Blue Mesa Water Bank Model

User Documentation

1.0 Model Overview

The Blue Mesa Water Bank Model augments baseline Colorado River flow with "bank" water obtained from hypothesized deficit irrigation and water banking practices. It simulates the development and operations of a water bank in Blue Mesa Reservoir. Under such a banking scheme, water savings from deficit irrigation are stored in an account in Blue Mesa and then released to the Colorado River at some point in the future to help meet State of Colorado compact obligations.

Within Blue Mesa, bank water is tracked and managed separately from the baseline reservoir storage account. Bank water releases are added to the system at Blue Mesa Reservoir and "routed," using simplified methods, to the Colorado-Utah state line and further to potential downstream compact compliance points. The model also allows for the simulation of "direct" deficit irrigation and municipal and industrial (M&I) conservation. In these simulations, either agricultural or M&I water use is reduced and the water savings are provided directly, and immediately, to the river (rather than via storage) to augment flows and to offset compact deficits.

The initiation of water banking activity, direct deficit irrigation, and M&I conservation are all triggered by user-defined criteria. Water is released from the water bank storage account under one of two conditions: bank storage is at capacity and unintentional spills occur or water is intentionally released to offset an existing compact deficit. Compact deficits are calculated in the model based on the Lee Ferry compact obligation of 75 million acre-feet (MAF) rolling 10-year total flow and a user-specified Colorado apportionment.

2.0 Model Calculations

The model operates on a monthly timestep and can simulate up to a 100-year period. It accommodates up to 10 different sets of hydrologic inputs, or scenarios, which the user selects at the start of the model run (**Figure 1**). The model user can also select the outputs to be generated for a given model run (**Figure 2**).

For the purposes of this documentation, the term "baseline" refers to normal river and reservoir operations and hydrology, without the addition of a water bank. Baseline inflows to Blue Mesa are defined by the Gunnison River above Blue Mesa data set. Baseline outflows from Blue Mesa are defined by the Gunnison River below Blue Mesa data set. Existing reservoir release requirements and the maintenance of local downstream flow targets are assumed to be implicit in this latter data set.

