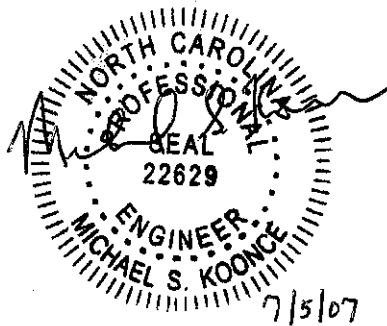


WATER SOURCE ALTERNATIVES STUDY

PREPARED FOR
FOX FIRE VILLAGE, NC



HYDROSTRUCTURES, PA

126A Commerce Court
Pittsboro, NC 27312

Table of Contents

Section:

1.0	Introduction.....	1
2.0	Existing Water System.....	1
2.1	Water Source	2
2.2	Distribution System	2
2.3	System Storage.....	2
2.4	Interconnections.....	3
3.0	Water Demand Projections.....	3
3.1	Current Water Demand.....	3
3.2	Population Trend and Predicted Demand	4
3.3	Undeveloped Area Predicted Demand.....	5
3.4	Total Foxfire Village Demand Prediction	6
4.0	Analysis of Water Source Alternatives	7
4.1	Groundwater Wells	7
4.2	Purchase Bulk Water from Moore County.....	8
4.3	Purchase Bulk Water from Montgomery County.....	8
4.4	Purchase Bulk Water from Richmond County	9
5.0	Recommendations and Conclusions.....	10

Tables:

Table 2.1	– Existing Well Production Summary
Table 3.1	– Foxfire Village Population Projections
Table 3.2	– Existing Service Area Demand Projections
Table 3.3	– ETJ Build-out and Demand Projections
Table 3.4	– Total Foxfire Village Demand Projections

Figures:

Figure 1	– Foxfire Village Vicinity Map
Figure 2	– Existing Water Distribution System Layout
Figure 3	– Interconnection with Moore County
Figure 4	– Interconnection with Montgomery County
Figure 5	– Interconnection with Richmond County

Appendix:

Appendix A	– Well Production Records 2005-2007
Appendix B	– Demand Projections Versus Well Capacity

ENGINEER'S REPORT
Water Source Alternatives Study
Foxfire Village, North Carolina

1.0 INTRODUCTION

Foxfire Village is located in the southwestern portion of Moore County near the border with both Montgomery County and Richmond County. Figure 1 shows the current Village Limits and Extra-territorial Jurisdiction boundary of the Village. The Village contains primarily single-family residential housing surrounding the Foxfire Village Golf Club. In recent years, its limits have expanded due to voluntary annexation of several new developments on the southern and western edges of the Village.

Water is provided to the residents within the Village by a series of six groundwater wells. As with many wells in the Sandhills region of North Carolina, these wells have relatively low yields due to their limited recharge areas. It has become increasingly difficult to find wells of sufficient yield to justify development into water supply wells. Several recent test wells showed potential yields less than 10 gallons per minute (gpm) during draw down testing. Water quality is also a concern to the Village. One well was abandoned more than 10 years ago due to petroleum contamination, and four of the six wells currently in use showed excessive levels of radium during recent testing.

Given the water quantity and quality concerns discussed above, the Village desires to evaluate the feasibility of connecting to neighboring water systems and purchasing water in bulk versus continuing to rely on its current well supply. This study projects the future water needs of Foxfire Village through the year 2030; examines the feasibility of interconnecting with the county-wide water systems in Moore County, Montgomery County and Richmond County; compares the cost of these interconnections to the continued use of groundwater wells; and recommends the most reliable and cost-effective short and long-term water sources.

2.0 EXISTING WATER SYSTEM

Foxfire Village operates a public water supply system under Public Water Supply ID No. 03-63-479. According to the Town's Local Water Supply Plan Update prepared in July of 2003, the system serves approximately 336 residential and 16 non-residential (commercial/institutional/industrial) accounts with an average daily water usage of approximately 51,000 gallons per day. Well production records provided by the Village show an average daily water production of 63,635 gpd for 2006. A map showing the layout of the existing water system is provided in Figure 2.

2.1 Water Source

Water for the system is produced by a series of six groundwater wells scattered throughout the Village. The safe yield, 2006 average daily and maximum daily production, and percent of capacity used for each well is shown in Table 2.1 below.

