City of Harrisonburg, Public Utilities Department

Grandview Water Treatment Plant

Replacement Fluoride System PER

W|W Commission: 216225.00

Final Report w/ Addendum #3: 3-8-17

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NOTES AND ERRATA:

THE ORIGINAL PER PREPARED FOR THIS PROJECT HAS BEEN MODIFIED AS OF MARCH 8, 2017 TO INCLUDE ADDITIONAL NARRATIVE DESCRIPTIONS AND COST ESTIMATE BREAKOUT PER PRELIMINARY REVIEW COMMENTS PROVIDED BY THE VDH AND CITY STAKEHOLDERS THROUGH MARCH 8, 2017. THIS REPORT INCLUDES AN ADDITIONAL FOURTH ALTERNATIVE BASED ON CITY STAKEHOLDER REVIEW OF THE INITIAL REPORT AND AS SUCH IS REFERENCED AS FINAL REPORT W/ ADDENDUM #3.

This report was prepared solely for the use of the City of Harrisonburg for this project. It is a statement of professional opinion based on information available at the time of preparation. It represents conditions at a specific time which is identified in the report and these conditions may change. To develop this report, the standard of care applicable to professional services was used.

INTRODUCTION

This basis-of-design report has been prepared to confirm project execution needs and alternatives for the replacement of the City of Harrisonburg's fluoride feed system at the Grandview Water Treatment Plant (WTP). This report outlines options for providing equivalent replacement of the City's current feed system which was taken out of service in 2016 due to corrosion problems within the chemical feed room at the WTP. The following narrative provides key criteria and alternatives that are required for the analysis of three alternatives.

BACKGROUND

Current guidelines from the Virginia Department of Health (VDH) indicate public water supplies should maintain fluoride levels in drinking water between from 0.9-1.2 parts per million (ppm) or milligrams/liter, (mg/l) as an aid to dental health. This is based upon current public health studies that correlate consumption of low amounts of fluoride in drinking water with reduced levels of tooth decay, (fluoride strengthens tooth enamel). As part of public water supply regulations, USEPA has established 4 ppm as the maximum allowable level of fluoride in drinking water and has set 2 ppm as a secondary control level to avoid the potential for staining of teeth due to dental fluorosis.

Based on this regulatory guidance, the City of Harrisonburg has been adding sodium fluoride to the City water supply as a public health service since the mid 1970's. Recent City water treatment records indicate the City successfully maintains an average concentration of 0.89 ppm in the finished water supply in accordance with these guidelines. This targeted level (0.89 ppm) establishes the primary sizing criteria for the proposed system although VDH has indicated it may lower the recommended ambient water concentration to 0.7 mg/l in the near future. The 0.89 ppm residual target is taken as conservative since metering equipment can be easily adjusted to achieve a lower finished water concentration if this regulatory guidance changes.

Up until 2002, the City utilized a granular sodium silicofluoride feed system to provide supplemental fluoride to the water supply. In 2002 as part of the City's WTP expansion project, the City replaced this granular system with a 23% liquid hydrofluosilicic acid feed system (HFSA). This upgrade greatly improved the safety and efficiency of fluoride addition as operators were no longer required to manually load 40 pound bulk bags of granular material into the fluoride saturator unit which was located on the second floor of the WTP. Shifting to the HFSA system minimized potential employee exposure to the concentrated granular fluoride and reduced the material handling frequency from daily material stocking to semi-annual filling of the 5,100 gallon HFSA bulk tank and non-contact pump dosing.

This system worked successfully from 2002-2016 when the City began to notice general corrosion induced problems within the main WTP chemical feed room attributed to fumes emanating from the HSFA equipment. This was adversely effecting service life of chemical feed systems within the WTP including the HSFA bulk storage tank and feed piping. Due to these concerns the City cleaned and purged the HSFA feed system and took it off line in September 2016 and initiated this effort to explore replacement options.

Table 1 provides a summary of the average, minimum and maximum amounts of fluoride chemicals used at WTP prior to the conversion to HSFA in 2002; and a summary of the average use of the 23% HSFA solution in 2015 (last full year of data) for comparison of the two former feed systems.

***Table 1**: Fluoride Feed Historical Summary*

	Sodium Silicofluoride (60%) 2002 System (lb/day)	Hydrofluosilicic Acid (23%) 2015 (gallons/day)
Average	83	26.2
Minimum	15	1.1
Maximum	131	48.0

The variability in feed rates in Table 1 is indicative of normal variations in City water demands and continual operator feed rate adjustments related to the monitoring of background fluoride levels in the WTP's source water (an average of 5 fluoride residual tests are run each day on finished water for water quality control purposes).

Table 2 provides a summary of the annual usage of HFSA in Fiscal Year 2016 and typical chemical supply costs used for baselining comparison of alternatives:

***Table 2**: Hydrofluosilicic Acid Usage Summary FY2016*

Gallons Used	8,710
Annual Cost	$26,103
Cost/Gallon	$3.00/gal

Based upon design discussions with the City WTP team they confirmed the need to match these performance requirements and requested that the new system be configured in a separate enclosed room with exterior ventilation or sited outdoors to reduce the potential for equipment corrosion problems.

System operators have also indicated they would be willing to return to a granular feed system if that would further reduce corrosion concerns within the building provided the system would not present additional safety, maintenance or operational concerns.

DESIGN REQUIREMENTS

Based on this background information, design of the proposed feed system has been sized based on feeding between 0.8-1.2 ppm of fluoride into the finished water supply to achieve a targeted residual of 0.89 ppm in the finished water following current VDH regulatory guidance provided in Appendix A.