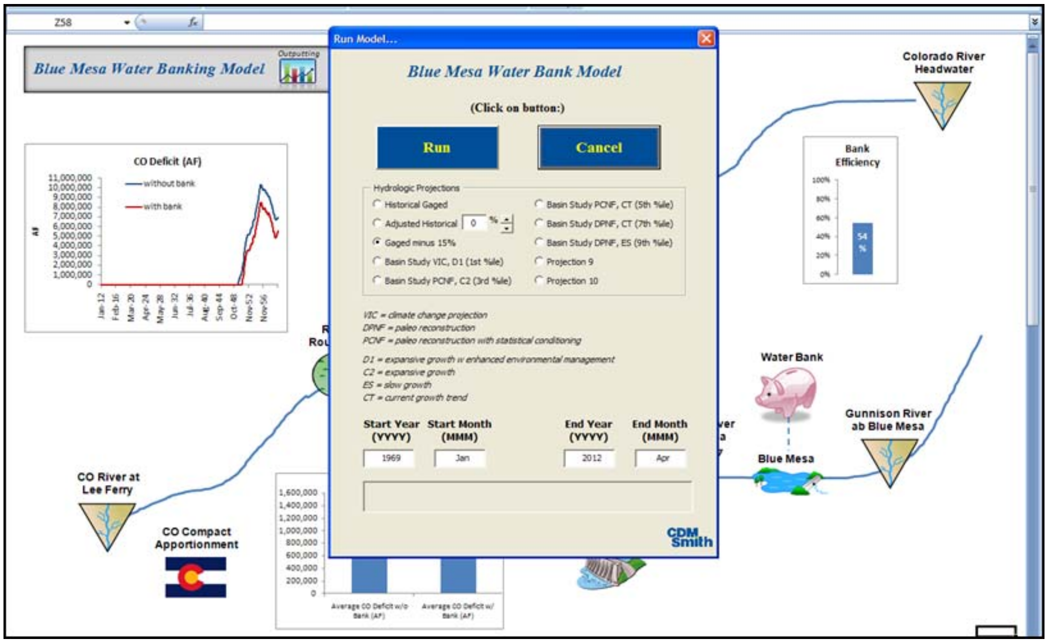

Figure 1. Run Start Form

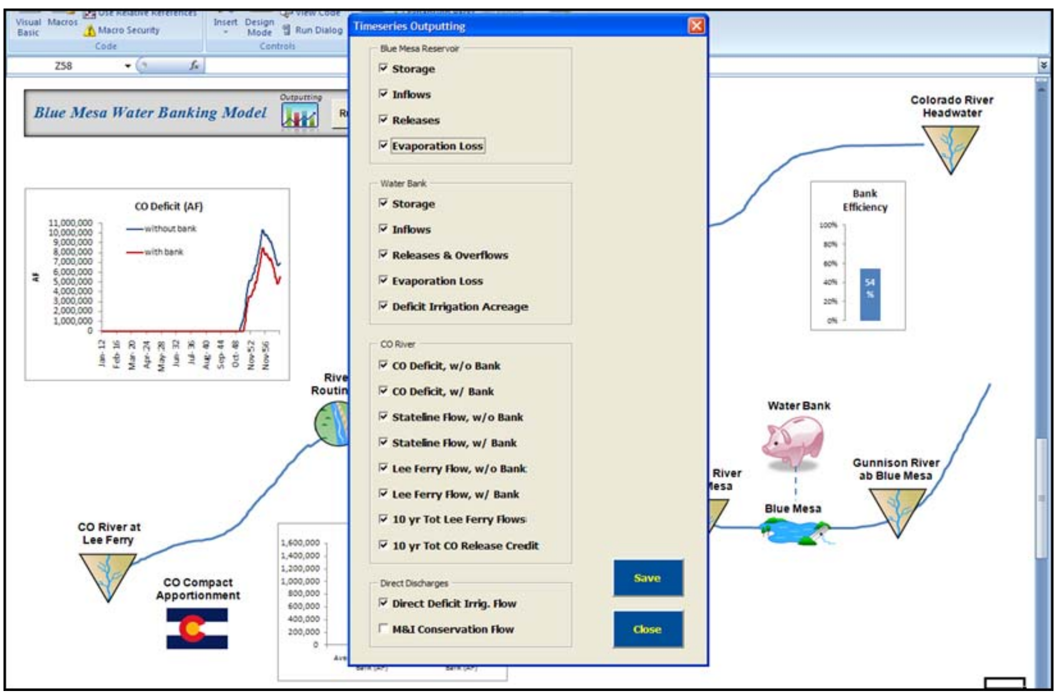

Figure 2. Outputting Options

As an alternative to using the implicit data set, Blue Mesa Reservoir release operations can also be simulated explicitly in the model according to user-prescribed sets of operating rules. This model feature allows for the investigation of modified reservoir operations that might better accommodate a water bank. Combinations of up to five different prioritized rules, defining releases from Blue Mesa as a function of various river flow and account storage metrics, can be specified by the user (**Figure 3**). The model attempts to satisfy each rule, in order of priority, in setting a release volume for a given month. Rules can be based on: maintaining a minimum or maximum monthly or annual outflow, maintaining a minimum or maximum monthly or annual storage volume, or hitting (as closely as possible) monthly storage targets defined in a storage curve. Note that there are important differences between a monthly storage minimum (or maximum) and a storage curve target. For the former, the model will not adjust a monthly release as long as current storage is at or above the monthly minimum. For the latter, monthly releases are adjusted at every timestep in order to achieve, as close as possible, the prescribed storage curve targets.

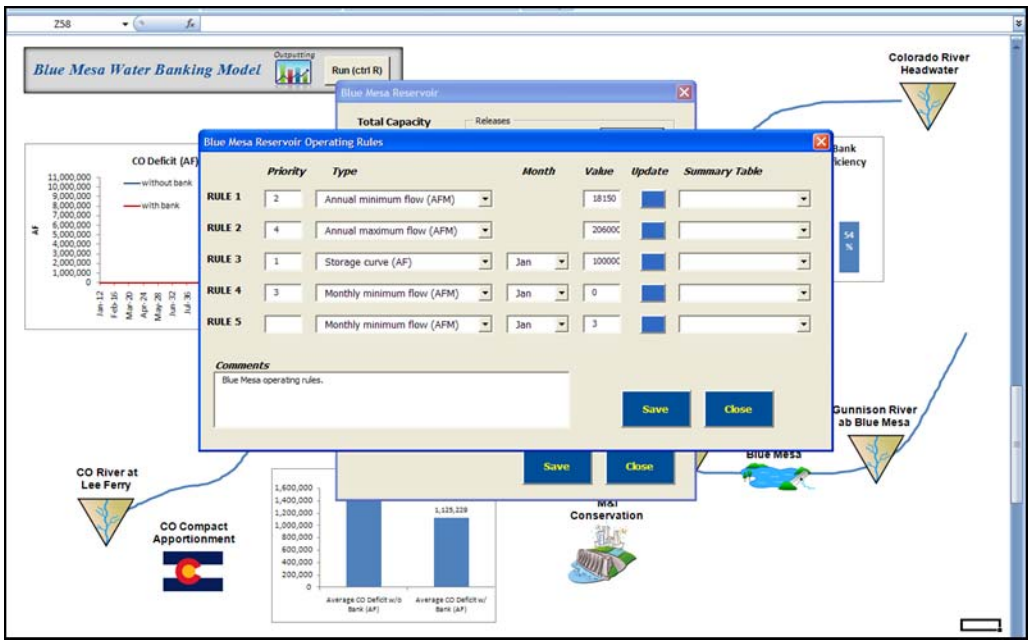

Figure 3. Blue Mesa Reservoir Release Rules

Evaporation from Blue Mesa is simulated in the model according to user-prescribed monthly rates and reservoir surface areas calculated with a user-defined area-capacity table (**Figure 4**). Baseline storage in Blue Mesa is calculated in the model at each timestep as a function of the inflows and outflows described above, assuming a total reservoir storage capacity of 829,500 acre-feet (AF). The fundamental storage routing equation used in the model for both baseline reservoir storage and water bank storage (described below) can be written as:

$$\frac{dS}{dt} = Q_{in} - Q_{out}$$

where S = storage, Q_{in} = total of all inflows to given storage account (including tributary flows and water bank deposits), and Q_{out} = total of all outflows from the account (including releases and evaporation).

