

APPENDIX H

PROGRAMMER'S NOTES

Programmers Notes

Modification of the Bear River Model

The Bear River Spreadsheet Model was written assuming that it may be modified for use in future investigations of other Wyoming river basins. Instructions are incorporated throughout this document providing hints and suggestions to the Programmer. Some overall suggestions are included here for consideration of the Programmer.

- As a general rule, whenever rows need to be added to any table (e.g. adding a node within an existing Reach), the Programmer should create a template for the new information using existing cells/tables. Existing worksheet rows which contain the type of information to be inserted should be copied and inserted where needed instead of adding them to the bottom of the table. The Bear River Model uses Alookup@ functions extensively. By Ainserting@ rows, Excel will automatically modify the formulas in cells referencing a table. If rows are added to a table without insertion, the lookup functions may not Afind@ the new information.
- The workbooks have been provided with the Aprotection mode@ enabled for each worksheet. No password has been used, therefore, the Programmer may turn the protection feature off if changes are required (Tools - Protection - Unprotect Worksheet).
- When entering data such as historic diversions, historic USGS gage data, etc., the Programmer should use a Apaste special@ command to protect the existing format and formulas by inserting only data values (Edit - Paste Special - Values).
- When copying existing formulas or tables, the Programmer should copy and paste entire rows of existing tables (or entire tables where appropriate), in lieu of copying a single cell formula and using it to fill a table. The reason for this is that many of the Alookup@ formulas may not copy to adjacent columns correctly.
- Whenever copying and pasting anything in the workbook, the Programmer should ensure that Excel has been set to copy in the Arelative address@ mode.

Additional detailed information has been provided to the Programmer in this document with the discussion of each worksheet.

For various sections of the Excel spreadsheet model, programmers notes have been prepared to assist or guide modifications in future modeling efforts.

GUI

The GUI was developed using Visual Basic within Microsoft⁷ Excel. Modification of the GUI requires an understanding of the Visual Basic programming language. When the User opens the Bear River Model file - the GUI - the model is informed where on the User's computer the file is located. All files must be located in the same folder for the model to operate properly. Once the GUI is initialized, the model will look in the same location for any additional files.

Future revisions of the Bear River Model will require the following minor modifications to the GUI:

1. The names of the Bear River files must be replaced with future file names in the programming code associated with each of the three model selection buttons.
2. Text in the forms presented in the GUI must be modified to reflect the future version.

Navigation Worksheets

Excel programmers modifying the spreadsheet model will need to modify the Reach/Node Description table located to the right of the visible screen, for the Navigation Worksheet to work properly. If new reaches must be entered, INSERT columns and renumber the header accordingly. This will cause formulas which reference this table to change accordingly. Also, if the table must be expanded vertically (i.e., more nodes must be added than the table currently accommodates), the same practice should be followed. That is, always INSERT rows or columns within the existing table. This allows the Programmer to avoid modification of formulas which influence the table.

The Programmer must also modify the macro associated with the pull-down menu to include all reaches in a new model. Begin by naming a cell in the upper left of any additional Reach worksheets. Then modify the Visual Basic (VB) code to include a "GoTo" reference for that worksheet. Figure DD.1 displays the VB code associated with the subroutine named AReach@. New reaches can be incorporated in this macro by copying one Aelse if@ statement and renaming the appropriate range number.

```
Sub GOTOReach(t4)
If Range("t4") = 1 Then
    Application.Goto Reference:="reach_1"
ElseIf Range("t4") = 2 Then
    Application.Goto Reference:="reach_2"
ElseIf Range("t4") = 3 Then
    .
    .
    .
End If

End Sub
```

Basin Map

The stick diagram was generated within Excel using graphical icons. Each icon is then assigned a macro which takes the User to the selected Reach. Modification of the basin map will require additional macros if new Reaches are added. Figure DD.2.3 displays an example macro taking the User to the Reach 5 worksheet where a cell at the top of the worksheet has been named AReach_5".

If an interactive map is incorporated in future versions of this model, a macro such as this should be assigned to the corresponding portions of the diagram.

```
Sub GOTOReach5()

Application.Goto Reference:="Reach_5"
End Sub
```

Results Navigator

This portion of the worksheet must be customized to correlate with any future versions of this model. Different river basins will have different compact allocation computations and formats.

When incorporated into this model, the Summary Navigator worksheet should be modified to allow the User to Ajump@ directly to the new tables.

