

SITE WATER DISTRIBUTION ANALYSIS REPORT 2003

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FIRE PROTECTION ENGINEERING GROUP

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2 FOREWORD

The scope of this document is to present the water flow test results that have been collected over the years by Fire Fighters and the Fire Protection Engineers Group at Brookhaven National Laboratory. This report provides an overview of the all the pieces that make up the water supply and distribution system. Observations, work that requires further study and recommendations for improvements are presented.

The author wants to recognize the following people for their input in creating this document.

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3 EXECUTIVE SUMMARY

There are over 26 miles of potable water distribution mains at Brookhaven National Laboratory. Records show that the system contains of 253 fire hydrants and 477 valves. A vast majority of the piping, hydrants, and valves are between 40 or 60 years old.

Annually Emergency Services conducts flow tests to determine the available pressure/flow capacities at 23 test sites around BNL. A detailed trend analysis of each test site along with a rated score for pipe condition and flow capacity is provided. The 2003 Site Water Distribution Analysis Report has determined that:

- Over sixty percent of the test sites have either a “Poor” or “Fair” piping condition rating.
- The apartments and cottages have the oldest and smallest mains on the network. All test sites in these areas are rated as “Poor” pipe condition and flow capacity.
- A majority of piping between the RHIC Ring Road loop and Cornell Avenue are rated as “Poor” pipe condition and flow capacity due to piping configuration and atypical material selection in the 1950’s and 1960’s.
- A program does not exist at BNL to collect and analyze pipe debris.
- A strategic plan is needed to develop plans and budgets to replace the remaining aging sections of BNL’s water distribution network. The Bell Avenue area piping was replaced in the mid 1990’s, is the perfect example of the benefits of replacing old piping at BNL. Since it was replaced, the flows and pressures in the have passed all review criteria with the highest marks.
- Impact on the network’s supply capacity cannot be fully predicted due to a lack of a computer model.

4 ANALYSIS

4.1 OBSERVATIONS

Observations are from test data, review of the system and interviews. The following observations are listed in no particulate order.

4.1.1 MAJORITY OF PIPING, VALVES AND HYDRANTS ARE BETWEEN 40 TO 60 YEARS OLD

The piping south of Cornell Avenue in most cases was installed in the 1940's as part of Camp Upton. The piping north of Cornell Avenue was installed as the major experiment facilities were brought online in the late 50's to mid 60's.

4.1.2 RESIDENCE AREA PIPING CONDITION IS WORST ON SITE

The Apartments and Cottages have the oldest and smallest mains on the network. All test sites in these areas are rated as "Poor" for pipe condition. There is a need to provide adequate supply redundancy for the area. The possibility of new housing facilities in the apartment area will change the supply demands.

4.1.3 BELL AVENUE AREA PIPING CONDITION IS BEST ON SITE

The Bell Avenue area piping that was replaced in the mid 1990's is the perfect example to demonstrate the positive impact of replacing old piping. Since it was replaced, system flows and pressures have passed all review criteria with the highest ratings.

4.1.4 CENTRAL NORTH AREA HAS A POOR PIPING CONDITION RATING

The piping between the RHIC's Ring Road loop and Cornell Avenue appears to be in poor shape due to atypical material selection (black steel, Cast Iron, etc.), for piping in the 1950's and 1960's. There are numerous dead end conditions which increase the severity of piping deterioration. In the 1990's some of the existing lines were reamed to improve water flow conditions. Reaming helps in the short term but requires that the piping receive future reaming treatments to remove rapid corrosion growth in the piping caused by the process. The piping strength will be diminished after each reaming treatment.

4.1.5 FOUR TEST SITES (17%) CANNOT MEET MAXIMUM EXPECTED FIRE FLOW (MEFF) DEMAND

The four sites (1, 2, 16, and 18) cannot meet the maximum expected fire flow demand which will require supplemental water sources. Fire fighting tanker apparatus with capacities of 2,000 gallons will be required to fight a fire in these areas.

4.1.6 DOMESTIC AND COOLING WATER DEMAND HAS DROPPED 37% SINCE THE EARLY 1990'S

The total site wide water demand is less than 2 million gallons per day (MGD) which dropped from 3.5 million gallons per day a decade ago. The drop in demand has helped the overall capacity of the system. However the reduced flow demands in the piping hides the deficiency of the piping. If demand had remained constant at 3.5 MGD from the early 1990's, the number of test points that have "Poor" or "Fair" piping condition or flow capacity would be much greater.

4.1.7 THREE SITES ARE LESS THAN 10% FROM NOT HAVING THE REQUIRED MEFF

In a few years, three sites (4, 17, and 21) may be required to have special Firefighting water supply strategy due to inadequate supplies to meet MEFF demands.

4.1.8 OVER 60% OF ALL TEST SITES HAVE FAIR OR POOR PIPING CONDITION

Nine Test Points (1, 2, 3, 4, 16, 17, 18, and 19) have a rating of "Poor" with respect to Piping Condition. Five Test Points (8, 11, 15, 20, and 23) have a rating of "Fair" with respect to Piping Condition.

4.1.9 TWO OF THE 23 TEST SITES THIS YEAR NOT TESTED DUE TO HYDRANT FAILURE

Two hydrants (132 and 55) were scheduled for repair in November. Analysis was made without the current year tests for test points 10 and 11.

4.1.10 OVER 35% OF THE TEST SITES ARE RATED "POOR" FLOW CAPACITY

Eight Test Points 1, 2, 3, 4, 8, 16, 17, 18, and 21 have a rating of "Poor" with respect to Flow Capacity. Impact on the network's supply capacity cannot be fully predicted due to a lack of a computer model.

4.1.11 39% OF THE TEST SITES HAVE A NEGATIVE 5 YEAR AVERAGE FLOW LOSS TREND

Nine Test Points (1, 3, 4, 8, 17, 19, 20, 21, and 23) have negative trends varying from -4.2% to -30.0% despite diminished domestic and cooling usage.

4.1.12 ALL HYDRANTS HAVE NOT BEEN INSPECTED AND MAINTAINED ANNUALLY AS REQUIRED

DOE requires compliance with NFPA 25. Private hydrants are required to be visually inspected annually and after each operation. In addition hydrants shall be lubricated annually and opened and closed yearly to ensure proper water flow and drainage. There are 253 hydrants on site.

4.1.13 ALL WATER SUPPLY VALVES HAVE NOT BEEN TESTED ANNUALLY AS REQUIRED

NFPA 25 requires that valves are operated annually through its full range and returned to its normal position. This annual operation has not been performed for over 10 years. There are over 470 valves (280 street valves, 74 service valves, 110 Post Indicator (PIV) valves, and 8 chamber valves.)

4.1.14 NO STRATEGIC PLAN OR FUNDING EXISTS FOR THE DISTRIBUTION NETWORK

There is a need to have a strategic plan for improving the distribution network. What exists today is a reactive approach to deal with periodic pipe breaks or broken hardware. Funding for pipe breaks or broken hardware is drawn from annual maintenance budgets. Definition of needs and the related costs to implement the strategy will have to be presented to management for funding support.

4.1.15 TRANSITE PIPING HEALTH RISKS

Transite pipe is cement lined pipe with asbestos fibers. Although the BNL monitoring program has not detected asbestos at levels greater than regulatory limits, many municipalities have been proactive manner to replacing the Transite piping due to the potential health risk liability. The use of Transite piping on this site is prevalent, and is over 40 years old.

4.1.16 NO COLLECTION & ANALYSIS OF PIPING DEBRIS FROM HYDRANT TESTS OR FLUSHING

There is no task or Standard Operating Procedure to collect piping debris from hydrant flow tests or system flushing efforts in order to determine the analyze the condition of the piping network.

