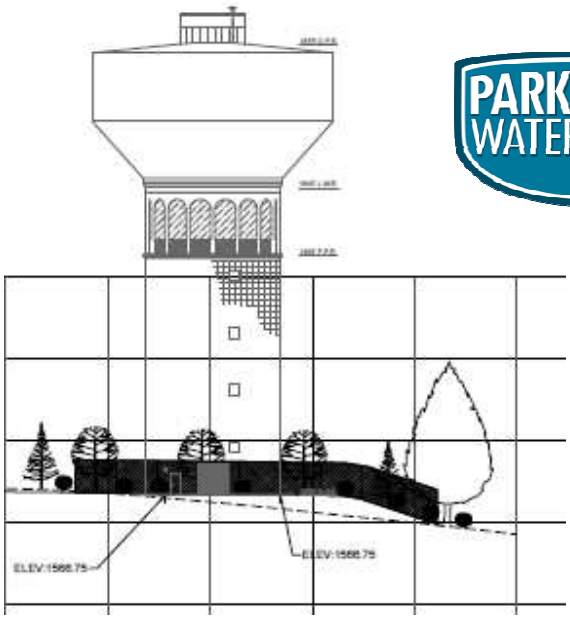

# City of Harrisonburg
# Department of Public Utilities

# Parkview Tank and Pump Station Replacement

## *Preliminary Engineering Report*

## January 2015

City of Harrisonburg Public Utilities: Meranda Lokey, Dave Gray, & Mike Collins

# Park View Tank & Pump Station
# Preliminary Engineering Report (PER)

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## I. Executive Summary

The Preliminary Engineering Report (PER) for the Park View Tank and Pump Station was prepared by Meranda Lokey, Dave Gray, and Mike Collins, all who are employees of the Harrisonburg Public Utilities Department (HPU). The PER culminated an effort that engaged stakeholders with technical expertise of the water system and / or with interests regarding perspectives about Harrisonburg community interests. The PER integrated the many stakeholder inputs into a preliminary project plan and was specifically crafted to engage two additional stakeholder groups, Harrisonburg City Council and the Virginia Department of Health Division of Water Resources. The approvals of these two additional stakeholders are necessary as we approach the critical point of the schedule where the decision is made to move into design or to stop the project.

The project has been driven by HPU's priorities to implementing asset management of critical assets (retiring assets before costs of operation become significant to the life cycle cost) and to providing high service levels pertaining to health and welfare (referring to adequate fire flow protection). The PER provided recommendations regarding scope, cost, and schedule for a proposed Capital Improvement Project (CIP) that will improve the City's water system in the Park View Pressure Zone (PVPZ).

**Scope:** The project is both very standard but yet very unique with regard to scope. A 500,000 gallon elevated water storage tank is proposed to be constructed on the property of Eastern Mennonite University (EMU) who has become a strong partner to the City's agenda. The tank design criteria recaptured State of Virginia regulations while reaching out to include many industry wide advancements. The PER lists a recommendation for an elevated composite (concrete pedestal with steel bowl) structure that is very typical in the industry as it holds high value with life cycle cost, perpetual sustainability, and aesthetic options. What are unusual about the project are the tank amenities that will remain as open options for a considerable time into the project. These amenities arose from stakeholders who had interests beyond the functions of the water system and they desired to add value toward enhancing community and educational purposes. One amenity included an observation floor in the tank structure. The second amenity featured the possibly of assimilating an astronomy education telescope into the function of the tank structure. These options are proposed to remain open as the project schedule permits while evaluating stakeholder support and possible funding sources.

The project also includes a pump station that will be located on property that is currently owned by EMU at the intersection of Mount Clinton Pike, Chicago Avenue and Park Road. The site has been selected in coordination with a City road project that will be completed in the near future. As with the tank, the pump station design criteria is in compliance with Virginia Waterworks Regulations and is also tailored to specific needs of the City's PVPZ water system needs. Aesthetic considerations will be included in the design as the building will be near the

face of the future EMU new entrance. The structure is also near the head of the City walking trail so EMU has asked to consider adding a bathroom facility to the pump station building.

The interconnection of the tank and pump station will utilize a new ductile iron 12 inch diameter pipe. Except across the EMU property where no pipe currently exists, the new waterline will be routed in the approximate area where existing waterline now lays. The route will be located in City R-O-W and will also cross two private properties where easements will be required.

**Schedule:** The schedule is driven to have the project completed by the end of construction season 2016. This will avoid any conflict with upcoming celebration activities at EMU in the summer of 2017 and the project schedule is compatible with both the growth needs of the community and the asset management goals of the City.

What is unique to the schedule is the sequencing of construction that has purposed to reduce the amount of CIP borrowed funding. The schedule proposes to complete utility and site work in the 2015 construction season and to complete the tank and pump station in the 2016 construction season. This will allow for the use of City forces to complete the utility and site work as opposed to using contracted forces, thus rechanneling the funding of some labor, equipment, and overhead costs that have been estimated to total approximately $354,000. Whereas the HPU Field Utilities staff has annually allocated 8,000 man hours to utility construction, this project will dominate the FY 2015 use of those resources. In contrast, the latter part of the schedule accommodates a tank and pump station bid for contracted services to be provided in the 2016 year. The preliminary site work that is performed in 2015 year in preparation for the tank and pump station will allow a more narrow scope of work to be defined for the bid. This will be advantageous to the city by eliminating subcontracts and accompanying markups.

The schedule will uniquely accommodate an interim funding schedule for the FY 2015 activities to be performed. The schedule will also allow for a later borrow schedule such to better define needed external funding while also allowing a window to consider funding for the added amenities.

**Cost:** The following costs to meet water system functions are presented in this PER as follows:

| | |
|---|---|
| Tank Structure Construction | $1,828,000 |
| Tank Site Construction | $ 421,000 |
| Tank Access Construction | $ 84,000 |
| Pump Station Construction | $ 342,000 |
| Pump Station Site Constructions | $ 55,000 |
| Waterline Construction | $ 371,000 |
| Tank Demolition | $ 100,000 |
| Subtotal Construction | $3,201,000 |
| Basic Engineering Services (7%) | $ 224,000 |
| Land Acquisitions | $ 405,000 |
| Legal and Administrative Services | $ 50,000 |
| Non Construction Contingency (10%) | $ 48,000 |
| Project Cost | $3,928,000 |
| | $3,524,000 with following approach: |

- **Appendix A** includes itemization of opportunities to use HPU construction resources that will reduce the CIP funding requirements by $354,000 (Tank site $122,000, Tank Access $32,000, Pump Station Site Work $22,000, and Utility Pipe $178,000). It is also projected that Basic Services can be reduced by $50,000 with use of City Construction Management resources.

The following costs are amenities to the tank that exceed the water system functions in favor of including community interests.

| | | |
|---|---|---|
| Interior Observation Deck Base Elements | $ 346,000 | |
| Interior Observation Deck Completed | $ 600,400 | |
| Interior Observation Deck ADA | $ 189,000 | |
| Telescope Support Framework | $ 196,000 | ($50,000 w/observation floor) |
| Pump Station Restroom | $ 20,000 | |

- Certain stakeholder amenities remain open without funding and are also itemized in cost in **Appendix A.**

## II. Introduction:

Based on information contained in previous studies written in 1996 and 2008, the following evaluation has been prepared to identify the City of Harrisonburg's plan for the water system improvements required in the Park View Pressure Zone (PVPZ). This study is part of the ongoing effort to improve fire flows and future capacity in the PVPZ primarily associated with Eastern Mennonite University (EMU).

This study follows both the 1996 and 2008 studies which identified that a new elevated water tank on the EMU campus would be the most effective way of meeting campus fire flow demands while providing additional storage for the PVPZ. The two previous studies outlined multiple options for improving PVPZ. Over the past 18 years, the City has worked alongside EMU to select the best option by taking into account the needs of both parties. In a meeting held on November 10, 2014, on the campus of EMU, the City again presented the site location of a proposed water storage tank that will be presented in this study.