Master Node List

This list is referenced throughout the workbook by Alookup@ functions. The Alookup@ functions primarily associate the name of a node with the node number when it is entered at certain locations. This eases input of information in tables such as the Node Tables, Return Flow Tables, etc. In those tables, the Programmer can simply enter the Node number and the Name is filled in automatically. Therefore, whenever a Node is added to a Reach, it must be inserted in this table.

Because the model frequently uses Alookup@ functions, it is highly recommended that the Programmer use Excel's AINSERT ROWS@ command whenever adding information to this or other data tables. When information is added this way, formulas which reference the table automatically update to refer to the newly expanded range. If rows are added to the bottom of a listing, the referenced formula may not Afind@ the new data.

This list is not required to be sorted in any particular order; all formulas referencing the table will retrieve the correct information regardless of order. However, for ease of reading, it is recommended that it be sorted either by node number or by node name.

If the User must add nodes between existing nodes, they do not necessarily need to be numbered in sequential order. The node numbers are not used by the model for anything other than identifiers. The correct sequence of nodes within a reach is determined by the Programmer when building the Reach worksheets.

Gage Data

The values presented in this table are input as values from separate analysis and worksheets outside of this model. The worksheet contains no links to other workbooks and no computations occur on this worksheet. These data are automatically retrieved by formulas in other worksheets via Alookup@ functions.

Diversions Data

This table is referenced by several other worksheets in the Bear River Model via Alookup@functions. There are no computations which are executed in this worksheet.

It is important to note that ALL nodes are included in this table, even if no diversions occur at that node (e.g. gaging station nodes). This simplifies the spreadsheet logic used in the Node Tables. By including all nodes in this table, the Node Tables are all identical and can generally be copied as many times as are needed without modification (see User and Programmer Notes pertaining to the node/reach worksheets for exceptions to this rule). Therefore, if no diversions occur at a node, simply leave the data columns blank or insert zeros.

Because the model uses Alookup@functions to retrieve data from this table, it is highly recommended that the Programmer use Excel's AINSERT ROWS@command whenever adding information to this or other data tables. When information is added this way, formulas reference the table automatically update to refer to the newly expanded range. If rows are added to the bottom of a listing, the referring formula may not Afind@the new data. After rows are inserted, the Programmer can copy the formulas in the AName@column to retrieve gage names automatically.

Import and Export Data

This table is referenced by several other worksheets in the Bear River Model via Alookup@functions. Any imports or exports which occur at any node of the model must be entered here. No computations are conducted within this worksheet.

It is important to note that ALL nodes are included in this table, even if no imports or exports occur there (e.g. gaging station nodes). This simplifies the spreadsheet logic used in the Node Tables. By including all nodes in this table, the Node Tables are all identical and can be copied as many times as are needed without modification. Therefore, if no diversions occur at a node, simply leave the data columns blank or insert zeros.

Because the model uses Alookup@functions to retrieve data from this table, it is highly recommended that the Programmer use Excel's AINSERT ROWS@command whenever adding information to this or other data tables.

Return Flow

All nodes where diversions occur must be included in the Return Flows worksheet. If nodes are added, the Programmer should follow the same precautions outlined in the discussion of previous worksheets and use Excel's **INSERT ROWS** commands. This simplifies modifications because formulas which reference this worksheet via **Lookup** functions will be modified automatically.

Once rows are inserted for new nodes, the Programmer can copy an existing **Node Evaluation** table as many times as needed. When the Programmer changes the Node Number, the Node Name and Total Diversions will update automatically with a **Lookup** to the Master Node List and the Diversions Data worksheets, respectively.

The Programmer must then modify the **Efficiency Pattern**, **Return Pattern**, **ATO** and **Percent** features to represent conditions associated with the diversions from the new node.

To update the **Irrigation Returns: Node Totals Table**, the Programmer must first be certain that all nodes are included in the list of nodes. For simplicity, the Programmer can copy the Node Number column from the Master Node List and paste it here. Then the Programmer can copy the remaining portion of a row including Name, Monthly Summation, and Reach number as many times as needed. The Programmer should be cautioned to verify that the ranges referenced in the monthly summation columns span the entire range of Node Evaluation tables following addition of nodes.

To update the **Irrigation Returns: Reach Totals Table** the Programmer must enter all reach numbers in the appropriate columns and then copy the formulas in the January through December columns. Verify that the range referenced in the monthly summation cells span the entire range of the **Irrigation Returns: Node Totals Table** after it was modified.