Table 2.1 –Existing Well Production Summary

Well Name	Well Number	12-Hour Yield (gpd)	2006 Avg. Daily Production (gpd)	2006 Percent of Capacity Used	2006 Max. Daily Production (gpd)	2006 Percent of Capacity Used
Eagle Drive	EA-6	10,800	5,158	47.7%	7,026	65.1%
S. Hoffman	SH-2	23,760	13,987	58.9%	17,374	73.1%
Hoffman	SH-1	23,760	13,731	57.8%	18,265	76.9%
Bluebird Lane	TO-1	23,760	12,435	52.3%	17,000	71.5%
Richmond Rd.	RR-4	17,280	11,524	66.7%	14,577	84.4%
Tennis Courts	TC-3	<u>12,240</u>	<u>6,801</u>	<u>55.6%</u>	9161	74.8%
Total		111,600	63,636	57.0%		

Appendix A contains a spreadsheet summarizing the total monthly production and average daily production for each well in the system from January of 2005 through April of 2007. It also includes graphs for each of the six wells showing the average daily production compared to the 12 hour safe yield.

2.2 Distribution System

The water distribution system includes approximately 2,900 feet of 12-inch water mains, 40,800 feet of 8-inch water mains, 37,900 feet of 6-inch water mains, and 18,700 feet of 2-inch water mains. The vast majority of the mains are constructed of PVC pipe, with small quantities of cast iron and asbestos cement pipe scattered throughout the system.

2.3 System Storage

Storage for the system is provided by a 200,000-gallon elevated storage tank. This tank is 121' tall with a high water level of approximately 691' mean sea level. Based on the current average daily usage of 63,636 gpd shown in Table 2.1 above, this tank provides more than 3 days of storage. This is ample compared to the half day's storage recommended by the State for municipal water systems.

2.4 Interconnections

Foxfire Village does not have any interconnections with surrounding water supply systems at the present time.

3.0 WATER DEMAND PROJECTIONS

To design water supply facilities necessary to provide service within a particular system, it is necessary to project the amount of water that will be needed within the system during the design life of the facilities. This parameter is referred to as *water demand* and can be measured alternately in million gallons per day (mgd), gallons per day (gpd) or gallons per minute (gpm).

Demand projections are typically derived through a combination of two methods: population projection and calculation of potential "build-out" of the service area. In the population projection method, the current water demand is multiplied by a growth factor, which is calculated based on historical growth patterns and observed population trends such as birth rates, death rates, and migration rates. Although this method is widely accepted, it can be of limited use in areas of recent high growth rates and limited build-out area available.

In areas where growth has increased rapidly, or where the future service area is considerably larger than the current service area, future water demands may be better estimated using the "build-out" of the service area. For this report, the service area of Foxfire Village is assumed to be the Extra-territorial Jurisdiction (ETJ) limits of the Village. Most of the undeveloped space throughout the ETJ is currently zoned RA, which requires a minimum lot size of 40,000 square feet (0.92 acres). For the purposes of this report it is assumed that the majority of potential development would be residential in nature and in accordance with this minimum lot size requirement.

3.1 Current Water Demand

The existing water demand was calculated using the monthly water billing records and the well production records for calendar year 2006. Based on information provided by the Village, the average daily production of the system during 2006 was approximately 63,600 gpd, with a maximum monthly average production of 79,700 gpd. This results in a maximum monthly to average daily peak factor of 1.25. These current demands are used as the baseline for projected future demands for Foxfire Village.

3.2 Population Trend and Predicted Demand

Population projection data for Foxfire Village was taken from two sources: the Village's 2002 Local Water Supply Plan and the North Carolina State Demographer's Office 2005 projections. Table 3.1 below shows the projected population for the Village through the year 2030.

Table 3.1 – Foxfire Village Population Projections

Year	2002 Local Water Supply Plan Projections	2005 NC Office of State Budget and Management
2005	512	512
2010	582 (13.7%)	554 (8.13%)
2015	-	593 (7.01%)
2020	592 (1.7%)	634 (6.97%)
2025	-	672 (6.05%)
2030	662 (11.9%)	712 (5.97%)

In Foxfire Village's case, population projections predict a growth rate that is considerably lower than the actual growth that will occur over the next 25 years. Both data sources shown in Table 3.1 predict only a handful of new Village residents each year. However, the Village issued 60 certificates of occupancy for new homes in 2006, and has issued an additional 33 new certificates of occupancy through May of 2007. These represent an *annual* increase of more than 12% for both 2006 and 2007, which is higher than the *5-year* increase projected in Table 3.1. Water demand also increased almost 15% between 2005 and 2006, and has increased almost 2% thus far in 2007 versus the same period in 2006.