As the City's WTP has a plant design capacity of 15 MGD this equates to a required peak capacity of 111 pounds of available fluoride per day (at average residual of 0.89 ppm). Based on 2015 average annual daily flow (AADF) at the WTP of 6.75 MGD, normal daily feed rate is expected to be on the order of 50 pounds/day of fluoride.

This peak and average day usage forms the basis of sizing the system components and corresponding cost analysis. Actual fluoride chemical feed rate will be dependent on flow and chemical availability of fluoride in base compound used in each feed system alternative (granular or liquid) as described in the analysis of alternatives in this report.

DESIGN ALTERNATIVES

The design team has evaluated four alternatives for upgrading the City's system to meet these treatment objectives. Alternatives 1 and 2 are based upon using a granular feed system with Alternatives 3 and 4 based on use of liquid HFSA feed system. Alternatives 1 and 3 are similar in that new equipment is sited within a purpose built room within the existing fluoride system area of the WTP chemical feed room. Alternatives 2 and 4 relocate the proposed equipment outside the WTP building to reduce potential for vapor induced corrosion within the WTP. Further details on these alternatives are provided below.

ALTERNATIVE 1

Alternative 1 includes the use of three (3) modular sodium fluoride upflow saturator feed systems (Figure 1) which will be located within the existing HSFA containment area of the WTP chemical feed room. These modular units are be sized to provide the required targeted finished water concentration of 0.89 ppm, with each of these systems is capable of treating up to 7.5 MGD at the required dosage rate. These systems would be manifolded together with two of the systems operating simultaneously with the third unit serving as standby or backup unit. Systems will be actively used in a rotating manner to keep equipment fully functional at all times.

***Figure 1**: Typical modular upflow saturator device (image courtesy of Integrity Systems, Inc.); Granular Sodium Fluoride is added to chamber on left and softened water is passed through the granular material resulting in concentrated brine which is accumulated in tank at right, a separate metering pump (orange item) is then used to meter chemical dosage into the water system.*

Installation of these units will require removal of the existing HFSA system including the 5,100-gallon bulk storage tank and support infrastructure. Feed piping to the raw water dosing point will be replaced in kind to match existing configuration. Installation of the new system will require removal of the existing air intake louver in the northwest exterior of the building and demolition of a segment of the exterior wall to enable installation of a new set of exterior double doors with integral intake louvers to provide stocking access for the sodium fluoride makeup chemicals from outside the building as shown in Figure 2.

An internal room will then be constructed on top of the existing containment walls within the chemical feed room using conventional stud walls and a flat roof (non-combustible construction) to form a separate vapor tight interior room for the fluoride feed system with an internal ceiling height of approximately 12-feet. The room will be outfitted with lighting and an external exhaust fan to vent the room to the exterior of the building. An interior doorway will be made in the southwest containment wall to provide access from the main operator corridor within the chemical feed room. A 4-foot square tempered window will incorporated into the interior wall along the operator's corridor to enable remote monitoring and access to primary feed pump equipment.

The 5-foot wide elevated sidewalk along the west elevation of the WTP building will also need to be extended out 10-15 feet into the existing driveway as a loading dock to enable direct truck delivery of pallets of the sodium fluoride with new steps formed along the south elevation of the WTP to provide pedestrian access (Figure 1). This elevated concrete loading dock will also include an overhead aluminum canopy anchored to the building to provide all weather cover to accommodate material deliveries. The loading dock extension would be installed to the same height as the existing elevated walkway leading to the chemical feed room to enable a normal pallet jack to move material into the new fluoride feed room. Aluminum handrails would be provided to match existing handrails in the area.

Sodium Fluoride Upflow Saturator and Feed System

Each of the three modular sodium fluoride feed systems are comprised of a saturator tank and solution/storage tank. Crystallized sodium fluoride is manually added to the saturator tank and softened water is pumped through the saturator tank dissolving the sodium fluoride crystals. This saturation process releases a 4% sodium fluoride solution into the process stream which is then accumulated in an adjacent primary solution/storage tank. These modular sodium fluoride feed systems are pre-assembled with an upflow fluoride saturator tank (80-gal); fluoride solution storage tank (80-gal); chemical metering pump; water supply feed system, piping, valves, fittings; control panel and integral secondary containment pallet (fiberglass-reinforced plastic). The three modular units will then be connected to a custom intake manifold where the WTP operators will control central metering pump dosage to the existing feed point. This manifold will include a fluoride feed controller and signal wiring integrated with the existing WTP control panel (SCADA).

When confirming the size of the fluoride saturator's several calculations were made in order to confirm the volume of on-site storage (bagged granular sodium fluoride) required to maintain a 30-day supply based on 15 MGD capacity while meeting targeted treatment level:

- Dry Fluoride Required to Maintain 0.89 ppm at WTP (AADF for 2015 = 6.75 MGD)

$$Dry\ Fluoride\,\frac{lb}{day} = 15\ MGD * 8.341 * 0.89\ ppm$$

$$Dry\ Fluoride\,\frac{lb}{day} = 111.35\,\frac{lbs}{day}\,F^{-1}$$

30-day supply would therefore be on the order of 3,350 pounds (rounding to nearest 50 pound bag); this would indicate on-site storage would be required for 67 bags based on full treatment capacity.

