

Appendix G

Review Comments & Responses

- Response Matrix
- May 14, 2009 (Memorandum)

Response Matrix

CH2MHILL Water Business Group Quality Review Form

Client/Project: Cary Water Distribution System Master Plan and Model

Project No.: 371661

Phase: Comments on Draft Master Plan dated 4/3/09

Work Product: Response to Comments on Draft Master Plan

Date: June 1, 2009



Comment Number	Reference	Comment From:	Review Comment	Response	Primary Person Responsible
1	Section 2	Glen Harrell	I believe these sections should be re-ordered and re-numbered. The GENERAL categories are "Existing", "Developing Permitted", "Developing Unpermitted", and "Vacant". Subcategories of "existing" include "Existing Unoccupied", "BWOS", and "Redeveloping". Subcategories of "Vacant" include "Vacant Cary" and "Vacant Morrisville"	Section 2 has been reorganized.	CH2M HILL
2	2.3.1	Glen Harrell	Developing Permitted is based on approved site plans for which sewer permits have been issued.	Revised to read: Developing Permitted parcels are those 2008 Wake County parcels that were identified to be within the Town-provided permitted development data layer without a water meter present in 2007. The Town provided a permitted development data layer, which was based on approved site plans with sewer permits that have been issued.	CH2M HILL
3	2.3.1	Glen Harrell	Developing Unpermitted is based on submitted site plans (may or may not have been approved).	Revised to read: Developing Unpermitted parcels are those parcels that were identified to be within the Town-provided planned development data layer without a water meter present in 2007. The planned development data layer represents developments with a submitted site plan that may or may not have been approved by the Town.	CH2M HILL
4	3.6	Glen Harrell	Any recommendations on whether KFR & CPKWY "OCVs" should remain or be modified to some other control valve type?	Because an OCV is a fully open and fully closed valve operation, pressures can be substantially different from the open position to the closed position. We checked the upstream and downstream pressures in the model and both the Kildaire and Cary Parkway valves can remain OCVs. If the valves were changed to any control strategy other than OCV, supply to the SPZ would be compromised during peak summer demand (could not deliver enough flow). However, the proposed Hwy 1 control valve does not need to be an OCV because it is the strongest of the three supply points. For this reason, the preliminary recommendation is that the Hwy 1 control valve be "flow controlled" and the existing Kildaire and Cary OCVs be used to maintain desired levels in the Plumtree tank. However, we first recommend that the Town conduct additional modeling analysis of the Kildaire, Cary Parkway, and proposed Hwy 1 control valves under various operational conditions during detailed design of the proposed Hwy 1 control valve. The modeling analysis should evaluate how to operate the control valves when the Plumtree tank is taken out of service for maintenance (no active tanks in the SPZ) and also when a primary supply main to the SPZ is broken or taken out of service. Potentially, this study may determine that the Kildaire and Cary Parkway OCVs can be converted to a different operating strategy after the Hwy 1 control valve is brought in service in 2010. Recommendation added to Section 7.7.	CH2M HILL
5	5.1.2	Glen Harrell	Flow projections were provided for Apex. Also, I understand that CH2M Hill recently completed a study of the Apex water distribution system. Was any of this information used?	In mid-2008, CH2M HILL developed water demand projections for the Town of Apex for its 2007 Local Water Supply Plan. Those projected demands for Apex were used in this Master Plan. Added as footnote to Table 5-3.	CH2M HILL
6	5.2.1	Glen Harrell	Modify discussion of 1" service connection to exclude implying 1" meter is called for. The detail shows an adaptor coupling to connect the ¾ x 5/8in meters. Only the service lines are required to be 1".	Revised to read: However, the Town of Cary requires 1-inch services lines for new residential service connections.	CH2M HILL
7	5.2.1.4	Glen Harrell	If updated flow estimates were available would the service line sizing METHOD described in M22 be recommended?	We cannot speculate on what the recommendation might be. However, with actual field-measured flow data from multiple residences the M22 calculations could be performed and the results analyzed.	No Action
8	5.2.2	Glen Harrell	Where is the discussion of what "marginal pressures" "should be"? What are other utilities' operating ranges? Note similar comment in 6.2.4 regarding "adequate service". These are "fluffy" terms that need to be better defined. What residual pressure "should" an "average household" have at the base of their plumbing system? What residual pressure can a "typical household" expect	Some language modified. As stated in Section 5.2.1.7, field-measured indoor water consumption data and service line length information is needed to answer these questions. We feel that attempting to make recommendations based on assumed water consumption values is not in the best interest of the Town because it will not provide an answer specifically tailored to the Town's needs. In the May 14, 2009 memorandum from CH2M HILL to the Town, we addressed these questions to the extent possible under the current scope of work. As mentioned in the memorandum, CH2M HILL can provide services to calculate residential service connections from the curb to meter to the residence and evaluate a number of alternatives based on different fixtures in the residence being operated, and using the field-measured water consumption data	No Action

