District Water Supply Plan 2010
SJRWMD/SRWMD Northeast Florida Water Supply Planning Area

Summary Report on

Groundwater Modeling Subgroup

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St. Johns River Water Management District

Suwannee River Water Management District

Table of Contents

1.0 Introduction

Every five years the St. Johns River Water Management District (SJRWMD) prepares a District Water Supply Assessment (WSA) and District Water Supply Plan (DWSP). Information from the WSA is used as a basis for preparing the DWSP. The purposes of the WSA are to identify future water supply needs and identify areas where those needs cannot be met by the water supply plans of major water users without unacceptable impacts to water resources or water dependent natural systems. Areas in which unacceptable impacts would occur if projected water withdrawals were allowed are designated as Priority Water Resource Caution Areas (PWRCAs). PWRCAs are identified in the WSA, which is prepared in accordance with the requirements of Subparagraph 373.036(2) (b) 4, Florida Statutes. In the Draft 2008 WSA, the SJRWMD also identified Potential Priority Water Resource Caution Areas (PPWRCAs).

The SJRWMD used groundwater flow models to predict groundwater level change in the Northeast Florida aquifer systems that would occur as a result of 2030 water use projections in the region. The predicted groundwater level changes in the aquifer systems were the basis for the determination of PPWRCAs and PWRCAs in the 2008 WSA. The PPWRCAs currently meet the SJRWMD's criteria for designation as PWRCAs; however, the SJRWMD delayed the designation as PWRCAs to allow for stakeholders in the areas designated as PPWRCAs to participate in the water supply planning process.

Due to the sensitive hydrologic and ecological conditions at the boundary between the St. Johns and Suwannee River Water Management Districts, and the lack of a groundwater hydrologic boundary between the Districts, the SJRWMD and the Suwannee River Water Management (SRWMD) jointly established a Northeast Groundwater Modeling Subgroup as an integral part of 2010 Water Supply Planning process. The domain included in the joint Northern Florida planning area currently includes all or portions of Alachua, Baker, Bradford, Clay, Duval, Flagler, Levy, Marion, Nassau, Putnam, St. Johns, Union and Volusia Counties.

2.0 Groundwater Modeling Subgroup Purpose and Scope

The SJRWMD contracted with the University of Florida Water Institute to facilitate the Groundwater Modeling Subgroup process and to prepare a document summarizing the findings and recommendations of the Groundwater Modeling Subgroup. The purpose of the Groundwater Modeling Subgroup was to assess the NEF and MegaModel groundwater models used in support of the St. Johns River and Suwannee River Water Management Districts' planning process for the Northern Planning Area, to identify weaknesses in the models that significantly limit the models' acceptability, and to recommend improvements (if necessary) to make the models acceptable.

The purpose of this report is to document the process, activities, and results of the Groundwater Modeling Subgroup. Results include an assessment of the model's strengths and limitations, and recommendations on how limitations might be overcome. All subgroup meeting summary reports are included as Appendices A-G (meeting summary appendices have not been included here, but are available at the ftp site referenced within each summary). In addition, all comments

and recommendations made by participants through an anonymous on-line poll conducted before the final subgroup meeting are available in Appendix H.

2.1. Acknowledgements

The UF Water Institute wishes to thank all of the individual participants who attended the Groundwater Modeling Subgroup meetings. In particular we thank the SJRWMD/SRWMD staff and consultants, the North East Florida Utility Coordination Group (NEFUCG) members and consultants, and members of the public for their patience, participation and input throughout process. We offer special thanks to Dina Hutchens of the SJRWMD staff who provided excellent support and who was always ready to offer a helping hand.

3.0 Description of the Subgroup Process

The University of Florida Water Institute facilitated a participatory subgroup process that required considerable commitment by the subgroup members, significant background preparation, and completion of specific technical responsibilities between meetings to remain meaningfully engaged in the process. Membership in Groundwater Modeling Subgroup was open and meetings included participants with varying levels of knowledge and expertise. The level of participation of subgroup members ranged from those who had the required technical expertise and skills to evaluate model inputs and run groundwater models, to those who did not have these skills but had significant interest in how the models are developed and how they are used.

Public meetings were planned to provide opportunities for information sharing, discussion and deliberation. Meetings included presentations of methodologies, discussion and prioritization of issues, and resulted in recommended actions to address prioritized concerns. Although 4 meetings were initially scheduled, a total of 7 meetings were held. In addition, the length of the meetings was increased from the initial plan to meet from 9:00AM – 3:00 PM, to full day meetings that lasted from 9:00 AM to 5:00 PM.

Attendance at the meetings averaged about 45. A total of 76 different people attended the subgroup meetings (17 attended all six meetings, 24 attended 3-5 meetings, and 35 attended 1-2 meetings). More than 160 people were on the contact list and received meeting announcements and summaries. The participants who attended all 7 meetings predominantly represented two groups: the SJRWMD/SRWMD staff and their consultants and the NEFUCG staff and their consultants. Although other stakeholders attended the meetings, few were as intimately involved in the process.

Subgroup meetings took place on the dates listed below at the SJRWMD Headquarters in Palatka, Florida. Meeting summaries for each of the meetings are included in the Appendices as noted:

August 26, 2009 – Appendix A
September 30, 2009 – Appendix B

October 22, 2009 – Appendix C
November 17, 2009 – Appendix D
December 11, 2009 – Appendix E
January 21, 2010 – Appendix F
February 1, 2010 – Appendix G

4.0 Results of the Subgroup Process

4.1 Summary of model analyses and changes made as a result of subgroup process

Over the course of 7 meetings the Groundwater Modeling Subgroup reviewed the NEF model development history, underlying conceptualization, data sources and assumptions for inputs (pumping, rainfall, recharge, aquifer parameters, hydrography) and boundary conditions (including perimeter general head boundaries and interior constant head boundaries), calibration strategy and results, verification strategy and results and 2030 predictive simulation strategy and sensitivities. Additional model analyses and model runs were suggested and conducted to address questions and concerns expressed by subgroup participants. Complete details regarding the reviews and analyses can be found in the individual meeting summaries that are included as Appendices A through G. A summary of the changes and improvements made to the NEF model as a result of this process are included below.

4.1.1 NEF model: 1995 Base Case

a) Water use was reviewed and the associated well file was updated.
b) Target revision: Some targets were removed when further investigation indicated target wells had construction issues, or were significantly influenced by local conditions not representative of conditions across the model cell as a whole. Additional targets were added to the 1995 base case simulation as a result of processing target data for the 2004 confirmation simulation.
c) Surface water constant head boundaries were revised based on available 1995 surface water stage data.
d) General head boundaries were revised: the north, south, and east boundary heads for the upper and lower Floridan were estimated based upon the USGS 1995 upper Floridan potentiometric surface using an ArcGIS process. The upper Floridan west boundary heads were also based on the USGS 1995 upper Floridan potentiometric surface as described above. The lower Floridan west boundary heads were adjusted from the upper Floridan west boundary heads to incorporate the head differences predicted by the 1993-4 MegaModel between the upper and lower Floridan aquifers at the boundary location.
e) Based on information provided by GRU and other staff analysis closed basins were delineated and estimates of additional natural drainage were incorporated into the model as recharge, in either the recharge package or the well package as drainage to sinks. This also resulted in minor recalibration of the southwest corner of the model.

f) The ET option changed from top layer only as prescribed in the original model, to top active layer which includes the southwest area of the model which is considered to be unconfined upper Floridan aquifer.
g) The conductance assigned at the lateral boundaries was revised based upon revisions in hydraulic conductivity to improve calibration. This was a result of the changes in heads along the boundaries.
h) Hydraulic conductivity, leakance, and recharge were recalibrated in the southwest corner of the model as a result of cumulative model changes in that area.

4.1.2 NEF Model: 2004 Confirmation Simulation

a) Targets were revised to reflect revisions made for 1995 model.
b) Surface water constant head boundary heads were revised based on available 2004 surface water stage data.
c) General head boundaries on the north, south, east boundaries of the upper and lower Floridan, and the west boundary of the upper Floridan, were revised based upon the USGS 2004 upper Floridan potentiometric surface map using an ArcGIS procedure as described above. The west boundary of the lower Floridan was adjusted using the predicted 1993-4 MegaModel upper and lower Floridan head differences using the procedure described above.
d) Recharge was revised based on modifications to the calibrated 1995 recharge and a newly developed recharge adjustment methodology.

One subgroup meeting was devoted to a review of the MegaModel conceptualization, set up, 1993/1994 calibration and 2030 predictions. Some issues were raised regarding the calibration of the MegaModel along the western boundary of the NEF. However because this model was primarily used to adjust 2030 boundary conditions for the NEF model, and because of the limited time available to complete the subgroup process, the subgroup focused its efforts on review of the NEF model and no further work on the MegaModel was performed.

4.2 Assessment of the NEF model's strengths and limitations

The NEF is a numerical groundwater flow model that uses a well-known computer code (MODFLOW) to approximate the steady-state regional groundwater flow system in North Florida. The model covers an approximately 8,800 square mile domain, using 2500 ft by 2500 ft grid cells. The steady-state assumption assumes that steady-state recharge and steady-state pumping stresses produce steady-state responses in the groundwater system that are representative of the temporal averages of the actual recharge, pumping stress, and aquifer response over the year being simulated. Inaccuracies in model conceptualization, inaccuracies in measurement data, inaccuracies is the time-averaging process and sub-grid scale variability may all contribute to deviations in model results from target values. The strengths and weaknesses of the NEF model, as determined during the Groundwater Modeling Subgroup process, are synthesized below. Verbatim strengths and weaknesses identified by individual subgroup participants through an anonymous on-line survey are included in Appendix H.

4.2.1 Strengths of the NEF model

a) Comprehensive compilation and inclusion of extensive data from the area.
b) Based on evaluation of long-term rain gage data and well hydrographs within the model domain, 1995 is a reasonable base year for calibration of a steady state model.
c) Large number of targets in the upper Floridan aquifer.
d) Incorporation of all runoff in closed basins as recharge (either diffuse or through sinkholes) in Alachua County.
e) Calibrated upper Floridan transmissivity values are consistent with aquifer pump test (APT) results.
f) 1995 baseline model is well calibrated for both surficial aquifer (residual standard deviation 3.48 ft, less than 2% total head variation) and upper Floridan aquifer (residual standard deviation 2.545ft, less than 3% of total head variation).
g) Observed head gradients between surficial and upper Floridan aquifers at available cluster wells are accurately represented in the 1995 base case simulation.
h) Calibrated 1995 recharge compares favorably with recharge/runoff estimates completed independently using river gage data in 10 sub-basins constituting approximately 20% of the land area and approximately 27% of the recharge area in the model domain.
i) Good prediction of upper Floridan aquifer results for the 2004 validation simulation (residual standard deviation 2.9 ft using "adjusted" 2004 recharge, residual standard deviation 2.67 ft using calibrated 1995 recharge).

4.2.2 Limitations of the NEF model

a) Limited number of targets in the surficial and lower Floridan aquifers.
b) Western boundary impinges on model predictions in some areas of concern.
c) 2004 recharge adjustment methodology appears to overcompensate for differences between the 1995 and 2004 theoretical recharge fields.
d) Relatively poor prediction of surficial aquifer levels for the 2004 validation simulation (residual standard deviation 8.39 ft, 4.2% total head variation) using "adjusted" 2004 recharge. Note: using the calibrated 1995 recharge for 2004 improves the residual standard deviation to 4.39 ft (2.1% total head variation). This result underscores limitations of the 2004 recharge adjustment methodology, but increases confidence in the use of the 1995 calibrated recharge field for 2030 drawdown projections.
e) Over-simplification of surficial aquifer processes due to: size of grid cells relative to spatial variation of topography, hydrogeology and spatial extent of wetland features; overuse of constant head boundaries for lakes and rivers; lack of river package to simulate stream baseflow; and potential inapplicability of lateral flow assumption in regions of high topographic relief or local geologic layering.
f) Lack of representation of the intermediate aquifer system.

4.2.3 Remaining areas of disagreement between members of the subgroup

Despite six months of dedicated work on the part of all participants, at the end of the subgroup process differences remained in the opinions of subgroup members. The major disagreements among subgroup members are summarized below.

a) The accuracy and appropriateness of the use of Nexrad rainfall data, the curve-number method for estimating runoff from rainfall on a cell-by cell basis, and the calibration of the resulting "theoretical" recharge for the 1995 baseline simulations.[1]
b) Whether predictions from a regional model with a calibration standard deviation of 3.48 ft in the surficial aquifer and 2.45 ft in the upper Floridan aquifer, along with prediction sensitivities of +/- 1 to 3 ft in the surficial aquifer and +/- 1 ft in the upper Floridan aquifer, should be used to trigger local environmental constraints based on 0.5 ft predicted drawdowns.[2]
c) Use of the MegaModel drawdown to adjust general head boundaries in the NEF model when the MegaModel simulates significantly higher heads in both 1993-4 and 2030 than those used for the 1995 NEF western boundary conditions.

4.3 Recommendations for addressing remaining limitations and disagreements

The St. Johns River Water Management District should formalize an adaptive process of model improvement that engages stakeholders in continuous cycles of field experimentation and observation; evaluation of underlying model assumptions; revision of model conceptualization; and iterative calibration, sensitivity, and uncertainty analysis. More time should be spent "up-front" with stakeholders providing input on methods and model evaluation criteria than on defending and/or critiquing the end product. Given the sensitive hydrologic and ecological conditions at the boundary between the St. Johns and Suwannee River Water Management Districts, and the lack of a groundwater hydrologic boundary between the Districts, the two Districts should work toward developing a common North Florida model. Specific recommendations for model improvements are summarized below.

[1] As a groundwater flow model, MODFLOW requires recharge rather than rainfall as an input. Given that recharge cannot be measured, calibration of this field is a generally accepted groundwater modeling practice as indicated in ASTM 5981, "Standard Guide for Calibrating a Ground-Water Flow Application." In my opinion the District's process for calibrating the 1995 recharge, although not optimal, appears to have compensated for much of the unusual spatial variability in the 1995 Nexrad rainfall as well as potential errors associated with the curve number runoff estimation process. This opinion is supported by the quality of the verification statistics obtained when the calibrated 1995 recharge is used in the 2004 simulations. While the calibrated 1995 recharge is not necessarily a good estimate of actual 2030 recharge, it can be used to estimate expected drawdowns that would occur due to increased 2030 pumping over the 1995 base condition.

[2] In my opinion this is an important issue that deserves further analysis and discussion between the District and Stakeholders.

4.3.1 Version 3 (to be completed within the next 2-4 months)

a) Continue to review and refine pumping data, calibration targets, and closed basins throughout the model domain.
b) Finalize and fully document the current (Version 3) model including all changes since Birdie (2008). The report should follow the outline recommended in ASTM D5447 "Standard Guide for Application of a Ground-Water Flow Model to a Site-Specific Problem" and all methods should be described in sufficient detail for an independent, competent modeler to reproduce results from the raw input data.
c) Rerun Version 3 with most recent 2030 population and water use projections.
d) Estimate upper and lower bounds of predicted water demand deficits based on upper and lower bounds of predicted surficial and upper Floridan drawdowns resulting from boundary condition, hydrogeologic parameter, and recharge predictive sensitivity analyses.
e) Develop a water supply plan that is robust across a range of likely 2030 future conditions that span uncertainties due to climate variability, population/water use projections and model error. The water supply plan should be sensitive to, and quantify to the maximum extent possible, both the economic risks and ecologic risks of its adoption given the uncertainty of future predictions.

4.3.2 Version 4 (to be completed within the next 6 months)

a) Add the river package to the current 1995 model.
b) Reevaluate/improve the accuracy of the 1995 NEXRAD data.
c) Recalibrate the 1995 model based on agreed-upon calibration statistics required for this particular model application.
d) Consider an alternative (or additional) confirmation year with more consistent rainfall and larger pumping differences compared to 1995 than 2004. Alternatively, consider developing multi-year calibration and confirmation simulations to dampen year to year rainfall variations and focus on groundwater changes due to pumping changes.
e) Reevaluate the confirmation year recharge adjustment methodology.
f) Evaluate differences in MegaModel and NEF Version 4 predictions if the MegaModel continues to be used to adjust western boundary conditions.
g) Consider developing a confirmation year simulation for the MegaModel if it continues to be used to adjust western boundary conditions.

4.3.3 Version 5 (for use in next Water Supply Planning Cycle)

a) Increase hydrogeologic characterization and hydrologic monitoring particularly along the western NEF boundary, at the transition between the confined and unconfined Floridan, and in the surficial and lower Floridan aquifers.
b) Consider expanding the NEF model boundary significantly westward to eliminate interference, or develop a common North Florida model with the Suwannee River Water Management District.

c) Consider adding intermediate aquifer if sufficient geologic and hydrologic data exist for its parameterization and calibration.
d) Reevaluate the use of the curve number methodology to estimate runoff.
e) Develop a methodology that allows local grid refinement in areas of special concern in the surficial aquifer (e.g. lakes region) where topographic, geologic, and hydrologic data exist for its parameterization and calibration (e.g. telescopic refinement or multi-grid techniques).
f) Consider developing a more spatially distributed representation of evapotranspiration and extinction depth based on land use/land cover maps.
g) Consider developing a transient model.
h) Consider developing a more fully coupled surface/groundwater flow model (i.e. either by coupling HSPF with MODFLOW, or by adopting a fully integrated hydrologic model such as MIKESHE or PARFLOW).

5.0 Conclusions

The NEF model has been generally developed, calibrated and verified in accordance with standard groundwater modeling practices as detailed in ASTM publications 5447, 5490, 5981, and 5611. Two important exceptions include: 1) the failure to establish agreement on the magnitude of acceptable residual calibration/verification statistics required for this particular model application prior to beginning the calibration process (ASTM 5981), and 2) as yet incomplete documentation of the model development, calibration, verification and predictive uncertainty analyses (ASTM 5447).

The current (version 3) NEF model is well calibrated in both the surficial and upper Floridan aquifers, accurately predicts head gradients between the surficial and Floridan aquifers at cluster wells, and accurately predicts upper Floridan conditions for the 2004 verification run particularly in areas where changes in pumping stress dominate changes in climatic drivers (i.e. recharge). Due to limitations in the conceptualization of the surficial aquifer and the limited number of surficial aquifer targets (detailed above), predicting surficial aquifer response to changes in upper Floridan pumping is more uncertain.