4.1.17 RUST IN WATER CAUSING AESTHETICS CONCERN

Rust caused by iron in piping is an issue that requires Plant Engineering to conduct periodic pipe flushing exercises to decrease the amount of rust buildup in the water. This is especially prevalent in the apartment area.

4.2 REQUIRES FURTHER STUDY OR WORK

4.2.1 CONDITION OF UNLINED PIPING FROM WATER DISTRIBUTION MAINS INTO BUILDINGS

Piping between the water mains and the building are as old as 60 years. Much of the piping appears to be non-lined piping. Non-lined piping corrodes at a rate greater than lined piping. This condition would over time hinder the ability of the automatic sprinkler and standpipe systems from operating at calculated flows and pressures.

4.2.2 DETERMINE CONDITION OF ALL HYDRANTS AND VALVES.

Program to test all hydrants and valves needs to be implemented to be develop cost estimate for the Strategic Plan.

4.2.3 RISK ASSESSMENT OF HYDRANTS AND VALVES NEEDS TO BE REVISED.

The building concentration areas on the site have changed. Hydrants and isolating valves need to be reviewed to determine maintenance and replacement priorities for Plant Engineering.

4.2.4 IMPLEMENT HYDRAULIC MODELING SYSTEM OF THE PIPING NETWORK

A software based hydraulic modeling system (KYpipe) has been purchased to better understand the implications of pipe aging and changes caused by planned expansion at BNL. With this product in place BNL can be proactive in developing the scope of work and costs to be included in new construction.

4.2.5 REVIEW HYDRANTS AND VALVES TO SEE IF ALL ARE REQUIRED

Effort to review the hydrants and valves to see if all 253 hydrants and 477 valves are required by standards.

5 RECOMMENDATIONS

5.1.1 CREATE STRATEGIC FUNDING PLAN FOR REPLACING THE DISTRIBUTION NETWORK

There is a need to have a strategic plan for replacing the distribution network piping, valves and hydrants over time. Large portions of the piping network are over 60 years old and the piping is deteriorating. What exists today is a reactive plan to deal with periodic pipe breaks or broken hardware. Definition of needs and the related costs to implement the strategy will have to be presented to management for funding support.

5.1.2 ESTABLISH PIPING DECAY MONITORING

A program to implement a piping decay monitoring system should be created at BNL. We need to understand the current and projected state of the distribution network with respect to the rate of decay and corrosion.

5.1.3 FLUSHING AND TESTING PROCEDURES TO INCLUDE COLLECTING/DOCUMENTING DEBRIS

As part of the decay monitoring we need to recover the corrosion and decay debris that is discharged from the piping during flushing and test efforts.

5.1.4 HYDRANTS AND SITE VALVES SHALL BE INSPECTED AND MAINTAINED AS REQUIRED

Annual inspection and maintenance of hydrants and valves shall conform to NFPA 25.

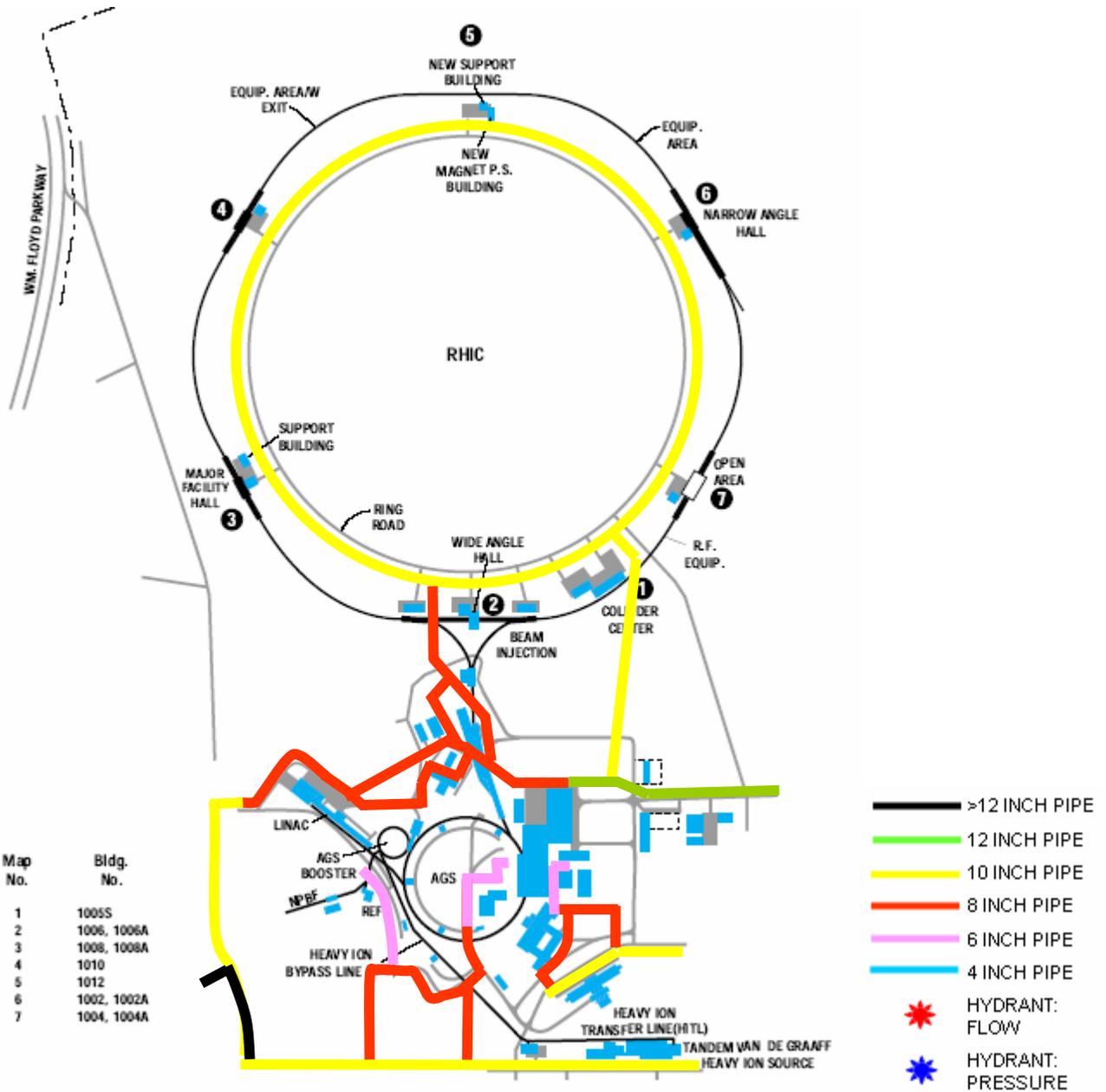
5.1.5 FLOW TESTING TO INCLUDE RECORDING WATER SUPPLY MONITORING INFORMATION

Procedures should be modified to include recording water elevation, lead well pump, and pump(s) online for service during all water tests. Information will enhance testing analysis by identifying additional variables that can influence test results.