Comment Number	Reference	Comment From:	Review Comment	Response	Primary Person Responsible
			with a "static pressure" of 40 psi at the water main? (include pressure losses in the TOC maintained service line).	We will include the May 14 memorandum as Appendix G of the Master Plan.	
9	5.2.2	Glen Harrell	Are you saying that 40-50psi system pressure is OK as long as peak demand fluctuations do not drop system pressure below X? If so, what is X? Also, what is the expected local demand from irrigation and plumbing systems during these peak periods? Do these peak flows impact "local distribution system" as much as more "regional" portions of the system?	With the current information available from the Town, the current AWWA recommendation of 40 psi minimum during max day demand and 30 psi minimum during peak hour demand is appropriate. An evaluation of new, large-scale residential service lines using field-measured consumption data might show that significant pressure loss is occurring in a 1-inch service line. CH2M HILL would be able to use such information to determine whether or not to recommend creating a few small high elevation districts which would require larger service lines. More details are presented in the May 14, 2009 memorandum from CH2M HILL to the Town. We will include the May 14 memorandum as Appendix G of the Master Plan.	No Action
10	5.2.2.4	Glen Harrell	Re-evaluate for what?	See response to Comment No. 8.	CH2M HILL
11	5.3	Glen Harrell	What about Non-res FFs?	Non-residential fire flows are listed in Table 5-1 and stated in Section 5.3.	No Action
12	5.4.1	Glen Harrell	(last sentence) – do we meet NCDENR requirements?	Yes. Section 5.4.1 states the criteria. Section 5.4.2.1.1 demonstrates that the Town's system meets the criteria.	No Action
13	5.5	Glen Harrell	define "necessary improvements" – Do you mean "planned improvements"?	Revised to read: planned improvements.	CH2M HILL
14	6.1.2	Glen Harrell	How does Apex diurnal assumption impact recommendations? See 5.1.2 above.	In the May 14, 2009 memorandum from CH2M HILL to the Town, we addressed this question to the extent possible under the current scope of work. We will include the May 14 memorandum as Appendix G of the Master Plan.	CH2M HILL
15	6.1.2.2	Glen Harrell	3rd paragraph – is this "marginal FF" a problem that needs to be addressed?	The areas mentioned were small and mostly built-out such that we could not justify making capital recommendations to improve fire flow. To examine in more detail, the Town could determine the ISO required fire flow for each building in these areas and then evaluate each facility under the ISO fire flow requirement using the hydraulic model.	No Action
16	6.2	Glen Harrell	There is only 1 prv on "Morrisville Old Town low pressure zone". Low pressure zone being eliminated by project currently under design.	We can modify if the Town provides the exact location of this PRV and where any closed valves are located.	Town of Cary or No Action
17	6.2.4	Glen Harrell	What is your definition of "adequate service"?	Clarified in this Section. "Adequate service" means that we assume that the existing operating hydraulic grade-line of 605-ft measured near the RDU Airport area is currently adequate for this customer and that if the Town lowered this area to the 540-ft zone, it would likely compromise existing sprinkler systems for the RDU Airport and those high elevation customers along Pleasant Grove Church Road. This is why we made a recommendation under Alternative 3 to construct a 540-to-605 booster pumping station which would essentially keep these high elevation areas on the existing grade-line of 605-ft if Alternative 3 were implemented.	CH2M HILL
18	Table 4-2	Ken Schuster	States that the pressure zone boundary layer cannot accurately differentiate between the WPZ and the CPZ in the Morrisville area. This was done using InfoWorks tracing function. Would it be of benefit to include a Figure that shows these traced locations?	This table indicates that the boundaries provided by the Town were not adequate to differentiate between WPZ and CPZ. CH2M HILL created new GIS boundary layers and used them in all of our figures. There are still some parallel pipes along Davis Drive that are on separate boundaries. Whether you use the InfoWorks tracing function or look at CH2M HILL's new boundaries, you have to be at the correct scale to see the difference. For this reason, we don't think a new figure is needed.	No Action
19	p. 4-16	Ken Schuster	3rd bullet; clarify the meaning of "developer proposed piping".	Revised to read: developer undesignated.	CH2M HILL
20	4.3.4	Ken Schuster	Have any of the suggested reasons for calibration discrepancies been investigated and resolved by PWUT? If so, it may be beneficial to include those updates in this section.	At the April 16, 2009 meeting, the Town responded that these have not been investigated.	No Action
21	5.4.2	Ken Schuster	States that the assumption is made that the Town of Apex has adequate storage and does not require additional storage from the Cary/Apex WTP clearwell. Does this assumption need to be verified?	See response to Comment No. 14.	CH2M HILL