The NEF version 3 model results point to limitations in the future availability of groundwater to provide for estimated 2030 water demands in the Northeast Florida Planning Area. While there is some uncertainty regarding the precise magnitude of the projected 2030 surficial and upper Florida drawdowns, the locations of maximum drawdown (and therefore maximum vulnerability) appear to be accurately represented for both aquifers. Therefore, it is prudent to begin planning based on the Version 3 model (updated as recommended above), but to continue to improve the model's performance, particularly in the surficial aquifer and at its western boundary. Specific recommendations for both the process for, and scope of, groundwater model improvement are detailed above.

Although the NEF surficial and upper Floridan calibrated head error standard deviations for 1995 are well within the recommended guidelines for regional groundwater model applications (in terms of their relationship to the overall head variation in the domain), there remain concerns that this regional model does not have sufficient local drawdown prediction accuracy in the surficial

aquifer to trigger environmental constraints that are based on 0.5 ft drawdown predictions in that aquifer. This issue is outside of the scope of the Groundwater Modeling Subgroup (since it involves a separate group of environmental constraint models) but deserves further analysis and discussion within the District and between the District and stakeholders.

The District should take care that a 2030 water supply plan is developed that is robust across a range of likely 2030 future conditions that span existing uncertainties due to climate variability, population/water use projections, and NEF model error. The 2030 predictive sensitivity analyses conducted during the subgroup process provide a basis for defining the range of likely future conditions that could be considered. The 2030 water supply plan should be sensitive to, and quantify to the maximum extent possible, both the economic risks and ecologic risks of its adoption given the uncertainty of future predictions.

6.0 References

ASTM International, ASTM D5447-04, Standard Guide for Application of a Ground-Water Flow Model to a Site-Specific Problem, 2004.

ASTM International, ASTM D5490-93 (Reapproved 2008), Standard Guide for Comparing Ground-Water Flow Model Simulations to Site-Specific Information, 1993,

ASTM International, ASTM D5611-94 (Reapproved 2008), Standard Guide for Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application

ASTM International, ASTM D5981-96 (Reapproved 2008), Standard Guide for Calibrating a Ground-Water Flow Model Application, 1996.

MODFLOW - USGS Ground-Water Software, MODFLOW-2000 Version 1.18.01, MODular three-dimensional finite-difference ground-water FLOW model--2000 updated version: http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html

HSPF - Brian R. Bicknell, et. al., Hydrological Simulation Program – Fortran (HSPF), EPA in cooperation with USGS, March 2001
http://www.epa.gov/waterscience/basins/bsnsdocs.html#hspf

MIKE SHE - De Golia, Peter, MIKE SHE, Danish Hyrdrologic Institute, Inc. (DHI), in *Appendix A: Model Fact Sheets at EPA:*
http://www.epa.gov/nrmrl/pubs/600r05149/600r05149mikeshe.pdf

PARFLOW - Maxwell, Reed, Simulation Platforms, ParFlow, Colorado School of Mines, Department of Geology and Geologic Engineering:
http://inside.mines.edu/~rmaxwell/maxwell_software.shtml

7.0 Subgroup Meeting Summaries (without appendices. Meeting summary appendices can be found on ftp site referenced within each summary)

Appendix A. August 26, 2009 - Meeting 1 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 1

Wednesday, August 26, 2009
9:00 a.m. – 5:00 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32177

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD)Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants, introduced the facilitation team, and reviewed the agenda and objectives for the meeting. A copy of the meeting agenda and participant sign-in sheets are attached to the end of this meeting summary as Appendices A and B respectively. Dr. Wendy Graham reiterated that according to the meeting objectives by the end of the first meeting, the subgroup members would:

1. Know the purpose of the subgroup and how its outputs will contribute to the overall planning process.
2. Agree to the subgroup charge, process and timeline to reach the subgroup goals.
3. Gain background knowledge regarding the Northeast Florida NEF and Peninsular Florida (MegaModel) groundwater flow models and how they are being used in the water supply planning process.
4. Understand the details of the NEF 1995 groundwater model.
5. Identify weaknesses in the NEF 1995 model that limit its acceptability for use in the planning process. (related to boundary conditions, water use, recharge, evapotranspiration (ET) and calibration).
6. Recommend further analyses or modifications to NEF 1995 model to make it acceptable for use in water supply planning actions.
7. Identify who and how the remaining issues related to the NEF 1995 model will be addressed before the next meeting.
8. Understand the assumptions underlying the current 2004 simulation. *Due to time constraints, discussion on this item was postponed until the next meeting scheduled for September 30, 2009).*
9. Provide input for consideration in the modifications to the 2004 simulation *Due to time constraints, discussion on this item was postponed until the next meeting scheduled for September 30, 2009).*

Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site until 5:00 p.m. Friday, October 2, 2009 ftp://ftp.sjrwmd.com/DWSP_2010/August_26_2009_NPA_GW_Modeling_Subgroup/

II. Getting Started as a Group

Lisette Staal, Research Coordinator, UF Water Institute, and the subgroup facilitator introduced this session (slide 3) and the importance of the working group. She asked the participants to introduce themselves, to indicate their

affiliation, and to share their level of expertise and time available to commit to subgroup process. (*All participants, prior to the start of the meeting, placed their name on a graph with axes measuring the level of modeling expertise and time available. A photo of the graph is attached to this report as Appendix C.*) A diverse audience was represented ranging from no modeling experience to highly experienced, and ranging from some participants with very little time to some with substantial time to commit. The majority of the attendees indicated they had some modeling knowledge and some time available, however only a small portion indicated full expertise and time for high level review. Those participants that indicated full expertise and significant time for high level review were in general restricted to SJRWMD modelers and consultants hired by the North Florida Utilities Coordination Group (NFUCG).

Dr. David Hornsby, SJRWMD and Program Manager for the subgroup, presented the background to help participants understand the context of the subgroup in the overall Water Supply Planning Process, including the purpose for the subgroup (slides 4 – 12).

Lisette Staal asked participants about their expectations for the meeting and role of the subgroup, and if they were in anyway different than anticipated. Participants raised some expectations that were outside of the charge of the sub-group, and these were noted in a "holding pond" for follow-up action outside of this subgroup. The items that were noted for the 'holding pond" appear in the action items of this report; these are designated to be handled outside of the subgroup. Ms. Staal then shared the working group process, and outlined a general timeline of meetings (slide 14), before moving the meeting toward the technical focus.

III. Overview of Role of Groundwater Models in the Water Supply Planning Process

This session, introduced by Dr. Wendy Graham, focused on presenting background material regarding the NEF and MegaModel models to help participants understand how they are being used in the Water Supply Planning Process for SJRWMD and SRWMD. Doug Munch, SJRWMD, presented an overview of how the models are used to simulate water level changes in surficial, upper Floridan and Lower Floridan aquifers throughout the SJRWMD (slides 16 – 20). Dr. David Hornsby, SJRWMD, summarized how groundwater model outputs are used in subsequent analyses to evaluate compliance with water resources constraints (i.e. impacts on native vegetation and lakes, and changes in spring flow (slides 24-45)). Price Robison, SJRWMD, (slides 46 - 55) and John Good, SRWMD (slides 56 - 71) summarized how groundwater model outputs are used to evaluate compliance with minimum flows and levels (MFLs) in SJRWMD and SRWMD respectively. David Hornsby wrapped up this session by summarizing how analyses of impacts on native vegetation and lakes, compliance with MFLs, changes in spring flow, and changes in groundwater quality are used to identify Priority Water Resource Caution Areas (PWRCAs) and Potential PWRCAs (PPWRCAs) (slides 72 - 81).

IV. NEF Groundwater Model

Dr. Wendy Graham introduced the session objectives and presenters. Vito Russo, SJRWMD, made a presentation on Version 3 of the Northeast Florida Regional Groundwater Flow Model, focused on model development history, description of the conceptual model, model set up, boundary conditions, data sources and assumptions underlying water use projections, recharge, evapotranspiration and calibration strategy and results (slides 85 – 106). Results of the peer review of the SJRWMD Northeast Florida Regional Groundwater Flow Model, Version 3, carried out by Peter Anderson, of Geotrans, were presented by Doug Munch (slides 107 – 143).

Lisette Staal introduced an activity to initiate detailed discussion of 1995 NEF modeling approach results, and to identify potential weaknesses or areas of concern. Participants were asked to visit a station for each of the specified areas: e.g. BOUNDARY CONDITIONS, RECHARGE, ET, WATER USE, CALIBRATION, and to write down on cards any weaknesses or concerns that they had relative to the acceptability of the model for that specific topic. Each of the stations included related wall size maps for reference. In addition, there was a designated area for OTHER. These cards were used as the basis for further discussion as described below. (The individual written responses are attached to this meeting summary as Appendix D and the maps are available on the FTP site noted at the beginning of this meeting summary.)

Dr. Wendy Graham summarized the individual written responses by category on flipcharts then led a discussion to prioritize major issues that were identified in each of the areas. The key issues summarized for each of the technical areas appear below:

BOUNDARY CONDITIONS

1. Process for setting head values for the NEF Generalized Head Boundary Condition (GHB). (SJRWMD personnel indicated that this process is documented in the NEF Version 2 documentation (Birdie et al, 2008), and that generally GHBs for layer 1 (Upper Floridan) use values from the averaged (May and September) 1995 USGS potentiometric surface.
2. Sensitivity Analysis of NEF Boundary conditions – further investigate Geotrans findings.
3. Issues regarding establishment of boundary conditions and rainfall for alternative year simulations. (SJRWMD personnel indicated preliminary runs for both 2004 and 2030 use 1995 boundary conditions, and 1995 rainfall. Final 2004 simulations will use values that represent the 2004 average USGS potentiometric surface map, 2004 rainfall and estimated 2004 pumped quantities. Current plans for final 2030 runs are to use GHB values from the MegaModel simulation, 1995 rainfall, along with estimated 2030 pumping. Time permitting staff will investigate the appropriateness of using an annual median rainfall distribution for 2030 run.)

RECHARGE

1. Evaluate runoff/recharge calculation methodology
    - How much total water lost through Soil Conservation Service (SCS) method?
    - How much total water does return flow add?
    - How is land-use change reflected in 2030 simulation?
    - How dependent is recharge on spatial distribution of 1995 rainfall?
    - Performance of sensitivity analysis of runoff/recharge methodology
    - Evaluation of recharge well inputs

EVAPOTRANSPIRATION (ET)

2. Sensitivity analysis of ET
3. Issues regarding how surface vegetation characteristics are reflected in the estimation of ET and runoff.
4. Sensitivity of the model to extinction depth variations in ET calculations

WATER USE

5. Sensitivity analysis for pumping quantities and distribution
    - Quality of overall projections for 2030
    - Changes in agricultural withdrawals between 1995 and 2030
    - Specific Sensitivity to industrial pumping projections for 2030
6. Impact of low intensity development (LID) on landuse and water use in 2030
7. Impact of District conservation goal(s) on 2030 projections
8. Water budget analysis near utility well-fields
9. Review reuse and domestic self supply compared to utility boundaries
10. Evaluating the integrity of 1995 well input file (Public Supply, and Other)

CALIBRATION – hydrogeologic parameterization/targets

11. Are calibrated parameters sensitive to 1995 rainfall distribution?
12. Compare calibrated hydrologeologic parameters to APT values
13. Review distribution of targets (may be low number of targets in surficial aquifer, SRWMD, Bradford County, lower Floridan Aquifer, Fernandina Permeable Zone)
14. Compare NEF version 3 calibrated values to version 1 and version 2 (SJRWMD personnel noted that the range of values is the same between versions 2 and 3, but spatial distribution is different)
15. How does 1995 calibration hold up for alternate year 2004? What additional parameters will be tweaked in 2004 runs?
16. How does 1995 calibration hold up for another more different year (dry year)?
17. Should a pre-development run be done?
18. What is the interplay between layer 1 and 2 leakance and layer 2 and 3 leakance values.

OTHER

- MegaModel peer review
- Sensitivity of NEF to hydrogeologic parameterization

- Review Georgia Coastal Plain model parameters and compare to NEF (*not in the scope of this subgroup, but will be done by NFUCG)*
- HSPF/SSAARS peer review (*not in the scope of this subgroup, but will be done by NFUCG)*
- Comparison North Florida (NF), NEF, MegaModel, Georgia Coastal Plain Model (*not in the scope of this subgroup, but will be done by NFUCG)*
- Compare 2030 drawdowns NF and NEF (*not in the scope of this subgroup, but will be done by NFUCG)*
- Use NEF 2004 simulation to evaluate compliance with environmental resource constraints and MFLs (i.e. wetlands, lakes, springs, aquifer water levels) and compare to observed data
- Resolution of groundwater model drawdown predictions vs. resolution of wetland and lake impact predictions. What is spatial resolution of GIS wetland and lake models?
- Review NEF River package implementation for upper Santa Fe River.

Dr. Wendy Graham facilitated discussion and prioritization of issues that were identified. The priority issues identified included (*numbering does not reflect order of priority).*

1. Sensitivity Analysis of NEF boundary conditions – further investigate Geotrans findings. (BOUNDARY CONDITIONS)
2. Evaluate runoff/recharge calculation methodology (RECHARGE)
    a. How much total water lost through SCS method?
    b. How much total water does return flow add?
    c. How is landuse change reflected in 2030 simulation?
    d. How dependent is recharge on spatial distribution of 1995 rainfall?
    e. Sensitivity analysis of runoff/recharge methodology
    f. Evaluation of recharge well inputs
3. Sensitivity of the model to extinction depth variations in ET calculations (ET)
4. Sensitivity analysis for pumping quantities and distribution (WATER USE)
    a. Quality of overall projections for 2030
    b. Changes in agricultural withdrawals between 1995 and 2030
    c. Specific Sensitivity to industrial pumping projections for 2030
5. Evaluating the integrity of 1995 well input file (Public Supply, and Other) (WATER USE)
6. How does calibration hold up for other more different year (dry year?) in lieu of pre-development run. – (CALIBRATION)
7. MegaModel peer review (OTHER)
8. Use 2004 simulation to evaluate compliance with environmental resource constraints and MFLs (i.e. wetlands, lakes, springs, aquifer water levels) and compare to observed data (OTHER)

During the final session of the meeting session task assignments for addressing priority issues along with due dates were established. The subgroup identified which priority issues District personnel will address and which priority issues other participants (NFUCG consultants) will address.
Tasks, responsible parties and due dates are listed on the following page.

1. **District personnel** will address the following priority issues and be ready to present at the next meeting – September 30, 2009

30-Sep	SJRWMD	Complete 2004 confirmation run - with and without river package
30-Sep	SJRWMD	Identify alternate years (with different climatic/pumping conditions) that could be used to assess calibration (in lieu of pre-development run).
30-Sep	SJRWMD	Investigate possibility of using 2004 simulation to evaluate compliance with MFLs and aquifer levels: compare simulated and observed data
30-Sep	SJRWMD	Evaluate the integrity of 1995 CII, Rec, Ag and DSS well input files – *(Doug Munch (SJRWMD) and Christina McDonough (NFUCG,CH2M HILL) will determine an overall strategy for District evaluation of the representation of the CII, Rec, Ag and DSS quantities in the well files*

2. **NFUCG consultants** will address the following priority issues and be ready to present at the next meeting – September 30, 2009

30-Sep	NFUCG	Perform additional sensitivity analyses to NEF Boundary Conditions.
30-Sep	NFUCG	Evaluate runoff/recharge calculation methodology, including o How much total water lost through SCS method? o How much total water does return flow add? o How is land-use change reflected in 2030 simulation? o How dependent is recharge on spatial distribution of 1995 rainfall? o Sensitivity analysis of runoff/recharge methodology o Evaluation of recharge well inputs
30-Sep	NFUCG	Perform additional sensitivity analyses of the model to extinction depth variations in ET calculations
30-Sep	NFUCG	Evaluate the integrity of 1995 public supply well input file – *(Doug Munch (SJRWMD) and Christina McDonough (NFUCG,CH2M HILL) will determine an overall strategy for CH2MHILL evaluation of the representation of the public supply quantities in the well file)*

3. **NFUCG** will address the following priorities to present at subsequent meetings:

October meeting	NFUCG	Perform peer review of revised Megamodel
November meeting	NFUCG	Perform additional sensitivity analyses of NEF model to pumping quantities and distribution including o Quality of overall projections for 2030 o Changes in agricultural withdrawals between 1995 and 2030 o Specific Sensitivity to industrial pumping projections for 2030

Several additional issues identified by the NFUCG and presented to SJRWMD will be explored by NFUCG consultants. They do not appear here as they are outside the scope of this subgroup. However, any information that they may find that could inform the subgroup would be welcome.

V. Next steps

1. Plan for Next meeting – September 30, 2009
   Agenda will include presentations and discussion of priority issues for 1995 NEF model as identified at this meeting. Due to time constraints the Review of 2004 Confirmation Simulation was not

presented at the first meeting and was postponed to the second meeting, so will be added to the agenda.

2. Communication protocol for in between meetings
   Both District staff and NFUCG consultants are working on several of the priority issues and will communicate directly with each other on these issue as appropriate. They will inform Dr. Wendy Graham, Technical Lead of the subgroup, of big issues that come up that might produce the need for detailed interactions between the groups between official meetings.

3. Next steps
   - Status report on Priority Issues will be submitted by SJRWMD and NFUCG to Dr. Wendy Graham by email by September 11.
   - SJRWMD and NFUCG will provide draft presentations on findings for each of the priority issues for the next meeting and submit to Dr. Wendy Graham by September 25th
   - SJRWMD will provide written documentation of assumptions underlying the 2004 run, targets and on-going modifications by September 11 . The Water Institute will post this information to "read-ahead" web site before the meeting.
   - The Water Institute will review written questions of clarification submitted by participants first meeting and share with SJRWMD by September 4 so that they can be quickly answered as necessary.

Public input, questions and comments were received and addressed throughout the meeting. The following items were placed in a "Holding Pond" (items mentioned during the meeting but not in the scope of the Subgroup). These items were shared with SJRWMD.

- Expansion of the role of the groundwater modeling sub-group beyond establishing the acceptability of the NEF and MegaModels for use in water supply planning.
- Questions regarding the methodology for discerning compliance with environmental constraints/MFLs
- Questions regarding the resolution of GIS models for identifying potential isolated problems - Does methodology recognize soil variability/seepage at small scales?