Because this recent surge in growth is not reflected in the population projection data, these projections are not useful for projecting future demand as they would severely underestimate demand. A review of other similarly fast growing communities shows that it is not uncommon to have five-year growth rates of 20% or higher, and it is conceivable that the existing service area of Foxfire Village could experience growth of this level or higher throughout the study period. This report utilizes a 5-year growth rate of 20% for the current Village limits, and Table 3.2 presents the average and maximum day demands for this area through the year 2030.

Table 3.2 – Existing Service Area Demand Projections

Year	Number of Customers	Avg. Day Demand (gpd)	Max. Day Demand (gpd)
2006	487	63,600	79,700
2010	584	76,320	95,640
2015	701	91,584	114,768
2020	842	109,900	137,720
2025	1009	131,880	165,265
2030	1212	158,260	198,320

As there are only approximately 1,100 parcels in the Village Limits, this projection basically assumes build-out conditions (several of the existing parcels are large and can be subdivided into multiple parcels).

3.3 Undeveloped Area Predicted Demand

Based on data obtained from the Moore County Geographical Information System (GIS) database, the Foxfire Village ETJ contains approximately 8,600 acres. Of this total, approximately 2,150 acres is within the current Village Limits. This leaves approximately 6,500 “undeveloped” acres within the ETJ but outside of the Village limits.

Within the current Foxfire Village Limits, the current average day water demand is 63,600 gpd. Dividing this demand by the 2,150 acres in the Village limits results in a current average of 29.6 gallons per acre. Assuming that the Village continues to operate in its current role as a provider of water only to those areas where it is already available or to areas where developers or potential customers request annexation and are willing to pay the needed infrastructure, that existing homes on wells continue to use these wells until they fail, and that the Village (or the County) does not construct a centralized public sewer system, it is reasonable to assume that the remainder of the ETJ will develop in a similar fashion.

Assuming that the entire ETJ develops at the same approximate density as the current Village Limits, the theoretical build-out flow for the undeveloped portions of the ETJ is 192,400 gpd (6,500 acres x 29.6 gallons per acre). This report assumes that the portion of the ETJ outside of the current Village Limits that will be served by the Village water system will increase at a uniform rate from 0% served at the present time to 25% served by the year 2030. The following tables

show the percentage of the undeveloped ETJ served and the projected average day demand through the end of the study period.

Table 3.3 – ETJ Build-out and Demand Projections

Year	Percent of Undeveloped ETJ Served	Acreage Served	Avg. Day Demand (gpd)	Max. Day Demand (gpd)
2006	0%	0	0	0
2010	5%	325 Acres	9,620	12,025
2015	10%	650 Acres	19,240	24,050
2020	15%	975 Acres	28,860	36,075
2025	20%	1,300 Acres	38,480	48,100
2030	25%	1,625 Acres	48,100	60,125

3.4 Total Foxfire Village Demand Prediction

The total demand for the entire Foxfire ETJ is calculated by adding the existing service area demand (shown in Table 3.2) and the undeveloped ETJ build-out (shown in Table 3.3). The results are shown in Table 3.4 below.

Table 3.4 – Total Foxfire Village Demand Projection

Year	Avg. Day Demand (gpd)	Max Day Demand (gpd)
2006	63,600	79,700
2010	85,940	107,665
2015	110,824	138,818
2020	138,760	173,795
2025	170,360	213,365
2030	206,360	258,445

These future demands represent the volume of water any water source will be expected to provide in the scenarios discussed in Section 4.

4.0 ANALYSIS OF WATER SOURCE ALTERNATIVES

As mentioned previously, this report compares four alternative water sources to meet the current and future demands of Foxfire Village. These are:

- Groundwater Wells
- Interconnection with Moore County
- Interconnection with Montgomery County
- Interconnection with Richmond County

For each alternative source, an evaluation was performed to determine the available supply, the closest point of interconnection, the construction cost for the interconnection, and the cost per thousand gallons (bulk rate).

4.1 Groundwater Wells

This scenario assumes that the Village continues to utilize the existing groundwater well system to provide water to the customers within its service area. It assumes that additional wells will be constructed as needed when the maximum day demand exceeds the 12-hour safe yield of all the wells in the system.