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22	5.6	Ken Schuster	5th paragraph, last sentence; it references MDD condition for the Raleigh (Trinity Road) connection specifically that it is range through year 2015. The sentence is not clear what happens after 2015. The MDD condition statement for the Durham connection is clear.	Revised to read: As well, during MDD conditions the Raleigh connection was within the range of the pump station capacity until year 2015. However, flows increased beyond the capacity of the station after 2015 to as high as 21 MGD by build-out.	CH2M HILL
23	General	Ken Schuster	I suggest a list be made of the changes to the final document as a result of the draft review comments.	This review form documents the changes that are made. This form will be included as Appendix G of the Master Plan.	CH2M HILL
24	Table 2-2	Ken Schuster	Is this based on having a water/sewer permit, water meter permit, or plan approval?	See response to Comments No. 2 and 3.	No Action
25	2.1.4.2	Ken Schuster	Include: "was permitted for water meter"?	Modified during the Section 2 reorganization (see response to Comment No. 1).	CH2M HILL
26	2.1.4.2	Ken Schuster	Did it not also include the volume of permitted flow under the sewer extension permit? Wasn't this the base flow value?	We did not need this for the water demands so did not include it.	No Action
27	2.1.4.2	Ken Schuster	On the other hand are the "developing permitted" those parcels with a water meter?	See response to Comment No. 2.	CH2M HILL
28	2.1.4.2	Ken Schuster	Unpermitted?	This is correct as written because it was under the subheading of "unpermitted" but has been modified during the Section 2 reorganization (see response to Comment No. 1).	No Action
29	2.1.4.2	Ken Schuster	What is ICI?	Defined in Table 2-4.	No Action
30	p. 3-3; 3.2	Kelvin Creech	Stated firm capacity of the CAWTF high service pump station is not consistent with the HDR technical memo. HDR reported 32.6 firm and 43.9 total; WSMP reports 28 firm and 37 total.	Reorganized Sections 3.2 and 3.5 to clarify and more detail provided on HSPS capacity calculations. Part of Section 3.5 revised to read: "For this analysis, the capacity of the HSPS was based on the intersection of the system curve in the model with the pump curves provided by the Town. This resulted in a total capacity of approximately 41 mgd and a firm capacity of approximately 37 mgd. Since the CPZ pumps can supply the WPZ, the firm capacity of the HSPS was determined with one of the large CPZ pumps out of service." It is recognized that these values may not be exact but are appropriate to use for this master planning level study. These values may not match previously reported capacities which may have been based on previous models or a different definition of firm capacity. The Town should refer to Figure 6-5 when evaluating the HSPS capacity because the system curve will dramatically change after transmission main CIP projects are completed in 2010. Section 6.4 has been revised to include additional information on the firm and total capacity of the CPZ and WPZ pumps.	CH2M HILL
31	Table 3-2	Kelvin Creech	Table 3-2 – confirm all pumping capacities – stated capacities may be greater than actual performance in the field	The project scope of work did not include conducting field pump tests. Revised to add footnote to indicate that firm capacities are based on design points and not field derived pump tests since this was not in our scope of work. We were instructed not to model Davis Drive BPS, Penny Road BPS, and Trinity Road BPS during this project.	CH2M HILL
32	Table 3-2	Kelvin Creech	Table 3-2 – there is an interconnection with the Town of Apex at Lake Pine Dr. but not sure of the condition of this site – if it may have some value we need to provide discussion about it	Instructed not to consider Lake Pine during this master plan study and we did not include it in site visits. Revised Section 3.3 to state that a Lake Pine interconnection with Apex exists and is an emergency connection only.	CH2M HILL
33	p. 3-4; 3.4	Kelvin Creech	Discussion of storage capacity at the CAWTF only mentions the two circular 3.0 MG clearwells – there is also a 2.0 MG clearwell (CW #1) – total clearwell storage at the CAWTF is 8.0 MG – revise section and tables 3-3 & 3-4	Revised section and tables.	CH2M HILL