Meeting was adjourned at 5:10 PM

Appendix B. September 30, 2009 - Meeting 2 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 2

Wednesday, September 30, 2009
9:00 a.m. – 4:00 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32177

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants and all participants introduced themselves. Dr. Graham reviewed the agenda and objectives for the meeting. A copy of the meeting agenda and participant sign-in sheets are attached to the end of this meeting summary as Appendix A. Dr. Wendy Graham reiterated that according to the meeting objectives by the end of the meeting, the subgroup members would:

10. Understand progress on analyses or modifications to NEF 1995 simulation recommended at the August 26, 2009 meeting.
11. Agree on the status of the NEF model's acceptability for use in water supply planning actions.
12. Identify who and how any remaining issues related to the NEF 1995 model will be addressed before the next meeting.
13. Understand the set up proposed for 2004 confirmation simulation.
14. Provide input for consideration to the 2004 confirmation simulation.
15. Identify who and how the remaining issues related to the 2004 confirmation simulation will be addressed before the next meeting.

Dr. Wendy Graham gave a recap of the previous meeting, where we are in the overall process and the specific NEF 1995 Simulation Priority Issues and Action Items identified in previous meeting. (*NEF-WSP ground_modeling slides 1-11*)

Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site - ftp://ftp.sjrwmd.com/DWSP_2010/September_30_2009_NPA_GW_Modeling_Subgroup/

II. NEF 1995 Simulation - Well input files and Boundary Conditions

Priority Issue: Evaluation of the integrity of 1995 well input files - Mr. Doug Munch, SJRWMD, provided a review of SJRWMD approach and results of actions related to evaluating the 1995 well input files (*SJRWMD slides1-4)* and Jeff Lehnen, CH2M HILL, provided comments on recent actions regarding the verification of well locations and depths for discussion. Remaining issues identified during discussion included:

Investigate Public Supply other than Marion County; including locations and well depths; send corrected values to SJRWMD	Pumping Wells
Verify power plant well depths in Nassau, Putnam, Duval counties send updated info to SJRWMD	Pumping Wells

Investigate outliers in water use categories other than public supply (PS); investigate difference in Marion County PS compared to AWUS; follow-up to correct values as necessary	Pumping Wells
Investigate pulp and paper plant well depths in Nassau, Putnam and Duval counties; follow up to correct values as necessary	Pumping Wells
Re-evaluate drainage and injection wells (check existing data and look for additional data).	Drainage/Injection Wells/ Natural Sinks
Re-evaluate large magnitude natural focused recharge features (sinks, etc): Haile, Alachua, Orange lake, Turkey Creek, Blues Creek, Mill Creek Sinks (re-evaluate existing data, look for new data, evaluate whether/how recharge from these sink drainage basins getting into model)	Drainage/Injection Wells/ Natural Sinks

Priority Issue: Boundary condition sensitivity analysis – Jeff Lehnen, CH2M HILL, provided a review of the approach and preliminary result of studies undertaken since the last meeting, including GHB head sensitivity analysis and GHB Conductance sensitivity analysis (*NFUCG Model Evaluations- slide 2- 12*). Remaining issues identified during discussion included:

In 2030, how will boundary conditions be determined? Sensitivity analysis may be needed.	Boundary Conditions
Investigate reasons for calibration improvement when adjust boundary condition: Related to particular target wells? Particular region in model?	Boundary Conditions
Compare model GHB heads by grid cell vs. interpolated USGS ave. pot. map; Estimate interpolation error	Boundary Conditions
Conduct sensitivity analysis for model predictions when boundary condition varied within range of interpolation error	Boundary Conditions

III. NEF 1995 Simulation - Evapotranspiration (ET) and Runoff/Recharge Methodology

Priority Issue: Sensitivity analysis on ET, and extinction depth – Jeff Lehnen, CH2M HILL, presented a review of the proposed approach (*NFUCG Model Evaluations- slides 13- 31*). Remaining issues identified during discussion included:

Compare ET zones to: soils maps, physiographic region/ demographic, landuse, and vegetation maps	ET
Evaluate ET sensitivity to zonation. Are more complex zones needed?	ET

Priority Issue: Review runoff/recharge methodology – Jeff Lehnen, CH2M HILL, presented results of review of the runoff/recharge methodology (*NFUCG Model Evaluations- slides 20 - 31*). There was significant discussion regarding methodology. Remaining issues identified during discussion included:

Provide utilities with SCS methodology and data files	Recharge
Evaluate SCS rainfall-runoff-recharge methodology; quantify total volume lost to surface runoff and total volume recharged by county	Recharge
How are "unmodeled" wetlands areas and sinks treated in SCS-CN method?	Recharge
Wetlands modeled as constant head boundaries are ~25% of GIS mapped wetlands; compare land surface elevation vs. depth to water table to evaluate wetland area in model	Recharge

IV. NEF 1995 Simulation - Discussion of Issues

Dr. Wendy Graham facilitated a discussion and prioritization of remaining issues that the subgroup would like to address and task assignments. The results of this discussion were revisited during the final session, next steps and assignments were noted.

V. 2004 Confirmation Simulation

Vito Russo, SJRWMD, presented the proposed model set up for final 2004 simulation and a review of 2004 calibration targets (*SJRWMD slides 5-13*). In addition, Jeff Lehnen, CH2M HILL, presented a review of the NEF calibration target data (*NFUCG Model Evaluations- slides 32- 44)*. Significant discussion was focused on the targets. Remaining issues identified during the discussion included:

NFUCG will provide the v2/v3 target file they have worked on to SJRWMD to determine 200/150 vs 160/150 target well discrepancy	Targets
Provide spreadsheet of target values for 1995 (unrounded) to utility group	Targets
Prepare time series plot water use by category from 1995 to 2009	2004 confirmation simulation
SJRWMD will resolve 200/150 vs 160/150 target well reduction discrepancy	Targets
Consider running uniform average rainfall scenario for 2030 in addition to 1995 spatial pattern (and 2004 spatial pattern?)	Rainfall
Provide the most recent table explaining target differences between 1995 (v3) and 1995 (v2) to utility group	Targets
Check that JAX, GNV, ST Aug rainfall stations evaluated by NFUCG are included in nexrad methodology for 1995	Rainfall
Evaluate whether ET parameters and runoff methodology sensitive to spatial rainfall pattern	Rainfall
completion of 2004 runs: 1) changing only pumping to 2004 values 2) changing boundary condition, rainfall/recharge, pumping to 2004 conditions 3) same as 1 with river package 4) same as 2 with river package	2004 confirmation simulation

Due to time constraints, the Priority Issue: Identify alternate years that could be used to assess calibration, was only touched on, and it was agreed to move the presentations and further discussion to the next meeting agenda.

VI. Plan for next meeting and next steps

All of the action items identified throughout the day were compiled on excel and presented to the group at the beginning of the session. Each of the items was numbered, and discussed relative to the level of effort needed, and the level of priority. Below is the list of action items listed by party responsible and due dates for addressing:

4. **SJRWMD personnel** will address the following priority issues and be ready to present at the next meeting – October 22, 2009

Line no.	Due Date	Responsible Party	Sub-group action Items	Related Area	Status/comments
13	1-Oct	SJRWMD	Provide Utilities with SCS methodology and data files	Recharge	HIGHEST PRIORITY
22	1-Oct	SJRWMD	Provide spreadsheet of target values for 1995 (unrounded) to utility group	Targets	Lower priority

25	1-Oct	SJRWMD	Prepare time series plot water use by category from 1995 to 2009	2004 confirmation	low effort , high priority
30	12-Oct	SJRWMD	Status report on action items will be submitted to Wendy Graham by email		
33	16-Oct	SJRWMD	Prepare draft presentations on findings for each of the priority issues for the next meeting and submit to Dr. Wendy Graham		
1	22-Oct	SJRWMD	Investigate outliers in water use categories other than public supply (PS); investigate difference in Marion County PS compared to AWUS; follow-up to correct values as necessary	Pumping Wells	Low effort, medium priority
4	22-Oct	SJRWMD	Investigate pulp and paper plant well depths in Nassau, Putnam and Duval counties; follow up to correct values as necessary	Pumping Wells	Low effort, medium priority
5	22-Oct	SJRWMD	Compare model GHB heads by grid cell vs. interpolated USGS average pot. map; Estimate interpolation error	Boundary Conditions	Medium effort, high priority
9	22-Oct	SJRWMD	Re-evaluate drainage and injection wells (check existing data and look for additional data).	Drainage/Injection Wells/Natural Sinks	Low effort, medium priority
10	22-Oct	SJRWMD	Re-evaluate large magnitude natural focused recharge features (sinks, etc): Haile, Alachua, Orange lake, Turkey Creek, Blues Creek, Mill Creek Sinks (re-evaluate existing data, look for new data, evaluate whether/how recharge from these sink drainage basins getting into model)	Drainage/Injection Wells/Natural Sinks	Medium effort, medium priority
16	22-Oct	SJRWMD	Wetlands modeled as constant head boundaries are ~25% of GIS mapped wetlands; compare land surface elevation vs. depth to water table to evaluate wetland area in model	Recharge	Low effort, high priority
17	22-Oct	SJRWMD	Check that JAX, GNV, ST Aug rain stations evaluated by NFUCG are included in nexrad methodology for 1995	Rainfall	Low effort, high priority
20	22-Oct	SJRWMD	completion of 2004 runs: 1) changing only pumping to 2004 values 2) changing BC, rainfall/recharge, pumping to 2004 conditions 3) same as 1 with river package 4) same as 2 with river package	2004 confirmation	High effort - HIGHEST priority

5. **NFUCG consultants** will address the following priority issues and be ready to present at the next meeting – October 22, 2009

Line no.	Due Date	Responsible Party	Sub-group action Items	Related Area	Status/comments
23	1-Oct	NFUCG	NFUCG will provide the v2/v3 target file they have worked on to SJRWMD to determine 200/150 vs 160/150 target well reduction discrepancy	targets	low effort high priority
29	12-Oct	NFUCG	Status report on action items will be submitted to Wendy Graham by email		

32	16-Oct	NFUCG	Prepare draft presentations on findings for each of the Priority Issues for the next meeting and submit to Wendy Graham		
2	22-Oct	NFUCG	Investigate PS other than Marion County; including locations and well depths; send corrected values to SJRWMD	Pumping Wells	Low effort, medium priority
3	22-Oct	NFUCG	Verify power plant well depths in Nassau, Putnam, Duval Counties send updated info to SJRWMD	Pumping Wells	Low effort, medium priority
6	22-Oct	NFUCG	Investigate reasons for calibration improvement when adjust BC: Related to particular target wells? Particular region in model?	Boundary Conditions	Medium effort, high priority
14	22-Oct	NFUCG	Evaluate SCS rainfall-runoff-recharge methodology; Quantify total volume lost to surface runoff and total volume recharged by county	Recharge	High effort - HIGHEST priority
15	22-Oct	NFUCG	How are "unmodeled" wetlands areas and sinks treated in SCS-CN method?	Recharge	High effort - highest priority
24	22-Oct	SJRWMD	SJRWMD will resolve 200/150 vs 160/150 target well reduction discrepancy	targets	Low effort, high priority

6. The following priorities will be addressed at subsequent meetings:

Line no.	**Due Date**	**Responsible Party**	**Sub-group action Items**	**Related Area**	Status/comments
7	30-Nov	NFUCG	Conduct sensitivity analysis for model predictions when boundary condition varied within range of interpolation error	Boundary Conditions	Wait until get boundary condition data from action item 5 from SJRWMD
11	30-Nov	NFUCG	Compare ET zones to: Soils maps, Physiographic region/ DEM, LU & Vegetation Maps	ET	Lower priority
12	30-Nov	NFUCG	Evaluate ET sensitivity to zonation. Are more complex zones needed?	ET	Lower priority
18	30-Nov	NFUCG	Evaluate whether ET parameters and runoff methodology sensitive to spatial rainfall pattern	Rainfall	Lower priority

VII. Next steps

1. Plan for Next meeting – October 22, 2009

Agenda will include presentations and discussion of priority issues for 1995 NEF model as identified at this meeting. In addition, the 2004 Simulation will be addressed. However, due to time constraints, the MegaModel will be delayed until the following meeting.

2. Communication protocol for in between meetings

This remains the same as determined in the first meeting. Both SJRWMD staff and NFUCG consultants are working on several of the priority issues and will communicate directly with each other on these issues as appropriate. They will inform Dr. Wendy Graham, Technical Lead of the subgroup, of big issues that come up that might produce the need for detailed interactions between the groups between official meetings.

3. Next steps

    - Status report on priority issues will be submitted by SJRWMD and NFUCG to Dr. Wendy Graham by email by October 12.
    - SJRWMD and NFUCG will provide draft presentations on findings for each of the priority issues for the next meeting and submit to Dr. Wendy Graham October 16th.
    - Email questions solicited to be submitted by Friday, October 1st. The Water Institute will review written questions of clarification submitted by participants at the first meeting and share with SJRWMD by October 5th so that they can be quickly answered as necessary.

Public input, questions and comments were addressed throughout the meeting. No written questions were submitted.

Meeting was adjourned at 4:15 PM

Appendix C. October 22, 2009 - Meeting 3 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 3

Thursday, October 22, 2009
9:00 a.m. – 5:00 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32177

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants and all participants introduced themselves. Dr. Graham set the context for the meeting by reiterating the subgroup purpose and process, providing an update on the sub-group progress to this point, and outlining future plans. She then introduced the objectives and agenda for this meeting (*NEF-WSP ground_modeling slides 1-7*). A copy of the meeting agenda and participant sign-in sheets are attached to the end of this meeting summary as Appendix A. The meeting objectives included:

1. Know where we are in the process
2. Understand progress on analyses/modifications to NEF 1995 simulation
3. Understand progress on NEF 2004 simulation runs
4. Identify remaining issues related to the 1995 or 2004 Simulations that significantly limit use for water supply planning
5. Discuss Possible Scenarios that could be analyzed for 2030
6. Next Steps

Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site - ftp://ftp.sjrwmd.com/DWSP_2010/091022_NEF_GW_Modeling_Subgroup_Meeting-Oct_22_2009/

II. NEF 1995 Simulation

This session started with a recap of the priority issues related to the NEF 1995 simulation and their status by Dr. Graham (*NEF-WSP ground_modeling slides 9-10*). Specific discussion on Boundary Condition sensitivity began with a presentation by Vito Russo, SJRWMD (*Russo-NEFmodel Revisions slides 1 - 8).* Jeff Lehnen, CH2M HILL, provided results of recent analyses carried out in response to previous meeting action items. The presentation addressed sensitivity analysis of NEF boundary conditions *(Lehnen slides 4- 20).* During the boundary condition discussion session issues regarding the data available to set the northern and western boundary conditions for the Upper and Lower Floridan aquifers were discussed, particularly the lack of data in the Lower Floridan. It was suggested that looking the MegaModel 93-94 Upper and Lower Floridan heads at the boundary may help determine appropriate boundary conditions for the 1995 simulation as well as the 2030 prediction (see section V). Discussion of data-clean-up issues included a review of the drainage features included in the 1995 simulation, and the inclusion of additional drainage features in western Alachua County *(Russo-NEFmodel Revisions slides 9-15)*, the comparison of USGS mapped wetland features to surficial aquifer heads *(Russo-NEFmodel Revisions slides 21-22)* and a review of NEXRAD vs. Thiessen polygon rainfall fields *(Lehnen slides 22-28).*

After open discussion, the following actions were suggested for pending data clean-up issues. Action items regarding boundary conditions are included in section V.

Table 1.

Activity	Responsible	Priority Level
Continue 1995 pumping well input file review	SJRWMD/ NFUCG	lower priority
Provide written summary of outcome of pumping well input file check - document changes made to 1995 input file	SJRWMD/ NFUCG	lower priority
Continue target well review	SJRWMD/ NFUCG	lower priority
Provide written summary of outcome of target well review	SJRWMD/ NFUCG	lower priority

III. NEF 1995 Simulation

A brief presentation of the effects of changing the northern and western boundary conditions, and including additional drainage features in western Alachua County was presented by Vito Russo, SJRWMD *(Russo-NEFmodel Revisions slides 13-15).* A complete presentation of revised 1995 simulation and comparison with the original 1995 simulation, including calibration scatter plots by layer, vertical gradients, maps of heads, residuals, recharge, etc. and water budget, was scheduled for this meeting, however, this was not able to be completed due to competing priorities. See section V for discussion of future model simulations.

Priority Issue: Runoff /Recharge methodology – Jeff Lehnen, CH2M HILL, provided results of recent analyses of the runoff/recharge methodology including assessing the SCS method to calculate runoff (*Lehnen – slides 30 - 39*), and quantifying volumes of rainfall lost to runoff, lost to ET, "lost" during calibration and finally volume of rainfall resulting in net recharge (*Lehnen – slides 40 - 46*). Results of a sensitivity analysis of model predictions to hydraulic conductivity and leakance were also presented (*Lehnen – slides 48 - 60*). Remaining issues/actions identified during discussion included:

Table 2.

Activity	Responsible	Priority Level
Compare NEF, NCF and MegaModel net recharge (spatially distributed)	Recharge	High Priority
Compare NEF 1995 net runoff/net recharge to net runoff/net recharge from District's regional HSPF models	Recharge	High Priority
Look at hydrography, basin coverages; which basins are connected to surface features by ditches, stormwater drainage?	Recharge	High Priority
Verify spatial extent of active Layer 3 cells and look for APT tests to explain layer 2-3 leakance anomaly (Duval County)	hydrogeologic parameterization	Lower Priority

IV. 2004 Confirmation Simulation

One of the actions identified in meeting #2 was full completion of 2004 runs including: 1) using revised 1995 parameterization, recharge and boundary conditions with 2004 pumping data and no river package, 2) using revised 1995 parameterization, with 2004 recharge, boundary conditions and pumping data and no river package, 3) simulation 1 with river package, and 4) simulation 2 with river package. However these simulations were not

completed prior to meeting #3 due to competing priorities. Therefore, Vito Russo, SJRWMD presented the results of the original 2004 confirmation simulation that was presented to the NFUCG meeting in July 2009 *(Russo-FirstCut2004ConfirmationSim slides 1 – 7).* Plans for additional simulations were discussed in Session V resulting in several suggestions.

Next Jeff Lehnen presented a comparison of USGS estimated predevelopment Upper Floridan levels; simulated Upper Floridan head levels using 1995 parameterization, recharge and boundary conditions with zero pumping; and simulated Upper Floridan head levels using 1995 parameterization and recharge, estimated predevelopment boundary conditions and zero pumping (*Lehnen – slides 62 - 73).* Discussion indicated that the simulation with predevelopment boundary conditions and zero pumping compared quite favorably to the estimated USGS predevelopment Upper Floridan levels, with some exceptions in the Lake Santa Fe area (simulated levels lower than USGS estimated) and in the northeastern portion of the domain where groundwater flow directions appear to off slightly, perhaps due to boundary condition effects. Actions resulting from the discussion included:

Table 3.