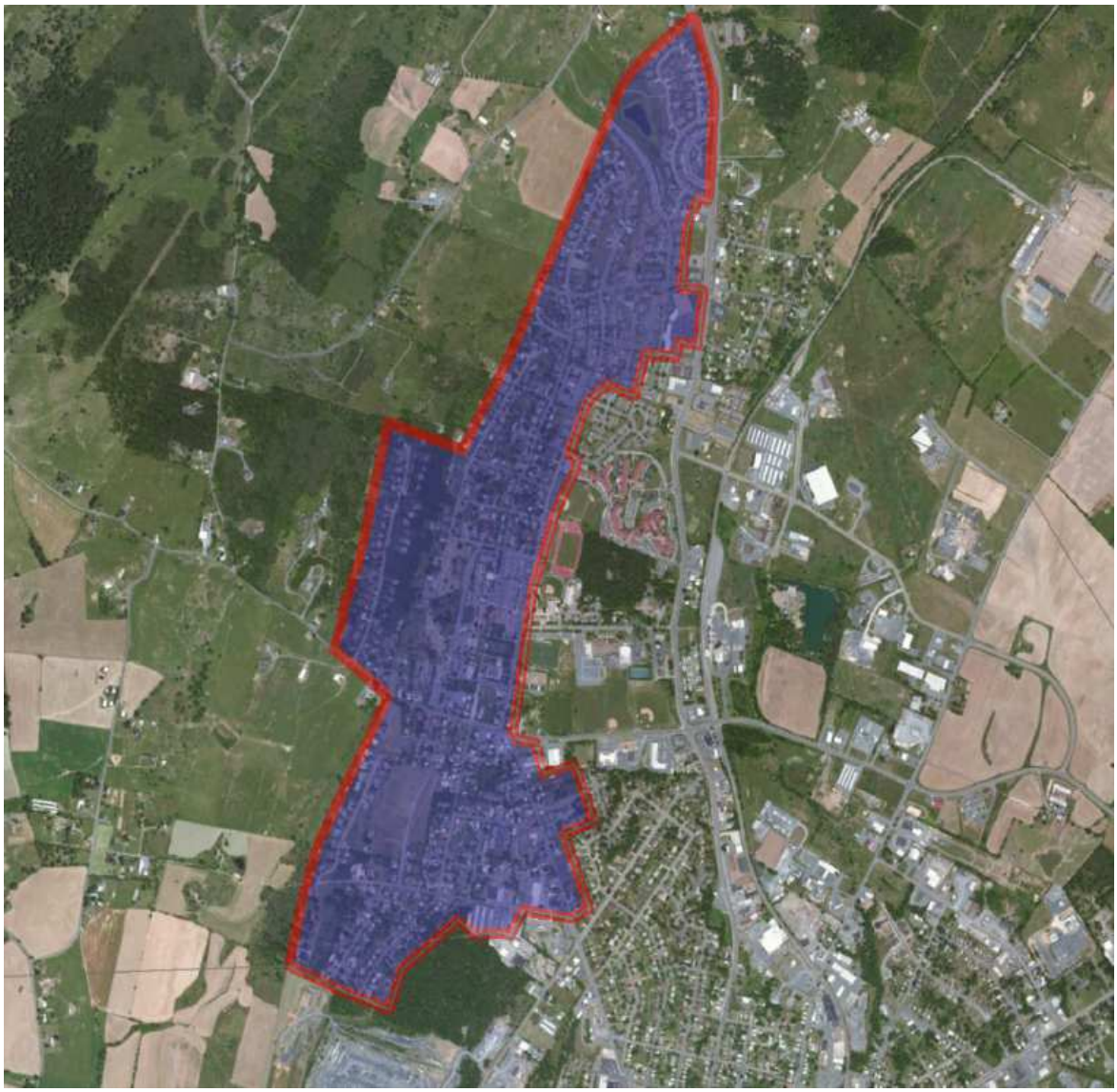
A key factor in selecting the EMU location in both the 1996 and 2008 studies was the requirement to deliver fire flows of 3,000 gallons per minute (gpm) for a 3-hour period to the EMU campus. This Needed Fire Flow (NFF) was developed by the Harrisonburg Fire Department in accordance with Insurance Services Office (ISO) and National Fire Protection Association (NFPA) fire protection standards and is still needed today. Due to system upgrade costs required to deliver this large volume of water for a 3-hour period, the original analysis determined that the tank site within the campus, which has been selected by the City, would be the most cost effective alternative. This site provides systematic benefits, such as enhancing water availability equally throughout the pressure zone, since it is in the central area of the PVPZ.

### Parkview Pressure Zone (PVPZ) Geographical Description

The PVPZ zone is geographically described as the area:

- West of Chicago Avenue from Greystone Street to Mount Clinton Pike
- West of Park Road from Mount Clinton Pike to Buttonwood Court
- West of Virginia Avenue from Buttonwood Court to North Corporate Limits

A geographical presentation of the PVPZ is shown below:



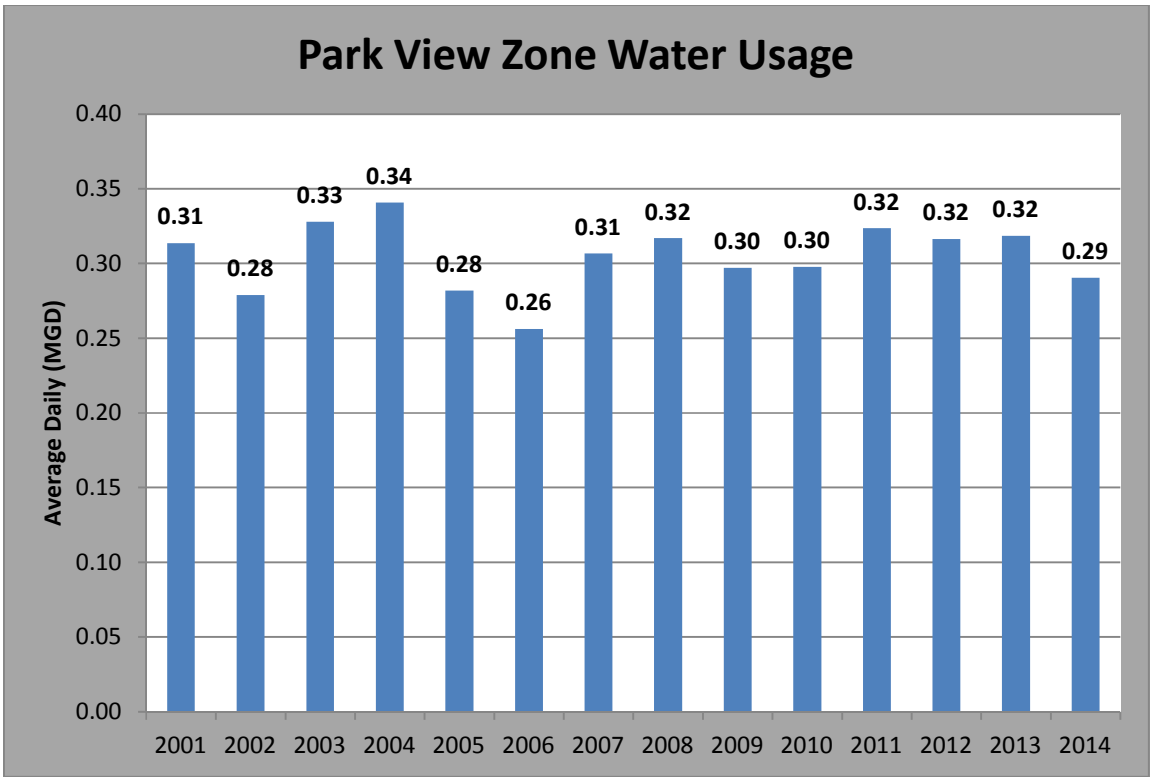
The PVPZ currently has 450.62 total acres in the geographical boundaries that include 47.65 acres of undeveloped land. Below the undeveloped acres are broken down by zoning classifications:

| Zoning Classification | Total Acreage |
|---|---|
| General Business District | 3.65 |
| General Industrial District | 2.32 |
| Residential District | 24.85 |
| Multiple Dwelling Residential District | 13.96 |
| Multiple Dwelling Residential District (Institutional) | 0.86 |
| Medium Density Mixed Residential Planned Community | 1.99 |

**Parkview Pressure Zone (PVPZ) Water System Description**

The existing water asset components of the PVPZ include the water storage tank which is located on Summit Street and was constructed in 1960 to serve the small Park View community and EMU. It is an elevated tank with a useable volume of 68,402 gallons of water. Another critical component is the pump station that is located on Greystone Street. The pump station was also constructed along with the tank in 1960 and has a maximum output capacity of 300 gallons per minute. At this time, the existing tank and pump station are nearing the end of their useful life and the neighborhood has outgrown the design criteria established in 1960.

The current PVPZ average daily water usage is just over a 1/3 million gallons per day. The chart below shows average water usage over a 14-year period.



## III. Project Drivers

Project drivers explain why the project is needed and why it is being recommended at a particular time. They underlie how the project will resolve a problem or issue as well as any background information necessary to understand the existing problem. For the City, our project drivers included:

- **Asset Management** – Defined as a systematic process of operating, maintaining, upgrading, and disposing of assets in the most cost effective manner. The City has engaged this process by having the existing tank professionally inspected in 1993, 2006, and 2011. During these inspections minor repair needs were identified to keep the tank operational; however, in order to continue to operate the tank beyond the year 2016, major repairs will be required. Estimates from the 2011 inspection totaled approximately $267,500 for the repairs. In addition to the tank, the pump station also has issues with obsolete pumps and repairs are becoming increasingly more difficult and costly.