Comment Number	Reference	Comment From:	Review Comment	Response	Primary Person Responsible
34	Table 3-3	Kelvin Creech	Table 3-3 – usable volume for Old Apex GST needs to be adjusted to the full capacity of this tank – historically the Town has only used partial capacity of this tank and SCADA is configured to only allow 2/3 filling but the full capacity above the 5.5 ft. level is available for future use	Revised Section 3.4 to include definition of usable volume: The "usable" volume should not be misconstrued as the daily operational volume that is utilized for equalization purposes. Rather, the "usable" volume addresses equalization, fire flow, and emergency volumes and the lowest level in the tank which can provide approximately 30 psi throughout the zone.	CH2M HILL
35	Table 3-3	Kelvin Creech	Usable volumes of Carpenter and Plumtree ETs do not reflect the operational conditions established by the Town – currently "low" levels in the tanks are set at ½ - 2/3 full to maintain adequate pressures – we need to have discussion as a group to confirm what are the actual conditions in these pressure zones so that if we can allow more turnover in these tanks for water quality maintenance then we take advantage of that – current discussion in the draft does not reflect what the Town believes to be the case for usable volumes in these tanks	In the May 14, 2009 memorandum from CH2M HILL to the Town, we addressed these issues in detail. We will include the May 14 memorandum as Appendix G of the Master Plan.	No Action
36	Table 3-4	Kelvin Creech	Table 3-4 and related discussion states that Davis Dr. BPS is used to meet peak demands – this BPS is currently only used for emergency water supply and is not used to meet peak demands under normal operating conditions – it may be used to address IBT management issues in the future	Revised.	CH2M HILL
37	Table 3-4	Kelvin Creech	Need to confirm the pump models stated in table 3-4 for WTP pumps – WTP staff will do that before the upcoming workshop	Revised per information received from Kelvin Creech by email on April 29, 2009.	CH2M HILL
38	Table 3-4	Kelvin Creech	Table 3-4 – additional comments for this table:	NA	NA
38a	Table 3-4	Kelvin Creech	- check to see if Penny Rd. BPS is bi-directional	Instructed not to consider Penny Road BPS. If this information is available from the Town we can include it.	Town of Cary or No Action
38b	Table 3-4	Kelvin Creech	- confirm capacity of 450 hp CPZ pumps at WTP – capacity stated here seems a little low	Table revised to show 3 large CPZ pumps.	CH2M HILL
38c	Table 3-4	Kelvin Creech	- Old Apex GST is used seasonally for providing additional system storage to aid with peak demand management – please add that to the "Function" information	Revised.	CH2M HILL
39	Table 3-7	Kelvin Creech	Table 3-7 – Pipeline mileage totals seem to be lower than PWUT Operations Div. understanding – please confirm totals	Revised.	CH2M HILL
40	Table 4-1	Kelvin Creech	Table 4-1 – Old Apex Ground Storage Tank referenced as "New Apex"	Revised.	CH2M HILL