Activity	Responsible	Priority Level
Plot results for surficial aquifer from existing NFUCG pre-development run	pre-development run	Lower Priority

V. Discussion of Possible Scenarios for 2030 simulation

Dr. Wendy Graham introduced this session indicating that the sub-group has spent significant time and resources on understanding the details of the NEF 1995 groundwater model, as well as the assumptions underlying the 2004 simulation and the results of the original 2004 simulation run. Helpful input has been provided and some adjustments have been made by SJRWMD. Fine tuning will continue. She then requested that the subgroup begin to consider scenario model runs that bracket uncertainty regarding model input parameters, boundary conditions and pumping conditions as a way to bracket 2030 model predictions and focus on issues that significantly limit the model's acceptability for use in the water supply planning process (*NEF-WSP ground_modeling slide 18*).

Dr. Graham began the discussion by posting 4 flipcharts, each with one of the 4 key issue areas previously discussed (BC, recharge, hydrogeologic parameterization, pumping projections). She then asked SJRWMD to share what methodology was used in the 2030 predictions for the Draft 2008 Water Supply Assessment for each of the areas noting them on appropriate flipchart. She then opened the discussion for the sub-group to consider other suggestions for simulations, scenarios or model runs that would help bracket a range of results to identify those with clearly significant impacts.

Table 4, on the next page, presents the results of the discussion including the priority issues, the current approach used and suggestions of other possible approaches.

Table 4

Priority Issue	**Approach currently written up in the Draft 2008 Water Supply Assessment**	**Other suggestions**
Boundary Conditions	1995 USGS GHB old	1995 USGS GHB old 1995 USGS GHB new w/o river package 1995 USGS GHB new w river package 1995 with 1993/94 MegaModel boundary conditions 2030 Megmodel with river package 1995 GHB + 10% layers 2 and 3 with river package 1995 GHB + 10% layers 2 and 3 w/o river package
Rainfall – Runoff Recharge	1995 rainfall → CN → calibration method then adjusted for water use/return changes 1995-2030	"What if" used long term average rainfall for 1995 as base case… would it calibrate to same net recharge? "what if" used long term average rainfall for 2030? "what if" 1995 model "forced" to absorb more recharge (may require recalibration) and this was used as base case Base year run actions: • compare net recharge NEF 1995 to MegaModel net recharge area and NCF recharge (over space) • compare to HSPF (water budgets) • look at drainage basins, hydrography to id closed basis -> adjust CN if warranted.
Hydrogeologic Parameters	1995 Calibration	Not discussed
Projected Pumping	GIS Assoc. – 2006 projections (middle to high)	Use revised population/water use projections GIS Assoc. is working on (due end of Dec 2009) Look at water use projection reduction possibilities: 2006 projections minus 5%, 10%, and 25%?

From the listing of suggested model runs above, several activities were identified and are listed in Table 5.
Table 5.

Activity	Topic Area	Priority Level
Increase net recharge into the model by a factor of 2, investigate what it would take to keep model calibrated. Use PEST to conduct a constrained re-calibration. Circulate 1 pg proposed methodology by Oct 28th. Comments back by Nov 2,	Recharge	High Priority
Start with long term average annual rainfall in the 1995 simulation, determine theoretical recharge and run model to see if remains in calibration. Conduct constrained re-calibration if necessary. Compare to base case. (preparation for possible long-term average rainfall for 2030 simulation)	Recharge	Medium Priority
Table 5. Continued Activity	Topic Area	Priority Level
run revised 1995 w/ new GHB, additional drainage/injection, new targets w/o river package	1995 simulation	Highest Priority
run 2004 confirmation w/ 2004 GHB, 2004 recharge, 2004 pumping (all categories) w/o river package	2004 simulation	Highest Priority
run revised 1995 w/ New GHB, additional Drainage/Injection, new	1995 simulation	Lower Priority

Targets with River Package		
run 2004 confirmation w/ 2004 GHB, 2004 Recharge, 2004 Pumping (all categories) with river package	2004 simulation	Lower Priority
Run 1995 model w/ 1995 GHB + 10% in layers 2 and 3; evaluate performance relative to base case.	BC	Holding Pond

VI. Plan for next meeting and next steps

Action items identified throughout the day were captured on flipchart. During this session, key action items were revisited and indication of priority was assigned, along with party responsible.

Following is the list of action items listed by party responsible and due dates for addressing:

7. **SJRWMD personnel** will address the following priority issues/actions

Due Date	**Responsible Party**	**Sub-group action Items**	**Related Area**	Status/comments
3-Nov	SJRWMD	Get new targets, depths and values for '95 and '04 to NFUCG	targets	Immediate
13-Nov	SJRWMD	Draft presentations turned in to WI		High Priority
17-Nov	SJRWMD	Look at hydrography, basin coverages; which basins are connected to surface features by ditches, stormwater drainage?	Recharge	High Priority
17-Nov	SJRWMD	Compare NEF 1995 net runoff/net recharge to net runoff/net recharge from District's regional HSPF models	Recharge	High Priority
17-Nov	SJRWMD	run revised 1995 w/ new GHB, additional drainage/injection, new Targets w/o River Package	1995 simulation	Highest Priority
17-Nov	SJRWMD	run 2004 confirmation w/ 2004 GHB, 2004 recharge, 2004 pumping (all categories) w/o river package	2004 simulation	Highest Priority
After Nov 17	SJRWMD	Verify spatial extent of active Layer 3 cells and look for APT tests to explain layer 2-3 leakance anomaly (Duval County)	hydrogeologic parameterization	Lower Priority
After Nov 17	SJRWMD	run revised 1995 w/ New GHB, additional Drainage/Injection, new targets with river package	1995 simulation	Medium Priority

After Nov 17	SJRWMD	run 2004 confirmation w/ 2004 GHB, 2004 recharge, 2004 pumping (all categories) with river package	2004 simulation	Medium Priority

8. **NFUCG consultants** will address the following priority issues/actions

Due Date	Responsible Party	Sub-group action Items	Related Area	Status/comments
13-Nov	NFUCG	Draft Presentations turned in to WI		High Priority
17-Nov	NFUCG	Compare NEF, NCF and MegaModel net recharge (spatially distributed)	Recharge	High Priority
17-Nov	NFUCG	Compare 1993/94 MegaModel boundary conditions and to 1995 GHB boundary conditions. Look in particular at Layer 2/layer 3 heads from MegaModel	BC	High Priority
17-Nov	NFUCG	Compare 2030 MegaModel BC to 1993/94 MegaModel boundary conditions	BC	High Priority
17-Nov	NFUCG	Review MegaModel	MegaModel	High Priority
17-Nov	NFUCG	Plot results for surficial aquifer from existing NFUCG pre-development run	pre-development run	Lower Priority
10/28/2009 method; Nov 3 comments Nov 17 results	NFUCG	Increase net recharge into the model by a factor of 2, investigate what it would take to keep model calibrated. Use PEST to conduct a constrained re-calibration. Circulate 1 pg proposed methodology by Oct 28th. Comments back by Nov 3.	Recharge	High Priority
Nov 17 if possible	NFUCG	Start with long term average annual rainfall in the 1995 simulation, determine theoretical recharge and run model to see if remains in calibration. Conduct constrained re-calibration if necessary. Compare to base case. (preparation for possible long-term ave rainfall for 2030 simulation)	Recharge	Medium Priority

After Nov 17	NFUCG	Run 1995 model w/ 1995 GHB + 10% in layers 2 and 3; evaluate performance relative to base case.	BC	Holding Pond

9. The following items of lower priority will be addressed by SJRWMD/NFUCG:

Due Date	**Responsible Party**	**Sub-group action Items**	**Related Area**	Status/comments
After Nov 17	SJRWMD/ NFUCG	Continue 1995 pumping well input file review	Data Clean-up	Lower Priority
After Nov 17	SJRWMD/ NFUCG	Provide written summary of outcome of pumping well input file check - document changes made to 1995 input file	Data Clean-up	Lower Priority
After Nov 17	SJRWMD/ NFUCG	Continue target well review	Data Clean-up	Lower Priority
After Nov 17	SJRWMD/ NFUCG	Provide written summary of outcome of target well review	Data Clean-up	Lower Priority

VII. Next steps

a) Action items -

November 17, 2009 meeting agenda will include presentations and discussion of priority issues for 1995 NEF model, the 2004 simulation runs, and the MegaModel. The Water Institute provided a list of actions reflecting the actions above to the responsible parties on Friday, October 23rd. Both SJRWMD staff and NFUCG consultants are working on several of the priority issues. The highest priority items should be accomplished first. Dr. Graham has requested that draft presentations be submitted prior to the next meeting. This has been designated as high priority as it is important for the facilitators' planning and to maximize the meeting interactions. Responsible parties will keep Dr. Wendy Graham appraised of any anticipated delays and inform her of big issues that come up that might produce the need for necessary intervention.

b) Public Input –

Public input, questions and comments were addressed throughout the meeting. During the final request for public input, a question was raised on whether the river package would be run. The response was yes, but not before the November 17th meeting. No written questions were submitted.

c) Next meetings -

The list of upcoming meetings was shared (slide number)

d) Meeting was adjourned at 5:10 PM

Appendix D. November 17, 2009 - Meeting 4 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 4

Tuesday, November 17, 2009
9:00 a.m. – 5:00 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32177

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants to the fourth subgroup meeting and asked who was attending for the first time (1 person). All participants introduced themselves. Dr. Graham set the context for the meeting by reiterating the subgroup purpose and process, providing an update on the subgroup progress to this point, and outlining future plans. She then introduced the objectives and agenda for this meeting (*NEF-WSP groundwater_modeling slides 1-5*). The meeting objectives included:

1. Share results of the 1995 simulation run, 2004 confirmation run and evaluation of runoff/recharge methodology to assess the status of the NEF model's acceptability for use in water supply planning
2. Gain understanding of the Peninsular Florida (MegaModel) groundwater flow model and identify issues that would limit its use in the water supply planning.
3. Discuss a framework for 2030 Predictions

To set the stage for the rest of the day, this session closed with a recap of the priority issues related to the NEF 1995 simulation and their status by Dr. Graham (*NEF-WSP groundwater_modeling slides 6-8*) and a handout of the priority issues was distributed (included in Appendix A)

A copy of the meeting agenda, handout, and participant sign-in sheets are attached to the end of this meeting summary as Appendix A, Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site -

ftp://wsmftp.sjrwmd.com/NPA/Nov_17_2009-NEF_GW_modeling_subgroup_meeting/

II. NEF 1995 Simulation

This session focused on 1995 NEF model modifications and revised 1995 NEF simulation runs made since the last meeting. Vito Russo, SJRWMD, introduced follow-up items that would be discussed during this session including HSPF surface water modeling status, analysis of NEF model domain's closed watersheds, Santa Fe watershed runoff/recharge analysis, and NEF and NCF overlap region recharge analysis (*SJRWMD slide 1, 2)*. Brian McGurk, SJRWMD, presented information on surface water models within NEF Model Domain (*SJRWMD slides 3, 4).* Doug Durden, SJRWMD, presented an analysis of the hydrologic data from Santa Fe River at Worthington Springs to determine a range of potential recharge values to validate the recharge value currently used in the 1995 NEF model (*SJRWMD slides 5-8*). Vito Russo presented a comparison of net recharge between the NEF and NCF models (*SJRWMD slides 9, 10).*

Pete Anderson, GEOTRANS, shared results of calibration exercises performed on NEF version 3 (GEOTRANS *slides 1-10)* as a result of recharge discussions in the last subgroup meeting. He used PEST to conduct a constrained recalibration of the model using the theoretical recharge (rather than calibrated recharge) and concluded that to get more recharge into the model while maintaining good calibration would require changing the zonation of the hydrogeological parameters in addition to adjusting their values by a constant factor. Vito Russo followed with a description of the Revised NEF-1995 model with all of the changes to date, including surface water stage data-CHB heads revision, lateral boundaries–GHB heads revision, target revision, natural drainage revision *(SJRWMD slides 11-16).* During open discussion, the following actions were suggested for issues related to the revised 1995 model.

Table 1. Suggested actions related to the revised 1995 NEF model

Activity	Responsible
GRU send latest data to SJRWMD regarding Alachua Sink/ Haile Sink recharge	GRU
Eliminate Runoff (and enforce recharge) in closed basins in western portion of 1995 NEF Model (green areas on map)	SJRWMD
Conduct runoff/recharge analysis in Black Creek basin (similar to what was done in Santa Fe)	SJRWMD
Conduct net runoff/recharge comparison (HSPF to NEF 1995) in January when it becomes available	SJRWMD
After all revisions, Look at contour differences in 1995 head simulation (from original 1995 simulation) at finer resolution (i.e. 0.1 ft) near Keystone Heights	SJRWMD
Add River Package to NEF 1995	SJRWMD
Use MegaModel Differences between Upper and Lower Floridan to adjust Lower Floridan Head Boundary Conditions in 1995 NEF Model	SJRWMD

III. 2004 Confirmation Simulation Run

In this session, Vito Russo, SJRWMD, shared findings of the 2004 confirmation simulation. *(SJRWMD slides 17-29).* During open discussion, the following actions were suggested for issues related to the 2004 confirmation run.

Table 2. Suggested actions related to the 2004 confirmation simulation.

Activity	Responsible
Check 2004 net recharge map, range of values seems high in some places	SJRWMD
Investigate spatial pattern of 2004 residuals	SJRWMD
Check 2004 simulation with new recharge for flooded cells, especially in high recharge regions	SJRWMD
Calculate NEF 2004 residuals statistics by layer, plot simulated versus observed regression	SJRWMD
Compare observed to predicted changes in spring flow between 1995 and 2004 where possible	SJRWMD
Review adjustment methodology to go from 1995 Calibrated Recharge to 2004 recharge. Is current calibration/adjustment process the best procedure for reflecting differences between 1995 and 2004, or does the simple addition/subtraction to the calibrated recharge (based on theoretical recharge differences) create inconsistencies?	SJRWMD
Add River Package to NEF 2004	SJRWMD

IV. MegaModel

The District plans to use the Mega model to set NEF model boundary heads for future NEF simulations. Patrick Tara, INTERA, provided an overview of the revision of the USGS Mega Model that was calibrated for 1993/94 and used for evaluation of projected 2030 groundwater withdrawals in the SJRWMD and SRWMD *(INTERA slide #1-56).*

V. Review/ Evaluation of the MegaModel

Jeff Lehnen, CH2MHill, reported on work carried out to compare NEF, NCF and MegaModel recharge *(NFUCG slide 2 – 13).* The NFUCG conclusions noted that the recharge distribution and conceptualization are different between the NEF model and the MegaModel, and that the NCF model has different values of recharge than the NEF model, but the range of values is generally similar.

Next Jeff Lehnen presented results of analyses carried out by the NFUCG to compare the boundary conditions, and the predicted heads, in the MegaModel and the NEF model. In summary, NFUCG concluded that the MegaModel shows generally lower water levels at NEF model boundaries than boundary conditions used to date by SJRWMD for both calibration and 2030 simulations, except on the western boundary where they are somewhat higher *(NFUCG slide 14 - 28).*

During the final part of this session, Jeff Lenhen presented results of the NFUCG MegaModel review and comparison to NEF model. This included an evaluation of calibration target residuals in Mega model, comparing simulations for calibration years and future conditions in Mega and NEF models, comparing aquifer parameter values for K, T, and leakance in Mega and NEF models (*NFUCG slides 29-51*).

During open discussion, the following actions were suggested for issues related to the MegaModel.

Table 3. Suggested actions related to the Mega Model.

Activity	Responsible
Investigate why increasing western boundary heads for NEF model (based on results from MegaModel) causes drop in head in south-east central portion of NEF model domain. How do target residual patterns and statistics hold up when do this.	NFUCG
Investigate differences in 93/94 pot map heads along the western boundary and 95 pot map heads along the western boundary	NFUCG
Investigate differences in 2030 MegaModel heads at western boundary versus 1995 pot map heads. It appears that 2030 MegaModel>1995.	NFUCG

VI. Evaluation of Runoff/Recharge Methodology

Discussions from previous meetings led to a desire to look more closely at recharge and the methodology applied in the 1995 NEF model. Jeff Lehnen's presentation reviewed the current SJRWMD for estimating/calibrating recharge and proposed the use of long term average rainfall and use of the 30 day CN method to estimate runoff as an alternative methodology that could possibly avoid the need to manually calibrate recharge (*NFUCG slide 53-57*). Suggestions for activities to explore alternative recharge appear in Table 4.

Table 4. Suggested activities to explore alternative recharge

Activity	Responsible
For long term average recharge simulation : Calculate residual statistics by layer, look at spatial distribution of residuals and plot simulated versus observed regressions for long term average recharge using current hydrogeologic parameters	NFUCG

Conduct constrained calibration using long term average recharge to take care of dry cells and improve performance (i.e. maintain spatial pattern, adjust layer wide values by constant %)	NFUCG

VII. Discussion of framework for 2030 predictions

Dr. Wendy Graham introduced this session indicating that the subgroup has spent significant time and resources on understanding the details of the NEF 1995 groundwater model as well as the assumptions underlying the 2004 simulation and the results of the original 2004 simulation run. Helpful input has been provided and some adjustments have been made by SJRWMD. Fine tuning will continue. However, at this point she suggested that the subgroup begin to consider scenario model runs (or predictive sensitivity runs) that bracket uncertainty regarding model input parameters, boundary conditions and pumping conditions as a way to bracket 2030 drawdown and spring flow predictions and focus on issues that significantly limit the model's acceptability for use in the water supply planning process. Note that this idea was also introduced in meeting # 3 (*NEF-WSP ground_modeling slide 18*).

The facilitated discussion resulted in suggestions of possible predictive sensitivity analyses for drawdown and spring flow. These suggested analyses, along with responsible parties, are noted in table 5. Note: For the predictive sensitivity simulations everything should be held constant from the Base Case simulation (described in the table below), except the one process/parameter being examined. Everything should be consistent between the 1995 and 2030 simulations except the pumping. All sensitivity cases that deviate from the 1995 revised base case should also quantify residual patterns and residual statistics for 1995 to evaluate the degree to which the model "remains calibrated" for 1995.