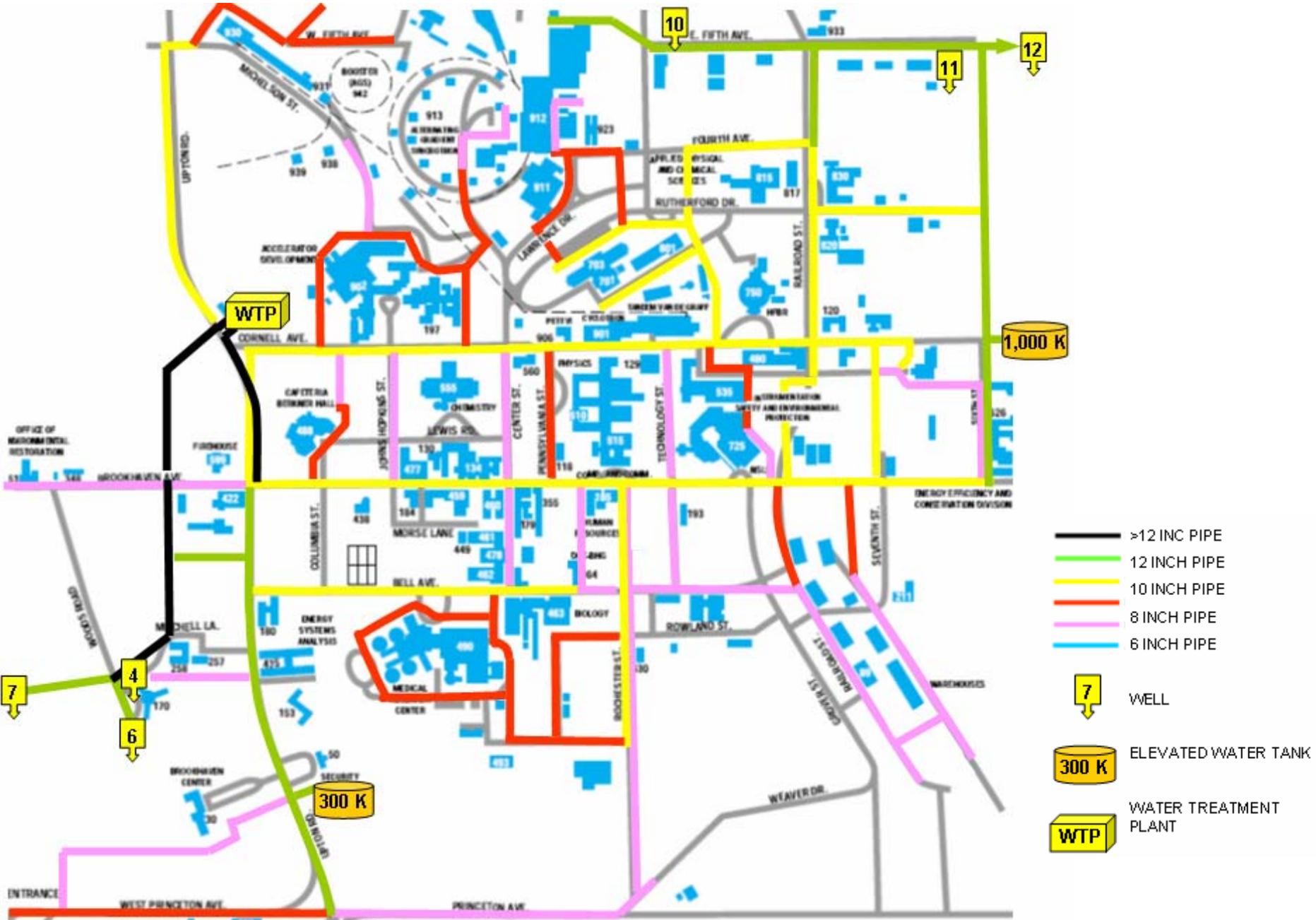
6 SITE WATER SUPPLY AND DISTRIBUTION SYSTEM

6.1 SITE WATER SUPPLY & DISTRIBUTION DRAWINGS

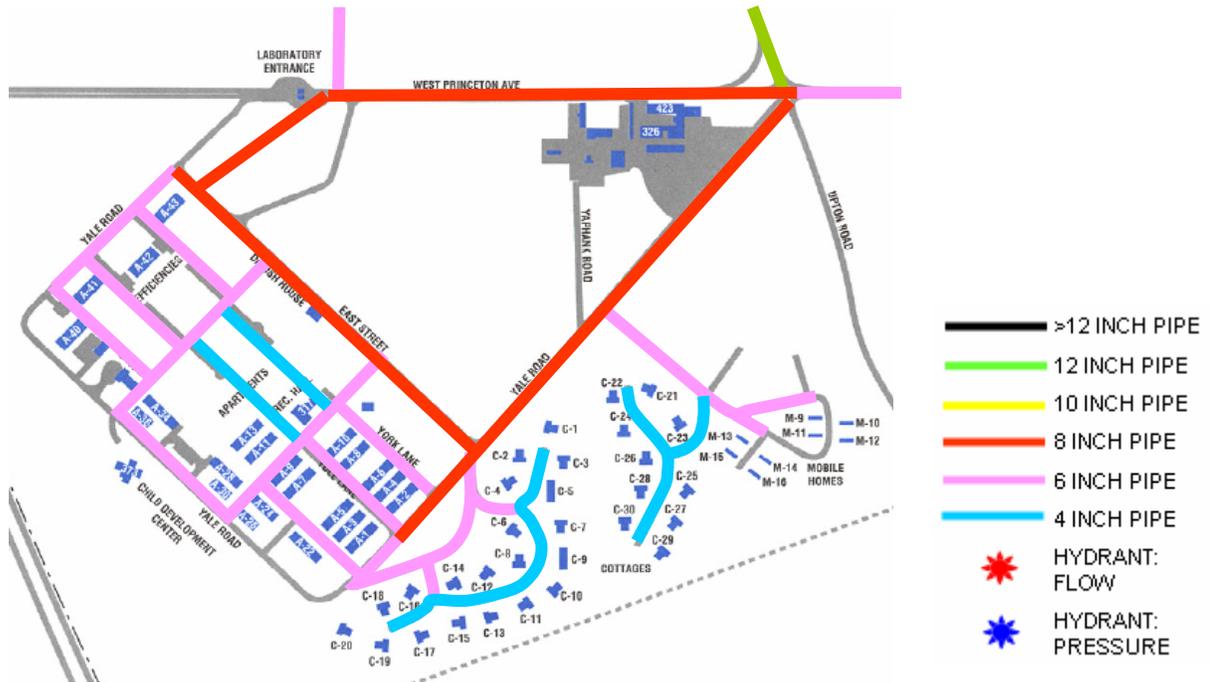
6.1.1 NORTH CAMPUS DRAWING



6.1.2 CENTRAL CAMPUS DRAWING



6.1.3 SOUTH CAMPUS DRAWING



6.2 SITE WATER SUPPLY

The potable water supply system piping network is fed by a combination of wells, elevated storage tanks and a water treatment plant

6.2.1 WELLS

There are six potable wells used to supply the water distribution system. They all draw from the Upper Glacial aquifer. In 2003, the wells on average provide 2.0 million gallons per day to the piping network. In prior years, the wells provided an average demand of 3.5 million gallons per day to the piping network. This reduction is a result of a water conservation program. The wells have a flow meter installed in the discharge that is monitored at the Water Treatment Plant (WTP), Building 624. The wells normally run on electric motors and are not connected to an emergency power source. During a power emergency situation they can be converted to fuel driven motors

6.2.1.1 WELL No. 4

Well No. 4, Building 614, was built in 1960. It is 147 feet deep and is equipped with 1,200 gallons per minute Byron Jackson deep-well turbine pump. The pump is driven by a 100 horsepower, 1770 rpm electric motor with variable speed control.

The well water is piped to the Water Treatment Plant, Building 624. In an emergency, the Well can be manually redirected to discharge directly into the water distribution system by operating the valves in chambers 6 and 7. Although volatile organic compounds have been detected in untreated water from well 4, these compounds are at concentrations below regulatory limits. The well's water is locally chlorinated with sodium hypochlorite.

6.2.1.2 WELL No. 6

Well No. 6, Building 618, was built in 1964. It is 150 feet deep and is equipped with 1,200 gallons per minute Fairbanks Morse vertical turbine pump. The pump is driven by a 100 horsepower, 1770 rpm electric motor with variable speed control.

The Well water discharges into the Water Treatment Plant, Building 624. In an emergency, the Well can be manually redirected to discharge directly into the water distribution system by operating the valves in chambers 6 and 7. Although volatile organic compounds have been detected in untreated water from well 6, these compounds are at concentrations below regulatory limits. The well's water is locally chlorinated with NaOCl.