Comment Number	Reference	Comment From:	Review Comment	Response	Primary Person Responsible
41	p. 4-18; 4.4.1.1	Kelvin Creech	Section 4.4.1.1 – Plumtree Street ET should be referenced as "Plumtree Way ET"	Revised.	CH2M HILL
42	p. 4-21; 4.4.2.1	Kelvin Creech	Section 4.4.2.1 – Please coordinate with WTP staff to confirm WPZ pump curves used for EPS	Received from Kelvin Creech by email on April 29, 2009. The differences between the pump curve received and the one used in the model is negligible and we have not modified the curve in the model.	No Action
43	p. 5-3; 5.1.2	Kelvin Creech	Section 5.1.2 – Need to determine Apex diurnal curve, storage requirements, etc. to properly account for Apex demand	See response to Comment No. 14.	CH2M HILL
44	p. 5-15; 5.4.2	Kelvin Creech	Section 5.4.2 – States entire volumes of Cary ET's is "usable" storage – this does not reflect what the Town believes to be the situation in the field – needs to be further evaluated per discussion at workshop on 4/16/09 or further defining "usable" storage so that all are in agreement with what this means	Revised Section 5.4 to include definition of usable volume: The "usable" volume should not be misconstrued as the daily operational volume that is utilized for equalization purposes. Rather, the "usable" volume addresses equalization, fire flow, and emergency volumes and the lowest level in the tank which can provide approximately 30 psi throughout the zone.	CH2M HILL
45	p. 5-15; 5.4.2	Kelvin Creech	Section 5.4.2 – first paragraph references table 5-3 but I think this is actually table 5-4	Revised table numbering.	CH2M HILL
46	p. 5-15; 5.4.2	Kelvin Creech	Section 5.4.2 – 2 nd paragraph needs amending to reflect comments on storage for WTP and Old Apex GST noted in comments #4 & 5 on page one of these comments	See response to Comment No. 44.	CH2M HILL
47	p. 5-19; Fig 5-6	Kelvin Creech	Figure 5-6 note 4 – comment on 3.0 MG storage at Old Apex GST – due to lowest safe level allowed in tank to protect pumps from running dry the max. low level is around 4-5 ft. which would mean this tank could never be fully utilized at 3.0 MG – need to confirm lowest level possible with Sam Tingler	Since a pipeline along Old Apex Road is proposed for the year 2015, a detailed analysis is recommended to determine if the existing pumps are suitable when the new 16" pipe is constructed and to determine the "usable" volume of the Old Apex Tank with the new or existing pumps. Recommendation added to Section 7.7.	CH2M HILL
48	p. 5-20; 5.6	Kelvin Creech	Section 5-6 – 2 nd paragraph states assumption made that 24 mgd could be conveyed through the 30" main – what is assumption based on - can that assumption be confirmed?	The assumption is based on meeting a velocity criteria of 7.5 fps and 107 feet of headloss as stated in the report. Because we were instructed not to analyze emergency conditions any further than this, the assumption was not confirmed through computer modeling.	No Action
49	p. 5-20; 5.6	Kelvin Creech	Section 5-6 – 3 rd paragraph states that the max. flow to Cary from Durham at Davis Dr. BPS is 7.0 mgd. Need to re-confirm this capacity. PWUT records show that the max. available capacity of this station pumping from Durham to Cary is 3-4 MGD	See response to Comment No. 31. In this section, we were looking at a future emergency scenario and used information from the 2008 Interconnection Study by Hazen and Sawyer which indicated that 7 mgd was available "from Durham to Cary" with several pump and pipeline improvements.	CH2M HILL
50	p. 5-21; 5.6	Kelvin Creech	Emergency conditions modeling and recommendations for future modeling are based on "average day demand" conditions – should we consider same type modeling for max. or summer demand season flows?	This work was performed using a spreadsheet flow balance (not a modeling analysis) using average and maximum day demands assuming that the 42" main was out of service. Based on a meeting with Cary on July 11, 2008, the consensus was that using maximum day demands was too conservative. We recommended that the Town further analyze this issue using maximum month demands in order to not be overly conservative. We were instructed not to analyze emergency conditions any further than what we had presented during the July 11 th meeting and so we did not perform modeling of any other emergency conditions. Emergency conditions could be further analyzed in a separate study using both average day and potentially maximum month demand conditions depending on the emergency situation being evaluated.	CH2M HILL

Comment Number	Reference	Comment From:	Review Comment	Response	Primary Person Responsible
51	6.1.2	Kelvin Creech	Section 6.1.2 – Apex diurnal curve and storage impacts needs to be determined for EPS runs (this comment also applies to p. 6-20 section 6.5)	See response to Comment No. 14.	CH2M HILL
52	6.5.2.1	Kelvin Creech	Section 6.5.2.1 – states capacity of one WPZ pump is 6.5 mgd – I assume that the capacity of these pumps has increased by 1.0 MG due to transmission improvements (current capacity is 5.5 MGD) – please confirm	Figures 6-5 and 6-6 describe existing and future pump capacities based on a combination of pumps. We do not provide capacities for individual pumps based on a particular year because this information can be misinterpreted.	No Action
53	6.5.3.1	Kelvin Creech	Section 6.5.3.1 – states Davis Dr. PRV could be utilized in lieu of other improvements – for this recommendation, Davis Dr. PRV would need to have a flow meter added and other SCADA as it is currently only used for emergency backup and was not designed for routine continual use – currently no way to measure flow through this connection to the WPZ – please include in CIP recommendations	We did not make a definitive recommendation about the Davis Drive PRV because this is dependent on the final Morrisville pressure zone boundaries that the Town may implement based on additional analysis. Revised to include flow meter in CIP.	No Action

May 14, 2009 (Memorandum)

Cary Water System Master Plan and Model Follow-Up on Issues Discussed at 4/16/09 Meeting

TO: Glen Harrell, PE; Engineering Services Manager (Utilities)
Town of Cary

FROM: Francine Durso, PE

COPIES: Paul West, PE; Jay Kirk, PE; Helen Lu, PE; Kathryn Benson, PE;
Adam Sharpe

DATE: May 14, 2009

Glen, this memo is to provide clarification and responses to some of the items discussed during the April 16, 2009 meeting and presentation, and our subsequent emails and telephone call on April 23, 2009.