Table 5. Predictive sensitivity analyses

Activity	Responsible
Base Case: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections to calculate 2030 drawdown.	SJRWMD
Sensitivity 1A: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94) boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections.	SJRWMD
Sensitivity 1B: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94)/2 boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections...	SJRWMD
Sensitivity 2: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, long term average recharge (add additional return flows for 2030), 2030 pumping projections.	NFUCG
Sensitivity 3ABCD: Use 1995 calibrated K1, L12, T2, L23 +/- xx% (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), and 2030 pumping projections.	NFUCG
Sensitivity 4AB: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections, ET extinction depth*2, ET extinction depth/2.	NFUCG
Sensitivity 5ABC: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections -10%, -20%, -30%.	SJRWMD

VIII. Plan for next meeting and next steps

Action items identified throughout the day were captured on flipcharts. During this session, potential predictive sensitivity analyses and key action items were revisited, given priority order, and responsible party noted. The list of action items by party responsible and due dates are outlined in the following Tables. Table 1 includes items for SJRWMD, Table 7 includes items for NFUCG, and Table 8 includes. lower priority are carried over from Subgroup Meeting #3 held on October 22nd and will be addressed by SJRWMD/NFUCG at a later time:

Table 6. SJRWMD personnel will address the following priority issues/actions

Due Date	**Responsible Party**	**Sub-group action Items**	**Related Area**	Status/comments
11-Dec	SJRWMD	Eliminate Runoff (and enforce recharge) in closed basins in western portion of 1995 NEF Model (green areas on map)	NEF 1995	1
11-Dec	SJRWMD	Use MegaModel Differences between Upper and Lower Floridan to adjust Lower Floridan Head Boundary Conditions in 1995 NEF Model	NEF 1995	1
11-Dec	SJRWMD	Transfer updated 1995 model (w/o river package) to NFUCG	NEF 1995	1
11-Dec	SJRWMD	Check 2004 net recharge map, range of values seems high in some places	NEF 2004	2
11-Dec	SJRWMD	Check 2004 simulation with new recharge for flooded cells, especially in high recharge regions	NEF 2004	2
11-Dec	SJRWMD	Investigate spatial pattern of 2004 residuals	NEF 2004	2
11-Dec	SJRWMD	Calculate NEF 2004 residuals statistics by layer, plot simulated versus observed regression	NEF 2004	2
11-Dec	SJRWMD	Review adjustment methodology to go from 1995 Calibrated Recharge to 2004 recharge. Is current calibration/adjustment process the best procedure for reflecting differences between 1995 and 2004, or does the simple addition/subtraction to the calibrated recharge (based on theoretical recharge differences) create inconsistencies?	NEF 2004	2
11-Dec	SJRWMD	compare observed to predicted changes in spring flow between 1995 and 2004 where possible	NEF 2004	2
11-Dec	SJRWMD	Base Case: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections to calculate 2030 drawdown	predictive sensitivity analyses for drawdown and spring flow	3

11-Dec	SJRWMD	Sensitivity 1A: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94) boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections	predictive sensitivity analyses for drawdown and spring flow	4
11-Dec	SJRWMD	Sensitivity 1B: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94)/2 boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections	predictive sensitivity analyses for drawdown and spring flow	4
11-Dec	SJRWMD	Sensitivity 5ABC: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections -10%, -20%, -30%	predictive sensitivity analyses for drawdown and spring flow	5
Jan	SJRWMD	Add River Package to NEF 1995	NEF 1995	after Dec meeting
Jan	SJRWMD	Conduct runoff/Recharge Analysis in Black Creek basin (similar to what was done in Santa Fe)	NEF 1995	after Dec meeting
Jan	SJRWMD	Conduct net runoff/recharge comparison (HSPF to NEF 1995) in January when it becomes Available	NEF 1995	after Dec meeting
Jan	SJRWMD	After all revisions, Look at contour differences in 1995 head simulation (from original 1995 simulation) at finer resolution (i.e. 0.1 ft) near Keystone Heights	NEF 1995	after Dec meeting
Jan	SJRWMD	Independently calibrate 2004 recharge, compare to adjusted 2004 recharge, compare to calibrated 1995 recharge	NEF 2004	after Dec meeting
Jan	SJRWMD	Add River Package to NEF 2004	NEF 2004	after Dec meeting

Table 7. NFUCG consultants will address the following priority issues/actions

Due Date	Responsible Party	Sub-group action Items	Related Area	Status/comments
23-Nov	GRU	GRU send latest data to SJRWMD regarding Alachua Sink/ Haile Sink recharge	NEF 1995	1
11-Dec	NFUCG	For long term average recharge simulation : Calculate residual statistics by layer, look at spatial distribution of residuals and plot simulated versus observed regressions for long term average recharge using current hydrogeologic parameters	Alternative Recharge	1
11-Dec	NFUCG	Conduct constrained calibration using long term average recharge to take care of dry cells and improve performance (i.e. maintain spatial pattern, adjust layer wide values by constant %)	Alternative Recharge	1
11-Dec	NFUCG	Sensitivity 3ABCD: Use 1995 calibrated K1, L12, T2, L23 +/- xx% (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections	predictive sensitivity analyses for drawdown and spring flow	2
11-Dec	NFUCG	Sensitivity 4AB: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections, ET extinction depth*2, ET extinction depth/2	predictive sensitivity analyses for drawdown and spring flow	3
Jan?	NFUCG	Sensitivity 2: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, long term average recharge (add additional return flows for 2030), 2030 pumping projections	predictive sensitivity analyses for drawdown and spring flow	4
Jan	NFUCG	Investigate why increasing western boundary heads for NEF model (based on results from MegaModel) causes drop in head in south-east central portion of NEF model domain. How do target residual patterns and statistics hold up when do this.	MegaModel	after Dec meeting
Jan	NFUCG	Investigate differences in 93/94 pot map heads along the western boundary and 95 pot map heads along the western boundary	MegaModel	after Dec meeting
Jan	NFUCG	Investigate differences in 2030 MegaModel heads at western boundary versus 1995 pot map heads. It appears that 2030 MegaModel>1995.	MegaModel	after Dec meeting

on hold	NFUCG	Run 1995 model w/ 1995 GHB + 10% in layers 2 and 3; evaluate performance relative to base case.	NEF-1995	on hold

Table 8 Items of lower priority to be addressed by SJRWMD/NFUCG at a later time:

Due Date	**Responsible Party**	**Sub-group action Items**	**Related Area**	Status/comments
After Nov 17	SJRWMD	Verify spatial extent of active Layer 3 cells and look for APT tests to explain layer 2-3 leakance anomaly (Duval County)	NEF-1995	later
After Nov 17	SJRWMD/ NFUCG	Continue 1995 pumping well input file review	NEF-1995	later
After Nov 17	SJRWMD/ NFUCG	Provide written summary of outcome of pumping well input file check - document changes made to 1995 input file	NEF-1995	later
After Nov 17	SJRWMD/ NFUCG	Continue target well review	NEF-1995	later
After Nov 17	SJRWMD/ NFUCG	Provide written summary of outcome of target well review	NEF-1995	later

IX. Next steps

The Water Institute will provide a list of actions reflecting the actions above to the responsible parties on Wednesday, November 18th. Both SJRWMD staff and NFUCG consultants are working on the action items and predictive sensitivity analyses. The items should be addressed in the order noted in the table. Dr. Graham has requested that draft presentations be submitted prior to the next meeting. Responsible parties will keep Dr. Wendy Graham appraised of any anticipated delays and inform her of big issues that come up that might produce the need for necessary intervention.

Public input, questions and comments were addressed throughout the meeting. There were no additional comments or written questions were submitted.

The list of upcoming meetings was shared (*NEF-WSP groundwater_modeling slide 20)*. Subgroup meeting #5 is scheduled for December 11, 2009 and the meeting agenda will include presentations and discussion of action items and predictive sensitivity analyses.

Meeting was adjourned at 5:10 PM

Appendix E. December 11, 2009 - Meeting 5 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 5

Friday, December 11, 2009
9:00 a.m. – 5:00 p.m.

SJRWMD Headquarters, Room 162
4049 Reid Street, Palatka, Florida 32177

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants to the fifth subgroup meeting and asked who was attending for the first time (1 person). All participants introduced themselves. Dr. Graham then set the context for the meeting. She reiterated the subgroup purpose, outlined the progress to date, noted that the subgroup has worked hard and is at a pivotal point in the context of the overall Water Supply Planning process. This was the 5th groundwater modeling sub-group meeting. The next sub-group meeting is scheduled for January 21st, 2010 which is one week before the NEF Water Supply Planning Area Work Group Meeting scheduled for January 29th, 2010. Since SJRWMD plans to reassess PWRCAs between the end of the January 2010 sub-group meeting and the work group meeting scheduled one week later, Dr. Graham indicated it was important during the meeting to understand what is needed from the subgroup in order to help the overall Water Supply Planning Process to move forward (*NEF-WSP groundwater_modeling slides 1-5*).

Dr. Graham then introduced the objectives and agenda for this meeting (*NEF-WSP groundwater_modeling slide 6*). The meeting objectives included:

1. Discuss modifications and results of revised NEF 1995 model
2. Discuss methodology and results of 2004 NEF confirmation run
3. Discuss 2030 predictive sensitivity analyses for drawdown and spring flow
4. Understand SJRWMD plans and timeline for moving forward
5. Determine remaining issues and actions required for subgroup to complete its charge

Next Dr. Graham recapped the priority issues established in the previous meeting for which work was carried out by SJRWMD and the NFUCG. These issues are reflected in the meeting agenda and are related to the NEF 1995, the 2004 simulation, alternative recharge, and predictive sensitivity analyses for drawdown and spring flow. In addition,

the lower priority issues around the NEF 2004 and MegaModel that had been established were shared (*NEF-WSP groundwater_modeling slides 7-12*). A handout of the priority issues was distributed (included in Appendix A).

A copy of the meeting agenda, handout, and participant sign-in sheets are attached to the end of this meeting summary as Appendix A. Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site - ftp://wsmftp.sjrwmd.com/NPA/Dec_11_2009_NEF_GW_Modeling_subgroup_meeting/

NEF 1995 Simulation

At the end of the previous subgroup meeting (November 17, 2009), it was established that a **1995 base case model** that incorporates all the modifications made to date should be documented and shared with the groundwater modeling subgroup so that all sensitivity analyses could be run using the same base case. Vito Russo, SJRWMD, provided a presentation of modifications to the revised 1995 model including changes to recharge/drainage estimation, boundary conditions and results of the limited recalibration after these changes (*SJRWMD slides 1- 7).*

Doug Durden, SJRWMD, presented the results of an independent rainfall/runoff/recharge analysis performed on Black Creek using available measured data (*SJRWMD slides 8-11*).

Vito Russo presented the results of the 1995 and 2004 simulations using the base case. The results of the 1995 simulation included water use distribution, simulation statistics, observed vs. simulated head plots, residual maps, contour maps and spring flows (*SJRWMD slides 12 – 20).* The results of the 2004 simulations included water use distribution, summary of 2004 recharge estimation methodology, boundary conditions, simulation statistics (using both 1995 and 2004 recharge files), and observed vs. simulated head plots, residual maps, contour maps, spring flows using 2004 recharge file (*SJRWMD slides 21 – 35).*

Questions were asked throughout the presentations and discussion was encouraged. Several issues were identified for further consideration and were noted on flipcharts and are summarized in Tables 1 (1995 model) and 2 (2004 model) below.

Table 1. Issues and suggested activity related to the 1995 NEF BASE CASE model- 1995 simulation

Provide total additional water (in mgd) that was provided through adjustments for closed basins
Further explore differences between head values in upper and lower Floridan for Northern and Southern boundaries
Conduct additional rainfall/runoff/recharge analyses for other basins (in addition to Black Creek and Santa Fe)
Provide a map of final calibrated hydrogeologic parameters values for all layers after adding closed-basins.

Table 2. Issues and suggested activity related to the 2004 simulation

Provide map of 1995 calibrated recharge vs. 2004 adjusted recharge
Further investigate outliers of 1995 and 2004 surficial and Upper Floridan aquifer target residuals, particularly in Keystone heights area
Revisit some of the outliers on the graph showing the change in the 1995-2004 observed and simulated head Change. Do outliers coincide with specific geographic areas? Look at adjusted recharge in these areas, if looks reasonable consider using PEST for a limited recalibration.
Recalibrate 1995 model to accommodate Hybrid 1995 recharge- does the recalibrated model then performed well using the hybrid 2004 recharge?

II. NEF Model – alternative recharge analyses

Concerns were expressed about the methodology employed for the calibration of the recharge in previous meetings. During the November subgroup meeting, an action item was established for the development of an alternative methodology for estimating recharge. Jeff Lehnen, CH2MHILL, presented the alternative recharge analyses conducted by NEFUCG. Two alternate methods were proposed: Long term rainfall with 30 day Monthly CN using long term (>100 yrs) rain gauge data; and 1995 Nexrad Rainfall with 30 day Monthly CN method, identified as the "hybrid" method. Jeff Lehnen, CH2MHill, presented the results of the analyses carried out by NEFUCG consultants *(NEFUCG slides 1-28).* NEFUCG expressed a low level of confidence with the current 1995 model calibrated using the current recharge estimation methodology, particularly with regard to the behavior of the surficial aquifer when other plausible recharge scenarios were used in the calibrated model.

Questions were asked throughout the presentations and discussion was encouraged. Issues identified were added to the flipcharts (see Tables 1 and 2).

III. 2030 predictive sensitivity analyses - SJRWMD

Doug Munch, SJRWMD, explained the SJRWMD philosophy guiding the 2030 simulations as an assessment of future (2030) water supply needs and resulting drawdowns. The District is primarily interested in evaluating the predicted drawdowns that 2030 pumping will cause over the current 1995 base case situation.

Dr. Graham reiterated the expectations of how the predictive sensitivity analyses outlined in the last meeting were to be carried out. In particular it was noted that for the predictive sensitivity simulations everything should be held constant from the Base Case simulation (described in the table below), except the one process/parameter being examined. Everything should be consistent between the 1995 and 2030 simulations except the pumping. All sensitivity cases that deviate from the 1995 revised base case should also quantify residual patterns and residual

statistics for 1995 to evaluate the degree to which the model "remains calibrated" for 1995. Below are the suggested predictive sensitivity analyses that were scheduled to be completed for this meeting.

Table 3. Predictive sensitivity analyses suggested and assigned during the November 17th Subgroup meeting

Predictive Sensitivity analysis	Responsible Party
Base Case: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections to calculate 2030 drawdown.	SJRWMD
Sensitivity 1A: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94) boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections.	SJRWMD
Sensitivity 1B: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC modified with (2030 -93/94)/2 boundary drawdowns for 2030, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections...	SJRWMD
Sensitivity 2: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, long term average recharge (add additional return flows for 2030), 2030 pumping projections.	NEFUCG
Sensitivity 3ABCD: Use 1995 calibrated K1, L12, T2, L23 +/- xx% (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), and 2030 pumping projections.	NEFUCG
Sensitivity 4AB: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections, ET extinction depth*2, ET extinction depth/2.	NEFUCG
Sensitivity 5ABC: Use revised NEF 1995 calibrated hydrogeologic parameters (w/o river package), 1995 BC, 1995 calibrated recharge (plus return flows in 2030), 2030 pumping projections -10%, -20%, -30%.	SJRWMD

Vito Russo presented results of the 2030 drawdown sensitivity simulations carried out by SJRWMD, i.e. Case 1A (BC sensitivity) and Case 5ABC (public water pumping projection sensitivity). Results shared included water use distribution, boundary conditions (1995 and 2030 GHB), drawdown maps and spring flows (*SJRWMD slides 36 – 42).*

IV. 2030 predictive sensitivity analyses - NEFUCG

NEFUCG had been tasked with carrying out 2030 predictive sensitivity analyses for the following cases: Case 2 (recharge sensitivity), Case 3ABCD (hydrogeologic parameter sensitivity), Case4AB ET (extinction depth sensitivity). The final "base case" revised 1995 model was only made available a few days before the meeting so the NEFUCG was not able to complete all of these simulations using the revised 1995 before the meeting. Jeff Lehnen, CH2MHill, presented the results of an alternate recharge predictive simulation, as well as sensitivity analyses of drawdown to a range of hydrogeological parameters *(NEFUCG slides 29 – 62*).

Jeff Lehnen raised several issues related to the NEF model (*NEFUCG slides 63-64*) and proposed a path forward which included continuing NEFUCG/District work effort to resolve issues (Rainfall & recharge, river package for water bodies, recalibrate the model) and postponing PWRCA Designation until issues resolved & model recalibrated (*NEFUCG Slide 65*). The final comment is outside of the mandate of the sub-group; however, it was discussed in session VII which focused on the SJRWMD view of the path forward for the overall Water Supply Planning process.

Table 4. Suggested Activities related to Predictive Sensitivity Analyses – using the 1995 Base case

SJRWMD provide a table of all water use categories for 1995, 2004, 2030 used in sensitivity cases 5ABC
SJRWMD compile 2030 spring flow table for sensitivity cases 5ABC as was presented for sensitivity case 1A
NEFUCG use long-term average recharge for simulation for both 1995 and 2030 to calculate drawdown for sensitivity case 2 and provide drawdown maps to SJRWMD for calculation of resulting PWRCAs.
Evaluate using Megamodel as 2030 Boundary condition; look at Megamodel calibration stats around boundary
Conduct trend analysis on observed data from wells near boundary; does trend indicate BC used in 2030 are reasonable
Look at 1995 and re-evaluate appropriateness as base year

V. Determine degree of consensus regarding acceptability of groundwater models for Water Supply Planning Process

This session focused on clarifying remaining concerns regarding the models' acceptability for the purpose of supporting water supply planning actions with the intention to develop recommendations for additional analyses/improvements. Several suggestions had been made in early comments and had been captured on the flipcharts previously reported. Table 5 includes a synthesis of these issues that were rearticulated during this part of the meeting.

Table 5. Issues and Suggested Activities - 1995, 2004, 2030

Why is 1995 the base case? Does unique rainfall/runoff/recharge pattern create unique, but not representative, hydrogeologic calibration?
Are problem areas in 2004 due to recharge adjustment or "not representative hydrogeologic calibration"?
2004 Floridan statistics are ok. Surficial stats are not ok--- larger outliers exist.
2004 predicts rebounds from reduced pumping OK, not too much data regarding drawdowns.
2030 predictive drawdowns sensitive to - L12, T, L23
Create 2 PWRCA maps from predictive sensitivity analyes: One based only on WQ/MFL/Spring Flow constraints, the other based on all environmental constraints (i.e. including vegetation impacts)

To address remaining concerns with the model, particularly the way recharge is currently handled, the following suggested proposals were noted:

Table 6. Suggested Proposals to address lack of confidence in the recharge calibration methodology

Recalibrate 1995 NEF to hybrid 1995 recharge –evaluate its performance for 2004. Compare to existing model performance
Add drains/river package, recalibrate 1995, resimulate 2004. Compare to existing model performance

VI. Current view from the District - plans and timeline for moving forward in the Water Supply Planning Process

Wendy Graham introduced this session by revisiting the Modeling Subgroup Timeline (*NEF-WSP groundwater_modeling Slide 5*). She noted that after the next meeting (January 2010) a summary consensus (or indication of areas of disagreement) was required in order to provide input to the SJRWMD in their process to re-assess PWRCAs. The current SJRWMD plan is that the PWRCAs, estimated from the latest NEF model, will be presented during the next NPA Work Group Meeting scheduled for January 29, 2010. SJRWMD shared their assessment of the modeling sub-group progress to date, their plans for use of outcome from modeling sub-group, and their timeline for moving ahead in the Water Supply Planning Process. Barbara Vergara, SJRWMD, then shared the priorities that the SJRWMD team felt needed to be covered by the next Groundwater Modeling meeting in January, in order to make progress toward agreement on the acceptability of the model for use in the Water Supply Planning Process.