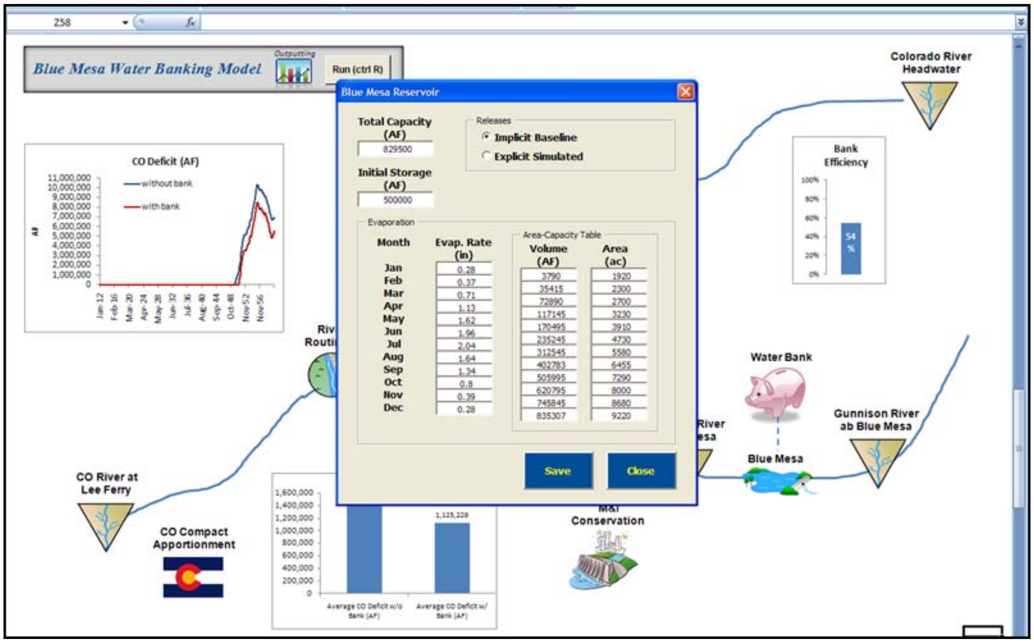

Figure 4. Blue Mesa Reservoir Inputs

Periodically, and simultaneous to the baseline reservoir operations, bank "deposits" to Blue Mesa are simulated in the model. This water is new to the system in the sense that it has historically been diverted upstream of the state line and consumed by crops. As the model adds it back to the system, via a water bank, the water ultimately serves to offset compact deficits associated with baseline Colorado River flows. Deficits are defined in the model as the difference between the 75 MAF rolling 10-year total flow obligation at Lee Ferry and the actual simulated 10-year value, when the latter is less than the former. The modeled deficit therefore changes at each timestep as a function of the baseline Lee Ferry flow monthly timeseries and any new water releases to the river from either the water bank, direct deficit irrigation, or M&I conservation practices (described below).

In calculating deficits, the model considers flows associated with both the given timestep and the previous 119 timesteps, for a 10-year total. Only a portion of this total deficit gets apportioned to the State of Colorado in the model. This default apportionment is based on the percentage of the total upper basin consumptive use provided to the state according to the 1948 Upper Colorado River Basin Compact (51.75 percent). This value can be modified by the user to investigate alternative assumptions (**Figure 5**).

Water bank deposits are initiated at any point in a simulation when user-defined criteria are met. These criteria can be either hydrologic (i.e., minimum 10-year flow) or a fixed date range (**Figure 6**). The magnitude of bank deposits (AFM) are also user prescribed and may come from independent analyses of potential Upper Basin deficit irrigation scenarios. Bank deposits are placed into the bank storage account, separate from the baseline Blue Mesa storage.