- **ISO – Fire Protection** – The ISO established standards for the amount of water that should be available to fight a fire. Currently it is 750 gpm for residential dwellings, 1,000 gpm for many commercial structures and upwards of 1,500 gpm for institutional structures. The larger structures at EMU have uniquely pushed the requirements to 3,000 gpm. Protecting the existing houses and other facilities in that area are a top priority for the City.

- **Growth** - Future growth and development for the Parkview could be hindered in size, type, and location of development type by the existing limitation in fire protection; this is also a priority that can be resolved by the proposed tank and pump station.

As a major stakeholder in this project, EMU falls under the drivers that have been identified above. The connections include:

- **EMU Large Assets** – Existing large EMU assets are not protected to the recommended fire flow rate and duration.

- **Future Construction** – Future development and projects on the campus are in jeopardy; the City Design and Construction Standards have adopted ISO policy where future development on the EMU campus will not be permitted where the ISO conditions are not met. The proposed tank is crucial to future development within the campus.

## IV. Project Management

The City of Harrisonburg is currently utilizing a Project Management Approach for the Parkview tank and pump station replacement project. We are using a traditional phased approach where steps are completed in sequence. We based our structure around five (5) different developmental components. Those include:

1. Initiation
2. Planning
3. Construction
4. Monitoring
5. Closure

The **initiation phase** of the project occurred in April 2013 with the chartering of the projects for the tank and pump station replacements. The project charters formally authorized the projects. The charter documents described the project scope, identified the Project Manager, it set high level project objectives, described the deliverable expectations, identified stakeholders, and established a concept budget. ..\..\1 Initiation 474\2013-04-29 Charter Record.pdf

The City is currently working within the **planning phase** of the project. Within the early part of this phase we developed our formal scope statement, selected our planning team, created work breakdown structures for our deliverables, identified our activities, estimated our resources, developed a project schedule, developed our budget, and identified our risks. Going forward, conceptual design plans of the final product will be delivered at the end of this phase.

In reality, the planning phase has been underway for nearly 20 years starting with the original "Parkview Tank Study" written in 1996. At the time of this report, the project is closing the preliminary engineering portion of the planning phase. The purpose of preliminary engineering is to set the foundation for a high level design that begins with the process of collecting and analyzing more detailed information about the project and then tying together the original design concepts and the detailed design. The deliverable of the preliminary engineering phase is the Preliminary Engineering Report (PER). In this report, the overall system configuration has been defined and the general framework of the project has been established.

Once the PER is reviewed and approved by all stakeholders, the planning/design phase will move into the detailed design portion. Here designers will build construction plans from ideas that were developed during preliminary engineering. Design will to elaborate each aspect of the project into solid drawings and specifications for each component of the new Parkview system. This detailed design will serve as the basis for the construction phase.

The phase where the work defined in the project plan gets completed is the **construction phase**. This phase involves coordinating people and resources and performing the activities of the project. This phase begins with the bidding process and continues to substantial

completion of the construction. The City's schedule for this phase will be defined in more detail once the planning and design phase is complete.

Another phase of the project is **monitoring and controlling**. This phase runs parallel with the construction phase and consists of observing the project execution so that potential problems can be identified in a timely manner and correction action can be taken to control the project. The benefit of this phase is to ensure that the project performance is observed and measured regularly. Components of monitoring and controlling include:

- Measuring project activities to determine where you are with the project
- Monitoring the scope, schedule and cost against the baseline
- Identifying corrective actions to address risks and issues
- Monitoring and influencing change control.

The final phase of the project is **closure**. The closure process involves the formal acceptance of the project by the owner and the ending of any contracts. The perpetual maintenance of the asset by the owner begins in this phase. This process is a great place to evaluate lessons learned and how to apply them to future projects with the project team.

HPU will undertake the Project Management duties and responsibilities for this project.

## V. Project Schedule

As stated earlier in the section, the City is currently in the planning phase of the project which included the preliminary engineering component. This was a critical step in the project because the PER established a preliminary scope, cost, and schedule. With the PER completed, design and funding options can be discussed with all stakeholders. HPU has developed the remaining schedule for this project to have the closure completed by the end of 2016. This will avoid any conflict with upcoming celebration activities at EMU in the summer of 2017 and it is compatible with both the growth needs of the community and the asset management goals of the City. A Gantt chart schedule for the project is provided in the **Appendix B** of this document.

What is unique to the schedule is the sequencing of construction that has purposed to reduce the amount of CIP borrowed funding. The schedule proposes to complete utility and site work in the 2015 construction season and to complete the tank and pump station in the 2016 construction season. This will allow for the use of City forces to complete the utility and site work as opposed to using contracted forces, thus redirecting some labor, equipment, and overhead costs. Whereas the HPU Field Utilities staff has annually allocated 8,000 man hours to utility construction, this project will dominate the FY 2015 use of those resources. In contrast, the latter part of the schedule accommodates a tank and pump station contract bid in the 2016 year.

The schedule will uniquely accommodate an interim funding schedule for the FY 2015 activities to be performed. The schedule will also allow for a later borrow schedule such to better define needed external funding while also allowing a window to considering funding for the added amenities.

**Planning Phase:**

As previously mentioned, the planning of the Parkview tank and pump station replacement started nearly 20 years ago. Since that time, many project activities have already taken place to get the City, EMU, and other stakeholders where we are today. Below is a list of activities that have been completed as well as activities that will take place in the future.

### Completed Activities

- Identified & Formulated High Level Scope – Prior to 1995
- Services Contract for Professional Engineering Services – February 1996
- Preliminary Engineering Report – February 1996
- Tank Site Alternative Analysis – September 2008
- Internal Review of System Options – November 2011
- System Options Report – November 2011
- Develop Stakeholder Management Strategy – October 2012
- Internal Review of Tank Site Options – October 2012
- Site Owners Stakeholder Input – February 2013

- EMU Directors Stakeholder Input – March 2013
- Target Site Owner Stakeholder Partnering – April 2013
- City Council Stakeholder Input – April 2013
- Preliminary Geotechnical Evaluation – May 2013
- EMU Faculty Stakeholder Input – May 2013
- On Line Forum Stakeholder Input – November 2013
- Public Meeting Stakeholder Input – January 2014
- City Tank Location Decision – November 2014
- Preliminary Access Route and Tank Site Planning - December 2014
- Pump Station Location Selection Process - December 2014
- Preliminary Tank Planning – December 2014
- Preliminary Waterline Route Planning – December 2014
- Preliminary Pump Station Planning – December 2014
- Preliminary Tank Amenities Planning – December 2014
- PER Development – December 2014

## Future Activities

- Operations & Performance Team (OPT) Approval of PER – February 2015
- City Council Approval of PER – January : February 2015
- Finalize Geotechnical Investigation- January : February 2015
- VDH Review of PER – February: March 2015
- Final PER Document – March 2015
- City Council Approval of Initial Funding Strategy – March 2015
- Phase I – Utility / Site Work Design Procurement – March 2015
- Phase I – Utility / Site Work Design – March: May 2015
- Phase I – OPT approval of Construction Drawings Phase I – May 2015
- Funding for Utility and Site Work – May 2015
- Phase II – Tank / Pump Station Design Procurement – May 2015
- Phase II – Tank / Pump Station Design –May: August 2015
- OPT Approval of Construction Drawings – August 2015
- City Council Approval of Final Budget Funding Strategy – August 2015
- VDH Review of Construction Drawings Phase II – August: October 2015
- Complete Drawings for Tank & Pump Station – October 2015
- Tank and Pump Station Construction Procurement – November 2015
- Tank and Pump Station Funding – November 2015

**Construction / Monitoring & Control**

- Construction Utility / Site Work Off Campus - May : August 2015
- Construction Utility / Site Work On Campus – May: December 2015
- Tank and Pump Station Construction – January: November 2016

**Closure:**

- Commissioning / Contract Closure / Project Closure – December 2016

## VI. Design Criteria and Construction Deliverables

**Tank Structure:**

The design criteria for the Park View Tank PER has been organized into several components that are defined in greater detail below. These subject topics include: i) the base design of the tank, ii) the tank site design, iii) the site access design, iv) various tank amenities and v) construction cost.

**Base Tank Design:** Four parameters drove the initial design of the future Park View Tank. These four parameters were volume, elevation, location, and type of structure. They were chosen as best fit the needs of the City's water system. Further discussion of each is listed below:

*Volume*: Tank volume, selected at 500,000 gallons total effective capacity for the future Harrisonburg Park View Tank, has considered two parameters.

1. Pursuant to Virginia Administrative Code Chapter 590, 12VAC5-590-690-B, "Minimum acceptable effective finished water storage for domestic purposes shall not be less than 200 gallons per equivalent residential connection at minimum pressure" where:

   "Equivalent Residential Connection" (ERC) means a volume of water used equal to a residential connection which is 400 gallons per day unless supportive data indicates otherwise"

   And

   "Minimum pressure" is a least 20 psi at the service connection based on the greater of maximum hour or maximum day flow plus applicable fire flows.

