date of Senate Bill 216, six entities have obtained water rights for RICDs. Now, after the passage of Senate Bill 01-216, there is a new avenue available to obtain water rights for RICDs.

Environmental and recreational flow needs have not historically been considered in water resources planning as standard water demands such as municipal, industrial and agricultural uses. Municipal, industrial and agricultural uses have widely accepted standard methods for projecting future water demands. During the first round of SWSI public and roundtable technical meetings, and during the public comment process, comments were received proposing different methodologies for estimating future environmental and recreational flows. Based on these comments it is apparent that differences of opinion exist regarding existing and proposed methodologies to determine environmental and recreational flow needs. The CWCB utilizes the R2 Cross Method, which provides an objective approach to determining environmental flow needs. In addition, the CWCB has adopted an objective method regarding RICD flows, which the CWCB will apply to future RICD applications. Requests and comments on future needs and methodologies for additional environmental and recreational demands will be catalogued, listed, and forwarded to the appropriate contacts in the Stream and Lake Protection section.

For the purposes of SWSI any additional environmental and recreational flows greater than decreed instream flows or recreational in-channel diversions and other agreements for flows may be evaluated as part of specific future water supply alternatives and evaluated under the same process and objectives as other future water supply alternatives to see how they perform in meeting the established objectives. Furthermore, it is anticipated that any potential impacts on environmental and recreational flows will likely have to be quantified and addressed under the requirements of the National Environmental Policy Act (NEPA) and regulatory permitting processes on a project-by-project basis. Environmental and recreational flow needs will be considered during the SWSI process when evaluating new water diversions or storage projects upstream or within the affected stream reaches.

In addition to the Colorado Instream Flow and the RICD Programs there are a number of other activities that result in water being left in-channel for environmental and recreational benefits. These include: interstate compact limitations or obligations; claimed reserved water rights by the federal government for National Forests and National Parks; certain mitigation measures required as permit conditions for reservoirs or water diversion structures; and other mitigation measures that result from addressing concerns of threatened and endangered species under the Endangered Species Act.

Interstate Compacts and Equitable Apportionment Decrees: Interstate compacts or equitable apportionment decrees exist for every major river basin in Colorado, and on several minor streams as well. These compacts and decrees divide the water in those basins and streams between Colorado and the downstream states. Thus, Colorado does not have the legal right to totally deplete the waters of any major river basin in the state beyond that provided by these compacts or decrees. Therefore, these agreements provide a certain measure of environmental and recreational protection.

Federal Reserved Water Rights of the U.S. Forest Service: A brief summary of Federal Reserved Water Rights is noted below:

- Water Division 1 – South Platte Basin: All instream flow claims were settled in litigation.
- Water Division 2 – Arkansas Basin: All instream flow claims were withdrawn with prejudice.
- Water Division 3 – Rio Grande Basin: All instream flow claims have been adjudicated and incorporated in to the water right priority system.
- Water Divisions 4, 5 and 6 – Gunnison, Colorado Mainstem, White and Yampa: No reserved water right claims were pursued by the USFS and the time to make such claims has expired. A cooperative effort to examine flow issues is currently underway with the CWCB.

- Water Division 7 – San Juan and Dolores Basins: Claims were made and prosecution of those claims is in-progress.

***Mitigation Measures***
Federal Permitting - Every project or diversion that exists on or crosses any federal land requires a federal permit and may be subject to the imposition of certain mitigation measures by the permitting agency, even projects or diversions that have existed for many years. These mitigation measures limit the ability of projects to totally dry any stream below the project diversion point. While the State of Colorado does not concede the legality of certain mitigation measures, SWSI will consider them in the context of alternatives development.

***Federal Endangered Species Act Considerations:***
Colorado River Basin - There are four endangered fish at present in the Colorado River Basin. In Colorado this includes the Yampa, White, Colorado mainstem, Gunnison, Dolores and San Juan River tributaries. Critical habitat for these fish has been designated on each one of these tributaries. Each tributary also has had or will have a set of flow recommendations and other mitigation measures (e.g., eradication of non-native species, and propagation and restocking of native species) identified that will seek to maintain or improve habitat for the endangered fish. Flow recommendations are subject to adaptive management and will change as additional information becomes available. Therefore, it is impossible to accurately predict the ultimate flow recommendations.

An element of the recovery of these species is a conservation agreement with the state, wherein the state agrees to maintain the conditions that led to recovery. This will include some form of legal protection, consistent with state water law and interstate compacts, for the flows that are eventually deemed necessary for recovery.

South Platte River Basin - There are three avian species in the Central Platte River in Nebraska and one fish species in the Lower Platte River in Nebraska, which are the subject of an endangered species cooperative agreement between Colorado, Nebraska, Wyoming, and the Federal government. A proposed program to address endangered species is currently under development. Colorado's contribution to the proposed program could include water re-regulation to address historic depletions, money for habitat acquisition and management, and monitoring and research, and a plan to address future depletions. This proposed program is also subject to adaptive management.

***Other Environmentally Sensitive Areas:***
Environmentally sensitive areas that may be affected by water development and management activities will be described at a reconnaissance level. These include sensitive land uses such as national and state parks and monuments, wilderness areas, national and state forests, and other sensitive federal and state land uses that may be impacted by water development and management activities.

Sensitive habitats in the state will be identified at a reconnaissance level based on readily available data. These include identifying critical habitat of federally listed endangered species, location of other endangered species habitat, location of habitat of state listed threatened and endangered species and species of special concern, significant wildlife habitat areas, gold medal trout fisheries, etc.

***Existing Senior Water Rights:***
There are certain circumstances under the priority system that create environmental benefits. For example, senior water rights in the Grand Junction area result in a large amount of water flowing to the Grand Valley. These large downstream water rights help maintain the flows in the Colorado River that are enjoyed by recreational users from the headwaters to Grand Junction. Absent these senior downstream water rights, water could be diverted much higher in the basin. The same is true in many other Colorado streams. The loss of senior agricultural or other water rights can cause secondary impacts to stream flows.

All these factors, when considered in total, provide considerable environmental benefits and place limitations on how much water can actually be developed and used. The need for additional environmental considerations that have been requested may further limit consumptive water development opportunities. SWSI will catalog these requests and consider environmental concerns and opportunities during the course of examining alternatives.