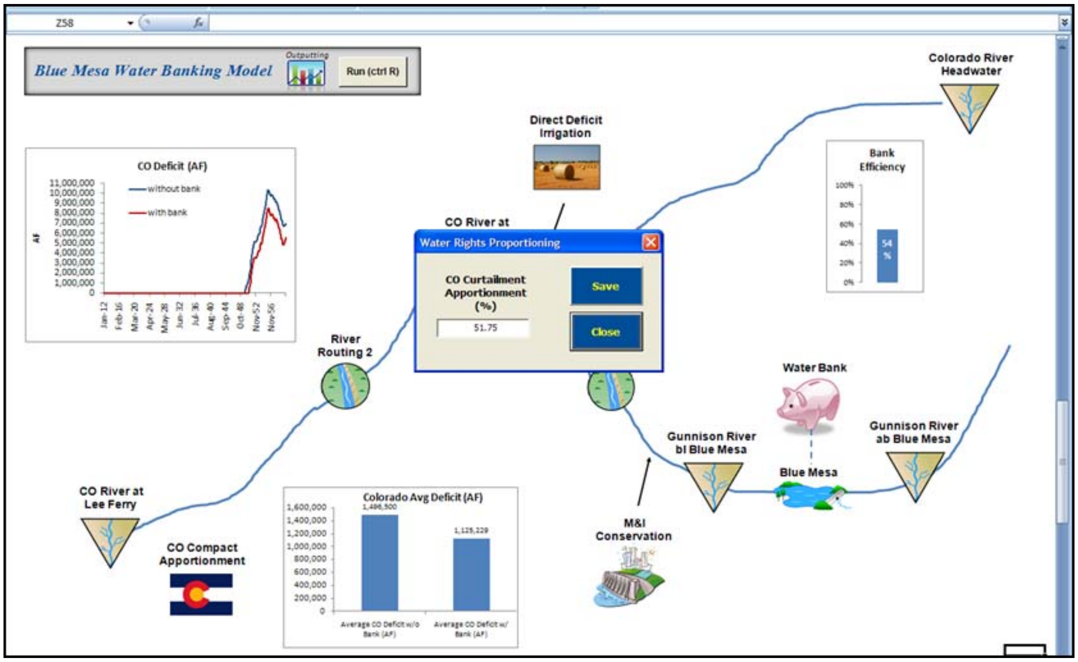

Figure 5. Colorado Deficit Apportionment

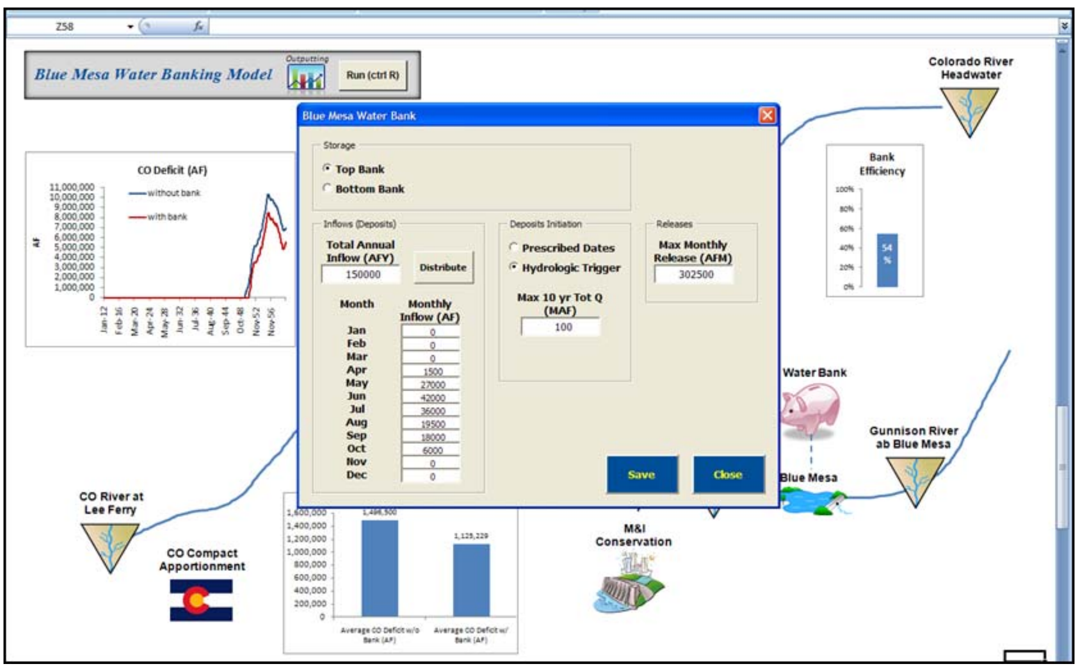

Figure 6. Water Bank Inputs

The bank storage account is defined according to a selected alignment (top vs. bottom) and a total capacity that is either calculated (top bank) or prescribed (bottom bank). For both types of bank accounts, a portion of the total Blue Mesa evaporative losses (described above) are applied to the water bank storage account. This apportionment is based on the volumetric proportions of storage in the two accounts (baseline vs. bank) at a given timestep.

For a top bank, storage capacity is dynamic and is calculated as the difference between total Blue Mesa storage capacity (829,500 AF) and the amount of baseline reservoir storage in a given month. In other words, the bank storage capacity is the excess capacity in the reservoir, which changes each month as a function of baseline reservoir operations. As a consequence of this, bank spills can be significant, as in the case of sudden onset of spring Gunnison River inflows to the reservoir. Bank overflows from a top bank are assumed to enter the Gunnison River below the reservoir and are included in the calculation of deficit offsets (described below). However, they are not controlled and may result in "wasted" water and a less efficient bank (described further below). In addition to unintended overflows, water is intentionally released from top bank storage, up to a user-defined maximum volume, during deficit months. As an example, if a 300,000 AF deficit has been apportioned to Colorado at a given timestep, the model will attempt to release this volume of bank water to offset the deficit. However, the actual amount available for release will be constrained by either the amount available in storage or the user-prescribed maximum monthly bank release.

For a bottom bank, the bank storage capacity is user-defined and static. Deposits to and releases from a bottom bank can occur at any time, regardless of overlying baseline storage levels, and subject to the same initiation and release criteria as described above. This type of banking operation would rely on careful paper accounting of water storage in the reservoir. As with a top alignment, any bank water deposits that occur in excess of available bank storage will result in immediate overflow and direct discharge to the river. However, unlike a top alignment, once water is placed into bottom bank storage, it is not vulnerable to spills. Stored bottom bank water remains intact, subject only to proportional evaporative losses (see above), until releases are triggered.

Direct deficit irrigation can also be simulated in the model as a means of augmenting river flows. Direct deficit irrigation can be specified for either of two general locations: upstream of the Colorado state line or upstream of the Lee Ferry gage. Transit losses associated with the two locations differ, as defined by the user. Up to 10 different direct deficit irrigation areas can be simulated. Each is parameterized according to total irrigated acreage, annual consumptive use, and monthly seasonal patterns associated with the consumptive use (**Figure 7**). As with water bank activities, initiation of direct deficit irrigation can be dependent on either a prescribed date range or the 10-year rolling total flow at the Lee Ferry gage. Monthly net water yield from direct deficit irrigation (Q^t_{irrig}) is calculated in the model as:

$$Q^t_{irrig} = Area * CU * \%monthly^t$$

where Area = total irrigation area included in deficit irrigation program (ac), CU = annual consumptive use (water not returned to river) associated with the irrigated area (ft yr^{-1}), and %monthly = monthly distribution factor.