Table 7. Priority Activities proposed by SJRWMD by the next Groundwater Modeling meeting in January

1. Examine 2004 outliers and the target locations where the differences in the 1995-2004 observed vs. predicted did not reflect the areas of drawdown very well and demonstrate the reasonableness of the current calibration. Make changes inside (parameter) / outside (recharge) model as appropriate
2. Revisit MegaModel statistics around the boundary, do a trend analysis on wells near the boundary to ascertain if the trend indicates boundary conditions used in 2030 are reasonable and provide evidence to reconfirm use of Megamodel as 2030 Boundary conditions.
3. Revisit 1995 as base calibration year (i.e. look at rainfall, groundwater levels and streamflow hydrographs in historical context) to address remaining concerns
4. Run all predictive sensitivities (1-5) drawdowns to look at resulting PWRCAs for WQ, MFL, spring flow and vegetation impacts. Run an additional scenario 6 - 2030 base case, 2030 reduced pumping for public water supplies, 2030 recharge. This will include the predictive sensitivities carried out by NEFUCG that are done to the BASE CASE. Produce 2 maps – one showing results using all environmental constraints and one showing results using only Water Quality, MFLs, Spring flow constraints
5. In the long run - add River package to the base case (bring in all drainage features that are in the MegaModel)

Dr. Graham initiated a discussion by asking if actions 1 – 4 of the SJRWMD priorities (noted above in Table 7) were carried out and the results were satisfactory, would that make the model acceptable to the NEFUCG? NEFUCG indicated that even if all the above priorities were addressed by SJRWMD, there remained a lack of confidence in the recharge estimation methodology. At the end of the discussion, there remained two proposals to address the issue of the recharge methodology: 1) recalibrate 1995 based on more independent method to estimate recharge –e.g. 1995 hybrid, and 2) adding the river package to the 1995 model. In addition, NEFUCG expressed concerns regarding the process being used by SJRWMD to assess the PWRCAs. This is an issue outside of the subgroup and will be addressed at other established meetings between SJRWMD and NEFUCG.

The time for discussion ran short (having already gone well beyond the 5:00 scheduled end time). Several suggestions for follow-up on issues remained including potential collaboration around completing the suggested proposals and therefore the group agreed to schedule a conference call to include SJRWMD, NEFUCG and WI to determine follow-up actions at a later time. David Hornsby, SJRWMD, scheduled the phone conference, and it was

held from 9am to 11am on Tuesday, December 15th. See Appendix B for an Email from Dr. Graham in preparation for the meeting, as well as suggested path presented during the conference call by NEFUCG. The results of the meeting included SJRWMD and NEFUCG proposing action items and timelines that they each would address before the January 21st meeting. Those ACTIONS are included below in the Next Steps session below.

VII. Plan for next meetings and next steps

SJRWMD and NEFUCG proposed action items and timelines that they each would complete in preparation for the January 21st meeting. These Actions are outlined below in Table 8 and Table 9, respectively.

Table 8. Actions for SJRWMD based on revised action items resulting from December 11, 2009 NEF Modeling Subgroup Meeting (email from D. Hornsby, 12/17/09)

Due Date	Responsible Party	Sub-group action Items
Jan 13	SJRWMD	1. Investigate data outliers (1994 and 2004) in the observed vs. simulate 1995-2004 difference plot presented during the December 11th meeting
Jan 13	SJRWMD	2. Investigate other observed/simulated head residuals in the model such as those in the Keystone Heights area for both 1995 and 2004.
Jan 15	SJRWMD	3. Provide the spatial distribution of recharge to model cells (precip – ET_{min} – runoff) for 1995, 2004, and 2030. *Dr. Graham will request from NFUCG long term average recharge and hybrid 1995 recharge and SJRWMD will map them in same format for comparison.*
Jan 15	SJRWMD	4. Provide table of total additional water (in mgd) added via Recharge Package and the Well Package through adjustments to the model in closed basins.
Jan 15	SJRWMD	5. Provide map of spatial distribution of final calibrated hydrogeologic parameters
Jan 15	SJRWMD	6. Evaluate stream flow analysis, if feasible (similar to analyses as those already completed for Black Creek and Santa Fe River basins) for other basins in the NEF model domain subject to the availability of data
Jan 15	SJRWMD	7. Re-evaluate/justify 1995 as base year (rainfall and well hydrographs)

Jan 15	SJRWMD	8. Provide a table of all water use categories for 1995, 2004, and 2030
Jan 15	SJRWMD	9. Review MEGA model calibration statistics for the region around the western NEF model boundary
Jan 15	SJRWMD	10. Perform trend analysis for wells near the western boundary of the NEF model to determine the reasonableness of the adjustment to the western NEF model boundary based on the MEGA model results provided by Intera.
Jan 15	SJRWMD	11. Conduct predictive 2030 simulations using the 1995 model with any new revisions which occur from the tasks above. For the 2030 simulations, incorporate the boundary conditions as prescribed by the Mega model and the 2030 recharge which accounts for additional return flows. Perform two additional simulations whereby the Public Water Supply use category in the model domain was reduced by 10% and 20% globally. Provide 1995 – 2030 drawdown maps for the surficial and Floridan aquifers for each of the simulations Provide 2030 spring flow table representing the results from the three simulations described above.(target date for availability is January 13, 2010)
Jan 15	SJRWMD	12. Provide drawdown and PWRCA maps for predictive sensitivity cases described in number 12. Make 2 different PWRCA maps: one that shows caution areas based only on water quality, MFLs, and springflow, and one that includes those plus vegetation impacts.
Jan 15	SJRWMD	13. *Dr. Graham will obtain drawdowns from NEFUCG for their recharge sensitivity analyses presented at last meeting*. District will map in same format was as 12 above

Table 9. Actions for NEFUCG based on revised action items resulting from December 11, 2009 NEF Modeling Subgroup Meeting (email from Rick Hutton 12/21/09) for Presentation at the January 21, 2010 Groundwater Modeling Subgroup Meeting

Due Date	Responsible Party	Sub-group action Items – FIRST PRIORITY
Jan 15	NEFUCG	1. Comparison of 1995 NEXRAD rainfall to long term average rainfall. Define differences in the 1995 NEXRAD rainfall distribution as compared to long-term average. Prepare a map showing the differences between 1995 and long term average rainfall averaged over physiographic regions, and areas of particular concern (such as critical recharge areas, closed basins, and the Keystone lakes region). (Note: Analysis will compare averages over regions rather comparing individual cells)
Jan 15	NEFUCG	2. Compare recharge distribution calculated using 3 scenarios. The 3 scenarios include: 1995 rainfall using District methodology, 1995 rainfall using 30 day CN, and long-term average rainfall using 30-day CN. Zoom into select areas of interest i.e. Lake region, Alachua county, Clay county, etc. Show averages over physiographic regions and closed basins.
Jan 15	NEFUCG	3. Exercise the model under various pumping and rainfall conditions. The purpose is to determine the model's stability under various pumping and recharge conditions. Obtain latest 1995 and 2004 model files. Run model files using 1995 and 2004 pumping and recharge, respectively. Also, run model files using long-term average recharge. Zoom into the lake region showing calibration targets for all simulations and compare and contrast. Overlay wetland areas of concern to emphasis the importance of this area.
Jan 15	NEFUCG	4. Prepare a table of APT data and compare to applicable model cell values.
Jan 15	NEFUCG	5. Determine specifics of District's plans to modify the model with River cells and recalibrate. Note: Our current understanding is that rivers, lakes, and wetland areas will be reconfigured by the District to be designated River cells. This is a significant revision to the model. Request District to provide an outline of their

		proposed approach. Provide input on the District's selected approach.
Jan 15	NEFUCG	*6.* Sensitivity analysis of drawdown predictions to critical aquifer parameters. Compare drawdown predictions using current model with variation of critical aquifer parameters. NEFUCG to consult with SJRWMD on what we mutually consider a reasonable range of variation of parameters, *and to provide SJRWMD final drawdown predictions for use in mapping the PWRCA that would result.*
Jan 15	NEFUCG	*7. Sensitivity analysis of drawdown predictions to use of long-term average recharge. Compare drawdown predictions using current model with long-term average recharge as forcing for both 1995 and 2030 simulations (everything else constant except pumping). Provide SJRWMD final drawdown predictions for use in mapping the PWRCA that would result.*
		Sub-group action Items – SECOND PRIORITY
Jan 15	NEFUCG	8. Limited PEST recalibration of Layer 1 conductivity and leakance. Use 1995 daily rainfall with 30 day CN runoff and perform limited PEST recalibration of layer 1 conductivity and leakance to improve model's flexibility to accept reasonably different recharge. Evaluate revised model flexibility to determine if the model can accept varying recharge better than base model.
Jan 15	NEFUCG	9. Perform a "predictive simulation" for 2004 using 1995 rainfall and 2004 pumpage. Using the 1995 model, vary only pumping file input using 2004 input file.

Public input, questions and comments were addressed throughout the meeting. There were no additional comments or written questions were submitted.

The list of upcoming meetings was shared (*NEF-WSP groundwater_modeling slide 20).* Subgroup meeting #6 is scheduled for January 21, 2010.

Meeting was adjourned at 5:40 PM.

Appendix F. January 21, 2010 - Meeting 6 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 6

Thursday, January 21, 2010
9:00 a.m. – 4:15 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32178

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute, and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup welcomed the participants to the sixth subgroup meeting. All participants introduced themselves and indicated the number of the subgroup meetings in which they had participated. Dr. Graham reiterated the subgroup purpose, noted that the deliverable is a report of the process including assessment of models' strengths and limitations, and recommendations on how limitations might be overcome, and revisited the timeline. An additional meeting has been added to the timeline (February 1st) specifically to discuss input for the Final Report and reach closure. Before the final meeting (March 25th), Dr. Graham will prepare a draft report, circulate it for review/comments, and revise based on comments. (*NEF-WSP groundwater_modeling slides 1-8*).

Dr. Graham then introduced the objectives and agenda for this meeting (*NEF-WSP groundwater_modeling slide 9*). The meeting objectives indicated that by the end of this meeting, the subgroup members will have:

- Reviewed the latest revision of the 1995 and 2004 model runs
- Reviewed 2030 Predictive Sensitivity Analyses and resulting priority water resource caution areas (PWRCAs) using latest model
- Reviewed alternative proposed recharge estimation methodology
- Discussed process for preparation and review of the Groundwater Modeling Subgroup Draft Report due February 15, 2010.

A copy of the meeting agenda and participant sign-in sheets are attached to the end of this meeting summary as Appendix A. Appendix B is the handout listing previous meeting action items. Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site:
ftp://wsmftp.sjrwmd.com/NPA/Jan_21_2010_NEF_GW_modeling_subgroup_meeting/

II. NEF Model – 1995 and 2004

SJRWMD presented results of work completed since the last meeting. (*SJRWMD slides 1- 35).*

Doug Durden, SJRWMD, presented a justification of 1995 as base year and rainfall/runoff analyses conducted for 10 basins in the Northeast Florida (NEF) groundwater flow model domain (*SJRWMD1 slides 1-16*). Doug Munch, SJRWMD, presented trend analyses for wells near western NEF Boundaries, (*SJRWMD1 slides 16-20*). Vito Russo, SJRWMD, made a presentation of modifications to, and results of, revised 1995 model simulation (base model) including a summary of total additional water added via recharge package and well package as a result of closed basins, as well as a presentation of methodology and results of the 2004 NEF confirmation run (*SJRWMD1 slides 16-35*).

III. 2030 predictive sensitivity analyses

Vito Russo, SJRWMD, shared a table of water use for all categories for 1995, 2004, 2030 and reviewed 2030 predictive surficial and Floridan aquifer drawdowns and springflow reductions for 2030 various public water supply demand scenarios (*SJRWMD1 slides 37-41*). David Hornsby, SJRWMD, presented the new population and water demand projections based on 2009 BEBR data (SJRWMD2 slides 1-3) and water resource impact analyses (vegetation impacts and lake MFL impacts and springflow reductions) based on the 2030 predictive simulations presented by Vito Russo (*SJRWMD2 slides 1-15*).

During discussion, concern was expressed regarding the appropriateness of the 0.5 ft drawdown criteria for designation of the PWRCAs when the residual standard deviation of the NEF head predictions is on the order of 3 ft (for all aquifer layers) for the 1995 calibration and 5 ft (for all aquifer layers) for the 2004 confirmation run.

After the lunch break, Al Canepa, SJRWMD, revisited the question about the drawdown criteria for designation of PWRCAs and agreed to schedule another meeting (outside of the subgroup process) to address this issue directly.

IV. 2030 NEFUCG: Additional Analyses and Results of Alternative Recharge Methodology

Dr. Chris Brown, University of North Florida, reported on studies carried out for Northeast florida Utility Coordination Group (NEFUCG) focused on statistical analyses of rainfall distributions for 1995 and 2004 *(Brown,Chris_Jan21_presentation_v2, slides 1-12)*. Then Jeff Lehnen, CH2MHill, presented results of the work carried out by NEFUCG consultants since the last meeting. This included: a) comparison of rainfall and recharge distributions using 1995 NEXTRAD, 1995 30 day-CN, and long-term average methodologies in sub-areas; (*NEFUCG slides 4-29)* b) comparison of calibration statistics for 1995 and 2004 simulations for various model runs (*NEFUCG slides 30-38),* c) results from alternative closed basin analyses (NEFUCG slides 39-41); d) comparison

of model parameters to aquifer performance testing (APT) data (*NEFUCG slide 42);* e) an evaluation of trends on NEF western boundary (*NEFUCG slides 43-53*). Chris Peters briefly described his efforts to recalibrate the 1995 NEF using the 1995-30 day CN approach using PEST and indicated that thus far he had not been able to improve the calibration significantly (*no slides presented*). Finally Jeff Lehnen summarized the NEFUCG concerns with the current model (*NEFUCG slides 53-64*).

V. Reaching Closure – next steps for the subgroup

Dr. Wendy Graham introduced the strategy for completing the Draft Groundwater Modeling Subgroup Report (due February 15th), and plans for next meeting (February 1st). (*NEF-WSP groundwater_modeling slides 17-19*).

The proposed process for developing the final report includes the following steps :

1. **Fri Jan 22th** : On-line poll to assess strengths and limitations, and recommendations
2. **Wed Jan 27th**: Receive written summary of model analyses and changes made from SJRWMD and NEFUCG
3. **Mon Feb 1st**: Meeting to discuss
   a. Summary of model analyses and changes made
   b. Assessment of model strengths & limitations
   c. Recommendations for addressing remaining concerns
4. **Mon Feb 15th**: Draft report circulated
5. **Mon Mar 1st** : Review comments received
6. **Mon March 15th**: Revised report circulated
7. **Thurs March 25th**: Present final report to subgroup, Evaluate process
8. **Thurs June 17th :** Present final report to work group

ACTIONS BEFORE NEXT MEETING:

Date	Responsible Party	Action
January 22, 2010	Water Institute	Send on-line poll to subgroup members who have participated in at least 1 meeting
January 27, 2010	SJRWMD and NEFUCG	Send written summary of model analyses and changes made to Dr.Wendy Graham – bulleted
January 27, 2010	All subgroup members who have participated in at least 1 meeting	Respond to on-line poll
February 1, 2010	SJRWMD	Complete all pending sensitivity analyses scenarios
Outside of subgroup mandate	SJRWMD	Schedule a District Wide meeting for a review of drawdown criteria for designation of PWRCA.

Public input, questions and comments were addressed throughout the meeting. There were no additional comments or written questions were submitted.

The list of upcoming meetings was shared (*NEF-WSP groundwater_modeling slide 20).* Subgroup meeting #7 is scheduled for February 1, 2010. Meeting was adjourned at 4:15 PM.

Appendix G. February 1, 2010 - Meeting 7 Summary

Meeting Summary

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area
Groundwater Modeling Subgroup - Meeting 7

Monday, February 1, 2010
9:00 a.m. – 4:15 p.m.

SJRWMD Governing Board Room
4049 Reid Street, Palatka, Florida 32178

I. Welcome

Dr. Wendy Graham, Director of the UF Water Institute and technical lead for the St. Johns River Water Management District (SJRWMD)/Suwannee River Water Management District (SRWMD) Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup, welcomed the participants to the seventh subgroup meeting. All participants introduced themselves. Dr. Graham reviewed briefly the subgroup purpose, product and process as well as the timeframe for drafting and reviewing the report (*NEF-WSP groundwater_modeling slides 1-8*).

Dr. Graham then introduced the objectives and agenda for this meeting (*NEF-WSP groundwater_modeling slide 9*), noting that this meeting was added to the initial timeline specifically to discuss input for the Final Report and reach closure. The meeting objectives included:

- Understand 2030 predictive sensitivity analyses results
- Discuss participants input regarding strengths, limitations and recommendations that will contribute to the Groundwater Modeling Subgroup Report – draft due to the district due February 15, 2010.

A copy of the meeting agenda and participant sign-in sheets are attached to the end of this meeting summary as Appendix A. Appendix B is the handout of responses to an on-line poll administered following meeting 6. Materials related to this meeting, including copies of all presentations, sign-in sheets, photos, and any materials handed out at the meeting will be available to the public at the following SJRWMD ftp site:
ftp://wsmftp.sjrwmd.com/NPA/Feb_1_2010_NEF_GW_modeling_subgroup_meeting/

II. 2030 Predictive Sensitivity Analyses Results

Doug Durden, SJRWMD, presented results of **2030 Predictive Sensitivity Analyses performed** since the previous meeting (*SJRWMD slides 1- 9).* These included sensitivity analyses for hydrogeologic parameters and recharge. Sensitivity analyses for pumping demand and boundary conditions had been presented previously and were not repeated with the latest version of the 1995 NEF model due to time limitations. Questions were raised about the coarseness of the contour intervals on some of the drawdown plots, and plots with a finer contour interval were subsequently distributed .