6.2.1.3 WELL No. 7

Well No. 7, Building 619, was built in 1964. It is 150 feet deep and is equipped with a 1,200 gallons per minute Fairbanks Morse vertical turbine pump. The pump is driven by a 100 horsepower, 1770 rpm electric motor with variable speed control.

The well water is piped to the Water Treatment Plant, Building 642. In an emergency, the Well can be manually redirected to discharge directly into the water distribution system by operating the valves in chambers 6 and 7. Although volatile organic compounds have been detected in untreated water from well 7, these compounds are at concentrations below regulatory limits. The well's water is locally chlorinated with NaOCl.

6.2.1.4 WELL No. 10

Well No. 10, Building 634, was built in 1980. It is 140 feet deep and is equipped with a 1,200 gallons per minute Johnson vertical turbine pump. The pump is driven by a 100 horsepower, 1780 rpm electric motor with variable speed control.

The well water is piped to the water distribution system. Historically, volatile organic compounds have been detected in untreated water from well 10; these compounds are at concentrations below regulatory limits. The water is locally treated with chlorine and caustic soda and is passed through activated carbon filters prior to distribution.

6.2.1.5 WELL No. 11

Well No. 11, Building 635, was built in 1980. It is 142 feet deep and is equipped with a 1,200 gallons per minute Johnson vertical turbine pump. The pump is driven by a 100 horsepower, 1780 rpm, electric motor with variable speed control.

The well water is piped to the water distribution system. Historically, volatile organic compounds have been detected in untreated water from well 11; these compounds are at concentrations below regulatory limits. The water is locally treated with chlorine and caustic soda and is passed through activated carbon filters prior to distribution.

6.2.1.6 WELL No. 12

Well No. 12, Building 637, was built in 1986. It is 137 feet deep and is equipped with a 1,200 gallons per minute Layne vertical turbine pump. The pump is driven by a 100 horsepower, 1780 rpm electric motor with variable speed control.

The well water is piped to the water distribution system. Historically, volatile organic compounds have been detected in untreated water from well 12; these compounds are at concentrations below regulatory limits. The water is locally treated with chlorine and caustic soda and is passed through activated carbon filters prior to distribution.

6.2.2 ELEVATED STORAGE TANKS

There are two elevated Storage Tanks attached to the water distribution system. The purpose of these tanks is to provide water to the distribution system during times when either well or WTP pumps are not running or when pump(s) online cannot meet the site demand. The tanks rely on the Well or WTP pumps excess flow to replenish capacity.

6.2.2.1 300,000 Gallon Tank (300K)

The 303,500 gallon elevated Storage Tank (64), was built in 1941. The tank has a single acting altitude valve at the base of the tank, which allows flow into the tank until it reaches a preset altitude above sea level. The valve is designed to close preventing overflow when the tank is full. The altitude valve is monitored at the Water Treatment Plant, Building 624. The tank is also equipped with an overflow pipe located at 239.6 feet above sea level if the valve fails. A check valve is provided on the piping to bypass the altitude valve in order to allow flow out of the tank.

6.2.2.2 1,000,000 Gallon Tank (1,000K)

The 1,000,000 gallon elevated Storage Tank (640), was built in 1985. The tank has a single acting altitude valve at the base of the tank, which allows flow into the tank until it reaches a preset altitude above sea level. The valve is designed to close preventing overflow when the tank is full. The altitude valve is monitored at the Water Treatment Plant, Building 624. The tank is also equipped with an overflow pipe located at 239.6 feet above sea level if the valve fails. A check valve is provided on the piping to bypass the altitude valve in order to allow flow out of the tank.

6.2.3 WATER TREATMENT PLANT

The Water Treatment Plant (WTP), building 624 was built in 1964. This plant has a maximum capacity of 6 million gallons per day of high quality potable water to the distribution system. Wells Nos. 4, 6, and 7 are connected to the WTP (3,600 GPM capacity). The wells produce water that requires treatment of iron and other components prior to being discharged by the WTP high-service pumps into the distribution network. There are four high-service pumps in the WTP, Building 624 rated at 1,200 gallons per minute each. In an emergency, the water from Wells Nos. 4, 6, and 7 can be manually redirected to by-pass the WTP and discharge directly into the water distribution system by operating the valves in chambers 6 and 7.

6.2.4 SITE WATER MONITORING AND CONTROLS

Located within the Water Treatment plant (WTP), Building 624 is the monitoring and controlling equipment for the site water supply system. Each well pump, high-service pump, elevated Storage Tank altitude valve, and flow meters are monitored and controlled. Wells are operated to meet system demand and maintain adequate pressure on the system. Wells are rotated/alternated by the Water Treatment Operators.

6.2.4.1 SITE WATER ALTITUDE MONITORING

The common means is by monitoring the level of water in the elevated tanks. The two altimeter valves provide information at the WTP on the present level of the tanks. The levels in the tanks are always the same. At 238 feet the system is completely full as noted in the "DIAGRAM OF THE SITE WATER PUMP CONTROLLER SETTINGS." At an altitude of 210 ft. both tanks are empty. At different levels set point alarms are transmitted to the WTP. These alarms are high level tank, low level tank, and emergency low level alarms. Both Tanks use the same set of points for high level alarms but due to the difference in size and height of the usable water in the tanks they have different low level alarms. The emergency low level alarm signifies that both tanks are empty.

6.2.4.2 PUMP SELECTION

As the water level drops in the system the Water Treatment Plant Operators during business hours determines which of the well(s) will be used to keep ahead of the rate of drop on the distribution system. Normally, only one pump is on-line when the tanks are not at capacity. If Wells 4, 6, or 7 are selected for use then a determination of which of the high-service pump(s) in the Water Treatment plant will be used to replenish the system.

6.2.4.3 SEQUENCE OF PUMP OPERATION

The Water Treatment Plant Operators determine the automatic sequence of pumps start and stops as shown in that will the "DIAGRAM OF THE SITE WATER PUMP CONTROLLER SETTINGS." There are separate controls for the 300K tank and the 1,000K tank. The 1,000K Tank is the primary tank and its pump control sequence is used almost exclusively now.

6.2.4.4 DIAGRAM OF THE SITE WATER PUMP CONTROLLER SETTINGS

	ELEVATION ABOVE SEA LEVEL (Ft.)	CONTROL SETTINGS FOR PUMPS					
		300K Tank			1,000K Tank		
Overflow: Both Tanks ▶	239.6						
High Level Alarm - ON: Both Tanks ▶	239						
	238	STOP			STOP		
High Level Alarm - OFF: Both Tanks ▶	237	PUMP 1			PUMP 1		
	236						
	235	START			START		
	234		STOP			STOP	
	233					PUMP 2	
	232		PUMP 2				
	231			STOP		START	
	230		START				STOP
	229			PUMP 3			PUMP 3
Low Level Alarm - OFF: Both Tanks ▶	228						
	227					START	
	226			START			STOP
Low Level Alarm - ON: 300K Tank ▶	225						PUMP 4
	224						
	223					START	
	222						STOP
	221						PUMP 5
Low Level Alarm - ON: 1,000K Tank ▶	220						
	219						START
	218						
	217						
	216						
	215						
	214						
	213						
	212						
	211						
Emergency Low Level Alarm - ON: 1,000K Tank ▶	210						

Source: Water Treatment Facility

6.3 FORMAT OF TEST DATA SHEETS

Each of the 23 Test Data Sheets consists of the following information:

- Title
- Site Map
- Symbol List
- MEFF & Risk Categories
- Summary Table
- Three Graphs
- Description
- Analysis

In order to understand how the ratings and analysis were formulated an understanding of the development of three sections of information need to be discussed. The three sections are: Fire Flow & Risk Categories, the “Summary Table” and the three graphs.