   As noted previously in this report, most recent records indicate that the annual average daily water consumption in the Park View Zone has been recorded at 0.34 MGD. Projecting how this demand might change with future conditions requires recognition of several influencing factors that are quite dynamic. One such factor is the undeveloped areas in the Park View Zone and how they will develop with respect to water demands. The second factor is the possible change in water use patterns among existing developed areas including potential expansion of water usage on the EMU campus. And finally, as HPU continues with its "Energy Management Initiative", many efforts will be considered to reduce the geographic definition of the Park View Water Zone. With great degree of hypothesis, HPU considers its future demand for the maximum day to be no greater than 0.50 MGD. As shown below, this parameter requires no less than 0.25 MG or 250,000 gallons of effective capacity.

- ❖ Water consumption = 0.5 MGD
- ❖ Water consumption =1,250 ERC
- ❖ Minimum effective tank volume per 12VAC5-590-690-B = 0.25 MG
  (1,250 ERC X 200 gallons per ERC = 250,000 gallons

2. The second parameter that was considered to size the tank was the Insurance Service Office (ISO) guidelines that the City of Harrisonburg has adopted in it "Design and Construction Standards". The standards specify fire flow and duration that are recommended for various applications. The size of the future Park View Tank in combination with the water that is input to the zone from pumping will directly influence the duration of the available fire flow.

   In 1996 Wiley & Wilson delivered to the City its first evaluation of fire protection conditions in the Park View Zone. This study concluded with the ISO driven recommendation to provide 3,000 gallons per minute to the Eastern Mennonite College Campus for 3 hours duration at 20 PSI. This recommendation remains applicable today as the City has moved forward to adopt the ISO Standard into its land development planning requirements.

   Pumping infrastructure to the Park View Zone will also be upgraded with this project. Additional information is provided later in this document. There are three potential sources to provide future pump input to the Park View Water Zone.

   - The major input will be from a new pump station that will be constructed in this project at a location nearer to the new tank site at the EMU Campus entrance on Park Road at the intersection of Mount Clinton Pike and Chicago Avenue.

   - The existing Park View Pump Station at Greystone Street will be evaluated for continued use or abandonment.

   - The Garber's Church Pump Station, currently in the City's inventory but not used to provide water to the Park View Zone, will be evaluated as a multipurpose application. One of the purposes would provide water to the Park View Zone.

   HPU expects to maintain at least 750 gallons per minute pumping capacity into the zone at all times. As shown below, this parameter requires no less than 0.405 MG or 405,000 gallons of effective capacity.

   - ❖ Minimum effective tank volume without pump input = 0.540 MG
   - ❖ Minimum effective tank volume with pump input at 750 gpm input = 0.405MG

Referencing the ISO fire protection planning as the governing criteria in the decision of tank volume and matching that volume with standard available sizes within the industry, the selected volume is as follows:

| |
|---|
| Future Park View Tank= 500,000 gallons or 0.5 MG |

The entire contents of the tank will be considered as "effective volume" recognizing that the elevations of the lowest possible water level will sustain the minimum required pressures. The next section, "Elevation", provides more insight.

*Elevation***:** The future Park View Tank is a replacement for the existing Park View Tank. The latter is an elevated structure with the following elevation and height setting and has been recognized to have 100% effective capacity.

- Bowl floor 1629.54 feet
- Overflow elevation 1644.44 feet
- Effective range 14.90 feet

Whereas the existing tank provides acceptable minimum working pressure to customers under normal operations, the elevations of the future tank bowl floor will be no lower than the existing elevation of 1629.54 feet. This will attempt to minimize impact upon the general service population in the Park View Zone as the users may have designed fire systems and may have grown accustomed to existing minimum pressure conditions.

As discussed in the following section, the location of the future tank will differ from the existing tank. Piping and pumping infrastructure updates will also be included. Hydraulic model validation is currently active with purpose to provide assurance that the integrated water system meets all requirements of 12VAC5-590-690-C. As noted earlier, this regulation mandates a minimum 20 psi working pressure at the serviced connection based on the greater of maximum hour or maximum day demand plus applicable fire flow.

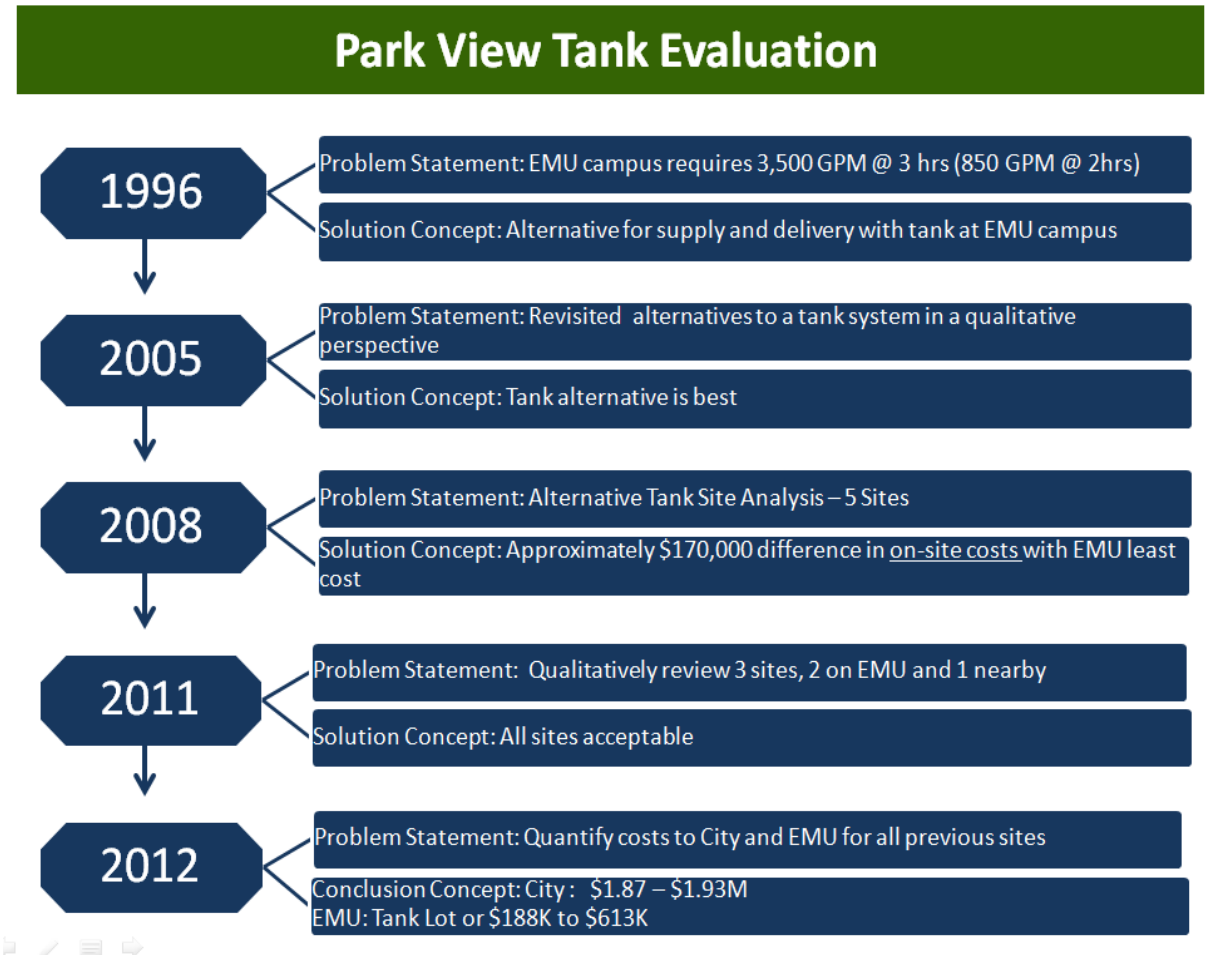
*Location:* The location of the future tank will differ from the existing tank. This decision has been made with the consideration of multiple issues:

- The first consideration was an engineering rule of thumb principle that suggested that the storage should be placed as close to the high demand area as would be reasonably possible.
- The second consideration was the issues of cost and functional feasibility within the water system performance. Specifically stated, the site should be of sufficient elevation

such to lend itself to constructing an affordable structure that can achieve the minimum pressure criteria for this project.

- The third consideration was how well the site will accommodate initial construction and then sustainability activities thereafter.
- The fourth consideration was the availability of a cooperative land owner that would partner with the City.