Based on current annual average demand (6.75 MGD) and 1.5 peaking factor, this would relate to a current 30-day storage requirement of 45 bags (2250 pounds of on-site storage).

$$Dry\ Fluoride\,\frac{lb}{day} = 6.75\ MGD * 1.5 * 8.341 * 0.89\ ppm$$

$$Dry\ Fluoride \frac{lb}{day} = 75.16 \frac{lbs}{day} F^{-1}$$

Based on normal palletized material shipments of 40, 50-pound bags per standard pallet on-site storage for two pallets is taken as a reasonable storage design capacity. This ability to store 80 bags (4,000 pounds) would provide approximately 80 days of on-site storage at current average annual flow of 6.75 MGD. This would require the City to order and receive fluoride material shipments once every three months (4x year) in order to meet average demands. Total annual usage would be around 18,300 pounds/year based on 6.75 MGD flows. At current material costs this is expected to cost approximately $20,000/year depending on shipping and handling charges. As water demands increase to current WTP capacity of 15 MGD this material handling frequency would need to increase to once every 36 days (10x year); with resultant chemical usage of approximately 40,600 pounds per year. Current material prices indicate this would result in annual costs of approximately $50,000/year at peak water plant treatment capacity.

Evaluating how the fluoride is generated and dispensed into the system for general sizing of feed pumps and equipment, the modular units are each designed to generate up to 7.7 gallons per hour of 4% solution. Based on two units operating 24-hours per day with 90% uptime they can therefore produce up to 332 gallons of 4% sodium fluoride solution each day which is enough to meet the 15 MGD WTP design capacity (111 pounds of fluoride added per day (55 pounds per saturator).

- 15 MGD, 2 units operating, 4% output solution (40,000 mg/l), 24 hour/day operation, 90% uptime)

$$Fluoride\ Output\ \frac{lb}{day} = 332\ gpd * 8.341 \frac{lbs}{gal} * 40{,}000\ ppm$$

$$Fluoride\ Output \frac{lb}{day} = 110.77 \frac{lbs}{day} F^{-1}$$

This would indicate WTP operators will need to add approximately 1 bag of sodium fluoride to each operating saturator daily at 15 MGD plant output. With three saturators in service simultaneously (500 gpd output) this could be reduced to 2-bags every three days at peak WTP capacity (15 MGD)

Primary WTP metering pumps would be sized around ability to provide up to 332 gal/day using two pumps with only one pump in duty status at a time (pumps operating in alternating mode for system reliability). Based on 90% uptime consideration for the metering pumps, this would equate to a maximum design flowrate of 15.37 gal/hour or a maximum feed rate of 0.25 gal/min for each primary metering pump at plant capacity of 15 MGD. Based on current average annual day demands of 6.75 MGD this would require metering pump output capacity turndown to 6.94 gal/hour or 0.12 gal/min for each primary metering pump for average daily WTP operational tempo (total of approximately 150 gal/day fluoride system output). This is within the operating range of a single modular saturator unit further reducing the expected chemical handling requirement on an average basis.

As softened water is used as saturator input, a single residential style ion-exchange water softener will be required to provide softened water to all three feed systems at a rate of 332 gpd at 30 psig per each feed system.

The following are additional miscellaneous connection requirements for each modular unit:

- 110V, single phase, 60 Hz, 15 Amp power to each control panel
- 3/8" connection from chemical metering pump discharge to injection point

- 1/2" socket connection for the soft water supply at 1 gpm at 30 psig
- 4-20 mA signal cabling from WTP SCADA network

Alternative 1 - Layout Overview

Figure 2 below shows a conceptual layout of the proposed fluoride feed system described above. This includes three modular sodium fluoride feed systems, one 10 gpm residential style water softener and storage space for two standard shipping pallets for bulk supplies. Standard exterior double doors allow for pallet access into the room, while operators can enter the room through the standard single door that leads from the chemical feed room. Operators will have access to the primary feed pumps, metering equipment and SCADA controls to be located just inside the new containment room. Figure 3 shows an orthogonal sketch of the inside southeast wall and exterior northeast wall for conceptual reference; outside canopy over loading dock is not shown. The required loading dock extension is highlighted in light blue, required wall penetrations in green, softener tanks in dark blue, pallet storage in magenta and modular saturators in red.