Models' strengths

Dr. Wendy Graham introduced this session as an opportunity to share and discuss participants' responses to the on-line survey in order to engage in conversation that would contribute ideas for synthesizing findings for final report. Although individual responses (and the NEFUCG consolidated response) had been received and shared with all participants prior to the meeting (see Appendix B), Dr. Graham solicited "common elements" as well as important "areas of contradiction" and listed them on flipcharts as a basis of discussion.

Brainstorm List of Common Opinions on Model Strengths

- Well calibrated in SAS and UFA for 1995
- Number of targets in the UFA
- 1995 is a reasonable base year for calibrating a steady state model (based on historical rain gage and well hydrographs data)
- Upper FL Transmissivities reasonable compared to APT data
- Upper Floridan is well predicted
- 2004 validation for UFA
- Calibrated recharge compared well to independent basin data analysis

Brainstorm list of Contradictory Opinions on Model Strengths

- Quality of 2004 validation
- Long history of the model (strength vs. weakness)
- Suitability of NEXRAD data to develop recharge
- Predictability of model for non-calibrated years
- Whether the process is complete

III. Models' limitations

Following the same format as the previous session, Dr. Wendy Graham solicited "common elements" as well as important "areas of contradiction" regarding the Models' limitations.

Brainstorm List of Common Opinions on Models' Limitations

- Lack of Santa Fe River flow reduction predictions (boundary and river package issues)
- Lack of intermediate aquifer layer
- Boundary not far enough west
- Number of surficial and Lower Floridan targets
- Challenges with verifying model's predictive capability
- Use of 2004 as confirmation year- similar pumping, changes in rainfall distribution
- 2004 validation for surficial aquifer
- 2004 recharge adjustment methodology
- Incorporating MegaModel drawdowns on western boundary (boundary impinging model decision domain)
- lack of river package
- use of constant head boundary for lakes and rivers
- size of grid cells makes surficial prediction difficult
- spatial scope of closed basin analysis
- Uncertainties associated with calibrating steady state regional model with transient point data and recognition of the limitation of use of regional predictions for local-scale impacts

Brainstorm List of Contradictory Opinions on Models' Limitations

- Appropriateness of the use of Nexrad rainfall data
- Appropriateness of calibrating recharge
- Consistency of quality of model calibration over model changes

V. Specific Recommendations for Model

Finally Dr. Graham solicited the opinions from the group on specific recommendations for addressing model limitations and areas of disagreement.

Recommendations

- Fully document version 3.
- Engage stakeholders in discussion of calibration methodology before work begins through on-going formal process
- Add river package/calibrate to river (base flow) gage data
- Add lake package (especially in the Sand Lake region)
- Recalibrate after adding above packages
- Check recharge calibration using data from basins covering more of the model domain (use consistent ET min recharge in model and data analyses)
- Check recharge calibration against HSPF recharge predictions
- Rerun the model with the latest population/water use projections
- Expand the boundary westward
- Develop a transient model
- Use smaller grid cells in areas of special concern and where there is data. Perhaps local grid refinement package in MODFLOW 2005 or telescoping approach with fine grid embedded within regional grid for boundary conditions
- Investigate adding intermediate aquifer layer (are there targets, is it mapable, what do well logs show?)
- Increase data collection along the western boundary. Additional wells to look at Upper Floridan/Lower Floridan head changes
- More Lower Floridan targets, and more surficial targets in areas of concern and transition between confined and unconfined Floridan.
- Reconsider use of NEXRAD for years prior to 2002
- In the long-term… consider alternative to CN method (e.g. Green Ampt)
- Consider more detailed spatial description for ET (e.g. Cell based land cover)

Dr. Graham asked what the subgroup thought should be done differently to engage stakeholders in a formal process for moving these recommendations forward. Barbara Vergara suggested that the existing process for Water Resources Development Planning could provide a framework and funding for future stakeholder involvement on the long run. Specific short-term suggestions for continuing/establishing formal stakeholder process included:

- More work up front in agreeing on methods rather that critiquing end product.
- Establish calibration targets up front in the stakeholder process
- Consider more formal uncertainty analysis (e.g. Monte Carlo analyses)
- Evaluate MegaModel calibration for 93/94 overall and in the NEF domain and develop confirmation run for the MegaModel to validate MegaModel for setting Western boundary
- SJRWMD and SRWMD should work together to create single North Florida model

- Continue active engagement focused on distinct versions of the model:

    - **Version 3**
        - ☑ Rerun with latest projections
        - ☑ Document
        - ☑ Sensitivity analysis on the Western boundary
        - ☑ Use to estimate shortfall for planning purposes

    - **Version 4**

        - ☑ Add river package, lake package, etc
        - ☑ Use same calibration year
        - ☑ Use same domain
        - ☑ Recalibrate (agree on statistics required)
        - ☑ Re-evaluate NEXRAD

    - **Version 5**

        - ☑ SJRWMD and SRWMD work together on common model
        - ☑ Reevaluate boundary
        - ☑ Reevaluate calibration year
        - ☑ Consider Transient Model
        - ☑ Consider Telescoping Model to improve surficial predictions
        - ☑ Reevaluate CN
        - ☑ Add Intermediate Aquifer
        - ☑ Reevaluate ET

VI. Next steps for drafting the sub-group REPORT

Wendy Graham reviewed the schedule for completing the Groundwater Modeling Subgroup Report. The first draft will be provided to the subgroup for comments by February 15th.

VII. Meeting Closure

Dr. Graham indicated that she was appreciative of the input and had what she needed to draft the Subgroup report. She asked the group if there were any additional comments they would like to provide.

Dr. Jeff Lehnen, representing the NEFUCG, noted that that after brainstorming strengths and limitations of the model and capturing them on flipcharts, it did not surprise them that there were significantly fewer strengths identified than limitations, and that there were a long list of recommendations. The strengths, he noted were related to the 1995 model and not necessarily its predictive use. He stated that the NEFUCG feels that the model predictions are not accurate enough to proceed with planning for environmental constraints that are triggered at half-foot drawdowns. Mr Lehman stated that although the model is not fatally flawed, the NEFUCG does not believe it is not robust enough for making policy decisions. The NEFUCG's hope for this process was to ensure that the science is as good as it can be, and they do not believe that this goal has been reached through this process.

Mr. Al Canepa, SJRWMD, acknowledged the utilities concerns and indicated that the planning process is dynamic and inherently flexible and therefore declaring PWRCAs at this point would not be committing Utilities to specific

projects or financial commitments at this time. Several utility representatives offered clarification of utility concerns based on the impact that of these types of decisions, and timing of decisions, has on their utility's fiscal position. In particular, the designation of PWRCA and specific Alternative Water Supply projects was identified as a critical factor of major concern. These issues are beyond the scope of the Groundwater Modeling subgroup and should be addressed through the continuing water planning process.

Public input, questions and comments were addressed throughout the meeting. No additional comments or written questions were submitted.

The list of upcoming meetings was shared (*NEF-WSP groundwater_modeling slide 20).* Subgroup meeting #8 is scheduled for March 25, 2010. Dr. Graham noted that there may not be need for the final meeting, and will let people know in good time if it is cancelled.

Meeting was adjourned at 4:15 PM.

Appendix H. Results of On-Line Survey

SJRWMD/SRWMD Northeast Florida Water Supply Planning Area Groundwater Modeling Subgroup
Results of On-Line Poll
* administered to subgroup members that participated in at least 1 of the Groundwater Modeling Subgroup meetings

Updated January 28, 2010

The on-line poll is part of the sub-group process and does not represent the sub-group conclusions
USE FOR DISCUSSION ONLY

1. What are the strengths of the NEF model?

Role	Expertise	Meetings	Strengths
Federal /State/County/ City Employee	Modeling NOVICE	4	I am submitting information derived from the Utility Group as follows: *(see NEFUCG Consolidated Comments)*
Independent Consultant	Experienced MODELER	6	1) A large number of water level calibration targets in the UFA. 2) Conceptualization and calibration of UFA
Independent Consultant	Experienced MODELER	5	1) Calibration to Floridan aquifer potentiometric surface for the 1995 baseline simulation 2) Reproducibility of Floridan aquifer results for the 2004 validation simulation 3) Incorporation of closed basin recharge and sinkholes 4) Use of 2004 land use for the 2004 validation simulation
NEFUCG Consolidated Comments	Model USER	6	While the District has made a number of incremental changes to the model during the Model Subgroup evaluations, overall there are still too many outstanding technical evaluations and revisions underway to conclude that the model is a reliable tool for predicting future impacts of increased groundwater withdrawals.
NEFUCG Utility Consultant	Experienced MODELER	5	The District has utilitized many of the NFUCG's comments and improved the model through many iterations, however this process is not finished.
NEFUCG Utility Consultant	Model USER	6	The NEF model and previous versions (Durden and Birdie) has been used by the District for CUP permitting for at least 10 yrs. The model seems to simulate base conditions pretty well and has reasonable calibration statistics in the UFA. Our experience with the model has, however, convinced us that when pumping conditions are changed, such was during a CUP modeling exercise, the accuracy of the model diverges rapidly as pumping is increased (or decreased). Therefore, as a permitting model it is suspect and certainly as a planning tool it is highly suspect.
NEFUCG Utility Staff	Model USER	5	Please see the NFUCG position sent separately.
NEFUCG Utility Staff	Modeling NOVICE	3	Please refer to consolidated NFUCG survey comments.
NEFUCG Utility Staff	Modeling NOVICE	6	We support and submitted the NFUCG comments.
NEFUCG Utility Staff	Modeling NOVICE	6	JEA supports the position of the NFUCG whose comments are provided below: *(see NEFUCG Consolidated Comments)*
SJRWMD/ SRWMD consultant	Experienced MODELER	5	The strengths of the NEF model are: 1) a long history of model development and improvement dating back over 10 years, 2) a comprehensive compilation and inclusion of hydrologic data from the area, 3) a calibration that matches or exceeds industry standards,

			4) demonstration that head differences between the surficial and Upper Floridan are accurately modeled, and 5) demonstration that the transmissivities used in the model are consistent with test results. The head difference comparison was presented in the peer-review and provides confidence that the model accurately represents the connection between the ultimate source of water (surficial aquifer) and the pumped aquifer (Upper Floridan).
SJRWMD/ SRWMD consultant	Experienced MODELER	5	The current version of the NEF is well calibrated. The conceptualization and development of the model followed common methodology utilized by many groundwater modelers. The model performs very well during the verification simulation (2004). Recharge is adeduately calibrated. The model uses an OBSERVED rainfall event (daily rainfall) to calibrate and OBSERVED head event (1995 average head). This is proper methodology. To do ANYTHING else (including using a long term average rainfall) would be outside the practices followed by modelers and cause the model to lose physical meaning.
SJRWMD/ SRWMD consultant	Experienced MODELER	6	I think the calibration of the model exceeds the requirments of a predictive tool necessary to evaluate 2030 impacts. The calibration is better than most I have seen for similar long term predictive tools.
SJRWMD/ SRWMD Staff	Model USER	5	It is the best tool available. It has been improved through much peer review, before the gw modeling subgroup and as a result of the gw modeling subgroup. Its statistics for the calibration and verification years are within the "good" range for a regional model covering such a wide and diverse area.
SJRWMD/ SRWMD Staff	Model USER	5	Even prior to the subgroup process, the NEF model appeared to be a well calibrated to the 1995 hydrologic condition. The modifications during the subgroup process appear to have strengthened the models predictive capabilities.
SJRWMD/ SRWMD Staff	Model USER	6	The fact that after this open process - even with the changes suggested by the utility group, the results STILL show unacceptable impacts in 1995 and unacceptable changes in 2030.
SJRWMD/ SRWMD Staff	Model USER	6	Good calibration, reasonable parameter values, built on multiple generations of models in NE Florida. All the modeling performed within the accepted industry standard. For a regional model covering varying conditions, the model performs extremely well. The model is a good respresentation of hydrologic process and the inter-relationships of the water budget, in terms of inflows and outflows as produced by the models mass balance. Model was well calibrated to the upper Floridan and given limited data for the surfical and lower Floridan the model produces reasonable matches. Although recharge was a calibration parameter, those resulting values are of good comparison with recharge/runoff calculations done separate from the modeling work. These calculations demonstrate the resonableness of the recharge calibration. The changes in the model resulting from the gw modeling subgroup were a positive addition to the orginal version 2 model. Predictive simulations results are good comparison to similar MEGA model predictive simulations. Therfore, the model is a good predictor of change. That being said, the model by design and application is to evaluate the changes to hydrologic system as a result of a change in pumping. While 2004 simulations were hampered by the calculation method for recharge, generally statistically the model performs well. Statistics for the 2004 model when pumping alone was simulating in the model was better than when pumping and recharge were combined. An excellent demonstration of the predictive capabilities was illustrated in the difference between 1995 and 2004. While the sum of the water use was not significantly different, the demonstration of the model to simulate the recovery in the potentiometric surface of the upper Floridan aquifer at the locations of the two paper mills which dramatically reduced pumping is very convincing. This tends to support the reasonableness of the parameter distributions within the model. This demonstration of recovery in water levels out weighs the models in ability to match water levels in other areas as well. This other aspect of the 2004 model is more likely a result of the 2004 recharge methodology.
SJRWMD/ SRWMD Staff	Model USER	6	The NEF model is very good at predicting heads in the Upper Floridian Aquifer based on varying pumping stresses. The model is the best available tool for determining impacts to the Upper Floridian aquifer from increased pumping of this aquifer.
SJRWMD/ SRWMD Staff	Modeling NOVICE	1	Good base year (1995) selected / seems to be well calibrated / used good data
Soil & Water Conservation	Modeling NOVICE	6	My focus is the Upper Santa Fe Basin. The model appears to be adequate to indicate that ground water withdraws at the projected levels will impact surface ecosystems and that

District	actions are needed to address these impacts. The fact that real river gauge data supports the recharge values in the model supports this conclusion. It is also clear from the NEF model that the groundwater impacts seen and predicted for the Upper Santa Fe Basin are due to ground water withdrawals outside the basin. This fact is also supported by other regional models

2. What are the limitations of the NEF model?

Role	Expertise	Meetings	Limitations
Federal /State/County/ City Employee	Modeling NOVICE	4	*(see NEFUCG Consolidated Comments)*
Independent Consultant	Experienced MODELER	6	1. The prediction of drawdown in the SAS is very sensitive to the ET extinction depth. This parameter seems to be overlooked in the model development. 2. The model estimated water levels in the SAS do not seem to match the observed water levels as good as desired. 3. The accuracy of representations for wetlands and surface water bodies (lakes, rivers, and springs) has not been demonstrated sufficiently that they will provide confidence in model predictions. 4. A multitude of flooded cells in 2030 predictive simulations and sensitivity analyses indicated that the model does not seem to handle additional recharge to the SAS very well. This is likely due to the fact that the recharge was uniquely calibrated for 1995 condition and the lakes and rivers in the model were represented by constant heads. 5. It is very difficult to simulate the SAS with a regional model having a grid size of 2500 feet by 2500 feet, especially in the areas where significant changes in topographic elevations over short distances and significant interaction between the surface water features and the SAS exist (e.g., sandhill lakes region). In addition, SAS responses, which are dependent on an accurate representation of surface water-groundwater interaction, are difficult to simulate in even a local-scale model but is overstretching in a regional model in which all of the surface water features were modeled as constant heads. Thus, I do not have much confidence in the NEF model's ability to predict the SAS responses. 6.The NEF model does not have the ability to simulate the stresses in the intermediate aquifer system.
Independent Consultant	Experienced MODELER	5	1) No river or drain nodes limit performance in the surficial aquifer 2) Western boundary is too far east to avoid interference effects from being observed 3) Use of FPGWM for simulation of western boundary condition 4) Use of current land use in 2030 predictive simulation
NEFUCG Consolidated comments	Model USER	6	a. Calibration targets have been revised throughout the review process and are still being evaluated along the western side of the model. It is unknown at this time how these further revisions will affect the performance of the model. b. Sensitivity analysis demonstrated that the model is sensitive to GHB elevations on the western boundary. We are concerned that using the Mega model to establish 2030 GHB heads makes the accuracy of the Mega model as important as the NEF model yet there has been limited opportunity to evaluate the precision of the Mega model. c. Simulations of predevelopment conditions demonstrated that the model under-predicts UFA water level elevations in critical areas and does not correctly simulate flow directions in large areas of the model. This calls into question the conceptualization of the model. d. The 1995 NEXRAD rainfall data is highly questionable both for the variable distribution and extreme range of quantities but also for its poor comparison to long term rain gauge data compiled by the NFUCG consultants and the District's staff. The rainfall data are unreliable and a different rainfall approach should be incorporated before the model can be applied. e. The SCS runoff calculations do not take into account antecedent moisture conditions. This results in more runoff during wet conditions and less runoff during dry conditions. This approach may significantly changes the net recharge values, especially in critical recharge areas, although the resulting effect is not quantified at this time. f. Drainage assumptions do not recognize closed basins or sinkhole features. Some of the closed basins and sinkholes have been preliminarily addressed in Alachua County however this analysis was not completed for the entire model domain. This significantly underestimates recharge to both the surficial and Floridan aquifers. g. Extensive evaluations have demonstrated that the model does not accept differing, realistic recharge amounts without flooded and dry cells, both indicators of poor surface water and wetland representations and inflexible model calibration. District's suggested fix (river cells) is not expected until May 2010 or later. This combined with suspect NEXRAD data makes the

			entire recharge package unreliable. h. Model calibration statistics demonstrate a gradual loss of precision in latest 1995 model revisions, 2004 simulations, and 2030 predictions. This indicates that changes made to the boundary heads, recharge, limited re-calibration in Alachua County, and differing pumping conditions have not been adequately addressed. Until all of the ongoing revisions are completed and the model recalibrated, we question the reliability of the model to simulate future conditions. i. The model does not include an intermediate aquifer. In areas where the intermediate aquifer is present, the predicted drawdowns in the surficial aquifer and in springs (connected to the intermediate aquifer) are overstated. j. Predictive sensitivity analysis has demonstrated a probable range of uncertainty in the model predicted drawdowns, with a range of accuracy of +/- 1 to 2 ft. Attempting to use the model in its current state to evaluate drawdown in the 0.1 to 0.5 ft range without taking into account the inherent imprecision of the model is unrealistic over an 8,000 square mile area. Field studies should be initiated to evaluate areas of concern to determine the relevant importance of local conditions such as wetland and lake hydrology, land use, site specific hydrogeologic conditions, and local pumping stresses compared to regional impacts before making policy decisions. k. The Utilities have not had an opportunity to review the latest population projections and water use categories to determine if those projections agree with their information and to confirm that the model wellfiles have been updated accordingly. This step is critical to making future predictions.
NEFUCG Utility Consultant	Experienced MODELER	5	The NFUCG has compiled and will submit a detailed document addressing these limitations.
NEFUCG Utility Consultant	Model USER	6	The model seems to have too many "legacy" issues to make it a reliable tool. The original model covered a smaller domain and had an inactive Layer 1. The model was expanded by Dr. Birdie to it's present domain using the Mega model parameters and layer 1 activated. There were so many calibration issues that a "phantom" layer was added above layer 1 (layer 0.1) to feed water into the model as well as numerous phantom injection wells to do the same. This was a very odd feature that leads us to believe there are many other adjustments in the aquifer parameters to try to compensate for this lack of water. These features made the model nearly unusable. The latest revisions scrapped the phantom layer, added NEXRAD rainfall, developed the SCS runoff methodology, and recalibrated the model. While the approach is more defensible, we still question the integrity of the NEXRAD data, the SCS runoff methodology, basin characterization, etc. since we have demonstrated that there are questionable assumptions and data in each of these steps. And finally, we believe it is a misapplication of the tool to rely on the model to simulate the surficial aquifer over such a large area. With all of the local factors that influence the behavior of the surficial aquifer, how can we have any confidence in the model to simulate a layer that is driven by rainfall and local drainage features the regional model can never hope to reasonably simulate. In every case I am familiar with, when local geology, local topography, local pumping, and local drainage are used to develop a local scale model, the results are dramatically different than those predicted by the regional model.
NEFUCG Utility Staff	Model USER	5	Please see the NFUCG position sent separately.
NEFUCG Utility Staff	Modeling NOVICE	3	Please refer to consolidated NFUCG survey comments.
NEFUCG Utility Staff	Modeling NOVICE	6	*(Referenced NFUCG consolidated response in previous question)*
NEFUCG Utility Staff	Modeling NOVICE	6	JEA supports the position of the NFUCG whose comments are provided below: *(see NEFUCG Consolidated Comments)*
SJRWMD/ SRWMD consultant	Experienced MODELER	5	The limitations of the NEF model are: 1) the need to include a calibration step with the recharge calculation, 2) the need to adjust the western boundary to account for pumping changes, 3) the limited number of Lower Floridan calibration targets, and 4) the challenges with verifying the model's predictive capability.