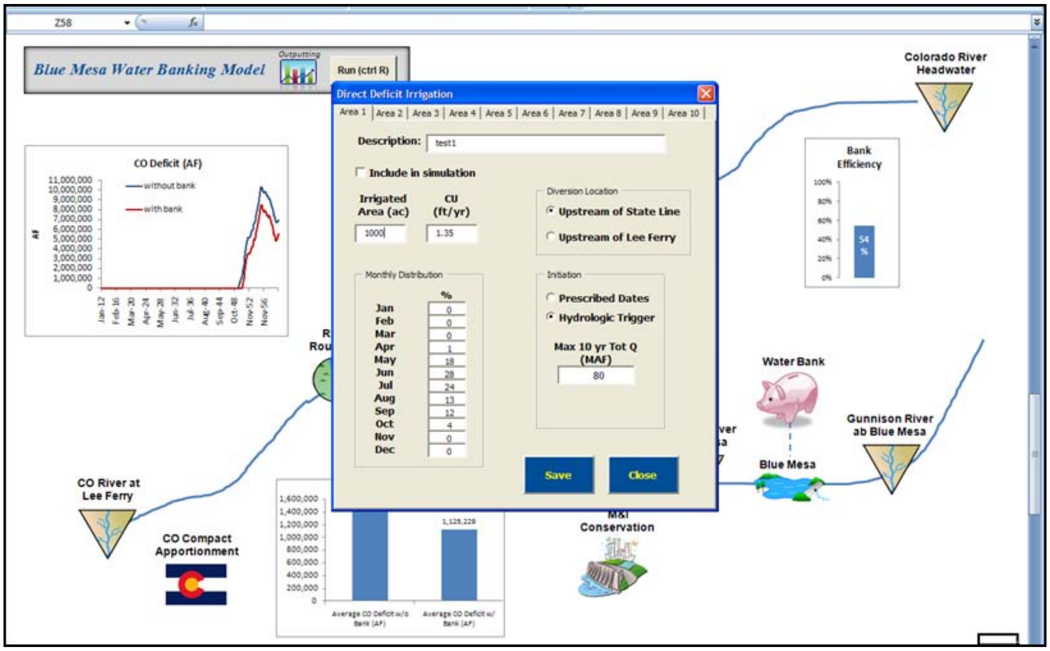

Figure 7. Direct Deficit Irrigation Inputs

M&I objects act in generally the same manner in the model as direct deficit irrigation objects. New water is introduced to the system via water conservation during model simulation when prescribed initiation criteria are met. As with direct deficit irrigation, up to 10 different M&I conservation efforts can be simulated for one of two relative locations. These objects are parameterized according to a total annual consumptive use, an annual percent conservation, and monthly patterns of usage (**Figure 8**). Monthly net water yield from M&I conservation ($Q^t_{M\&I}$) is calculated in the model as:

$$Q^t_{M\&I} = CU * \%conservation * \%monthly^t$$

where CU = annual consumptive use, %conservation = total conservation savings as a percentage of annual consumptive use, and %monthly = monthly distribution factor.

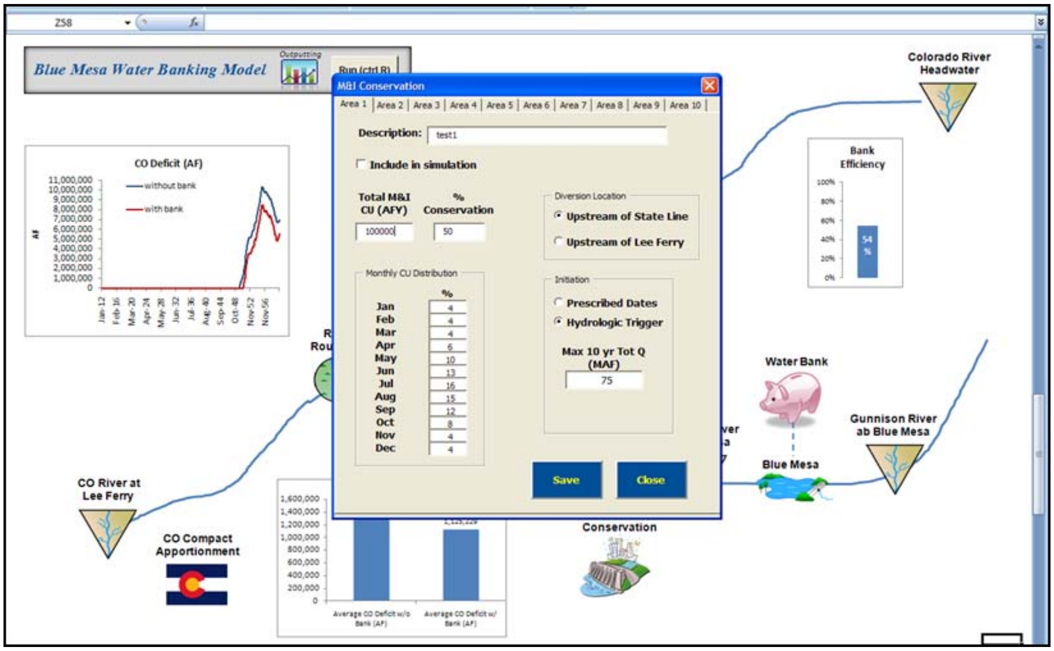

Figure 8. M&I Conservation Inputs

Water released from the simulated water bank (either intended releases or unintended overflows), direct deficit irrigation or M&I conservation activities, gets "credited" to the State of Colorado's compact obligation. Releases are assumed to offset state deficits on a 1:1 basis, after transit losses. Transit losses are user-defined (**Figure 9**) and deplete a portion of the released water during transit to downstream locations. Water is "routed" to key downstream locations according to these transit losses and, if applicable, monthly travel times. Routed water augments downstream baseline river flows. Credited net downstream flow volumes resulting from bank, direct deficit, or M&I conservation releases are calculated in the model as:

$$Q_{offset}^{t} = Q_{release}^{t-lag} * (1 - \%transitloss_1) * (1 - \%transitloss_2)$$

where Q^t_{offset} = flow volume credited to state to offset compact deficit, $Q^{t\text{-lag}}_{release}$ = water release at time t-lag, $\%transitloss_1$ = transit loss from water bank to Colorado state line, and $\%transitloss_2$ = transit loss from state line to Lee Ferry. It should be noted that implied in this approach is the assumption that the released bank water will eventually result in higher river flows delivered to the lower Colorado River Basin, thereby helping to meet compact obligations. Explicit and detailed routing of this water through the Upper Colorado River basin is, however, beyond the scope of this project.