Appendix 2 contains a graph showing both the average day and maximum day demand for the Village of Foxfire as shown in Table 3.4, and compares them with the current 12-hour safe yield of the six existing wells (111,600 gpd). The 12-hour well yield (horizontal blue line) shows that the proposed Well 7 on Hoffman Road will need to be put into service by 2009. A recent drawdown test performed on the test well indicated a 30 gpm (21,600 gpd) production rate for this well. Additional wells with a similar 30 gpm capacity are shown to be placed in service whenever the projected maximum day demand (red line) exceeds the 12-hour yield of the wells in service.

The estimated construction for each new well; including land, construction, contingencies and engineering and inspection, is \$187,500. (*Debt service = \$14,385.45 (\$165k, 6%, 20 year), Well produces 7,884,000 gallons (30 gpm, 12 hour yield for 365 days)*)

Using data obtained from the Village's Water Fund Budget, the operation and maintenance cost for producing water was calculated. In 2006, the total yearly cost was \$ 24,235 (including chemicals, utilities, maintenance and repairs, and testing) to produce a total of 23,226,900 gallons. This results in an estimated water production cost

of \$1.04 per thousand gallons, which increased from \$0.88 per thousand gallons in 2005. This is an increase of 18% per year.

4.2 Purchase Bulk Water From Moore County

Moore County currently operates a water system which provides water to the Seven Lakes area. Water is provided by 3 groundwater wells in Seven Lakes, supplemented by a booster pump station and 12-inch water main from the Pinehurst system. Water storage in this area is provided by a 200,000 gallon elevated tank in Seven Lakes with a high water level of 724' mean sea level (msl).

According to conversations with Moore County Public Works staff, there is not sufficient capacity available in this area to serve Foxfire Village at the present time. In fact, the County is considering a moratorium on large developments in the area due primarily to a lack of water supply. The County is in the process of completing a Water Source Evaluation Plan for the entire County, which would evaluate the available alternatives and recommend the best source for both the short and long-term. The County has also had preliminary discussions with Montgomery County regarding the purchase of bulk water to serve this area. However, until this plan is complete and the County secures additional supply, Moore County is not a feasible source for Foxfire Village.

Once the County does secure additional capacity in the Seven Lakes area, it would then become a feasible source for bulk water. To connect to the County System, Foxfire Village would be required to construct an 8-inch transmission main from Highway 211 to the Village along Hoffman Road. This proposed route is approximately 17,600 linear feet in length, and the proposed water main would cost approximately \$411,125 in today's dollars including construction, contingencies (10%) and engineering and inspection (15%).

4.3 Purchase Bulk Water From Montgomery County

Montgomery County operates a county-wide water system which serves the municipalities in the County as well as a large portion of the rural residents in the County. Water is provided by a 6.0 mgd water treatment plant located on the western side of the County on Lake Tillery. Average daily demand for the County is less than 4.0 mgd, so excess capacity is available.

According to Montgomery County staff, the County already sells bulk

water to the Town of Robbins in Moore County and is very interested in selling bulk water to Moore County and/or Foxfire Village.

Montgomery County has an existing 12-inch main on Highway 211 serving Perdue Farms near the Moore County border. Montgomery County also has a 200,000 gallon elevated storage tank with a high water level of 845.3' msl on Highway 211 east of the Town of Candor. It is approximately 41,600 linear feet from the end of this existing 12-inch water main to Moore County's existing 12-inch water main in Seven Lakes. The estimated project cost to install a 12-inch water main through this area is \$1,587,000. Adding the \$411,125 cost described earlier to extend water from Highway 211 to Foxfire Village along Hoffman Road, the total cost to connect Foxfire Village to Montgomery County is \$1,998,150.

Given the relatively small amount of water needed by Foxfire Village, this figure is not cost effective. However, should Moore County choose to connect with Montgomery County as a source for the Seven Lakes area, this option becomes much more cost effective. This is primarily because Foxfire Village would need only about 250,000 gpd out of the approximately 2,500,000 gpd capacity of the line.

4.4 Purchase Bulk Water From Richmond County

The final source considered for Foxfire Village is an interconnection with Richmond County. Richmond County operates a county-wide water system which serves the majority of the residents in the County. Water is provided by a 6.75 mgd surface water treatment plant located on the western side of the County on the Pee Dee River. According to Richmond County staff, the plant currently produces approximately 5.5 to 6.0 mgd in the summer months (or between 80% and 90% of its current capacity) due to increased irrigation demand. Because of this, the County is not interested in bulk water sales at this time.