SJRWMD/ SRWMD consultant	Experienced MODELER	5	At this point (without a river package), the model can not be utilized to predict impacts to surface water features. The river package will enable the model to predict surface water impacts.
SJRWMD/ SRWMD consultant	Experienced MODELER	6	I think the lack of river cells and the use of constant head cells is the largest limitation. The constant head fluxes should also be evaluated. Right not there is a net flux into the model. The main trunk of the St John (which is all that is simulated at this time) is in the literature, a regional GW discharge zone.
SJRWMD/ SRWMD Staff	Model USER	5	Without a river package to provide surface drainage for runoff events, runoff was accounted for by calibrating the recharge input to the model. This is a valid approach, and it is doubtful that having a river package to provide runoff within the model will produce substantially different results. However, this approach provides those who are unhappy with the modeling results a point of argument. Also, not having a river package makes it difficult to assess the impacts of pumping on the stream-based water resource values being protected by the SRWMD Upper Santa Fe River Minimum Flows and Levels, and on the water resource values of the upper Suwannee River.
SJRWMD/ SRWMD Staff	Model USER	5	The major limitation is the inability to measure fluxes in rivers and streams within the model domain.
SJRWMD/ SRWMD Staff	Model USER	6	The fact that the well stresses reach the boundary. However, for this planning exercise this is adequately compensated for by use of the "Mega" model for boundary adjustment.
SJRWMD/ SRWMD Staff	Model USER	6	Lateral boundary conditions are a limitation when performing predictive simulations. Without inclusion of the Intera Mega Model boundary drawdowns, drawdowns near the boundary would limited. Model is limited in the calibration and validation simulations by not incorporating enough surface water features to account for the rainfall/runoff process. Model is limited in the sense of site specific evaluations do to model grid size. Large changes in water levels and topography over single grid cells is a recognized limit in regional gw modeling, this is an issue for calibration as well as in prediction. This limitation is more apparent in simulating the surficial aquifer and therefore some level of uncertainty needs to be investigated.
SJRWMD/ SRWMD Staff	Model USER	6	The NEF model's predictive capabilities in the surficial aquifer are not as good as they should be with the available packages currently available in Modflow. All of the constant head cells in the model may result in predicting less drawdown than is actually occurring since these cells supply an infinite amount of water.
SJRWMD/ SRWMD Staff	Modeling NOVICE	1	no river package
Soil &Water Conservation District	Modeling NOVICE	6	For the Upper Santa Fe Basin combining the surficial aquifer and the intermediate aquifer into layer 1 of the model is a concern. The surficial and intermediate aquifers may be important to basin springs, lakes, private wells, and rivers in the basin but the aquifer systems may not respond the same to recharge events. The imtermediate aquifer may also impact the rate of recharge into the Upper Floridan. The relations ships between surfical and intermediate aquifers may be responsible for the 2 well data points in Layer 1 that the model is having problems matching. A clearer understanding of the surficial and intermediate aquifers in the Upper Santa Fe Basin is needed but that may be better addressed using other modeling approaches. Better data may be needed for Agricultural water use in the Upper Santa Fe Basin. If as I expect less water is actually being withdrawn for Agricultural use than was used in the model and if in the future Agricultural use was increased to the levels used in the model there may be added impacts on ground water levels. For future planning it may be important to determine if agricultural use will have any significant impact on predicted ground water levels and if it does refine the way agricultural use is modeled. For example water used for frost or freeze protection may have a lower percentage of the withdrawn water recharging the groundwater due to increased runoff. However, water used for frost and freeze protection would also have a much lower ET which may balance out the increased runoff. Getting good data on actual agricultural water use is also important.

3. What specific recommendations would you make for addressing the limitations you have identified?

Role	Expertise	Meetings	Recommendations
Federal /State/County/ City Employee	Modeling NOVICE	4	*(see NEFUCG Consolidated Comments)*
Independent Consultant	Experienced MODELER	6	1. The river package for rivers and Lake Package for lakes especially in sand hill lake region are recommended to be used. 2. A finer grid should be used in model development if a regional model is intended to be used to evaluate the SAS responses especially in the areas where significant changes in topographic elevations over short distances and significant interaction between the surface water features and the SAS exist (e.g., sandhill lakes region). 3. ET extinction depth could be calculated for each model cell using vegetation type (landuse coverage) and root-depth studies. 4. Recharge should be estimated so that only minor calibration would be needed. Reliability of Nexrad rainfall data should be verified. SCS method may not be appropriate for a cell-by-cell runoff calculation. Other methodologies should be investigated or SCS methodology could be applied to basins rather than each cell or revised. 5. Using the reliable APT data to constrain the model parameters such as transmissivity during calibration would increase the confidence on model calibration.
Independent Consultant	Experienced MODELER	5	Finalize and fully document the current model including all recent changes. With documentation completed, this model version is an adequate tool for evaluating potential future resource impacts in the Floridan aquifer away from the western model boundary. Use of the model to evaluate the surficial aquifer and/or near the western boundary would tend to produce results that are more suspect. The recommendations proposed for improvement below are intended to be completed as part of a future model revision. 1) Include river and drain nodes to better simulate surface water features and eliminate the need for manual calibration of recharge. Recalibrate the model. 2) Expand the NEF model boundary significantly westward to eliminate the need for the PFGWM. The PFGWM utilizes a variety of assumptions and a conceptualization that does not match the NEF model. 3) Use future land use data for 2030 simulations
NEFUCG Consolidated comments	Model USER	6	a. Allow time for a detailed review of the Mega model to provide confidence that it predicts calibration targets and drawdowns within the NEF domain in a reasonably similar way as the NEF model under identical pumping conditions. This should improve confidence in using the Mega model to set NEF boundary heads for future simulations. If the Mega model cannot replicate NEF calibration target and drawdowns, further evaluations of one or both models would be in order. b. Investigate why the NEF model incorrectly simulates Floridan aquifer water levels and direction of flow when all pumping is turned off (predevelopment). This could be a symptom of incorrect aquifer parameters or boundary head elevations. c. Evaluate the impact of increased water use outside of the model domain (Georgia, Suwannee District, Volusia County) and determine their unique impact on constraints. Since those impacts are lowering NEF boundary heads in 2030, do not disregard these impacts when allocating contributory impacts to public utilities within the model boundary. For example, if aquifer stresses in the Suwannee District represented by lower GHB heads contribute to 0.81 ft of drawdown in the Lake region, that amount should not be attributed to NEF utilities. d. Replace the 1995 NEXRAD rainfall data with 1995 or long term rain gauge data. Recalculate all of the recharge values and modify the model as necessary to accept the revised recharge amounts without utilizing a manual recharge calibration step. This approach would provide a more reliable precipitation approach and could have a significant impact on the distribution and amounts of net recharge. e. Re-conceptualize the runoff methodology to address antecedent moisture conditions and reconcile the fact that the SCS method is an unrealistically conservative estimate intended to ensure oversizing in the design of small scale retention basins, not for regional water supply

			planning. f. Evaluate major drainage basins in the model domain and compare to surface runoff hydrograph data if available. Use the same ET as in the model when calculating runoff or run the model with a range of ET values to compare to basin runoff data. Modify the conceptualization of the model to incorporate closed basins and sinkholes wherever they occur, not just in Alachua County. g. Incorporate river cells, constant head cells, and drain cells as justified to better represent the surface features in the model such as rivers, streams, lakes and wetlands. Ensure that these features actually exist before proceeding. This work should be completed and the model recalibrated before making 2030 projections since they are highly likely to change the amount of recharge reaching the surficial aquifer and will impact the Floridan aquifer. h. The model should be recalibrated, in collaboration with NFUCG, to address all of the changes made to date, the ongoing evaluations by the District, and the issues we believe contribute to the limitations of the model. i. The Utilities should be given time to review the latest population projections to determine if those projections agree with their information and allow time for interaction with the District to develop confidence in the projected withdrawals given the prevailing economic conditions before making policy decisions. j. The recommendations provided above can be done in a reasonable time frame to render the existing steady state model significantly better for making decisions in the current water supply planning cycle. In the longer term, and separate from this effort, a transient model should be developed to support planning and permitting needs of the District and its constituents.
NEFUCG Utility Consultant	Experienced MODELER	5	The NFUCG has compiled and will submit a detailed document with specific recommendations.
NEFUCG Utility Consultant	Model USER	6	I really do believe recommendations being made by the NEFUCG should be given serious consideration. There are a number of changes in the works that could have a significant impact on the model function. District staff seemed to undermine confidence in the NEXRAD data in our last meeting and Dr. Brown came to similar conclusions. Incorporating river cells in such a broad distribution (as shown in Patrick Tara's 1/15 e-mail to Doug Munch) really calls into question the entire recharge package. The District's conflicting statements regarding the issue of changes made to the 2004 simulation. On one hand they modified recharge to a new NEXRAD file, changed land use, changed pumping, and revised the calibration targets; yet on the other hand Doug Munch states in the response to Rick Hutton's letter that "...the model's purpose is to approximate changes in water level due to changes in pumping....and is not intended to simulate water level changes due to different climatic events." The District doesn't expect to have the revise river package calibrated until late May and they don't yet offer a solution to the NEXRAD data quality issue, the integrity of the Mega model to establish GHB heads in the NEF, or the basin evaluation and how that work will be incorporated (especially in light of the addition of the river package). These are all significant changes to the model and I believe the District should wait the necessary 6+ months to see the results before policy decisions are made. And finally, since my team has worked very hard to present pertinent evaluations in a spirit of cooperation, as scientists we will be very disappointed if politics over-run the science. Let's face it, the sense of urgency the District may have felt a year or two ago has diminished with most utilities experiencing 15 to 20% lower demands and zero to negative growth. I think we have time to get the science right before making sweeping policy decisions. Thanks to you and your team for leading these meetings and keeping us organized, on schedule, and focused on the truly important issues.
NEFUCG Utility Staff	Model USER	5	Please see the NFUCG position sent separately.
NEFUCG Utility Staff	Modeling NOVICE	3	Please refer to consolidated NFUCG survey comments.
NEFUCG Utility Staff	Modeling NOVICE	6	*(Referenced NFUCG consolidated response in previous question)*
NEFUCG Utility Staff	Modeling NOVICE	6	JEA supports the position of the NFUCG whose comments are provided below: *(see NEFUCG Consolidated Comments)*
SJRWMD/ SRWMD	Experienced MODELER	5	1. Calibration of recharge. Several suggestions have been made to eliminate the calibration step from the recharge

consultant			calculation. It should be recognized that this need only arises when a second calibration period or "verification" period such as the 2004 simulation, is desired. The District has stated that they will use the 1995 calibrated recharge in their 2030 predictive simulation and therefore the methods that went into deriving this recharge are somewhat secondary. Estimating recharge and then fine tuning it by calibration, as was done here, is a commonly used and accepted practice in groundwater modeling. The 2004 derived recharge is only used for the verification, not the prediction. Several suggestions for deriving a recharge that a) would not require further adjustment and b) would be more representative of an average were suggested. I would offer another suggestion of calibrating to data (pumping, recharge, and head targets) from a multi-year period, such as a 3-5 yr average. This method would likely address (b) directly and has some promise of addressing (b). 2. Western Boundary. It was suggested that the Mega-Model should be used to compute a head change from 1995 to 2030 and superimpose this on the NEF model to account for the head change resulting from the cone of depression extending beyond NEF model boundaries. I believe this is a reasonable approach whose implications can easily be tested in a sensitivity analysis. The trend analysis performed by Intera is consistent with the model results. 3. Lower Floridan calibration targets. Predictive sensitivity analysis may be an appropriate way of addressing this limitation. This would entail determining the range in probable impacts for a reasonable change in Lower Floridan parameters. Note that any change to the Lower Floridan would need to result in a calibrated model. 4. Model verification. A large part of the meeting discussion focused on the 2004 verification. Although I agree that it would be desirable to demonstrate that the model can reproduce a cause and effect relationship between pumping and drawdown, I do not believe that the current method is a fair test. Since the predictive 2030 model is intended to show the effect of pumping (not recharge) and the 1995-2004 verification necessarily shows the effect of pumping AND recharge; the "verification" is arguably a more difficult test of the model. I believe that the model may actually predict water level change due to pumping fairly well, as evidenced by the good match in the wells in the Fernandina Beach area where the paper mills were shut down. A better method of performing the verification could be derived. I have two suggestions that have some promise. One would be to use a longer time period for calibration and verification data sets. If climate were averaged over a 3 to 5 year period, it is more likely a more typical recharge could be obtained for calibration; it is also likely that a second 3-5 year time period could be identified for verification that would have a recharge rate similar to the calibration. This averaging has the desirable effect of removing anomalies that are specific to a given year. Simply stated, recharge will approach some average as more years are used in the computation; this 3-5 year average should be closer to the average of another 3-5 year period than rate at 2 individual (1995 and 2004) years. Since 3-5 year average head targets and pumping would also be required in this method, anomalies in pumping and head target would also be averaged out. Similar 3-5 year time frames could be identified using the data and methods presented by Doug Durden and Chris Brown at the last meeting. The second suggestion would be to identify a small subset of observation wells whose water levels in 2004 or some other time period are dominated by pumping (as opposed to recharge) and use these for verification that the model responds accurately to changes in pumping. The current 2004 verification uses all the calibration target wells and therefore shows how well the model responds to changes in pumping AND recharge. The ideas and methodology for this discussion are discussed in "Making Calibration Targets Consistent With Expectations for Predictions" by Andersen and Council (2008).
SJRWMD/ SRWMD consultant	Experienced MODELER	5	Addition of the river package will help the model address surface water impacts. Adding the river package will also allow for the removal of constant head BCs which currently represent the lower St. Johns River.
SJRWMD/ SRWMD consultant	Experienced MODELER	6	Exactly what is being done, inclusion of the river cells and contraint of the river cell fluxes to estimated baseflow fluxes. If necessary the District may want to explore transient modeling as well as integrated hydrologic modeling. The IHM developed by SWFWMD and TBW uses HSPF (currently the engineering dept is calibrating an HSPF model of the ST Johns). The integrated model would constrain the calibration further. Recharge would not be a calibration knob but would be defined by the surface water component (in this case HSPF). HSPF is also much more advanced in comparison to the SCS method currently used in the NEF development.
SJRWMD/ SRWMD Staff	Model USER	5	These limitations are not critical or even necessary for the designation of Priority Water Resource Caution Areas, so no immediate action is needed to proceed with the planning process. In the long run (next several months), adding a river package seems necessary to defuse the calibrated recharge argument and to provide a tool for assessing impacts on river water resource values in the Suwannee River Water Management District. SJRWMD intends to add a river package to the model by the end of May, 2010.

SJRWMD/ SRWMD Staff	Model USER	5	Addition of the river package to the NEF to give the model the ability to evaluate flux in rivers and streams.
SJRWMD/ SRWMD Staff	Model USER	6	Add River Package.
SJRWMD/ SRWMD Staff	Model USER	6	Revision of the model with application of the river cells consistent with the NHD layer..which also was used in the Intera version of the Mega Model. Once the 1995 is calibrated, utilize parameter estimation techniques to improve rough calibration and investigate and document uncertainty aspects of the model. While much effort has been spent on 2004, it maybe appropriate to consider an alternative year for validation. If another validation year is selected or 2004 is continued, iterate between the two years as a method of recalibrating the 1995 model.
SJRWMD/ SRWMD Staff	Model USER	6	The river should be represented using the river package. There should have been more discussion on how the lakes are represented. Using the constant head does not seem appropriate when there are GHB and lake packages available. It seems like we spent 6 meetings discussing recharge. Recharge could be improved but is not a fatal flaw in the models predictive capability in the Upper Floridian Aquifer. All of the constant head cells in the model may result in predicting less drawdown than is actually occurring since these cells supply an infinite amount of water. Groundwater pumping in the SJRWMD and SRWMD have had significant impact to declining levels in the Upper Floridian Aquifer. The utilities and the districts will be spending a lot of money for alternative water supplies. What is the harm in delaying the process another 6 months to get a tool that will be better suited to address propotionality of impacts?
SJRWMD/ SRWMD Staff	Modeling NOVICE	1	insert river package
Soil &Water Conservation	Modeling NOVICE	6	Included in item 2 comments.