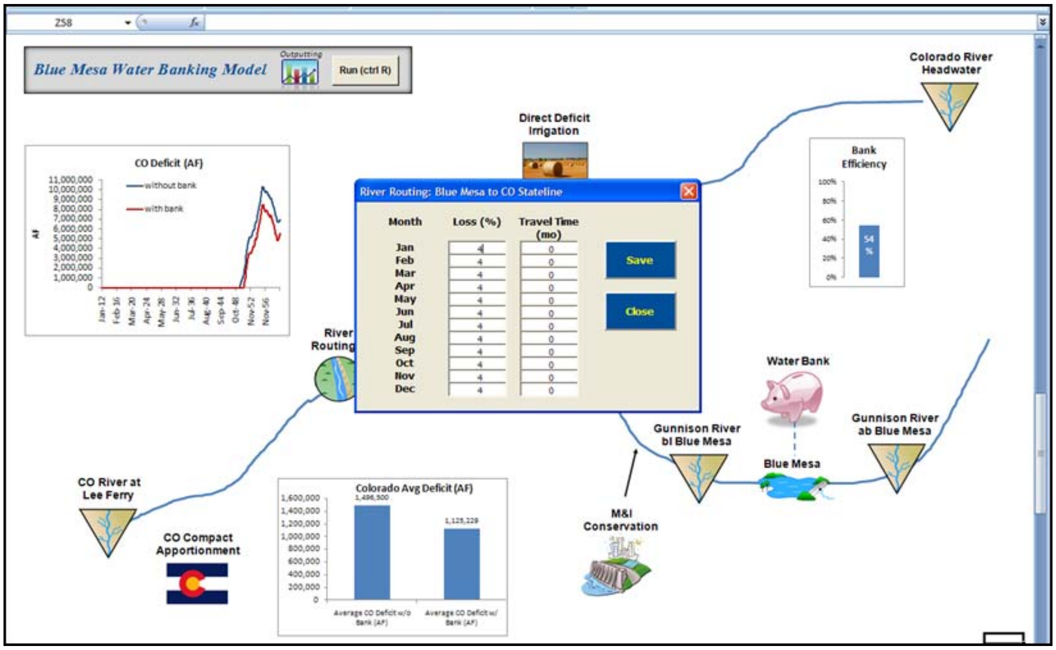

Figure 9. River Routing Inputs

As described above, baseline Colorado River flows at the Lee Ferry (Arizona) gage location determine whether the system is initially in "deficit" or "surplus" with respect to the Colorado River compact. Note that while baseline Lee Ferry flows are prescribed by the user, default hydrologic scenarios were obtained from sophisticated river modeling of the entire Upper Colorado River Basin undertaken as part of the Reclamation Basin Supply study. In other words, output from the more complex Basin Model serve as input to the simplified water bank model. Implicit in these data sets, therefore, are basin demand and consumption projections, hydrologic uncertainty (including climate change), storage and infrastructure considerations, and natural river transit gains and losses.

A key output of the current model is "water bank efficiency." This parameter is defined as the total amount of bank water that serves to offset calculated deficits divided by the total of water "deposited" to the bank. In other words, it could be thought of as the ratio of total yield to total deposit. Differences between the two are attributable to evaporative and transit losses and water "wasted" as a result of unintended releases (overflows) from the bank. Note that bank overflows, though unintended, may ultimately still reduce future deficits and increase yield, in which case they are not counted as wasted water in the model. However, they also may only augment surplus 10-year flows at Lee Ferry, both currently and in the future, in which case the overflows are counted in the model as "wasted." Wasted water calculations are performed internally in the model through careful accounting of each timestep's bank release.

3.0 List of Inputs

- Monthly baseline river flows: Gunnison River at Blue Mesa, Gunnison River at Crystal Reservoir, Colorado River at Lee Ferry, and Colorado River at Colorado-Utah state line (currently for reference only)
- Blue Mesa Reservoir physical parameters: total storage capacity, monthly evaporation rates, and area-capacity table
- Blue Mesa Operating Rules: up to five different rules used to set monthly releases, ordered by priority, and defined by minimum or maximum flow or reservoir storage targets or a seasonal storage curve
- Water Bank details: alignment, monthly inflows, initiation criteria, max monthly release
- Direct deficit irrigation details: irrigated acreage, annual consumptive use, irrigation efficiency, monthly distribution factors, initiation criteria, relative basin location
- M&I conservation details: total annual consumptive use, percent conservation achieved, monthly distribution factors, initiation criteria, relative basin location
- River routing: transit losses and travel times associated with bank, direct deficit irrigation, or M&I conservation water as it moves from upstream (e.g., Blue Mesa) to downstream locations (e.g., Colorado-Utah state line or Lee Ferry, Arizona); used in the accounting of State of Colorado compact deficit offsets and calculation of river flows at key downstream locations

4.0 List of Outputs

- Monthly river flows after banking activity: Gunnison River below Blue Mesa, Colorado River at Colorado-Utah state line, Colorado River at Lee Ferry
- Monthly baseline storage in Blue Mesa Reservoir
- Monthly bank water storage
- Monthly bank inflows ("deposits")
- Deficit irrigation acreage associated with bank inflows
- Monthly direct deficit irrigation flow augmentation
- Monthly M&I conservation flow augmentation
- Monthly 10-year rolling flow totals at Lee Ferry: with and without banking activity
- Monthly 10-year rolling total flow augmentation credited to State of Colorado
- Monthly evaporative losses from both Blue Mesa baseline and water bank storage accounts
- Monthly releases and overflows from both Blue Mesa baseline and water bank storage accounts
- Monthly Colorado River deficits, apportioned to Colorado: with and without banking activity

- Overall mean Colorado deficit, averaged over the simulation period: with and without banking activity
- Total bank wasted water, totaled over the simulation period (AF)
- Overall bank efficiency = (total bank deposit – total wasted water) / total bank deposit