6.3.1 DESCRIPTION OF FIRE FLOW AND RISK CATEGORIES

Each of the 23 water flow test points have a fire flow and ratings assign to four risk categories as shown below. Each risk category is rated with either a low, moderate or high concern classification based on specific criteria for each of the risks.

MEFF 1,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION POOR	FLOW CAPACITY LIMITED	PIPING NETWORK MULTIPLE PATHS
---------------------------	--------------------------------------	----------------------------------	----------------------------------	--

6.3.1.1 MAXIMUM EXPECTED FIRE FLOW (MEFF)

Maximum Expected Fire Flow (MEFF) value represents the estimated fire fighter flow necessary to attack the largest realistic fire in the area. There are several recognized mathematical models that determine the MEFF for a building/area. For this study the BNL Fire Chief and the senior BNL fire protection engineer determined the minimum gallons per minute (GPM) flow. The criteria used to determine the values is a combination of the size of the assets being protected, the criticality of the area/buildings to BNL operations, building construction, proximity of building structures, and the amount of automatic sprinkler and standpipe systems in use.

6.3.1.2 OCCUPANCY

“Occupancy” rating describes the area to be protected around the test point. The criteria used to determine the rating is a combination of the value of the assets being protected, the criticality of the area/buildings to BNL operations, building occupancy and construction, proximity of building structures, and the amount of automatic sprinkler and standpipe systems in use.

6.3.1.3 PIPING CONDITION

“Piping Condition” rating describes the present condition of the piping. The criteria used to determine the rating is the historical flow trends, the age, and condition of piping materials used. A “GOOD” rating signifies that the available water flow has not decreased for at least a decade and meets MEFF. A “FAIR” or “POOR” rating deals with the severity of the negative flow trend over the testing period and the available flow compared to MEFF.

6.3.1.4 FLOW CAPACITY

“Growth Potential” rating describes the ability of the present piping condition to take on new or shifting domestic demands in the area. The criteria used to determine the rating is the available fire flow at 20 PSI. A “GOOD” rating signifies that the available water flow at 20 PSI is well above the minimum required fire flow for the area. A “LIMITED” or “POOR” rating determines the severity of the difference between the available flow and the MEFF.

6.3.1.5 PIPING NETWORK

“Piping Network” rating describes the configuration of the supply piping to support the test point area. The criteria used to determine the rating is the configuration, condition and ability of the source piping to support the test area

pipng. A "MULTIPLE PATH" rating signifies that multiple source paths are available to the test point area piping. A "DEAD END" rating signifies that the source piping to the test point area piping is restricted to a single pipe path.

6.3.2 DESCRIPTION OF THE SUMMARY TABLE

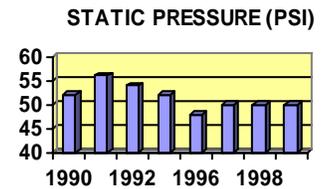
Each of the 23 water flow test points has a statistic summary table as shown below. The table provides a set of calculated values based on the historical test data available at each point. The information presented is averages based on three time periods: Overall, last 10 years, and last 5 years. Average Trend analysis was used in conjunction with the graph data to form the flow and pressure analysis. In some cases a certain year was eliminated from the averages if the test results seemed either too high or low. Eliminated test data for a particular year is noted in the analysis section of the test point page.

SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	51.5 PSI	50 PSI	50 PSI
FLOW AVERAGE @ 20 PSI	1536 GPM	1520 GPM	1454 GPM
FLOW CHANGE FROM OVERALL	-	-1.1%	-5.6%

6.3.3 DESCRIPTION OF THE THREE GRAPHS

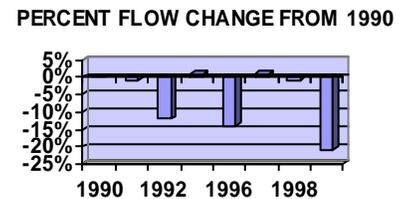
6.3.3.1 STATIC PRESSURE GRAPH

The static pressure graph shows the first piece of information to complete a water flow test. A pressure reading is made at the designated pressure hydrant with no flow at the designated flow hydrant. The hydrant locations are shown on the maps. This pressure reading determines how the piping system interacts with the day to day domestic or mechanical water usage. However another variable exist on the site water mains that can produce swing in pressure readings up to 10 PSI. That variable is the two elevated water tanks. Low elevated tank levels can produce lower static pressures even when the day to day domestic or mechanical water usage has not changed.



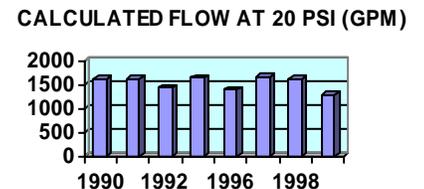
6.3.3.2 CALCULATED FLOW AT 20 PSI GRAPH

The final two pieces of information to complete a water flow test is a pressure reading at the designated pressure hydrant at the same time determining the actual flow at the designated flow hydrant. 20 PSI is the industry recognized minimum pressure on a site water main system for determining adequate fire supplies. In all cases at BNL, we could not produce a flow from a single hydrant that will produce a 20 PSI reading at the pressure hydrant. Therefore we hydraulically calculate the expected flow at the desired pressure minimum 20 PSI hydrant reading. The results of the calculations are represented in this graph.



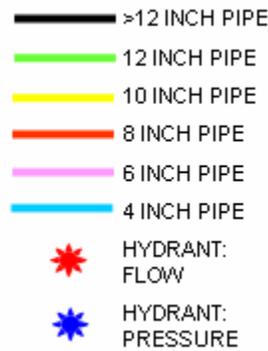
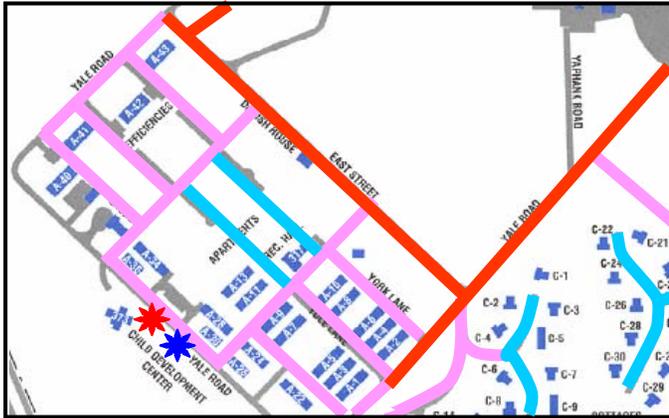
6.3.3.3 PERCENT FLOW CHANGE FROM BASE YEAR GRAPH

The "Percent Flow Change from Base" graph is a subset of information from the "Calculated Flow At 20 PSI" graph. What is represented in the graph is the present change for an individual year as compared with the base year. The base year should always be assumed to be the first year of reading and noted as having 0% change from the base. This graph allows us to analysis trends in the "Calculated Flow At 20 PSI" graph.