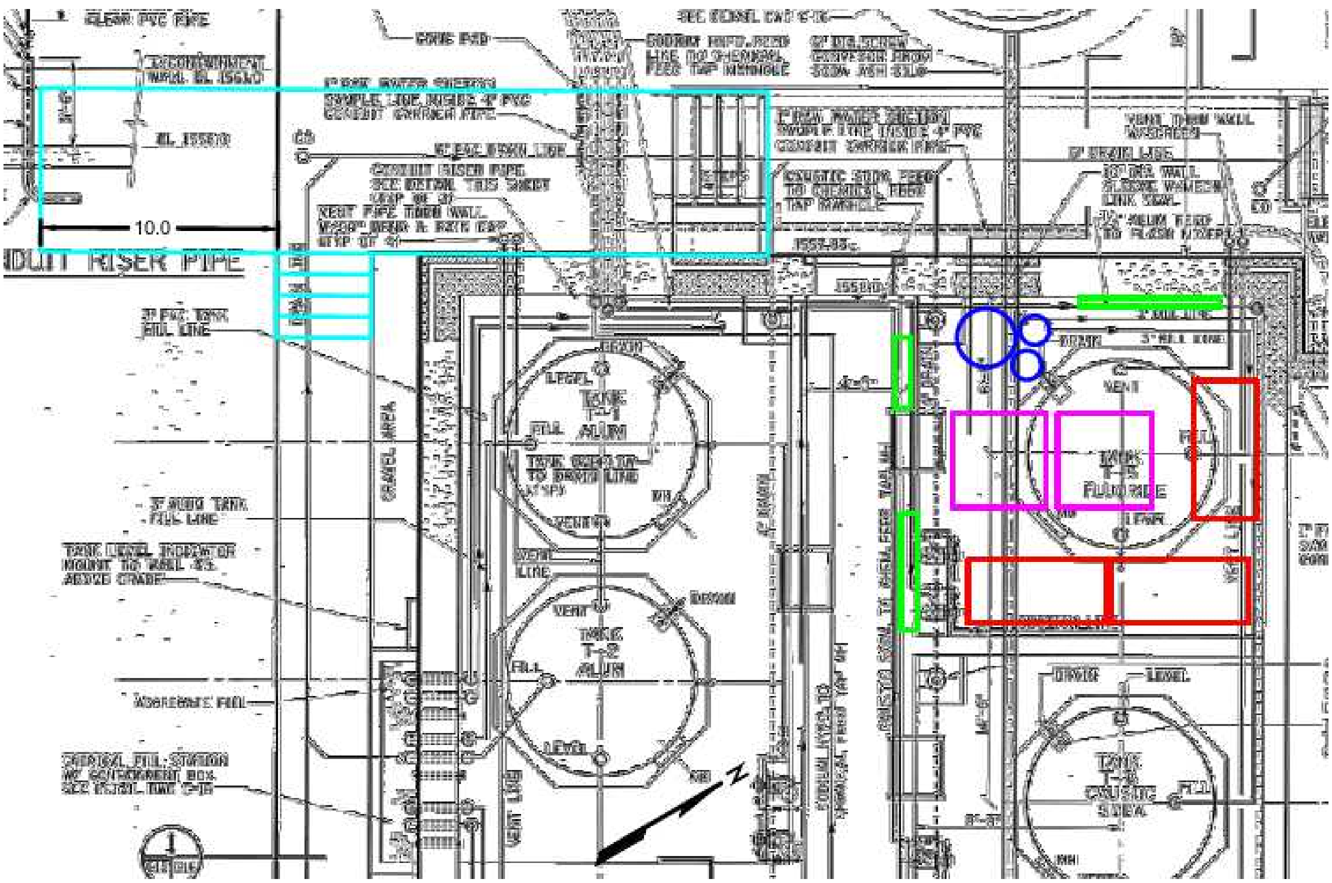

***Figure 2**: Basis of Design Concept, Alternative 1 (not to scale)*

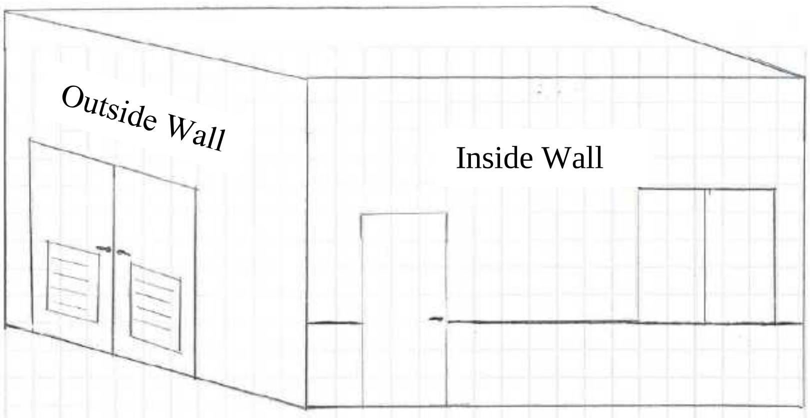

***Figure 3**: Orthogonal Sketch of Alternative 1 (not to scale)*

Operation and Maintenance

Operation and maintenance of the modular sodium fluoride systems will require periodic addition of sodium fluoride salt to each saturator tank and adjustment of dosing rate based on monitoring of ambient fluoride levels in the treated water. Metering pump output will be monitored using the WTP's existing SCADA system. Operators will be required to wear personal protective equipment (bibb, gloves and respirator) to avoid inadvertent exposure to the fluoride salt when charging the saturator units. Handling of bags of salt will require use of a pallet jack or similar bulk material cart to move palletized bags from the loading dock into the new sodium fluoride feed room.

Overall fluoride dosing system maintenance should be minimal as the metering pumps draw from a low concentration solution tank. It is estimated that installation and start-up of the modular units will take less than two hours per system, indicating all three units could be commissioned within one day of contractor mobilization.

ALTERNATIVE 2

Alternative 2 consists of the same chemical feed process as Alternative 1; however, the location for all of the equipment would be in new 20'X12' precast building installed in front of the existing soda ash silo as shown in Figure 4. This approach would require extension of the existing concrete sidewalk/access pad approximately 10-feet to the southeast to provide a uniform base for the new precast building. In addition, a 10' x 10' concrete pad would be added to provide a loading platform into the building, a loading dock canopy will also be included over this area to facilitate all weather operations.

Alternative 2 Layout Overview

Figure 4 shows the overall layout of the new prefabricated building housing the sodium fluoride equipment and sodium fluoride salt pallets in addition to the new concrete pad, color coding is similar to system description provided in Alternative 1 above.