In conclusion, the "EMU Tank Site" alternative was chosen. The progression to this conclusion began with the 1996 study by Wiley & Wilson which used the engineering rule of thumb to place the tank nearest to the largest area of demand. In 2005, the City visited a qualitative evaluation of alternatives to an elevated tank system. In 2008, Wiley & Wilson completed the "Alternative Tank Site Study Analysis" which added four potential sites to the "EMU site". The 2008 study delivered its recommendation based mostly on the costs to construct the tank and to install infrastructure that will be required to deliver the fire flow to the EMU campus. In 2011, the City expanded the 2008 evaluation beyond cost. This study included a qualitative matrix evaluation of issues and sub-issues that pertained to fire flow, lifecycle cost, customer impacts, water system performance, and ancillary concerns. In 2012, the City moved the latter study to a quantitative format. This decision process is shown in the following:



*Type of Tank:* An elevated tank will be required as influenced by the selection of the tank site and the other criteria as previously referenced. Whereas the City desires the best lifecycle cost and an aesthetically acceptable structure, a composite type tank was the most likely choice for this project. The tank will be designed and constructed to comply with 12VAC5-590-1080 and AWWA D-100. In addition, **Appendix C** includes the following information about the composite elevated tank:

- Product brochures are provided to visualize the final concept of the tank.
- Product drawings are provided as detail guidelines to the design process.
- Product specifications are provided to guide the quality during the design.

Making reference to **Appendix C**, the 500,000 gallon tank will have a tank bowl diameter of 50 feet, a tank bowl range of 37.5 feet, and a support structure diameter of 28 feet. As discussed under the "Elevations" section above, the future tank bowl floor will be no lower than the existing elevation of 1629.54 feet; therefore, the overflow of the new tank will be 1667.04 which will be 22.6 feet higher than the existing overflow.

The composite structure targets the effective tensile strength of steel in the bowl and the compressive strength of concrete in the support structure. The self supporting dome roof minimizes interior supports in the vapor prone areas of the tank that are prone to corrosion. The combined unit produces a long lasting and reliable structure with minimized life cycle costs to its owner. Both the concrete and the steel can be tailored to provide unique aesthetic value. The concrete support structure lends itself to a multi-purpose use of interior space such as the amenities desired by stakeholders and discussed later in this document.

*Base Tank Features:*

Water Quality: At the expected average demand in the service zone of 0.34 to 0.5 MGD, the age of the water should be about 1.47 to 1.00 days. This benchmark is important from the perspective of water quality. As the size of the tank increases the water age also increases. Aging water can lead to deterioration of the water quality as a result of disinfectant residual loss and bacterial re-growth. Therefore, facilities should be operated to ensure that the age of water is not excessive by taking into account the quality of the water, its reactivity, the type of disinfectant used, and the travel time before and after the water's entry into the facility. Since this monitor parameter will be specific to the conditions that will be incurred in the future, the City will use its SCADA monitor system to display water age in the tank using the approximation of (See **Appendix D**):

Water Age = {0.5 + (V1/(V2-V1))} (td + tf)

Where V1 = volume of the water at the start of the fill period
V2 = volume of the water at the end of the fill period
td = the draw time
tf = the fill time

With the water age made readily available, City staff can work to understand benchmark levels and to use these self directed benchmarks to control disinfectant levels and to set fill / draw cycles to control water quality. To make this benchmark readily available, the City SCADA system will be programmed to address to benchmark this issue. The 0.5 MGD tank volume is not expected to present problems that cannot be addressed under this design.

Although water age is an important factor in water quality, poor mixing in storage facilities can exacerbate aging problems by creating zones of older water. During design, the City will consider options to facilitate a complete mix water model and avoid dead spots or plug flow. Several means and references are provided in **Appendix D** and might become available to provide for achieving this goal. For costing purposes, the Caldwell mixing system has been included in this PER; however, the City will pursue options to achieve the most efficient and effective means of mixing.

Corrosion Control: The steel component of the tank will be provided a painted corrosion protection system both internally and externally pursuant to AWWA D-100. This system is most likely to be an epoxy application.

The City of Harrisonburg generally has practiced protecting its inventory of existing potable water storage tanks by installing a cathode type protection system at each tank. The system provides a sacrificial anode type unit meeting AWWA D106-10. The cost estimate for this project has provided for adding a similar type cathode protection system for the specific purpose of protecting the interior submerged steel surfaces of the steel bowl structure at the top of the tank.

Safety features: Included in the project are access and safety provisions that include a handrail for the exterior roof, an internal ladder on the access tube that will allow entry through the bowl to the outside roof, and provisions for adding lightning protection. The former two provisions are necessary and the latter feature will be further evaluated in terms of valid requirements.

Other features: Included in the cost estimate are provisions to provide lettering and decorative graphics to the exterior of the elevated bowl. It is most likely that these letters and graphics will depict a logo for Eastern Mennonite University. This provision is completely optional and may be bid in this manner.

The base design also includes provisions to accommodate cellular antennas; however, this is also an option.

Also included in the design is a concrete floor inside the base which will make the initial effort to use the tank for multipurpose functions. This provision is also optional.

*Cost:* Appendix A provides an itemized estimate of $1,828,000 to construct the tank.

**Tank Site:**

A preliminary grading plan and a geotechnical evaluation have been completed at the proposed tank site. General information pertaining to these issues is provided in **Appendix E** of this report. The following are inclusive:

- Site preparation
- Allowance for foundation improvements
- Paving around the tank site
- Landscaping to accommodate integration into EMU site culture
- Provisions for electrical and communications
- External lighting at the tank base
- Water system piping, connections and control vault
- Accommodations for tank water overflow events should they occur

The estimated cost for site work is estimated in the **Appendix A** is $420,600; approximately $122,000 of the work can be directed to using HPU resources.

**Construction & Maintenance Access:**

Access to the tank must be considered in terms of both construction and sustainability. Construction access to the site was limited to only one option; it requires crossing EMU from Hillcrest Drive to the proposed tank site. Two options were available for perpetual access; the construction access route and a second route that began at Mount Clinton Pike and continued through Village Square, following the pipeline easement, before entering onto EMU property.

Final recommendation has consolidated the construction and perpetual access across EMU from Hillside Drive to the proposed tank site. The EMU property owner has agreed to this concept as the road will be located to the rear western boundary and the project will provide aesthetic amenities to integrate into the EMU land use agenda.

**Appendix E** provides information for construction that includes: 630 lf access road, 75 LF of ADA compliant walking trail, a storm pipe with one DI, and segmental block retaining wall along a section of the road. The road and trail typical section is planned to be 6” 21-B stone under laying 2” of SM-9.5AL surface mix asphalt. A bio-filter is assumed to be a bio-retention type unit with under drains, filter media, and plantings.

The estimated cost for access road site work is estimated in the **Appendix A** is $84,000; approximately $32,000 of the work can be directed to HPU resources.

**Stakeholder Amenities:**

Comments were received from the general public by the City of Harrisonburg during scheduled opportunities. The comments that were received generally followed a theme suggesting that efforts should be given such that the future tank structure will bring added value to the community and to the mission of EMU. As such, these added amenities would be beyond the goals and costs required for the functionality of the water system. The most interest was shown in the following:

- An observation deck
- A provision to continue and enhance the astronomy program at EMU
- An accommodation to optimize long term use and management of the existing structures at the north end of the EMU tank property site that is adjacent to Hillside Drive. These structures included an abandoned observatory, a radio station, and a university discipleship center.

The study reports for these additional interests are generalized below and are provided in detail in **Appendix F**.

Observation Features: An observation deck was one most prominent interest that was identified by the comments that were received. The concept has possible contribution back to EMU and the community. In response, the City authorized a preliminary study that was completed and featured an exterior cantilever deck with an observation floor. The original cantilever deck was provided with a basic open air environment.

The study then advanced the original concept to include an enclosure of the deck with climate controlled conditions. Recognizing that previous options were limited to a small occupancy and no ADA access, additional features were added to overcome these limitations.

As an alternative to the climate controlled option, the study then gave evaluation to an interior observation floor that has become common in other applications for the type of tank chosen for this project. This latter option has gathered greater momentum from the City's partner (EMU) as the interior floor would provide significant opportunity to integrate with the education agenda. At this time, no external source of funding has been identified to make this option feasible to the project; however, the time frame will remain open until the time for award of the tank contract.

Astronomy Enhancements: Comments were received during the stakeholder input efforts to also consider the placement of a telescope on the top of the new tank structure. Whereas EMU had once operated an observatory in near proximity to the future tank site, consideration was given to resurrecting this opportunity. The vision of this effort would allow for disposal of the old observatory infrastructure and possibly open opportunity for a joint JMU and EMU educational effort.

In the previously referenced study for adding the observation features, the focus was expanded to include structural provisions within the initial tank structure such that a telescope could be placed at a later date. Following the comment period, a team with interests represented for EMU, JMU, and the City held discussions pertaining to this matter. Whereas JMU is currently exploring the placement of a telescope in an alternative location, the proposed Park View Tank provides pros and cons to consider as an alternative. At this time no conclusion or external source of funding has been identified to make this option feasible to the project. The telescope option, as similar to the observation deck, will remain open until the time for award of the tank contract.

