



SECONDARY WATER QUALITY TREATMENT SYSTEM REQUEST

Carlyle Manor Well #6

NC 03-92-373

WSF ID No: P60

AQUA NORTH CAROLINA, INC.

A. EXECUTIVE SUMMARY

The Bayleaf Master Water System is comprised of 125 approved and active wells. Carlyle Manor Well #6 is a single point of entry into the distribution system with no tanks on site. **The latest Mn concentration at Carlyle Manor Well #6 is 0.374 mg/L from 7/9/2020 which makes it one of Aqua's Group 1 Priority Secondary Water Quality Projects as per the latest Water Quality Plan.** EPA identified this well during UCMR 4 sampling as a well of concern and required Aqua to respond with an action plan to address manganese levels above the EPA Health Advisory Limit (HAL). Based on studies performed by AWWA and other organizations, elevated concentrations of Mn are being linked to cause adverse health effects. Preliminary engineering studies indicate that Manganese Dioxide filtration is the most effective and permanent solution since it physically removes Fe and Mn.

Aqua proposes Option 1 of creating a combined entry point between well 4 and 6 by routing raw water from Well #6 across the street to Well #4 and installing a second oxidation-filtration system in the existing Well #4 filter building in order to remove Fe/Mn below the sMCLs. After being filtered, the Well #6 finished water will be combined with filtered water from Well #4 and routed to the distribution system through the new combined point-of-entry of Wells #4&6. Option 1 capex is ~\$30,000 less than Option 2 (Install Well 6 Filter in New Building Located at Well 6 with no interconnecting raw water main).

The existing filter at well #4 is not large enough to accommodate the combined flows from both wells. The backwash produced for this new second filter is estimated to be less than 5,000 gallons per week, so it can be discharged to the ground in lieu of purchasing the expensive backwash recycle and sludge management systems. A new backwash supply system will be installed to provide BW water for both filters in order to avoid pulling BW water from the distribution system.

See attached map for proposed system improvements.

Capex and Opex estimates are given below in Section D.2. Capex estimates are provided for Option 1 (Install Well 6 Filter in Existing Well 4 Building with raw water main) and Option 2 (Install Well 6 Filter in New Building Located at Well 6 with no interconnecting raw water main).

PROPOSED SYSTEM REQUIRING TREATMENT

1. System Name:	<u>Bayleaf Master-Carlyle Manor Well #6</u>
2. PWS ID:	<u>NC 03-92-373</u>
3. No. Active Residential Connections:	<u>6,175</u>
4. No. Permitted Residential Connections:	<u>6,356</u>

5. List of DEH/PWSS Approved Wells and Storage

TABLE 1: Approved and Active Wells in Proposed System

Well Name and No.	Past 12 Month Average		Latest POE Inorganic Sampling Results				
	Well Production (GPM)	Runtime (hrs./day)	Fe (mg/L)*	Mn (mg/L)	Fe/Mn Loading Rate (lbs./day)**	Fe/Mn Loading Rate (lbs./yr.)	Average Fe/Mn Loading Rate Per Residential Customer (lbs./yr.)
Well #1, P49	80	8	ND	ND	0	0	0
Well #4, P3B	45	8	ND	ND	0	0	0
Well #6, P60	59	8	0.02	0.374	0.1	51	0.3
Well #7, P1D	93	8	ND	ND	0	0	0

*Raw samples are taken directly at the wellhead before chemical treatment and point of entry (POE) samples are taken after chemical injection and treatment but before the tank and distribution system

** Loading rates are normalized based on a 12-hour per day well runtime.

TABLE 2: Existing Storage at Well Sites

Well Name and No.	Storage Description		Most Recent Cleaning Date
	Type	Gallons	Dist. System
Bayleaf System	Elevated	1,750,000	Mar. 2021
Bayleaf System	Hydro	10,000	
Bayleaf System	Ground	104,500	

*This well uses existing storage in Bayleaf Master System.

6. Past Three (3) Years Flushing Occurrences, list month/year:

Response: May 2019, Feb. 2020, Jan. 2021

7. Next Planned Distribution System Flushing Occurrence:

Response: This water system will be flushed again March 2022 and on an ongoing annual basis. Disclaimer: Flushing does not completely remove the mineral accumulation in the

distribution mains when utilizing water with exceptionally high levels of iron and manganese in the source water.