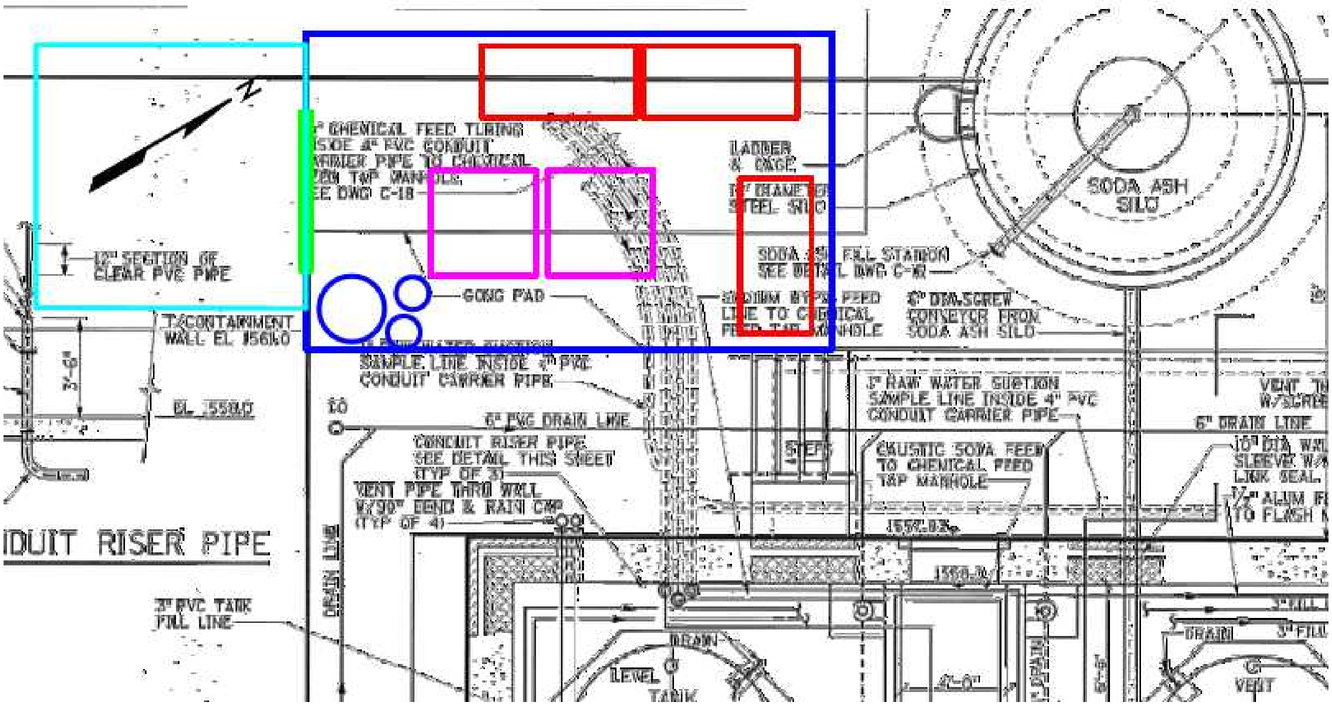

Figure 4: Basis of Design Concept, Alternative 2 (not to scale)

Operation and Maintenance

Operation and maintenance of this system will be similar to description in Alternative 1, primary difference is the system is located outside the existing WTP so operators will be required to traverse outdoors exposed to the weather when servicing the equipment.

Primary maintenance and installation differences between Alternatives 1 and 2 include the need to provide servicing utilities (water, power, and communications) to the new building and the requirement for WTP operators to traverse outside for monitoring, maintenance and control of the new feed systems. The location of this system would require coordination with the required access to the soda ash silo or removal of this silo if redundancy is confirmed (operators report this silo is no longer currently in service).

ALTERNATIVE 3

Alternative 3 would replace the existing 23% HFSA system with a new HSFA system using a smaller 2,600-gallon FRP bulk tank within the existing chemical feed room as shown in Figure 5 below. This alternative would template in the existing containment area but the tank would be half as tall as the existing tank so the entire fluoride feed system could be enclosed and separated from the existing chemical feed room.