7 TEST DATA SHEETS

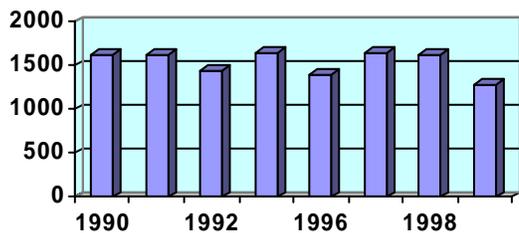
7.1 TEST POINT 1: APARTMENTS



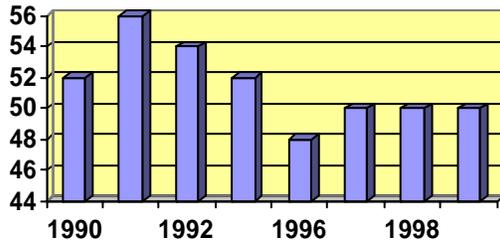
MEFF 1,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	51.5 PSI	50 PSI	50 PSI
FLOW AVERAGE @ 20 PSI	1536 GPM	1520 GPM	1454 GPM
FLOW CHANGE FROM OVERALL	-	-1.1%	-5.6%

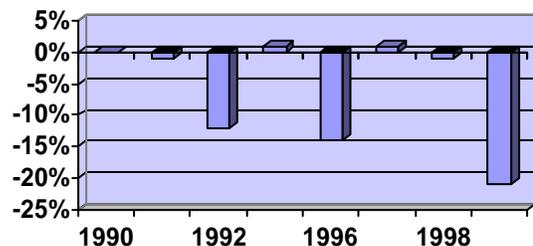
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H003 and the flow hydrant H002. This test point is the most hydraulically remote from the supply wells and Water Treatment Facility. The nearest water supply source (300K Tank) is about 5,300 feet away. The local cross mains are less than 8 inch in size. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is a mixture of Cast Iron & Transite Cement Lined piping. The local mains are connected to an 8 inch loop supplied by a 12 inch feed along Upton Ave and two six inch feeds.

ANALYSIS

Static pressures have remained relatively consistent (~50 PSI.) The consistent readings can be attributed to the remoteness of the piping network and the low flow demand for domestic or mechanical usage in the apartments. It appears that that overall site wide water demand changes have no major effect on the water supply in this area. Average flow loss from 1990 has decreased by up to 5.6% and is below 1500 GPM. This flow rate loss can be attributed to the age of the piping and the reliance to the three feeds into the 8 inch loop.

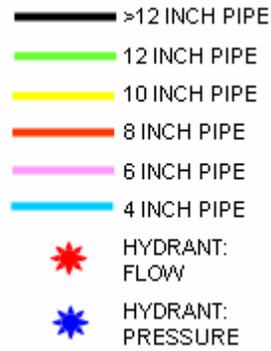
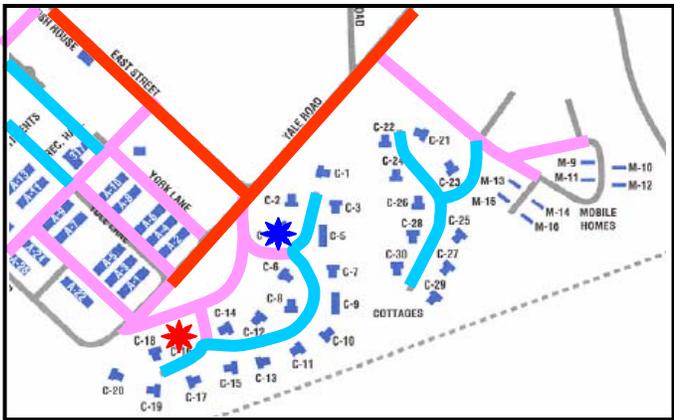
Occupancy is rated "Ordinary Hazard" due to the densely populated wood frame construction buildings.

Piping Condition is rated "Poor" since the flow trend is losing capacity at roughly 5% over the last 13 years.

Flow Capacity is rated "Poor" because of the limited flow at current demand loading through the main piping network and is unable to meet MEFF demands.

Piping Network of water supplies is rated "Dead End" since all water must enter via the isolated 8 inch loop. The two six inch feeds along Princeton Ave. have to be investigated to see if can support the area by themselves.

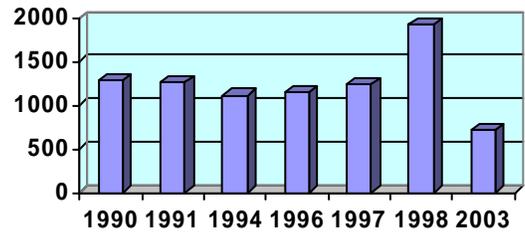
7.2 TEST POINT 2: COTTAGES



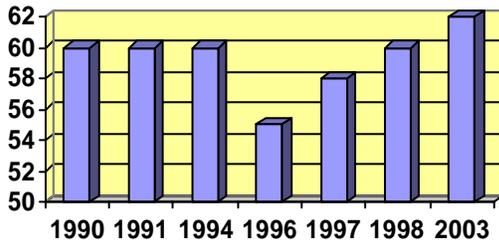
MEFF 1,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEADEND
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	59.3 PSI	59.0 PSI	61.0 PSI
FLOW AVERAGE @ 20 PSI	1127 GPM	1054 GPM	711 GPM
FLOW CHANGE FROM OVERALL	-	-6.9%	-58.6%

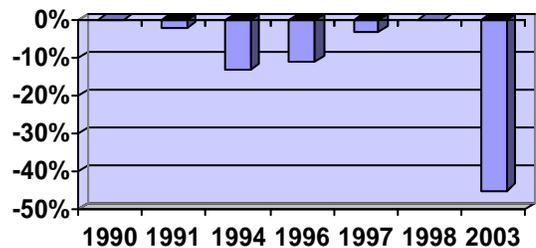
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H181 and the flow hydrant H191. The nearest water supply source (300K Tank) is about 4,800 feet away. The local cross mains are less than 8 inch in size. The local mains are connected to an 8 inch loop. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is a mixture of Cast Iron and Transite Cement Lined piping.

ANALYSIS

Static pressures have remained relatively consistent (~60 PSI.) The consistent readings can be attributed to the remoteness of the piping network and the low flow demand for domestic or mechanical usage in the cottages. It appears that that overall site wide water demand changes have no major effect on the water supply in this area. The flow for year 1998 was eliminated from analysis since it does not fall within the expected range as compared to the other test points. The available flow average is below 1050 GPM. The flow loss has exceeded 15% since 1990. This flow rate loss can be attributed to the age of the piping and the reliance to the three feeds into the 8 inch loop.

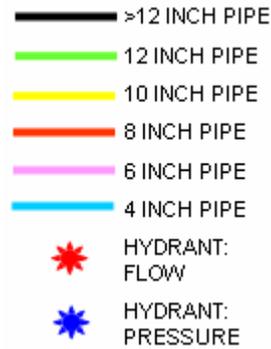
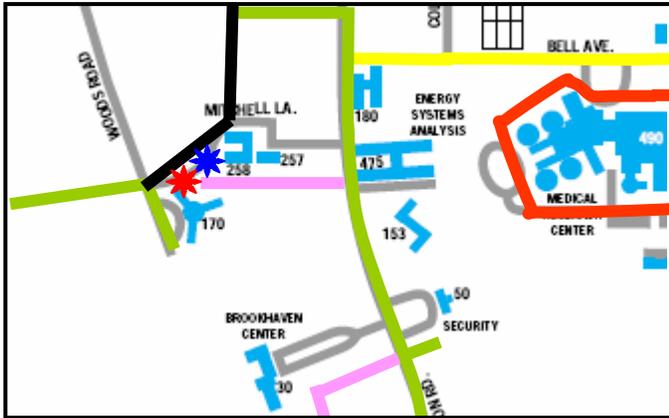
Occupancy is rated "Ordinary Hazard" due to the densely populated wood frame construction buildings.

Piping Condition is rated "Poor" since the flow trend is losing capacity.

Flow Capacity is rated "Poor" because of the limited flow at current demand loading through the main piping network and is unable to meet MEFF demands

Piping Network of water supplies is rated "Dead End" since all water must enter via the isolated 8 inch loop. The two six inch feeds along Princeton Ave. have to be investigated by hydraulic modeling to see if can support the area by themselves.