However, design is underway on an expansion of the water treatment plant to 10.75 mgd. This upgrade is not yet approved and funded by the County, but it is an option being considered for the future. Once this proposed upgrade becomes a reality, Richmond County will have excess capacity to explore bulk water sales to neighboring systems such as Foxfire Village, and staff indicated a willingness to discuss this option with the Village.

Richmond County currently has a 12-inch water main on Highway 73 approximately one mile east of Highway 220. To connect to the

Richmond County System, Foxfire Village would be required to construct an 8-inch transmission main from this point to the Village along NC Highway 73, SR 1003 and Richmond Road. This proposed route is approximately 47,000 linear feet in length, and the proposed water main would cost approximately \$1,222,465 including construction, contingencies (10%) and engineering and inspection (15%).

This is nearly three times the cost as an interconnection with Moore County and, combined with Richmond County's lack of interest in selling bulk water at this time, makes this a less desirable alternative source.

5.0 RECOMMENDATIONS AND CONCLUSIONS

As shown in the analysis presented in Section 4 of this report, the most **cost-effective** water source for Foxfire Village is to continue to utilize groundwater wells. Even assuming that the operation and maintenance cost associated with these wells continues to increase at a relatively high rate, groundwater is simply cheaper to produce than surface water can be purchased from a neighboring provider.

However, the longer the Village relies on wells as its primary source of water, the more likely they are to experience water shortages and experience water quality issues. The water quantity problem is already being seen as evidenced by the four test wells drilled in the past year with less than 10 gpm in pumping capacity, and the quality concerns have become an issue with the radium levels detected in four of the six existing wells. The data presented in Appendix 2 shows that the Village will be required to construct an additional 7 wells by the year 2030 to meet its increasing demand, assuming that 30 gpm per well is obtainable.

Other public water systems in the Sandhills area including Seven Lakes, Highland Hills, the Village of Pinehurst, and the Town of Pinebluff have also experienced water quantity and/or quality problems with their wells. The most relevant of these to Foxfire Village is the Seven Lakes system, which experienced declining well yields and increasing radium levels over the past 10 to 15 years that forced the County to abandon all but three wells and construct an interconnection with the Village of Pinehurst system.

Given the long-term limitations of wells in the Foxfire area, it is an inevitability that the Village will connect with one of the neighboring county-wide systems in the future. Of the three alternatives to groundwater wells discussed in Section 4, the most cost-effective solution is to purchase bulk water from Moore County. This is primarily due to the close proximity of the Foxfire Village water system to the County's existing infrastructure on Highway 211 when compared to either Montgomery County or Richmond County.

Moore County is still in the process of determining what its long-term water source for the Seven Lakes/West End area is going to be, and until this source is developed they will not have sufficient capacity to provide water to Foxfire Village. However, Foxfire Village should initiate discussions with Moore County regarding participation in any water source improvements serving the western portion of the County now, so that the County includes Foxfire Village's water supply needs in any project it undertakes. To plan for this future interconnection there are several other steps Foxfire Village should take as soon as possible, including:

- Begin capital improvements fund to save money for future water connection with neighboring water system. Interconnection is a practical, common and vital component of water system management.
- Initiate discussions with potential loan and grant providers such as the North Carolina Public Water Supply Section SRF Unit, the United States Department of Agriculture Rural Development Agency, or the Rural Center to determine the Village's eligibility for grants or low interest loan programs.

Since Foxfire Village will continue to rely on its wells for at least the short term, there are several steps that can be taken to protect their quantity and quality, including:

- Perform engineering and construction services to repair radium impacted wells. A program should also be instituted regarding well construction standards to reduce the possibility of future radium (radiological) issues.
- Put in place ordinances prohibiting private well drilling in the Village Limits. Both the Village of Pinehurst and the Town of Pinebluff have implemented similar regulations in recent years, which prohibit new private wells or replacement of existing private wells once they fail.
- Institute water conservation measures (increasing block rates, irrigation limitations, etc.) to reduce daily usage, particularly during summer months when irrigation usage is high. Reducing maximum day demands will allow the Village to postpone construction of new wells and extend the life of the existing wells.