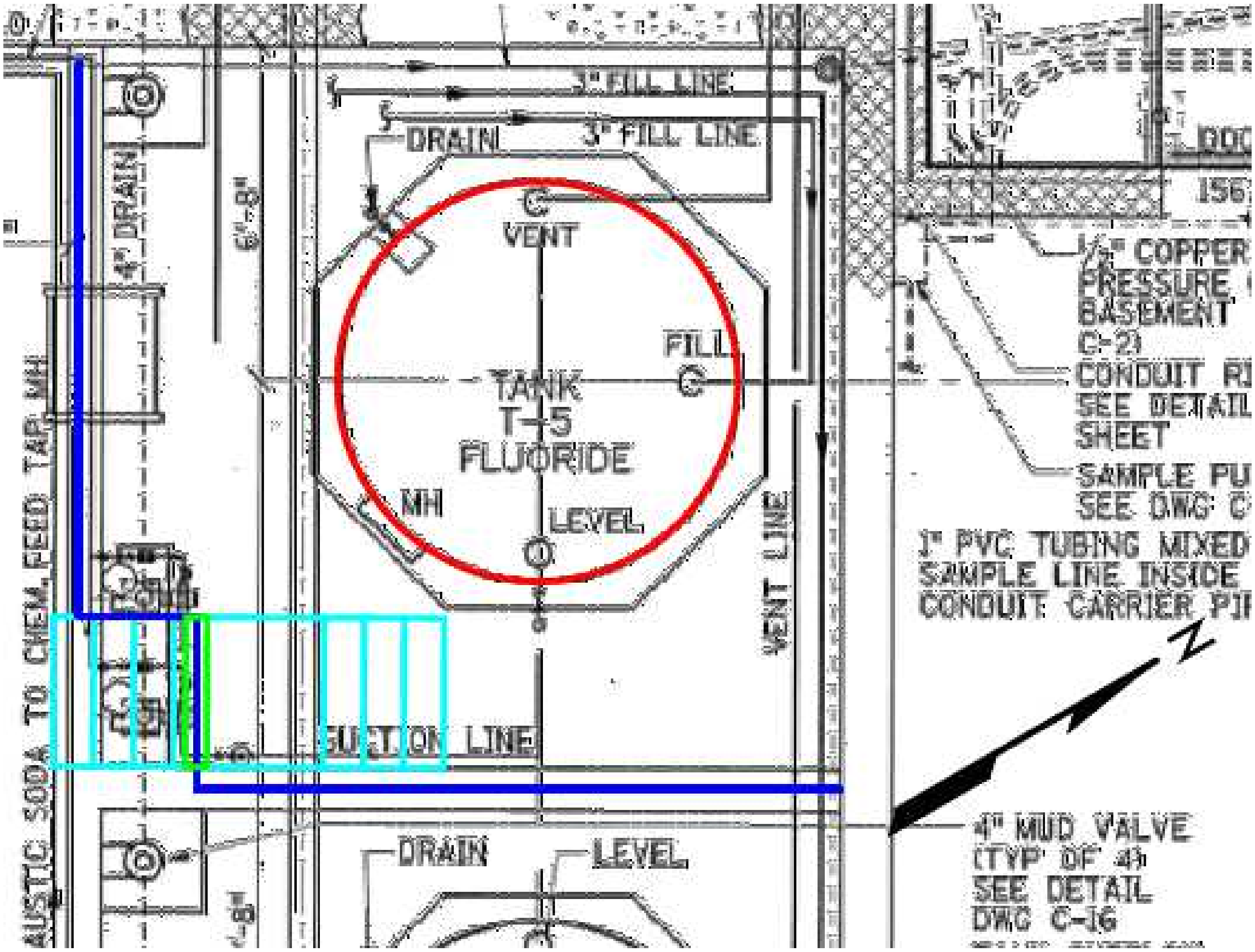

***Figure 5**: Basis of Design Concept, Alternative 3 (not to scale)*

The programmed cost for Alternative 3 includes replacing the existing chemical metering pumps, associated pipe manifold and controls instrumentation. Metering pump setup includes a duplex pump manifold, calibration column, flowmeter, valving and replacement of discharge tubing to connect to the existing fluoride dosing point outside the building. These metering pumps will be remotely monitored and controlled using the existing water plant SCADA system and replacement system cost includes integrating the local pump control panel into the existing SCADA network. The existing bulk unloading and transfer piping for the HFSA system will be reused as part of the HFSA system upgrade, with new fill, discharge, drain and vent piping connections plumbed to the new storage tank.

As described in Alternative 1, a new enclosure room will be constructed on top of the existing containment walls to create a separate HSFA feed room. Due to the new tank size requirements the floor to ceiling height in the new room would extend to approximately 15 feet inside the existing building. An operator's window, pump access portal and interior access door as described in Alternative 1 would be included in this alternative. The current ventilation system and louver would be reused as an independent system for the new room, with a new exhaust fan provide for venting. Stairs and a standard door would be added on the south side of the containment in order to provide access while maintaining the necessary level of secondary containment. To accommodate for the stairs, the metering equipment currently located on the south side of the containment area would be relocated as part of metering pump replacement.

Alternative 3 Layout Overview

Figure 5 shows the overall layout of the new enclosure for the HFSA system inside the existing chemical feed room. The new 2,600-gallon tank has the same diameter as the existing 5,100-gallon tank and therefore, would be placed in the same location on the concrete base. New cast in place stairs would lead into the room from within the existing containment area footprint as shown. The containment wall system would only need to be 24-inches tall under this scenario so a maximum of four stair risers and access door landing would be required. Based on reliability needs the City may consider using two smaller tanks to provide duality of storage this will be further refined during design development with City stakeholders.

Operation and Maintenance

The smaller HFSA tank would result in more frequent fills by the chemical supplier (quarterly vs semi-annually now); however, this should be the only maintenance and operations difference between the WTP's current HFSA system and this proposed system. All existing chemical fill lines and feed piping would be replaced under this alternative.

ALTERNATIVE 4 (ADDENDUM #3 TO 2-8-17 PER)

Alternative 4 is similar to Alternative 3 but utilizes an exterior storage concept to reduce potential for indoor concentration of fluoride vapors within the chemical feed room. This alternative includes siting an exterior rated, 2,600 gallon, 23% HFSA storage tank on the west end of the WTP building using an integrally molded, double wall tank. A metering pump building (precast 10' x 12' building) will be installed adjacent to the tank as shown in Figure 6 below. This approach would require extension of the existing concrete sidewalk/access pad on the west end of the WTP building approximately 12 feet (approximately 250 SFT of concrete pad total) to provide a base for the tank and metering pump building. A sidewalk canopy (optional) will be extended from the rear door of the chemical feed room to the new metering pump building to facilitate all weather operations.