1. Western Pressure Zone Residential Pressure

A. Existing Conditions

CH2M HILL performed a 2009 maximum day demand simulation with the hydraulic model in an attempt to replicate the low pressure occurrence in the southeastern portion of the Western Pressure Zone. The following model boundary conditions were utilized:

- The Davis Drive Pressure Reducing Valve (PRV) was closed,
- The Davis Drive Pumping Station was off-line, and
- High service pumps were operated in a manner that kept the level in the Carpenter Road Elevated Tank between elevation 540 to 528 (top 12 feet – see Figure F1 in Appendix F).

As shown in Figure 6-1A, the model simulation identified peak hour pressures below 30 psi throughout the eastern portion of the Western Pressure Zone due to the fact that this area is supplied by a single 16-inch main along Morrisville Carpenter Road. Peak hour velocities in this main are above 7 fps resulting in significant headloss in the main.

As shown in Figure 6-1B, CH2M HILL found that if the system were operated with the Davis Drive PRV open during peak hour conditions, pressures in these same areas would range from 40 psi to 100 psi. For this reason and due to the fact that the Town had planned to construct additional mains in the southeastern portion of the Western Pressure Zone (described below), CH2M HILL did not recommend modifying the pressure zone boundary in this area.

B. Future Conditions

Prior to the 2009 Master Plan, the Town had planned to construct three pipeline projects in the southeastern portion of the Western Pressure Zone by the year 2009 which would potentially mitigate low pressure problems in this high elevation area. These pipelines are shown in Figure 5-1:

- WPZ-4: 12-inch High House Road Water Line (WT1165)
- WPZ-5: 12-inch Carpenter Upchurch Road Water Line (WT1160)
- WPZ-6: 12-inch Louis Stevens Drive Water Line (WT1168)

Based on the model simulation results, only WPZ-4 is hydraulically necessary to satisfy the Town's Policy Statement 129 (30 psi peak hour pressure criteria). WPZ-5 and WPZ-6 provide local service and operational redundancy in this part of the zone. With these new pipelines in service, the Davis Drive PRV closed, and the Carpenter Road Elevated Tank water levels operated in the top half of the tank (see Figure F6 in Appendix F), the pressure criteria established for this project as shown in Table 5-1 can be satisfied.

C. Summary

Based on the hydraulic model simulation results, the Town of Cary should be able to achieve peak hour pressures in the Western Pressure Zone ranging from 40 psi to 100 psi with better operation of the Davis Drive PRV. Historically, this valve was manually opened via SCADA by Operations Staff at the Cary/Apex WTP during peak summer demands. Potentially, a low pressure set-point could be programmed in SCADA to automatically open during low pressures in the southeastern portion of the Western Pressure Zone.

In addition, WPZ-4 will provide additional redundancy in the zone for when the Davis Drive PRV is out of service for maintenance or during loss of a pressure signal.

Based on the results of the modeling analysis conducted during the 2009 Master Plan, CH2M HILL does not recommend changing the southeast boundary of the Western Pressure Zone.

2. Minimum Pressure Criteria

A. Town of Cary

Minimum pressure criteria for Cary was discussed at the meeting and based on those discussions it seems that there are essentially two questions of interest to the Town:

- Whether or not to change Policy Statement 129
- Whether or not to increase service line/meter size requirements

There are several reasons that CH2M HILL does not believe a global policy statement change for the entire system is in the Town's best interest to address these questions:

- There appear to be only a few small areas of high elevation (marginal pressure) in the Cary water system which is typical of most water systems

- Two of the high elevation areas with the most pressure complaints will exceed standard AWWA pressure criteria after upcoming 2009/2010 water line improvements are in place (WPZ-4 and SPZ-6)
- If the maximum day or peak hour pressure criteria for an entire zone were to be increased, then a majority of each zone would have pressures well above AWWA criteria and large areas would be at or above 100 psi

The Town may consider creating a few small "special service area" districts (based on an adopted high elevation for each zone) which could require new development or any entity requesting a building permit to install larger service lines and meters to further minimize pressure loss. Most importantly, creating "special service area" districts will strategically focus on the marginal areas while not imposing additional constraints on areas that already have adequate pressure. This approach would address the service line pressure criteria issue while the CIP recommendations address the pressure issue from the regional perspective.

In addition, CH2M HILL can provide services to model residential service connections from the meter to the residence and evaluate a number of alternatives based on different fixtures in the residence being operated.

We also investigated minimum pressure criteria from several similar municipalities as described below.