Integration with Existing EMU Structures: The final amenity that was considered was a building connection that would integrate the existing EMU Discipleship Center to the new tank structure. This amenity would require the tank to be located to a new site approximately 500 feet north of the selected tank site. This location was preferred by a minority number of stakeholders and presented several disadvantages such as interferences with the discipleship center, the observatory, the radio station operations, EMU priorities, and neighbors. This option is no longer open for consideration.

Conclusion: Both the interior observation deck and the astronomy telescope foundation appear to have retained some momentum at this time. If either or both gain additional momentum and funding sources by the time for design, the project may move forward with open consideration to including the "basic elements" as an option in the bid.

The basic elements refer to constructing the infrastructure that is needed in the initial tank structure that will allow the stated amenities to be constructed at some undefined time after completion of the project. The consideration as an option will allow the City to receive prices that are definite and to accept or not accept the option in making the award.

The preliminary engineering studies for all amenities are provided in detail in **Appendix F** of this document. Included in the same **Appendix F** is a table that displays the preliminary estimates for the basic elements and the total cost for each amenity; these cost have been further refined in **Appendix A**.

Funding will be a significant parameter in the decisions for undertaking the initial basic elements and then the completion of the amenities.

- The cost estimates for the observation floor base elements, then the completed amenity, and then ADA accommodations are included in Appendix A at $346,000, $600,000, and $189,000, respectively.

- The cost estimate for the base elements of the telescope support foundation is included in Appendix A at $196,000 or at $50,000 as an addition to the observation floor.

**Pump Station:**

The preliminary planning for the Park View Pump Station is organized into several components that are defined in greater detail below. These components include: the base design criteria of the pump station, the base features of the station, additional amenities to be considered in the design and cost.

**Base Criteria:**

The initial basic design of the pump station will be driven to meet four primary requirements. The first of these is the required transfer rate of the station. The second is the head conditions to be overcome by the station. The third is the number and type of pumps to be used. The fourth and final criterion is the location of the station.

*Transfer Flow Rate*: The transfer flow rate must be designed to balance the peak demand of the system, the fire flow delivery, and the pump run times.

Peak demand: As noted previously in this report, most recent records indicate that the annual average daily water consumption in the Park View Zone has been recorded at 0.34 MGD and projects the future demand for the maximum day to be no greater than 0.50 MGD.
Recognizing this future demand projection, the peak hourly demand for the Park View Zone is calculated as 1.625 MGD (1,128 gpm) where the Peak Demand is equal to the Average Daily Demand times a Peak Factor as follows:

$$PF = (18 + p^{0.5}) / (4 + p^{0.5})$$

Where p is the population equivalent in thousands, and the population equivalent is 100 gallons per person per day.

500,000 gpd / 100 = 5,000 population equivalent (p = 5.0)

$$P.F. = (18 + 5.0^{0.5}) / (4 + 5.0^{0.5}) = 3.25$$

Peak Hourly Demand = ADD x PF = 0.50 x 3.25 = 1.625 MGD (1,128 gpm)

Fire demand: As stated above in the tank sizing section of this report, the size of the future Park View Tank, and the water zone input from pumping, will directly influence the duration of the available fire flow. The City currently recognizes the maximum required fire flow demand in the Park View Zone to be 3,000 gpm for a 3 hour duration at 20 psi.

There are three potential sources to provide future pump input to the Park View Water Zone.

- The major input will be from the new pump station that will be constructed in this project at a location near the intersection of Mount Clinton Pike and Chicago Avenue.

- The existing Park View Pump Station at Greystone Drive will be evaluated for continued use or abandonment.

- The Garber's Church Pump Station, currently in the City's inventory but not used to provide water to the Park View Zone, will be evaluated as a multipurpose application. One of the purposes would provide water to the Park View Zone.

As stated in the tank sizing discussion above, HPU expects to maintain at least 750 gallons per minute pumping capacity into the zone at all times. This pumping rate, combined with a tank of at least 0.405 MG will meet the maximum fire flow requirements for the zone.

If not properly sized, the pumps may either run too long or too short to be efficient for the system. The pumps should be sized to run above the normal demand rate so that they can fill the tank throughout the day, but should not be sized such to fill the tank during periods of maximum daily demand and fire flow. Recognizing the average daily demand of 0.50 MG (347 gpm) and a fire flow of 3,000 gpm, a pump design rate of 750 to 1,000 gpm would be appropriate.

The pump station will be equipped with a SCADA unit and connected to the City's SCADA network. When the network detects a predetermined water level in the tank a pump will engage to transfer water into the Park View Zone. If the system were designed to engage a pump when the tank reaches 50% of the available storage and while the domestic demand on the system was at the average rate of 347 gpm, one pump would be sufficient to begin filling the tank. An average pumping rate of 1,000 gpm would satisfy the 347 gpm domestic demand while delivering 653 gpm into the tank. This one pump would run 6.4 hours to refill the tank to full condition.

*Head Conditions*: The pumps in the station must be sized to provide the required flow rate with enough energy to raise the water level in the tank to the top of the bowl. This includes a static component that is driven by the hydraulic grade difference between the energy on the inlet side of the pumps and the water level in the tank bowl. In addition to the static component, the pumps must also be able to overcome the friction losses added from the flow of water through the pipeline network. During full flow conditions, this total energy head requirement is calculated to be 140 feet of total dynamic head, TDH.

Static Head: The pump system must be designed to integrate with the system pressures within the Park View Zone. Recognizing the tank elevations discussed in earlier sections, the static hydraulic grade elevation to be expected at the discharge side of the pump station will range from a maximum of 1667.04 to a minimum of 1629.54 as the tank cycles from overflow to the bottom of the bowl. Pressure on the discharge side of the pumps will depend on the elevation

of the site where the pump station is located. Currently the pump station is proposed near the intersection of Mt. Clinton Pike and Chicago Avenue at an approximate elevation of 1420. Therefore the static system pressure at the pump station discharge may be expected to range from 107 psi to 91 psi.

The pumps are not required to impart all of this energy to raise the water to the tank, as some pressure is already supplied from the water on the inlet side of the pumps. The supply system where the pump station is to be located has a normal working pressure of 58 psi. Therefore the pumps will need to add 107 – 58 psi = 49 psi (113 feet) of static head.

Dynamic Head: The dynamic head calculations will include the various head losses that occur in the system during flow conditions. These losses happen on both the suction and discharge sides of the pump station.

In the summer of 2014 the HPU conducted a fire hydrant flow test in the system supplying the suction side of the proposed pump station. During this test, 993 gallons per minute was flushed from a hydrant approximately 400 feet east of the proposed pump station site. During this test the system pressure dropped from a working pressure of 58 psi to a residual of 50 psi at the test hydrant. This residual pressure will be used as the inlet supply pressure for the station. With the station location, HPU is considering a project to re-valve a portion of the water system to provide a second supply line to the inlet of the pump station. This would improve the supply hydraulics and reduce the energy requirements of the pump. This will be validated through modeling during the detailed design process.

Similarly, on the discharge side of the pump station, the biggest influence on hydraulic losses will be the design flow rate and the transmission piping to the tank. Preliminary design includes approximately 2,300 feet of new 12" pipe be constructed between the pump station and the tank. At a design flow rate of 1,000 gpm, the friction loss in this pipeline is 3.4 psi.

*Pump Selection*: As described in the sections above, the preliminary design for the Park View Pump Station will include a design flow rate of 1,000 gpm at a head of 140 feet. This reflects the 107 psi static pressure of a full tank, a 3.4 psi friction accommodation and approximately 50 psi suction pressure.

Number: Pursuant to Virginia Administrative Code Chapter 590, 12VAC5-590-1040-B, "At least two pumping units shall be provided. If only two units are provided, each shall be capable of delivering the peak demand." The HPU desires for the design to provide two pumps, each capable of delivering the design flow rate of 1,000 gpm at 140 feet TDH. This will allow for a smaller building size and minimized costs associated with construction.

Type: The type of pumps selected for this project should be consistent with others in the City's inventory. This consistency provides familiarity with the operation and maintenance of the units and may reduce stock parts that are common to a brand or style of unit. To be consistent with other common pump stations in the City's system, the HPU desires a frame mounted end

suction pump similar to the Goulds ITT Series A-C 2000. Preliminarily, it appears that a 6 x 6 x 13S pump at 1765 rpm would satisfy the design flow rate and head conditions. This selection will be reviewed and refined during detailed design.

*Location*: The station must be located where the supply to the pump inlet is adequate to meet the design flow rate maintaining a minimum of 20 psi in the supply system. It is possible that the existing system may require some improvements to enhance delivery to the selected site. Similarly, the station must be located in proximity to the tank such that water can be delivered to the tank without creating excessive system pressures. This can generally be achieved by locating the station near to the tank to reduce the dynamic friction losses or by increasing the transmission pipeline size.