5.0 Key Assumptions

- Under a water banking scheme, Blue Mesa Reservoir "baseline" storage will be tracked and managed separately from any new water bank water in the reservoir.
- Under a water banking scheme, bank water released from Blue Mesa, and water augmentation from direct deficit irrigation or M&I conservation, will be credited to the State of Colorado and serve to offset any calculated river flow deficits on a 1:1 basis, after transit losses. Implicit in this assumption is the larger assumption that this water will eventually result in higher flows delivered to the lower basin. In order to achieve this in reality, it is assumed that some type of regulatory framework would be implemented whereby bank water is protected from Upper Basin downstream uses. Further, an exchange agreement with Lake Powell operators will likely be required to ensure that an appropriate amount of water is released from the reservoir to the lower basin in recognition of the bank-augmented inflows to the reservoir.
- Total Lee Ferry flow deficits will be apportioned to Colorado based on the percent of total Upper Basin consumptive use applied to Colorado per the 1948 Upper Colorado River Basin Compact. This value, as defined by the compact, is 51.75 percent. This value can, however, be varied in the model by the user.

6.0 User Quick Reference and Interface Guide

The Blue Mesa water bank model was developed using Visual Basic for Applications (VBA) within Microsoft *Excel*. It is written in modular object-oriented code to allow for easy future enhancements and modifications. It is fully portable and does not require any specialized software (other than Microsoft *Excel*). It includes a user-friendly interface that is intended to make the model useable for a broad range of possible end users.

6.1 Model Objects

User inputs are specified via a series of input forms accessed by clicking on object icons on the "Main" screen of the model. Details of each object type and their associated inputs are provided below.

6.1.1 Tributary Object

There are four main tributary objects in the model: Gunnison River ab Blue Mesa, Gunnison River bl Blue Mesa, Colorado River at Stateline, and Colorado River at Lee Ferry. Each of these is parameterized by a user-defined monthly timeseries of flow data (AFM) (**Figure 10**). Gunnison River flows are specified for just above, and just below, Blue Mesa Reservoir. Colorado River flows are specified for at the Colorado-Utah state line and at Lee Ferry (Arizona).

Colorado River at Lee Ferry

Year (YYYY)	Month (MMM)	Historical Gaged Monthly Flow (AFM)	* Adjusted Historical Monthly Flow (AFM)	Historical minus 15% Monthly Flow (AFM)	VIC D1 Monthly Flow (AFM)	PCNF C2 Monthly Flow (AFM)	PCNF CT Monthly Flow (AFM)	DPNF CT Monthly Flow (AFM)	VIC CT Monthly Flow (AFM)	Projection 9 Monthly Flow (AFM)	Projection 10 Monthly Flow (AFM)
1969	Jan	575,580	575,580	489,243	-	-	-	-	-		
1969	Feb	463,496	463,496	393,971	-	-	-	-	-		
1969	Mar	712,368	712,368	605,512	-	-	-	-	-		
1969	Apr	873,077	873,077	742,116	-	-	-	-	-		
1969	May	763,975	763,975	649,379	-	-	-	-	-		
1969	Jun	875,525	875,525	744,196	-	-	-	-	-		
1969	Jul	959,112	959,112	815,245	-	-	-	-	-		
1969	Aug	932,819	932,819	792,896	-	-	-	-	-		
1969	Sep	795,544	795,544	676,212	-	-	-	-	-		
1969	Oct	630,800	630,800	536,180	-	-	-	-	-		
1969	Nov	707,843	707,843	601,667	-	-	-	-	-		
1969	Dec	815,886	815,886	693,503	-	-	-	-	-		
1970	Jan	707,925	707,925	601,736	-	-	-	-	-		
1970	Feb	446,231	446,231	379,297	-	-	-	-	-		
1970	Mar	487,864	487,864	414,685	-	-	-	-	-		
1970	Apr	942,627	942,627	801,233	-	-	-	-	-		
1970	May	899,748	899,748	764,786	-	-	-	-	-		
1970	Jun	800,488	800,488	680,415	-	-	-	-	-		
1970	Jul	769,533	769,533	654,103	-	-	-	-	-		
1970	Aug	776,772	776,772	660,256	-	-	-	-	-		
1970	Sep	702,062	702,062	596,753	-	-	-	-	-		
1970	Oct	498,561	498,561	423,776	-	-	-	-	-		
1970	Nov	450,043	450,043	382,537	-	-	-	-	-		
1970	Dec	671,853	671,853	571,075	-	-	-	-	-		
1971	Jan	493,012	493,012	419,060	-	-	-	-	-		
1971	Feb	417,242	417,242	354,656	-	-	-	-	-		
1971	Mar	641,539	641,539	545,309	-	-	-	-	-		
1971	Apr	1,011,023	1,011,023	859,369	-	-	-	-	-		
1971	May	926,102	926,102	787,186	-	-	-	-	-		
1971	Jun	894,505	894,505	760,329	-	-	-	-	-		
1971	Jul	943,547	943,547	802,015	-	-	-	-	-		
1971	Aug	882,710	882,710	750,304	-	-	-	-	-		
1971	Sep	776,508	776,508	660,032	-	-	-	-	-		
1971	Oct	586,877	586,877	498,845	-	-	-	-	-		
1971	Nov	765,166	765,166	650,391	-	-	-	-	-		
1971	Dec	939,667	939,667	798,717	-	-	-	-	-		
1972	Jan	806,823	806,823	685,800	-	-	-	-	-		
1972	Feb	445,530	445,530	378,700	-	-	-	-	-		

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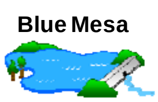
Colorado at Lee Ferry

Figure 10. Tributary Inputs

6.1.2 Blue Mesa Object



The Blue Mesa Reservoir object provides for parameterization of the physical reservoir and "baseline" operations. Baseline, in this context, refers to operations of the reservoir outside of the proposed water bank. Inputs include total reservoir storage capacity, initial (start of simulation) reservoir storage, monthly evaporation rates, and reservoir bathymetry (area-capacity table) (Figure 4).