B. Forsyth County, GA

Forsyth County does not have a Policy Statement but uses the AWWA baseline requirement of 20 psi as a minimum pressure when dealing with customer service issues at peak use times. Low pressure complaints only occur during peak system demand, typically in the morning while irrigation systems are in use. The County works with customers on a case-by-case basis to alleviate these situations, and does look at various improvements on its side of the meter to increase pressure such as increased line sizes, changing valve settings to modify pressure zones, adding booster stations, etc. However, if the County were to increase pressure all the time as a standard practice this would result in other problems since the normal operating pressure in many parts of the system can be well over 100 psi. The County has added pressure reducing valves to create a small lower pressure zone for certain pockets of the system. Also, the County added a booster station to expand its super high pressure zone to include a new development that would have experienced low pressures otherwise.

C. Prince William County, VA

Prince William County Sanitation Authority uses the VA Building Code requirement of 30 psi as its minimum requirement. For areas that may have low pressure the Authority gave two examples:

- For a new development, the developer would be required to provide fire flow, but during peak times the pressures may potentially drop below the minimum due to heavy irrigation usage and bigger homes. In that case, the Authority would work with the

developer and may require them to install a booster for the area instead of at each individual home. They noted that this type of situation has not yet come up.

- With the growth of irrigation systems and incrementally increased usage, the Authority uses a high penalty water rate on usage above about 20,000 gallons per month of about \$14/1,000 gallons. This process has tended to make usage more efficient. If efficiency is not realized, then the Authority uses this revenue to make modifications as needed to bolster its system to meet the peak needs.

D. Loudon County, VA

Loudon County operates two separate types of systems: a central system which uses wholesale purchased water with about 55,000 connections; and smaller community systems on wells.

- For its central system, the County is provided water at fairly high pressure from its wholesale provider, so pressure has not been an issue historically. As its central system has grown, the County has had to create three pressure zones where previously it had only one. It is now installing a booster pump to create a higher pressure zone in an area of higher elevation towards the outer reaches of its service area.
- For the community systems, the County previously required 30 psi at the meter for peak hour demands. Over time, as the homes have gotten larger, it has increased this minimum to 40 psi and then to 50 psi minimum at the meter for all new community systems. Where feasible, the County has raised the pressure in some of the previous systems designed for 30 psi minimum. The County is also talking with its building community to potentially eliminate excessive headlosses within the homes in different ways, such as not requiring pressure reducers in areas that will never experience excessively high pressures or recommending larger diameter indoor plumbing (1-inch instead of 3/4-inch).

3. Water Demand Projections

A. Comparison with 2000 Master Plan Demand Projections

The table shown below which was discussed during the presentation is correct. Note that these are demands for Cary and Morrisville only; Apex demands are not included in these numbers. There is a fundamental difference in the way in which the 2000 Master Plan MDD was calculated and the way in which the MDD was calculated for this 2009 Master Plan.

In the 2000 Master Plan:

- The maximum day peaking factor was not applied to demands for RDU and RTP South.
- The MDD assumed a maximum day to average day demand ratio of 1.62 based on 1994 to 1998 historical average excluding 1996 due to Hurricane Fran.

In the 2009 Master Plan:

- The peaking factor was applied to all customer categories.
- A peaking factor of 1.64 was selected for use in this Master Plan based on discussions with the Town of Cary staff. The Town already uses this peaking factor for interbasin transfer reporting to the State and is close to the average of the actual maximum day peaking factors for 1997 through 2007, shown in Table 2-8 of the draft report.

Source Document	Planning Period Demands (mgd) For Cary and Morrisville Only				
	2007	2010	2015	2025	Build- Out
ADD (2009 Master Plan)	14.7	19.1	23.1	25.1	31.5
ADD (2000 MP)	18.5	20.8	24.9	n/a	33.6
<i>Change</i>	<i>-3.8</i>	<i>-1.7</i>	<i>-1.8</i>	<i>n/a</i>	<i>-2.1</i>
MDD (2009 Master Plan)	24.0	31.4	37.9	41.2	51.6
MDD (2000 MP)	28.7	32.3	38.7	n/a	52.6
<i>Change</i>	<i>-4.7</i>	<i>-0.9</i>	<i>-0.8</i>	<i>n/a</i>	<i>-1.0</i>

B. Population Projections

The following table presents Cary water service populations that correspond to the average day demands shown above. These are not town-wide populations (except at build-out)¹ since some residents of Cary are not connected to the Town’s water system. Apex is not included in these populations. For comparison, the population projections presented in the IWRMP are shown also.

To calculate future populations, we applied the persons per household values from Exhibit 4-10 in the 2007 IWRMP to the parcel specific development densities (lots and units) calculated as described in the 2009 Master Plan Sections 2.3.1 through 2.3.4.