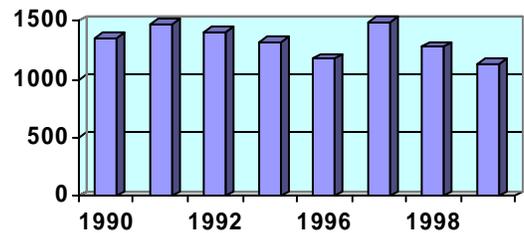
7.3 TEST POINT 3: GUEST HOUSE / CURIE- WOMEN'S RESIDENCE



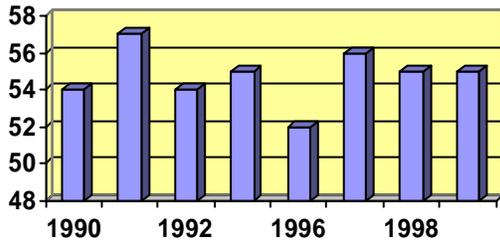
MEFF 750 GPM	OCCUPANCY LOW HAZARD	PIPING CONDITION POOR	FLOW CAPACITY LIMITED	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	54.8 PSI	54.6 PSI	55 PSI
FLOW AVERAGE @ 20 PSI	1329 GPM	1279 GPM	1206 GPM
FLOW CHANGE FROM OVERALL	-	-3.8%	-10.2%

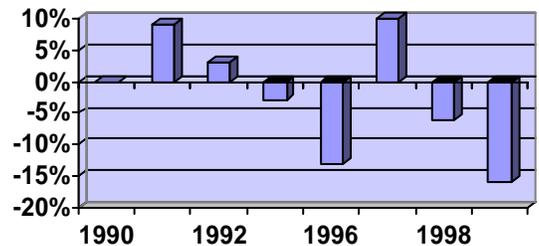
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H059 and the flow hydrant H163. The nearest water supply source (300K Tank) is roughly 1,100 feet away. The local branch main is 6 inch in size. The local mains are connected to the 12 inch feed along Upton Ave. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is Transite Cement Lined piping

ANALYSIS

Static pressures have remained relatively consistent (~55 PSI.) The consistent readings can be attributed the low flow demand for domestic or mechanical usage in the residences. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is about 1200 GPM which is the worst on the site. Average flow loss from 1990 has decreased by up to 10%. This flow rate loss can be attributed to the age and size of the piping.

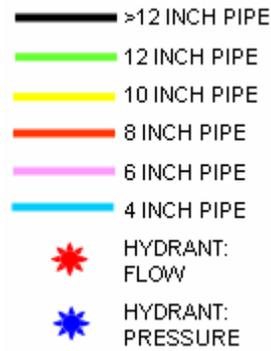
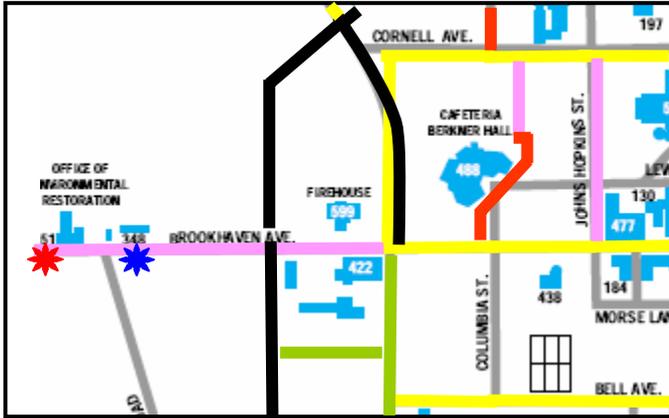
Occupancy is rated "Low Hazard" due to the limited fire loading in the area.

Piping Condition is rated "Poor" since the flow trend is losing capacity at roughly 10% over the last 13 years.

Flow Capacity is rated "Limited" because of the limited flow at current demand loading through the piping network.

Piping Network of water supplies is rated "Dead End" since it gets the majority of water from the 300K storage tank located in close proximity to the hydrants. It will have to be investigated by hydraulic modeling to see if by eliminate the 300K storage tank as a source that the Residences will have adequate flow and pressure

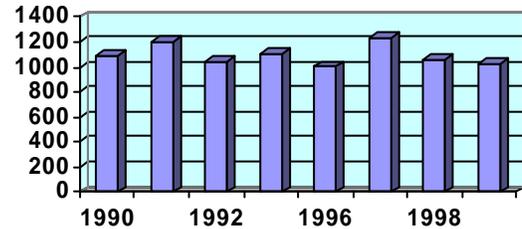
7.4 TEST POINT 4: WEST BROOKHAVEN AVENUE



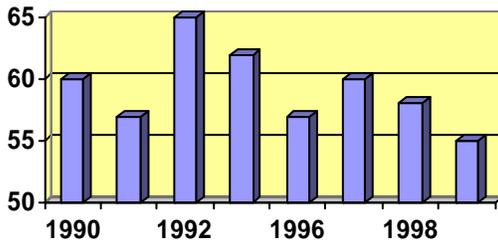
MEFF 1,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	59.3 PSI	58.4 PSI	56.5 PSI
FLOW AVERAGE @ 20 PSI	1097 GPM	1087 GPM	1046 GPM
FLOW CHANGE FROM OVERALL	-	-0.9%	-4.9%

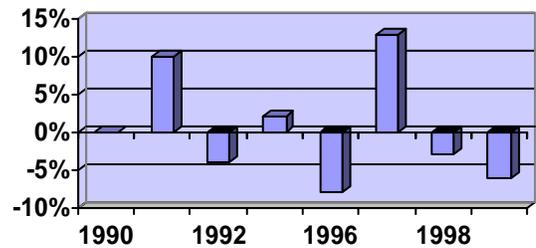
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H041 and the flow hydrant H042. The nearest water supply source (Water Treatment Facility) is roughly 1,200 feet away. The local branch main is 6 inch in size. The local main is connected to the 10 inch feed along Upton Ave. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is Transite Cement Lined piping

ANALYSIS

Average static pressures have dropped about 5% when you compare the results in the last 5 years to overall testing results. The change in the readings can be attributed the central site's changing flow demands and aging of the piping. Further investigation is required to establish if this is truly a trend.

The average available flow is now about 1050 GPM. This flow is the worst on the site. Average flow loss from 1990 has decreased by up to 5%. This flow rate loss can be attributed to the age and size of the piping.

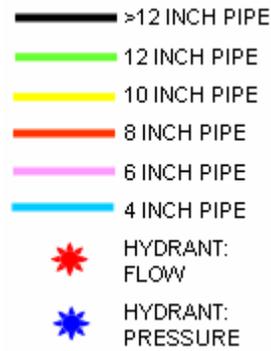
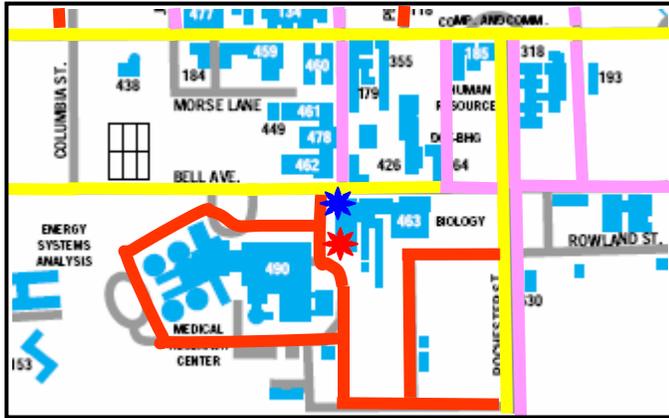
Occupancy is rated "High Hazard" due to Building 348 wood frame with large sources, and close proximity to William Floyd Parkway.

Piping Condition is rated "Poor" since the flow trend is losing capacity at roughly 5% over the last 13 years.

Flow Capacity is rated "Poor" because of the limited flow at current demand loading through the main piping network.

