APPENDIX D –

Model Weighting Description

This report provides a detailed account of the weighting of nodes and arcs in the Tar River Basin model. Weighting greatly reduces the amount of coding required by the programmer, especially the conditional If → Then statements that are inherent in many software packages. OASIS operates using 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.

Note that 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, so excess water will stay in storage unless the reservoir is spilling. The user manual for OASIS provides more description on how model weighting works.

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

Upper Tar River

The reservoirs on the upper Tar are 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**
New City Pond	060	500	200	200	-10
Old City Pond	066	525	225	225	-10

Other weights in the area include:

Description	Node/arc Number	Weight
Tarr Ag Demand	012	250
Louis Ag Demand	052	250
Franklinton Demand	074	250
Franklin County Demand	076	235
Cedr Ag Demand	082	150
Louisburg Demand	086	250

New City Pond and Old City Pond are located in the Cedar Creek watershed. The municipal water supply demands placed on these reservoirs receive higher weight than usable storage in these reservoirs (as defined by B and C zone weights). Dead storage, which is inaccessible storage, is represented by the A zone and receives a higher weight than the demand weight so that the model does not dip into this storage. The flood pool is represented by the D zone, and has a negative weight to discourage storing water in this zone.

Middle Tar River

The weighting for the reservoir and quarry in Rocky Mount are set up to prevent water from being released upstream to meet its needs and from releasing water to meet unrelated needs downstream.

The reservoir storage weights in this area are:

		Storage Zone Weights			
Reservoir	**Node Number**	**A**	**B**	**C**	**D**
Tar River	120	200	100	100	-10
Quarry	140	200			

Other weights in the area include:

Description	Node/arc Number	Weight
Rocky Mount Ag Demand	122	150
Rocky Mount Demand	146	140
Tar River Reservoir Minimum Release	120.130	125
Reservoir water supply (target)	120.146	+500, - 0 (no delivery below 124.9 feet) +0, -500 (full delivery by default)
Quarry supply	140.135	+1000, -1000 (fixed pumping rate when drought triggers 2 or 3 are on) +2000, -0 (no supply)

The higher B and C zone weights for New City Pond and Old City Pond relative to Tar River reservoir prevent releases from being made to supplement the reservoir (except when spilling, when flow cannot be controlled). From Tar River reservoir, the demand weights are higher so they take priority over storage. If water remains, the minimum release will then take priority over storage. Since storage in the usable pool (zones B and C) get last priority, these zones get the lowest weight. However, these weights are set higher than non-city demands downstream (e.g., Tarboro).

Due to its operational simplicity, the quarry requires only one storage zone for modeling. In this case, the available storage is the amount between zero storage (or the lowest point on the storage-elevation curve) and maximum storage. All storage will be depleted if the storage weight is less than that for helping meet demand or minimum flows. If there is a limit to how low storage can practically go, such as the lowest water supply intake point, it is more appropriate to model the reservoir with multiple storage zones to ensure that withdrawals are discontinued when dropping below the minimum allowable level. For this reason, the Tar River reservoir uses multiple zones.

Weighting in OASIS can also be done with target commands in the OCL, in which case a penalty is assigned for being above or below the target. For Rocky Mount's operations, a target is applied to water supply from its reservoir. Below 124.9 feet, water production will shift from the reservoir treatment plant to the Sunset Avenue plant downstream. In this case, any production from the reservoir in excess (+) of the target value (which is set to zero) will be penalized 500 points. This penalty far exceeds the storage and demand weights, so the model will not draw water from reservoir storage. Under normal conditions, when the pool is full at 125 feet, the reservoir will get penalized 500 points for every unit of water below (-) the target, which is set to the normal Rocky Mount demand. In this case, the reservoir will supply the demand, not the Sunset Avenue plant.

A target command is used for the quarry supply such that a fixed pumping withdrawal only occurs when probability-based drought triggers 2 or 3 are on. Otherwise, the release will be zero since there the penalty for anything above that is very high.

Middle/Lower Tar River

Weights in this area (including the Swift Creek, Fishing Creek, and Conetoe Creek tributaries) consist of the following:

Description	Node/arc Number	Weight
Fishing Creek Ag Demand	202	150
Enfield Demand	226	150
Swift Ag Demand	242	150
Tarboro Demand	296	75
Tarboro Ag Demand	302	75
Conetoe Ag Demand	382	150
Greenville Demand	392	76
Farmville IBT	394	75
Greene Co. IBT	396	75
Winterville IBT	398	75
Greenville Ag Demand	402	75

The most upstream demands (on Fishing Creek and Swift Creek) receive the highest weight since they are met first. For demands on the Tar River downstream of the Tar River reservoir, the weights are all lower than the usable storage weight for the reservoir. This prevents releases from the reservoir to meet these demands. In terms of prioritizing demand, Greenville demand gets higher weight than the interbasin transfers that are supplied from Greenville.