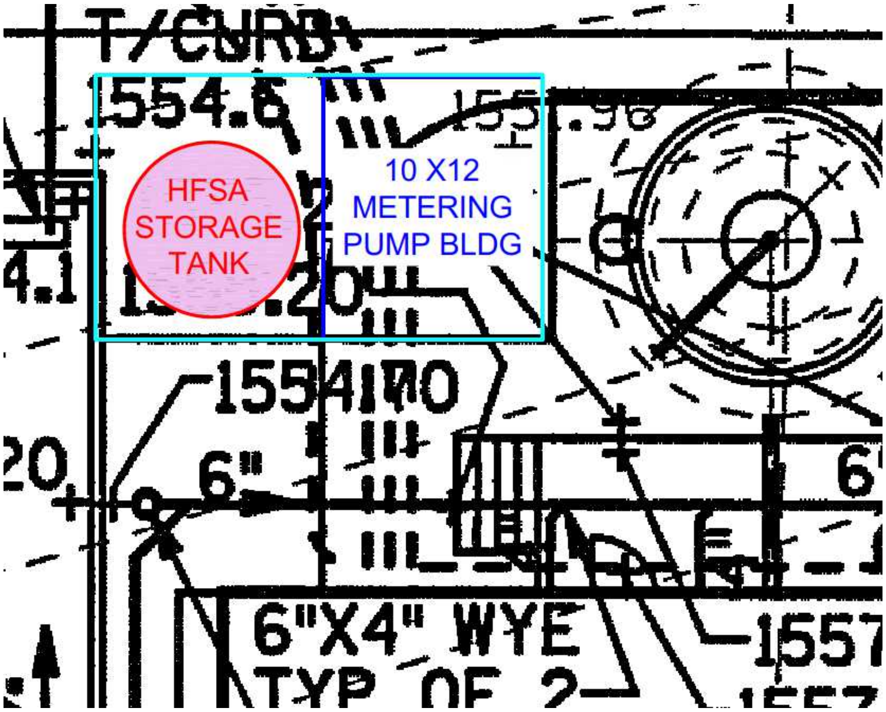

***Figure 6**: Basis of Design Concept, Alternative 4 (not to scale)*

Alternative 4 Layout Overview

Figure 6 shows the overall layout of the new precast pump building, outdoor HFSA storage tank, and new concrete pad associated with this option. A new HFSA delivery connection would be provided as a top-fill feature on the new tank which is sited adjacent to the existing chemical truck service point at the WTP.

Operation and Maintenance

Operation and maintenance of Alternative 4 will be similar to description in Alternative 3. Primary differences include the need to provide servicing utilities (water, power, and communications) to the new meter pump building and the requirement for WTP operators to traverse outside for monitoring, maintenance and control of the new feed systems. The location of this system will also require coordination access to the soda ash silo or removal of this silo if redundancy is confirmed (operators report this silo is no longer utilized).

PROJECT COST ANALYSIS

Table 3 reflects a summary of probable capital costs for each of the four alternatives outlined above based on construction in the 2017 timeframe. As there is no appreciable operational cost difference between the alternatives a comparative life-cycle cost analysis has not been developed for this analysis.

Straight line capitalization of the cost of the proposed improvements over a 10-year period indicates an annualized capital cost of between $19,000-$40,000/year depending on alternative selected (plus amortization currently 3% APR). A portion of these capital costs may be further offset by using grant funds currently available from the VDH Office of Drinking Water. Operational costs are not expected to vary significantly between options and are expected to remain consistent with current operational costs of $20,000/year.

Evaluating cost and options, it is apparent that Alternative 4 is the preferable option based on lower risk of interior vapor accumulation problems associated with the HSFA system. Alternative 4 also appears comparative to Alternative 3 projected capital costs. All systems are projected to have an equivalent design life of 15-20 years based on typical service life of acid feed systems, system replacement value timeframe is therefore projected to be nearly equivalent among the alternatives. Based on selection of Alternative 4, re-establishing the fluoride feed system for the City of Harrisonburg is expected to add up to $0.02 to the cost of treating each 1,000 gallons of water (based on current average water production figures).

Table 3: Opinion of Comparative Project Costs

Item		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sodium Fluoride Feed System(s)		$82,000	$82,000	-	-
Hydrofluorisilicic Acid Metering Pumps and Contol System		-	-	$25,000	$25,000
Hydrofluorisilicic Acid Feed Tank		-	-	$12,500	$18,000
Water Softener		$600	$600	-	-
Miscellaneous Piping and Utility Rework		$2,500	$15,000	$5,000	$5,000
Fiberglass ChemPruf Axial Flow Fan		$2,500	$2,500	$2,500	$2,500
Concrete Loading Dock, Stairs, and Canopy		$52,000	$33,900	-	$20,000
Handrails		$2,500	-	$1,500	-
Metering Pumps		$9,400	$9,400	-	-
Prefabricated Building		-	$35,000	-	$25,000
Demolition Work		$18,000	$12,600	$8,000	$2,500
Enclosure for Inside Chemical Feed Room		$31,800	-	$34,500	-
Subtotal		$201,300	$191,000	$89,000	$98,000
Mobilization/Demobilization (Labor)	10%	$20,130	$19,100	$8,900	$9,800
Subtotal:		$221,430	$210,100	$97,900	$107,800
Design and Permitting Costs	15%	$33,215	$31,515	$14,685	$16,170
Contractor General Conditions and O&P	25%	$55,358	$52,525	$24,475	$26,950
Subtotal Construction Cost		**$310,002**	**$294,140**	**$137,060**	**$150,920**
Contingencies	25%	$77,501	$73,535	$34,265	$37,730
Total Construction Cost		**$387,503**	**$367,675**	**$171,325**	**$188,650**

CONCLUSION

Given the similarity in operational requirements and system configurations considered, selection of the City's preferred alternative will be based upon balancing available funding with personnel safety and operational concerns. Based on review of this analysis, the City operations team has confirmed that Alternative 4 is the preferred alternative from a cost and safety perspective and that alternative will be selected for design development subject to availability of funding.

We understand that funding at this time is indeterminate and the City may wish to pursue conjunctive grant funding from VDH of this project to help alleviate costs. We have made preliminary contacts with the VDH fluoridation program and have determined that grant funds may be available in FY17 for this project depending on timing of the City's funding application. Once the City determines the preferred method of executing this project we are prepared to assist with further design development and grant application coordination as appropriate.