8. List of chemicals being used:

TABLE 3: Existing Chemicals Used at Well Site

Well Name and No.	State Approved Treatment			
	Disinfectant	Caustic	Sequestrant	Fe/Mn Filter
Carlyle Manor Well #6	X	N/A	X	Proposed

9. Current description of the water treatment system for each well over the past three (3) years, including specific names of chemicals and dates of changes:

Response: Started feeding Seaquest in Oct. 2015.

10. Planned changes (if any) for chemical treatment within the next six (6) months:

Response: None.

11. Comments on Approved/Current Well Capacity.

Response: None.

B. CURRENT SECONDARY WATER QUALITY CONCERNS

- 1. How many wells require treatment? 1
- 2. Can system operate with single well offline? No*

* Based on the historical demands of the Bayleaf Master System, every well is required to meet demand. Subsequently, the production from Carlyle Manor #1 is required and cannot be taken offline or remain offline.

- 3. Are combined Fe/Mn concentrations above 1 mg/L? No*

*However, the latest POE Mn concentration is over 0.3 mg/L

- 4. Date of most recent POE Fe/Mn sampling results 7/9/2020

TABLE 4: Past 3 Years Fe/Mn Analysis

Carlyle Manor Well #6 Laboratory Analysis at POE						
Date	Iron (Fe), mg/L			Manganese (Mn), mg/L		
	Tot.	Sol.	Insol.	Tot.	Sol.	Insol.
8/4/2014	0.144	-	-	0.314	-	-

7/10/2017	ND	-	-	0.290	-	-
1/8/2020	-	-	-	0.408	-	-
7/6/2020	-	-	-	0.347	-	-
7/9/2020	< 0.022	-	-	0.374	-	-

- Describe previous actions to improve secondary water quality and describe results (i.e., installation of particulate filters and sequestering agents).

Response: Aqua is flushing the distribution system annually and feeding Seaquest. The intent of the sequestering agent is to physically chelate or hold Fe and Mn in a soluble state, ideally decreasing the insoluble concentration and resolving water discoloration issues. Because Fe usually reaches the surface in mostly an insoluble state, it is very challenging to convert insoluble Fe back into a soluble state unless the chemical dose of the sequestering agent is increased heavily. Also, sufficiently long contact time is a necessary criterion to make this happen. Because sequestering does not physically remove Mn, Aqua is concerned that its efforts to reduce total Mn will not be effective without adding a Fe/Mn treatment system or equivalent treatment system such as a those using solid phase Manganese Dioxide.

D. UTILITY COMMISSION REQUIRED INFORMATION

- Well Location Map Attached
- DEH/PWS Approval Letter Attached
- Original 24 hr. Pump Status Report Attached
- Past 36 months of pump status reports Attached
- Inorganic Analysis Report submitted to DEH for well approval Attached
- Past 6 yrs. inorganic analysis from each wellhead Attached
- Past 3 yrs. Fe/Mn analyses, both soluble and insoluble. See Table 4 Above

Note: For item (6) above, provide information on baseline (w/o treatment – raw samples taken at the well head) and point of entry (after treatment).

E. CUSTOMER COMPLAINT DATA

- Total number of customer complaints in past 6 months 39
- Total number of customer complaints in past 12 months 69
- For past 6 months, do customer secondary water complaints exceed 10% of the number of active customers? No
- Provide 12-month list of all water quality complaints Attached
- Provide 12-month list of all completed water quality work orders Attached
- Describe most common customer complaint over the past 12-month period relating to secondary water quality, i.e., discolored water, taste, or odor.

Response: Brown, black, and yellow discolored water complaints.