Options Table

Incorporation of a *Irrigation Return Pattern* or *Irrigation Return Lag* relationship which differs from those included in this model can be done by either over-writing one of the existing lines or by inserting a new line within the existing table. If irrigation returns are determined to require longer than three months before returning to the river system, a column may be inserted in the *Irrigation Return Lags* table. However, it is important to note that the formulas of the *Irrigation Returns* worksheet will need modification to reflect any additional months.

Evaporative Losses

Detailed stage / capacity / area data were not available for the reservoirs included in the Bear River Model. In versions of this model constructed to represent other Wyoming river basins, additional reservoir data may be available. In that event, the Programmer may incorporate that data in this worksheet in lieu of using an average reservoir surface area and a dynamic calculation of reservoir evaporation may be programmed.

Node Tables

Adaptation of the Bear River Model for other river basins will require reconstruction of the Reach/Node worksheets on a node-by-node basis. Because all values in the Node tables are obtained via *Lookup* functions, this is a relatively easy task.

The Node Inflow to any Node Table is referenced in one of three ways:

1. If the node is the upstream end of the model, or upstream node of a modeled tributary, the inflow is retrieved from the *Gaging Data* worksheet using a *Vlookup* function. Refer to Node 1.00 for an example of this method.
2. If the node is located at the upstream end of any other reach, the Node Inflow is referenced as the NET Flow from the Reach which feeds it. In this case, cell references must be manually modified. Refer to Node 4.00 for an example of this method.

3. If the node is located at any midpoint within a Reach, the Node Inflow is simply the NET Flow from the Node upstream of it. Refer to Node 1.01 for an example of this method.

Most nodes will be built using the third method described above. In this case, once the Node Inflow cells have been modified as in the example (i.e., Node 1.01), the Node Table may be copied as many times as needed and the Reach can be constructed in a sequential manner.

At nodes representing a confluence of Reaches, a line must be inserted into the Node, the appropriate NET Flows referenced, and the flows combined. Refer to Node 3.00 for an example of this computation.

The Programmer must enter the Node Number in the cell at the top of each Node Table cell and the worksheet will return the Node Name and all corresponding data from the worksheets referenced.

Reach Gain/Loss

Ungaged Reach Gain/Losses must be computed on a Reach-by-Reach basis in a manner as shown in the AGain/Loss@ worksheet. To do this, the Programmer must reference the appropriate gage data, diversion data, return flow data and reservoir data, building a budget as shown in the worksheet. Each Reach will require construction of an individual table with that Reach's specific conditions incorporated. At the bottom of each computation table, the Programmer must enter a Reach Name which corresponds to the Reach(s) for which the Gains/Losses will be applied. The Reach Names must then be entered into the Summary Table and the tables will automatically update.

Ungaged Reach gains are added to the upstream end of a Reach to make them available to diversions within the Reach. Ungaged Reach losses are subtracted at the downstream end. To facilitate this feature, the Programmer must enter the Reach Name in the Reach Gains line at the upstream node of a reach and the Node Table will automatically update. The Reach Name must also be entered in Ungaged Losses line of the Reach's downstream node and the Node Table will automatically update.

By incorporating Ungaged Gains and Losses, the spreadsheet model is calibrated to match historic gaging data at each gage node.

Results Worksheets

The AOutflow Calculations: By Node@ tables were generated using lookup functions which reference the corresponding Reach worksheets. The values in the ANode@ column were entered manually and the lookup tables constructed accordingly.

The AOutflow Calculations: By Reach@ table simply references the downstream limit of each AOutflow Calculations: By Node@ table.

Diversions Summary

The ASummary of Diversion Calculations: By Node@ tables were generated using lookup functions which reference the corresponding Reach worksheets. The values in the ANode@ column were entered manually and the lookup tables constructed accordingly.

The ASummary of Diversion Calculations: By Reach@ table references the ASummary of Diversion Calculations: By Node@ tables using SUMIF functions.

The AComparison of Estimated vs Historic Diversions@ table looks up historic diversions for each node in the Diversions Data worksheet. It also looks up the estimated diversions in the ASummary of Diversion Calculations: By Node@ tables and computes the comparisons.

Compact Allocations Summary

These worksheets must be rebuilt in accordance with any compact governing the river basin being modeled in any future versions of this model.