APPENDIX A

VDH FLUORIDE FEED SYSTEM FACTSHEETS

Water Fluoridation in Virginia

A RESOURCE GUIDE FOR POTABLE WATER PRODUCTION FACILITY OPERATORS

FLUOROSILICIC ACID

Your Community Benefits

- Thousands of research studies and 60 years of experience have shown that water fluoridation is safe, effective and the best method of improving oral health in a community.
- Water fluoridation is recognized as a major public health achievement of the 20th century by the Centers for Disease Control and Prevention (CDC).
- Although dental caries (tooth decay) is largely preventable, it remains the most common chronic disease of children aged 5 to 17 years. In the U.S., tooth decay affects
  - 1 out of 4 elementary school children
  - 2 out of 3 adolescents
  - 9 out of 10 adults
- Both children and adults benefit from water fluoridation. Studies have demonstrated that people in communities with fluoridated water have 20 to 40 percent less tooth decay than those in communities without fluoridated water.
- The cost to fluoridate water for the lifetime of one person is less than the cost to treat one cavity.
- Every dollar spent on fluoridation saves $38 in avoided dental bills.
- In 2002, the CDC estimated that 66 percent of U.S. residents who receive their water from community water systems, or 170 million people, had access to fluoridated water. The *Healthy People 2010* goal is to increase this to 75 percent. In Virginia, 93.8 percent of the population has access to fluoridated water, resulting in better oral health, less dental pain, and fewer cavities for millions of people living in Virginia.

Optimal Fluoridation

For Virginia, the most benefit to oral health is achieved when waters are fluoridated to 0.9 mg/L.

Optimal fluoridation is achieved when the fluoride level in potable water is maintained in the control range of 0.8 to 1.2 mg/L.

The benefits of fluoridation are quickly lost when fluoride levels drop below the optimal range.

The U.S. Environmental Protection Agency (EPA) has set both the maximum contaminate level (MCL) and the maximum contaminant level goal (MCLG) for fluoride to 4 mg/L. In addition, the secondary maximum contaminant level goal (SMCLG) of 2 mg/L has been set for fluoride to minimize potential dental fluorosis (staining of the teeth).

Operation

Monitor water fluoride levels daily to ensure optimal fluoridation, and adjust feed rates as necessary.

Send split samples monthly to the state health laboratory to verify your accuracy in measuring fluoride levels.

Each batch of fluorosilicic acid may have a different concentration, which should be supplied by the manufacturer. Blends of different batches in a bulk storage tank could have a different concentration than either batch. Therefore, verify the acid concentration when computing the quantity of acid to add.

Because natural fluoride levels can vary seasonally, verify the quantity of acid necessary to achieve the optimum fluoride level.

Inspect the diaphragms, pistons, or tubing of the feed pumps and replace worn parts. Ensure that replacement parts are fluoride compatible. Also, inspect feed tubes/pipes for possible encrustations and for accumulated air pockets, both of which can restrict flow.

Recheck the pump delivery calibration weekly to verify that the pump is operating properly.

Safety Corner

Although fluoride is entirely safe at the recommended optimum dosage levels in potable water, it can be harmful at more concentrated levels.

Always wear a full-face shield, splash-proof goggles, Neoprene gloves with cuffs, boots, and acid-proof aprons when handling or working with fluorosilicic acid.

Inspect all pipes and tubing regularly for leaks, and repair them promptly if necessary.

Always clean equipment and gear after their exposure to fluorosilicic acid.

Do not consume food or beverages in proximity to the fluoride storage area.

Ensure that fluorosilicic acid storage tanks are sealed and that volatile fumes vented to outdoors.

Important Contacts

For questions on the Fluoridation Program in Virginia, contact the Virginia Department of Health, Fluoride Program, 804-864-7781.

For questions on the health effects of fluoridation, contact the Virginia Department of Health, Fluoride Program, 804-864-7781.

For questions on drinking water in Virginia, contact the Office of Drinking Water, 804-864-7514.

The following Web sites are good sources of information about fluoridation:

American Dental Association:
www.ada.org/public/topics/fluoride/index.asp

Centers for Disease Control and Prevention:
www.cdc.gov/OralHealth/topics/fluoridation.htm

American Water Works Association:
http://awwa.org/Advocacy/pressroom/fluoride.cfm

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Recommended fluoride overfeed actions for community water systems, MMWR 1995 (CDC)

Fluoride level	Actions Recommended
0.1 mg/L above control range to 2.0 mg/L	1. Leave the fluoridation system on. 2. Determine malfunction and repair.
2.1 mg/L to 4.0 mg/L	1. Leave the fluoridation system on. 2. Determine malfunction and repair. 3. Notify supervisor and report the incident to the appropriate county or state agencies.
4.1 mg/L to 10.0 mg/L	1. Determine malfunction and immediately attempt repair. 2. If the problem is not found and corrected quickly, turn off the fluoridation system. 3. Notify supervisor and report the incident to the appropriate county or state agencies. 4. Take water samples at several points in the distribution system and test the fluoride content. Retest if results are still high. 5. Determine malfunction and repair. Then, with supervisor's permission, restart the fluoridation system.
10.1 mg/L or greater+	1. Turn off the fluoridation system immediately. 2. Notify supervisor and report the incident immediately to the appropriate county or state agencies and follow their instructions. 3. Take water samples at several points in the distribution system and test the fluoride content. Retest if results are still high. Save part of each sample for the state laboratory to test. 4. Determine malfunction and repair. Then, with supervisor's and the state's permission, restart the fluoridation system.

+The state might require public notification to prevent consumption of high levels of fluoridated water.