Since 2013 the City's Public Works Department has been working with Eastern Mennonite University planners to coordinate the widening of Mount Clinton Pike, a project which includes a new traffic circle at the intersection of Mount Clinton Pike, Park Road and Chicago Avenue. This widening will encumber some land of the University while also providing in return a new improved entrance to the University from the south and east. In the early design meetings, a small lot was reserved near the intersection for the proposed pump station. This lot is well situated to meet the requirements for both the supply and discharge sides of the pump station.

- Supply system. As stated earlier, the HPU performed a flow test of the system in Mt Clinton Pike during the summer of 2014. This testing showed an available flow delivery of approximately 1,000 gpm at a pressure of 50 psi. Hydraulic calculations project the ultimate delivery at the point of the test to be 2,300 gpm at 20 psi. This is adequate to meet the supply requirements of the pump station.

  In an effort to provide reliability and redundancy in the system, the HPU will study a possible second feed to the supply of the pump station. Current system configuration includes an existing 6" waterline in Chicago Avenue connected to the Park View Zone. HPU will evaluate replacing a portion of this line with a larger diameter pipeline connected to the lower pressure zone to supplement supply. The elevation of this portion of the City's system is such that the services would reduce to a normal working pressure of approximately 47 psi. The HPU must consider the impact of this reduced pressure to the existing domestic and fire systems. This system reconfiguration is not required to meet the design flow at the pump station, but may be considered for future system enhancements.

- Discharge system. The existing system between the proposed pump station lot and water tank is a looped network of piping ranging from 6" to 10" in diameter with ages dating back to 1923, with the majority of the piping constructed in 1960. This network is generally appropriate for distribution of domestic and fire demands, it is not optimally sized for tank filling operations.

The HPU will plan to construct a new transmission pipeline from the proposed pump station to the new tank. This new main will be sized to transfer water to and from the tank at velocities below 3 feet per second at minimum friction losses. Additional information, including a geographical presentation of the route, is provided in Waterline Section that follows in this report.

**Base Features**:

The pump station structure will be designed to meet the requirements of Virginia Administrative Code Chapter 590, 12VAC5-590-1040. The base design will include a solid structure of adequate size to protect the pumps and associated piping as well as the mechanical and electronic controls. The building will be equipped with items to ensure proper operation and maintenance of the station. This equipment shall include a hoist for aid in removal of the pumps or motors for repairs, heating, ventilation, adequate interior and exterior lighting, SCADA control module, local metering and both a primary and auxiliary power supply.

*Building Structure*: Security of the station is of paramount importance. To that end, the HPU will plan a structural building to provide protection of all operating equipment from both weather and unauthorized personnel. The exterior of the building will be designed in coordination with the Eastern Mennonite University select staff to ensure an architectural fit with the surrounding campus.

*Concrete floors*: As with all other stations in the City's system, the floors of the building will be concrete sloped to floor drains. The pumps will be mounted on concrete pedestals integrated into the floor design to manage pump vibrations

*Crane Hoist:* A hoist system will be provided to aid in the maintenance and removal of the pumps and motors. The hoist will be designed such to lift the pumps or motors and convey them to a location where they can be loaded onto a vehicle for transportation to a repair shop if needed.

*Heating:* The building will be equipped with a thermostat and heater to ensure the pumps and piping do not freeze during cold temperatures.

*Ventilation / Dehumidification*: The building will be equipped with a second thermostat to open motorized ventilation louvers to dissipate heat generated by the pump motors.

*Lighting:* The exterior of the building will be designed with security lighting to illuminate around the building outside of daylight hours. This is a measure of security to deter vandalism at the site. Interior lighting will be designed to provide adequate lighting for all maintenance activities. Skylights will be considered for energy efficiency.

*Pumps:* The station will be designed with two frame mounted pumps, each capable of delivering the design flow. The HPU desires that these pumps be frame mounted end suction

centrifugal pumps consistent with other stations in the City's distribution system. The pumps will each be mounted on a concrete pedestal designed with the floor of the pump station such to minimize the transmission of vibration throughout the station. The pumps will be separated to provide space for maintenance personnel to inspect or repair the pumps and motors while maintaining a safe distance from the second pump and motor.

*SCADA:* The City operates a network of SCADA units in each of the pump stations, tanks and some of the control valve vaults. The new tank and pump station will utilize this SCADA network to control the operation of the newly configured Park View system. The SCADA system includes a primary control unit located at the Water Treatment Plant which is manned continuously, with the only exception being a short period over each weekend. In addition to the continuous manning of the primary unit, the system is configured to send critical alarms (applicable to control and monitoring features listed below) to City personnel through a combination of several media. SCADA features will include:

- Automated start and stop. Generally, the SCADA system will monitor tank level to control the start and stop of the pump. Other parameters such as suction and discharge pressures, control valve positions or flow measurements will also be programmed into the SCADA system to start or stop the pumps to protect the system or the pumps.

- Automated pump alternation. The SCADA will also be used to monitor the run hours of each pump. This data is useful to alternate the pumps and balance the operation of each. This is a standard technique utilized to lengthen the life of each pump and maintain similar performance between the two units.

- Alarming. The SCADA network will also monitor the system for many parameters that could be harmful to the City's distribution system or equipment. Suction or discharge pressures in the station will be monitored to ensure that the pumps are operating within acceptable range. Station power will also be monitored and an alarm sent to City personnel should the station lose primary power.

- Energy Management: The SCADA system will also monitor power consumption and demand with purpose to allow operators to optimize within the functions available to the pumps and to the applicable electric utility rate schedule.

- In addition to monitoring the operating conditions in the water system, the SCADA system will also monitor for unauthorized entry into the station. If entry is detected, an alarm is sent to the City's central SCADA system which is monitored continuously.

*Metering:* The pump station will be provided a meter in the discharge piping to measure the station output flow. This flow will be recorded and monitored through the SCADA system. This data will be recorded for historical monitoring and optimization of the system. It will also be monitored for instantaneous and automatic comparison against the run commands for the pump.

*Power Supply:* The pump station will be designed with both primary and backup or auxiliary power.

- Primary. Primary power will be provided through the Harrisonburg Electric Commission. This arrangement has proven reliable through many other stations across the City.

- Auxiliary. Auxiliary power will be provided by an on-site generator. The size and fuel type for this generator will be determined during detailed design of the station. Generally, the generator will be sized to start and run one pump plus the heater and controls. Other similar stations in the HPU inventory utilize either diesel or propane fueled generators.

**Stakeholder Amenities:**

While the primary function of the pump station is to transfer water into the new tank in the Park View Zone, the project may also accommodate additional functions requested by stakeholders. As mentioned above, the City is working with the Eastern Mennonite University to plan the widening of Mt. Clinton Pike. This widening project will also include a trail for the public. As the pump station is located near the head of the proposed trail, the design will consider the addition of public restrooms to the rear of the pump station building. This accommodation will be accessible separate from the secure pump station. Great care will be given to protect the security of the pump station operation and the safety of the public in the adjoined public restrooms. Both noise and vibration concerns must be overcome to make this amenity a feasible addition to the final design.

