APPENDIX D –

Model Weighting Description

Section 1. Introduction

This report provides a detailed account of the weighting of nodes and arcs in the Roanoke River Basin model. OASIS uses a linear program solver, which means that it tries to maximize the overall value of allocating water subject to the goals (which have associated weights) and constraints (which must be met). The general strategy with goal-setting is to assign weights to mimic the real-world operating goals. For example, setting a reservoir's storage weight higher than that of an unassociated demand downstream will prevent water from being released from that reservoir to meet the demand. Weighting is also used to properly dictate minimum releases and other flow targets.

In general, positive weights encourage action and negative weights discourage action. Storing water, meeting demand, and meeting flow targets all have positive weights. If pumping can be avoided in favor of gravity flow, the pumping arc will have a negative weight, the gravity flow arc a positive weight. The model solver will gain more points by allocating each increment of flow to the positive-weight arc.

Weighting is mostly relative. If the weight in storage (say 2) is higher than a weight for demand (say 1), the demand will not be met. Minimum flow weights are handled differently at times since they can be additive. If there are multiple minimum flow locations downstream of a reservoir, OASIS will assign value to the minimum releases based on the sum of those weights. So if there are three locations, each having a weight of 1, the model will get 3 points releasing water from an upstream reservoir to meet the minimum flows. If the storage weight is 2, then the reservoir will draw down to meet the minimum flows. Flow exceeding the minimum flow does not get any additional value. The user manual for OASIS provides more description on how model weighting works.

Reservoirs can have up to four zones to which weights can be assigned. The A zone is below dead storage (which is generally non-usable storage). Often this represents the sediment pool, which could be tapped in an emergency situation. The B zone is between dead storage and the lower rule curve. This zone may be usable depending on the purpose. It might be used to maintain minimum releases from the lake, but not used or avoided for water supply because the intake does not extend down to that zone or because the water quality is poor. The C zone is the zone between the lower and upper rules, in which the lakes normally operate. The D zone is above the upper rule curve and below the maximum storage and is usually reserved for flood storage. Note that some reservoirs, including those being modeled as run-of-river, may only need one storage zone. This can simplify the number of weights in larger systems, but is generally not recommended because the model may draw into dead storage, down to the minimum storage in the elevation-storage-area table (even though physically it would not be possible to do), if the storage weight is less than weights for other uses.

Each section of this document describes a portion of the model, progressing downstream in the basin.

Section 2. Upper Roanoke River

Smith Mountain and Leesville reservoirs are in the headwaters of the Roanoke, and therefore proper weighting must be set up to prevent water being released to meet unrelated needs further downstream.

The reservoir storage weights in this area are:

		Storage Zone Weights			
Reservoir	**Node Number**	**A**	**B**	**C**	**D**
SmithMtn	100	10000	100	50	-2000
Leesville	200	10000	100	50	-2000

Other weights in the area include:

Description	Node/arc Number	Weight
Leesville Release	200.215	5000
Leesville Leakage	200.206	1000
WVWA	015	110
Salem	025	110
Rocky Mount	055	110
SM_Lee Ag	101	120
Bedford	214	90
Altavista (Town)	217	90
Dominion Altavista	218	90
Burlington Ind.	219	90
Altavista Ag	221	90
Brookneal Ag	241	90
Brookneal Dem	242	90
Dominion Pittsylvania	243	90
Boxley	244	90
Campbell Co	245	90
Keysville	246	90
Old Dominion Clover	248	90

The C- zone storage weights on reservoirs are all set lower than their associated withdrawals, which allow withdrawals to be made. For reservoirs with a minimum release, the B- zone weight is lower than the weight on the release arc. Agricultural demands are weighted higher than lake withdrawals and B- and C- zone storage since they represent upstream irrigation withdrawals.

Note that operations of the Smith Mountain system are complex, and much of the operations are defined using OCL commands in addition to weighting (See Appendix A).

Section 3. Dan and Smith Rivers

As with the Smith Mtn / Leesville, Philpott is in headwaters of the basin, and therefore proper weighting must be set up to prevent water being released to meet unrelated needs further downstream.

The reservoir storage weights in this area are:

		Storage Zone Weights			
Reservoir	**Node Number**	**A**	**B**	**C**	**D**
Philpott	300	10000	100	50	-2000

Other weights in the area include:

Description	Node/arc Number	Weight
Philpott Bypass	300.301	1000
Philpott Release	300.302	1000
Hanes	305	110
Francisco Ag	312	110
Belews Ck Steam Station	313	110
Madison Demand	315	110
Philpott Ag	316	120
Stuart	319	110
Mayo Ag	321	110
Mayodan	325	110
Wentworth Ag	331	110
Dan River Steam Station	332	90
Eden	335	110
Eden Ag	341	90
Paces Ag	347	90
Clarksville	364	50
Yanceyville	365	90
Dan R. Inc.	851	110
Martinsville	856	90
CP Films	857	90
Henry Co.	858	90
Danville	861	90

The C- zone storage weights on reservoirs are all set lower than their associated withdrawals, which allow withdrawals to be made. For reservoirs with a minimum release, the B- zone weight is lower than the weight on the release arc. Agricultural demands are weighted higher than lake withdrawals and B- and C- zone storage since they represent upstream irrigation withdrawals.

Note that operations of Philpott are complex, and much of the operations are defined using OCL commands in addition to weighting (See Appendix A).

Section 4. Kerr, Gaston and Roanoke Rapids

The reservoir storage weights in this area are:

		Storage Zone Weights			
Reservoir	**Node Number**	**A**	**B**	**C**	**D**
Hyco	370	10000	500	500	-1000
Mayo	380	10000	500	500	-1000
Kerr	400	9900	40	0.9	-500
Gaston	600	10000	100	50	-900
Rapids	700	10000	95	45	-2500

Other weights in the area include:

Description	**Node/arc Number**	**Weight**
Hyco Release	370.390	2000
Mayo Release	380.390	2000
Kerr Bypass	400.401	1100
Kerr Release	400.600	1000
Rapids Bypass	700.701	1000
Rapids Release	700.720	1000
Hyco Ag	373	750
Roxboro Steam Electric	374	600
Roxboro	375	700
Mayo Steam Electric	377	600
Kerr Ag	403	60
KLRWS	405	50
Va_Corrections	406	50
MeckCogen	407	110
Unallocated VA Supply	408	50
Unallocated NC Supply	409	50
Gaston Ag	603	120
RRSA	605	110
VaBeach	695	110
Rapids Ag	703	105
RRapids	705	100
Rapids Mill	706	10
Weldon Demand	715	10
Hamilton Ag	803	20
Hamilton	805	10
Enterprise Farms	806	10
Gretna	868	90
Chatham	869	90
Halifax	870	90

The C- zone storage weights on reservoirs are all set lower than their associated withdrawals, which allow withdrawals to be made. For reservoirs with a minimum release, the B- zone weight

is lower than the weight on the release arc. Agricultural demands are weighted higher than lake withdrawals and B- and C- zone storage since they represent upstream irrigation withdrawals.

Note that operations of Kerr/Gaston/Rapids are complex, and much of the operations are defined using OCL commands in addition to weighting (See Appendix A).