The 2007 population was calculated using the number of accounts for the single family residential and multi-family residential customer classes for Cary and Morrisville split out individually and multiplied by the pph factors from Exhibit 4-10 in the 2007 IWRMP.

If actual 2007 population data exists, it would likely include residents that are not connected to the system, so it would be difficult to use actual 2007 population data in this calculation.

Cary Water Service Area Projected Population

Residential Population	Years				
	2007	2010	2015	2025	Build-Out
Calculated based on ADD above and pph from IWRMP	137,630	170,457	203,874	213,101	249,165
From 2007 IWRMP	131,460	146,400	174,150	222,500	243,050

(1) At build-out it is assumed that everyone is connected to the Cary water system

C. Use of 2009 Demands for Existing Model Scenario

Section 6.1 of the report describes the use of 2009 demands for the existing system hydraulic evaluation. 2009 demands were used for existing conditions in order to provide a model that is as accurate as possible in order to evaluate the Town’s current system performance. The 2009 demands were linearly interpolated between the 2007 and the 2010 demands and are shown below for both average day and maximum day.

	Years		
	2007	2009 (interpolated)	2010
ADD (MGD)	14.7	17.6	19.1
MDD (MGD)	24.0	28.9	31.4

4. Non-Revenue Water

Information provided by the Town of Cary from its AWWA water audits for the fiscal year 2003 through 2008, excluding 2007, demonstrates that the average non-revenue water percentage is 8.9%. This includes unbilled authorized consumption, unauthorized consumption, meter inaccuracy and leakage. Attachment 1 shows the calculations provided by the Town of Cary.

The Master Plan uses an average of 9% for non-revenue water as described in Section 2.5. Since the two values are similar, 9% for non-revenue water will be used in the Master Plan.

5. Apex Diurnal Demands and System Storage

A detailed diurnal demand analysis and storage analysis for the Apex water distribution system was not included in the scope of work of this Master Plan. However, since the demands in the Apex system are supplied through connections at Green Level and Jenks

Road, the Central Pressure Zone pressure and flows are impacted by supply fluctuations to Apex which are dependent on the Apex storage capacity and tank level operation.

For the 2009 modeling scenario, a diurnal flow pattern similar to that observed during the 2008 calibration period was utilized for the Apex system. However, the year 2010, 2015, 2025, and build-out modeling scenarios considered that the Apex supply at the Green Level and Jenks Road control valves is similar to a pumping station which should provide maximum day demand (based on design criteria in Table 5-1 of the Master Plan). For this reason, a constant demand or flat diurnal curve was utilized during the EPS model simulations for the Apex system. This assertion is based on the industry standard practice of designing storage tanks to supply those flows in excess of maximum day demand. However, if the storage capacity in Apex is insufficient, then either flows in excess of maximum day demand must be provided at the Jenks Road and Green Level control valves or additional storage volume is required in the Apex system. For these reasons, Section 7.7.3 of the Master Plan makes a recommendation to further develop a normalized diurnal demand curve and to perform a storage volume analysis for the Apex system.

A review of one to two years worth of SCADA data for the Jenks Road and Green Level flow meters and levels for all the Apex tanks is recommended to develop a diurnal demand pattern for the Apex system. More importantly, a storage volume analysis is required in order to develop a "storage plan" for the Apex system. Based on the demand projections, the maximum day demand will triple by build-out (4.8 mgd at 2007 to 15.3 mgd at build-out). It is highly likely that the Apex system currently does not have adequate storage for future demand conditions. The storage analysis will precipitate a discussion on whether and how much to expand the Apex storage capacity and if/how much supply through Jenks Road and Green Level control valves should be in excess of maximum day demand.

It is recommended that the Apex storage and diurnal demand analysis be conducted along with the water quality task because CIP recommendation will be verified using the updated model.

ATTACHMENT 1

Provided by Town of Cary on 4/23/09

FY	Service Area	Non-rev water MG %	Unbilled Authorized Consumption %	Unauthorized Consumption %	Metering Inacc%	Leakage %	
	Water Supp MG						
2008	5,150.89	615.270	11.9	2.9	0.2	1.8	7
2006	4,645.154	420.624	9	3.3	0.3	0.0 na	5.4
2005	4,246.105	276.085	6.5	2.9	0.2	0.0 na	3.4
2004	4,327.591	510.251	11.8	3.8	0.3	0.0 na	7.7
2003	4,157.846	220.466	5.3	1.3	0.3	0.0 na	3.7
Avg % = 8.9%							