**Costs:**

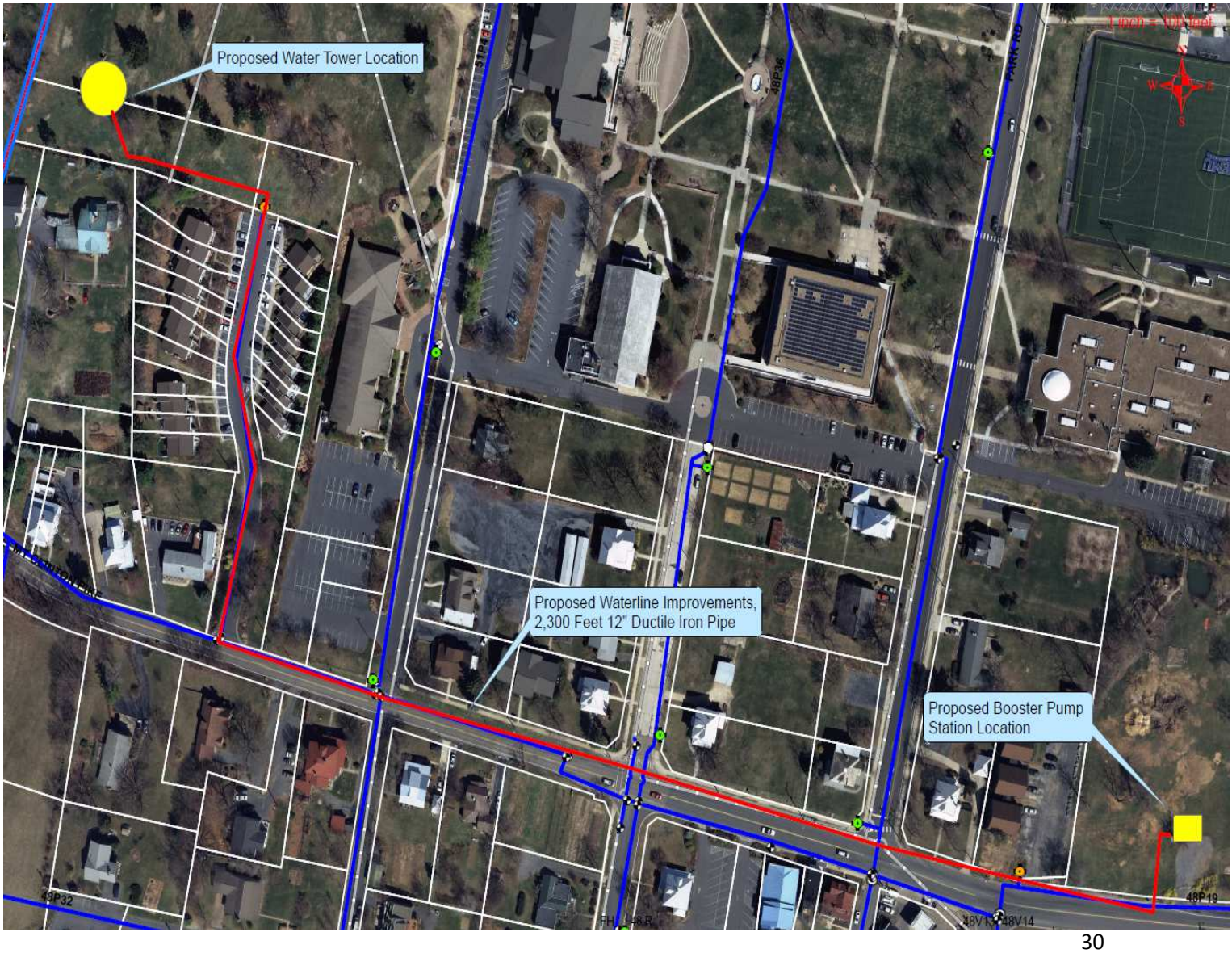
Allowances for the pump station and site work are provided in **Appendix A** at $342,000 and $55,000, respectively; $32,000 in site work can be completed with HPU resources.

**Waterline:**

The project will include the design and construction of a new transmission water main to meet the discharge requirements as discussed earlier under the topic of the pump station. This main will be designed to replace existing waterlines of smaller size to both increase the available flow through the system and minimize losses to improve efficiency. The waterline must be designed to efficiently transfer the required flow, maintain appropriate velocities and minimize friction losses. The route of the waterline shall combine the most cost effective route without imposing unnecessary hardship on the existing landowners that must be crossed.

**<u>Base Criteria</u>**:

*Location:* The pipeline, along with the tank and pump station, are shown in the geographical presentation that follows.



The pipeline begins at the site of the proposed pump station and then terminates at the site of the proposed water tank. In general, the goal of the pipeline route was to be within the City's right-of-way for the majority of the length as possible. This approach minimizes the lands to be encumbered and simultaneously reduces the costs associated with land acquisitions.

The waterline begins at the proposed pump station and will remain within the City's right-of-way from the pump station headed west on Mt. Clinton Pike to the intersection of Village Square. This route passes along the southern edge of the University properties and crosses an existing 10" waterline that runs north through the University. At this crossing the two lines will be connected, providing enhanced delivery to the 10".

At Village Square the waterline will generally follow an existing 6" waterline that will be abandoned. Village Square is a private street with an existing 6" waterline through the full length of the roadway. The original Village Square design specifically reserved this street and the waterline as privately owned and maintained by the property owners. Accordingly, there is currently no easement on this waterline and the arrangement does not meet current City Standards for backflow prevention, metering, and perpetual ownership responsibilities. The HPU is still in conversation with Village Square regarding this existing 6" waterline and the proposed new 12" waterline. By granting a new easement, the Village Square owners can transfer the liability of maintaining their water service to the City HPU. Although this is not yet finalized with the Village Square property owners, the City HPU intends to proceed with design of this waterline route and to further discuss this issue with the owners.

Leaving Village Square, the waterline will cross onto Eastern Mennonite University property. The preliminary design locates the waterline in a 20' public waterline easement adjoining the southern property line from Village Square to the site of the new tank.

*Transfer flow rate*: As outlined in the pump station design sections earlier in this document, the pumps are sized to transfer 1,000 gallons per minute through the distribution system to the tank. However, a larger fire flow demand is expected in the zone and the new transmission main will assist in delivering these higher flows to the campus and the remaining zone. The largest current fire flow demand on the Eastern Mennonite Campus is 3,000 gpm for the Dogwood Commons.

*Velocity:* Recognizing the design flowrate of the transmission main to be 3,000 gpm, the line must be sized to pass this flow with reasonable velocity. Industry standards seek to maintain velocities below 10 feet per second. Using this criteria, the pipeline at 12" would provide an acceptable velocity of 8.5 feet per second.

*Friction*: Friction losses steal energy from the water system. As water flows through the piped network, energy is lost to friction. The amount of friction is most impacted by the velocity of the water in the pipeline. By keeping the velocities low, the friction losses can be reduced. The 12" line provides normal operating velocities of less than 3 feet per second and pressure loss of

3.4 psi. Under the 3,000 gpm fire flow, the velocity increases to 8.5 feet per second and the pressure loss to 26.3 psi if the flow is carried through the full length of the pipeline.

**Base Features:**

The waterline will be designed for construction as all typical waterlines in the City's system. The pipe will be cement lined class 52 ductile iron materials with a design pressure rating of at least 150 psi. Mechanically restrained fittings and thrust blocks will be provided at all tees or bends. Bedding will be in accordance with City standards, providing compacted bedding and backfill to protect the pipeline and road surface where appropriate.

**Cost:**

The new waterline is estimated to be 2,300 feet of 12" waterline. **Appendix A** provides a construction estimate of $371,000 for contracted price; $178,000 of the work can be completed by HPU resources.

## VII. Acquisitions:

Acquisition of land privileges is an incidental requirement and cost to the project. The Park View Tank and Pump Station Project will require the City to partner with two specific land owners: Eastern Mennonite University (EMU) and Village Square Townhomes Ownership Group.

From our EMU partner:

- The City will require temporary and permanent easements for access road to the tank site.

- The City will require temporary and permanent easements for the construction of a waterline along the southern property boundary from the tank location to the neighbor Village Square property. The details of this easement have not been defined, but will generally be a 20' public water easement with additional temporary construction easement.

- The City will require temporary and permanent easements for the overflow storm drain pipe.

- The City will require acquisition of the tank site, either by easement or possibly a fee simple land purchase, and shall be accompanied with a temporary construction easement.

- The City will require acquisition of the pump station site, either by easement or possibly a fee simple land purchase, and shall be accompanied with a temporary construction easement. At the time of this report the City's Public Works Department is working with the University on the land exchange associated with the road widening and pump station lot acquisition.

From our Village Square Townhomes Ownership Partner:

- The City will require a temporary and permanent easement for the new waterline that will replace an existing waterline in Village Square. The existing waterline has not been properly conveyed to the City for perpetual ownership and maintenance; therefore, a resolution to this issue will be included in the acquisition process. Final agreement for the easement must address the value of the City acceptance to transfer responsibility for perpetual maintenance of the waterline from the property owners to the City. If approved, this agreement will include a 20' public water easement and temporary construction easement.

City officials and contracted services have worked actively to place value on the above referenced property acquisitions using conceptual interpretations of requirements to

accommodate construction. Minor adjustments to finalizing this cost value remains somewhat dependent upon formal construction documents that will not be available until design has been completed and negotiations. Prior to design the City will work to establish memorandums of understanding with each property owner and then finalizing the acquisition transaction prior to construction. The City will remain open to placing the value of compensation toward stakeholder amenities if desired by the stakeholders to make the amenities financially possible. Appendix A includes on itemization of cost that provides a total cost of $405,000.

## VIII. Demolition of Existing Tank Park View Tank:

The project will include removal of the existing Tank. The PER has included limited effort to defining the scope, cost and schedule for this aspect of the work. It is known that the existing tank structure on Summit Avenue will be removed from the City water system after the new tank has been commissioned and determined acceptable under extended operations. The PER cost estimate will allow $100,000 to remove the existing structure; the work is a specialty trade and may need specific quotes to determine a better estimate. It should be noted that the cost of removal may be somewhat offset by attention to the sale of scrap metal and the sale of the land parcel that now houses the existing tank

## IX. Basic Services:

Basic services will require Civil Engineering services in the form of design and in the form of client representation both in the office and on site during construction. The design phase will include final drawings and specifications. The construction phase will include bid and award of contract, technical assistance during construction, and field inspection during construction. These costs will be refined at a later time; however, an estimate of $224,000 is included in the PER. This reflects a 7% percentage of construction as published by ASCE for a construction project of the construction cost of $3,201,000.

## X. Summary:

The executive summary is provided at the beginning of this document.