Also included in this object is the option to either implicitly or explicitly simulate reservoir release operations. For the former, the model uses the user defined monthly flow rates for the Gunnison River bl Blue Mesa tributary object (above) to define reservoir outflows. In other words, baseline reservoir operations are implicitly included in the prescribed flow rates, as described in Section 6.2. For the latter, model users may explicitly define a series of prioritized release rules (Figure 3). These rules can be based on minimum or maximum required flow rates or storage levels or monthly storage curves. For the latter, the model attempts to adjust reservoir releases at each timestep to achieve, as closely as possible, the prescribed monthly target. Each rule is prioritized according to user-specified ranking numbers. At each simulation timestep, the model attempts to achieve each specified rule in order of priority. After each rule edit, users should click on the "Update" button prior to moving on to another rule. Summaries of each rule or set of rules are available in the drop down "Summary Tables."

6.1.3 Water Bank Object

Water bank inputs include bank storage account alignment (top bank or bottom bank), total account capacity (bottom bank only), annual and monthly inflows to the account, a maximum monthly release constraint, and bank deposit initiation criteria (Figure 6). Bank deposits can be initiated during a simulated either with a prescribed date trigger or a hydrologic trigger, as described above. For the date trigger, specified inflows to the bank account are applied in the model constantly throughout the prescribed date range. For the hydrologic trigger, inflows are initiated when Lee Ferry 10-year total flows fall below the specified threshold. Inflows are stopped when 10-year flows rise back above the threshold.

6.1.4 Direct Deficit Irrigation Object

Direct Deficit Irrigation

The direct deficit irrigation object allows for user-defined deficit irrigation at multiple locations in the modeled basin with conserved water discharged directly to the river (rather than into the water bank). Up to 10 different direct deficit irrigation areas can be defined by the user. Inputs, for each area, include deficit irrigation area, annual and monthly irrigation consumptive use, relative basin location, and deficit irrigation initiation criteria (Figure 8). Relative basin locations are used in the model to appropriately apply transit losses and lag times to the deficit irrigation flow volumes and to add the resulting net flows to downstream river flows. The model assumes that the State of Colorado receives full credit (minus transit losses) toward mitigating a compact deficit for any direct deficit irrigation discharge to the river system.

6.1.5 M&I Conservation Object

M&I Conservation

The M&I conservation object represents M&I water conservation practices implemented specifically to offset a compact obligation. As water is conserved, more remains in the river, and downstream deficits are reduced. As with the direct deficit irrigation object, the model assumes that the state receives full credit (minus transit losses) toward mitigating a compact deficit for any new water in the system resulting from M&I conservation. Up to 10 different M&I conservation programs can be simulated in the model, as defined by the user. Inputs, for each, include total annual M&I consumptive use, monthly water use distribution factors, percent conservation, relative basin location for the M&I diversion, and conservation initiation criteria (Figure 9). As above, specified relative basin locations are used in the model to appropriately apply transit losses and lag times to the conservation flow volumes and to add the resulting net flows to downstream river flows.

6.1.6 River Routing Objects

River Routing1

Two river routing icons appear on the main model screen, each requiring its own set of inputs. The river routing objects provide for the simulation of transit losses and flow travel times from upstream Gunnison River locations (e.g., the water bank) to the Colorado state line and from the state line down to the Lee Ferry compact points, respectively. Lumped transit losses might include, for example, seepage or evaporative losses as water flows down the river. Transit losses are only applied to the "new" water added to the system from the Blue Mesa water bank, direct deficit irrigation, or M&I conservation. River routing inputs include monthly variable transit losses (expressed as a percentage) and monthly variable lag times (Figure 7).

6.1.7 CO Compact Apportionment

CO Compact Apportionment

Only a fraction of any calculated flow deficit at Lee Ferry gets apportioned to Colorado. This fraction is user-specified via the Colorado Compact Apportionment object (Figure 5). The default value in the model (51.75 percent) is based on the 1948 Upper Colorado Basin Compact.

6.2 Hydrologic Scenarios

Multiple hydrologic scenario options are available to the model user at the initiation of a run (Figure 1). Currently, options include: historical gage data (1969 – 2012), historical gage data minus a uniform 15 percent, historical gage data minus a user-specified alternative percentage, and five different future scenarios (2012 – 2060) developed by Bureau of Reclamation under a separate study. These future scenarios capture projected increases in demand, of varying magnitude, coupled with projected increased hydrologic and climate variability - beyond that observed in recent historical record. Available scenarios represent a sampling of the worst-case projections out of a total data set of over 11,000. Percentiles associated with each scenario are provided on the Run form. These percentiles, ranging from the 1st to the 9th, were calculated across all 11,000+ data sets with respect to minimum 10-year rolling total flows at the Lee Ferry compact point.

Further details on the hydrologic scenarios have been provided elsewhere (Tasks 1 and 2 Technical Memorandum, CDM Smith). Note that default simulation periods (start date and end date) are provided automatically on the Run form based on the selected scenario. However, the user can modify these dates if, for example, a shorter simulation period is desired.

6.3 Model Output Selections

To simplify post-processing and analysis, and to decrease simulation run time, a subset of all available outputs can be specified by the user for writing to the model output sheet (Figure 2). The user form in Figure 2 is accessed via the multi-colored bar and line chart icon above the RUN button (and shown at left). Output requests must be specified prior to the start of simulation. All output is provided in tabular format in the "Model Output" worksheet.