C. PROPOSED SECONDARY WATER QUALITY TREATMENT

1. Proposed treatment recommendation: Oxidation-Filtration Treatment System
2. System Capex Estimate:

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Mar 01 2022

Capex - Option 1 - Install Well 6 Filter in Existing Well 4 Building					
	Total design flow rate =	60	GPM		
TASK	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
1	Equipment-Only Filter Skid, no recycle, sludge management systems required since backwash is less than 5,000 gal per week	1	EACH	\$ 94,600	\$ 94,600
2	Backwash supply system sized large enough to for both filter systems so backwash no longer needs to be pulled from the distribution system	1	EACH	\$ 31,500	\$ 31,500
3	Freight (based on shipping costs of similar size filters)	1	EACH	\$ 2,000	\$ 2,000
4	Engineering Design, Permitting, Bidding, & CA/CO (based on design costs of similar size filters)	1	EACH	\$ 30,000	\$ 30,000
5	Construction Mobilization and Demobilization	1	EACH	\$ 5,000	\$ 5,000
6	Site Clearing, Grubbing, Grading, Gravel, erosion control required to install raw water main from well 6 to well 4	1	EACH	\$ 25,000	\$ 25,000
7	Filter Equipment Installation-Including but not limited to all water piping, water treatment filter installation, and necessary appurtenances, within the existing filter building. Also includes all extension piping near filter building	1	EACH	\$ 15,000	\$ 15,000
8	Backwash Supply Tank Installation-Including but not limited to all piping from 12" above grade to 4" air gap, concrete pad, tank setting, electrical, and necessary appurtenances.	1	EACH	\$ 10,000	\$ 10,000
9	Yard Piping-Including but not limited to all underground raw water main pipe, fittings, and valves	360	FT	\$ 100	\$ 36,000
12	Electrical/Controls-Including but not limited to all electrical power and controls wiring, conduit, panels, fixtures, electric heaters, thermostats, junction boxes, control equipment not provide by filter manufacturer, and miscellaneous appurtenances	1	EACH	\$ 15,000	\$ 15,000
13	Aqua Direct Cost (payroll, water quality sampling) @	3%			\$ 7,923
14	Contingencies @	5%			\$ 13,601
TOTAL COST/TREATED GPM:					\$ 4,833
TOTAL ESTIMATED PROJECT COSTS:					\$ 290,000

Capex - Option 2 - Install Well 6 Filter in New Building Located at Well 6					
	Total design flow rate =	60	GPM		
TASK	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
1	Equipment -Only Filter Skid, no recycle, sludge management systems required since backwash is less than 5,000 gal per week	1	EACH	\$ 94,600	\$ 94,600
2	Backwash supply system smaller since only supplying water for well 6 filter	1	EACH	\$ 21,600	\$ 21,600
3	Freight (based on shipping costs of similar size filters)	1	EACH	\$ 2,000	\$ 2,000
4	Engineering Design, Permitting, Bidding, & CA/CO (based on design costs of similar size filters)	1	EACH	\$ 30,000	\$ 30,000
5	Construction Mobilization and Demobilization	1	EACH	\$ 5,000	\$ 5,000
6	Site Clearing, Grubbing, Grading, Gravel, erosion control	1	EACH	\$ 25,000	\$ 25,000
7	Filter Equipment Installation-Including but not limited to all water piping, water treatment filter installation, and necessary appurtenances, within the existing filter building. Also includes all extension piping near filter building	1	EACH	\$ 15,000	\$ 15,000
8	Filter Building Construction	1	EACH	\$ 50,000	\$ 50,000
9	Backwash Supply Tank Installation-Including but not limited to all piping from 12" above grade to 4" air gap, concrete pad, tank setting, electrical, and necessary appurtenances.	1	EACH	\$ 10,000	\$ 10,000
10	Yard Piping-Including but not limited to all underground pipe, fittings, and valves	1	EACH	\$ 15,000	\$ 15,000
11	Electrical/Controls-Including but not limited to all electrical power and controls wiring, conduit, panels, fixtures, electric heaters, thermostats, junction boxes, control equipment not provide by filter manufacturer, and miscellaneous appurtenances	1	EACH	\$ 20,000	\$ 20,000
12	Aqua Direct Cost (payroll, water quality sampling) @	3%			\$ 8,646
13	Contingencies @	5%			\$ 14,842
TOTAL COST/TREATED GPM:					\$ 5,333
TOTAL ESTIMATED PROJECT COSTS:					\$ 320,000

Note: The above information is for planning purposes only and is subject to change based on further engineering evaluations, water quality analyses, site conditions, and other site-specific discoveries and information

3. Opex Estimate: \$10,000
4. Comments:

Aqua proposes Option 1 to install an oxidation-filtration system for Carlyle Manor Well #6 in order to remove Fe/Mn below the sMCLs.