Piping Network of water supplies is rated "Dead End" since it gets water from single line connection

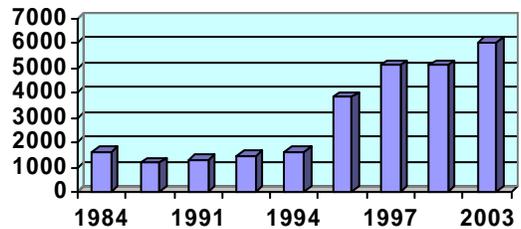
7.5 TEST POINT 5: BELL AVENUE



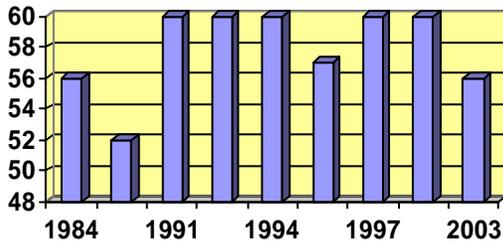
MEFF 1,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	57.9 PSI	58.6 PSI	58.0 PSI
FLOW AVERAGE @ 20 PSI	3031 GPM	4336 GPM	5571 GPM
FLOW CHANGE FROM OVERALL	-	30.1%	45.6%

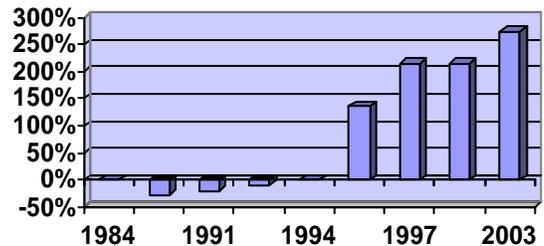
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1984



DESCRIPTION

The pressure hydrant was H069 and the flow hydrant H068. The nearest water supply source (Water Treatment Facility) is about 2,200 feet away. The local mains are a combination of 8 and 10 inch grid piping and were replaced in the mid 1990's with Cement Lined Ductile Iron piping as part of the Bell Avenue project.

ANALYSIS

Static pressures have remained relatively consistent (~58 PSI.) The consistent readings can be attributed the large diameter grid piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 5500 GPM. Average flow rate from 1984 has increased by up to 45%. This flow rate increase can be attributed to the replaced piping installed in the mid 1990's. Next report will have a new baseline of 1996 to reflect the changes in the new piping infrastructure in this area.

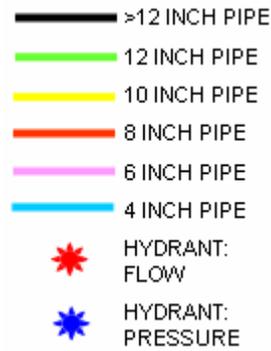
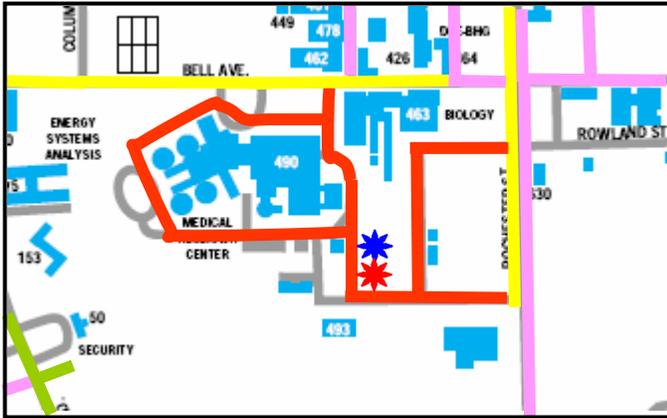
Occupancy is rated "High Hazard" due to use of medical gases, and chemical and biological labs.

Piping Condition is rated "Good" since the Bell Avenue piping was replaced.

Flow Capacity is rated "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

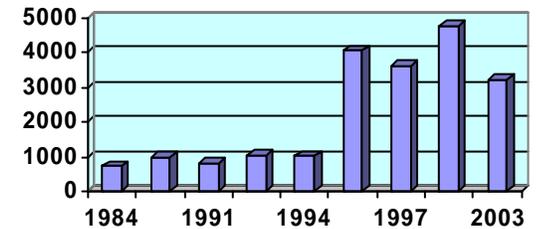
7.6 TEST POINT 6: AVERY STREET



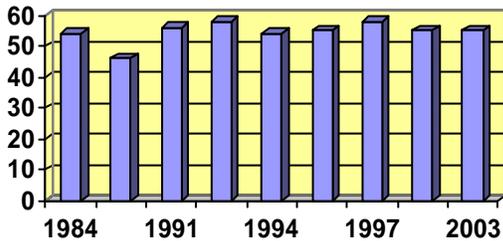
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	54.5 PSI	55.4 PSI	55.0 PSI
FLOW AVERAGE @ 20 PSI	2242 GPM	3330 GPM	3981 GPM
FLOW CHANGE FROM OVERALL	-	32.7%	43.7%

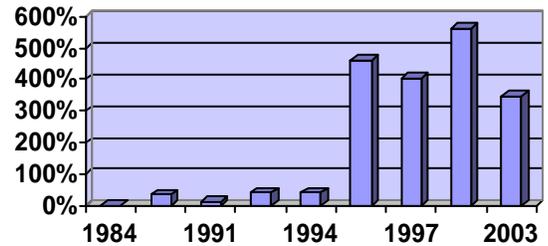
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1984



DESCRIPTION

The pressure hydrant was H067 and the flow hydrant H182. The nearest water supply source (Water Treatment Facility) is about 2,900 feet away. The local mains are 8 inch and were replaced in the mid 1990's with Cement Lined Ductile Iron piping as part of the Bell Avenue project.

ANALYSIS

Static pressures have remained relatively consistent (~55 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 4,000 GPM. Average flow rate from 1984 has increased by up to 44%. This flow rate increase can be attributed to the replaced piping installed in the mid 1990's. Next report will have a new baseline of 1996 to reflect the changes in the new piping infrastructure in this area.

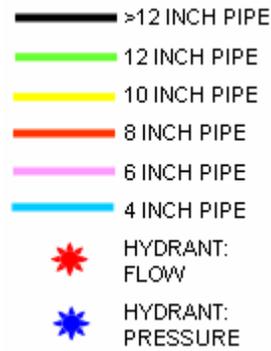
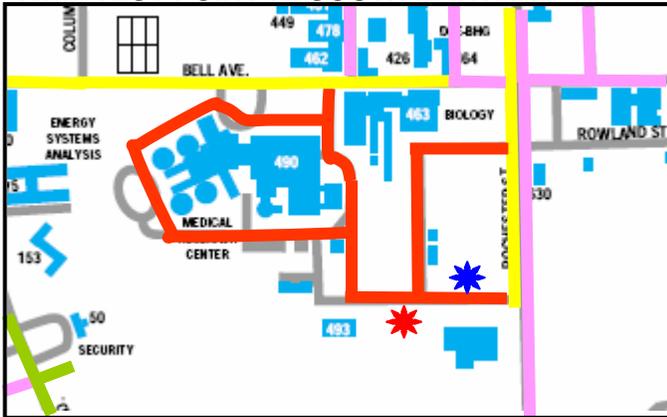
Occupancy is rated "High Hazard" due to large fire loads in storage areas with no automatic sprinkler protection.

Piping Condition is rated "Good" since the Bell Avenue piping was replaced.

Flow Capacity is rated "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

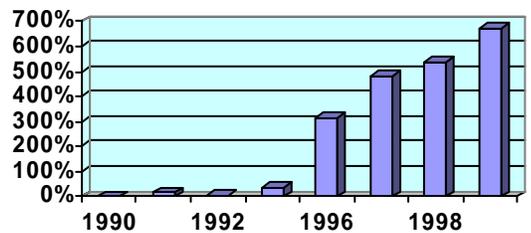
7.7 TEST POINT 7: SOUTH HARVARD



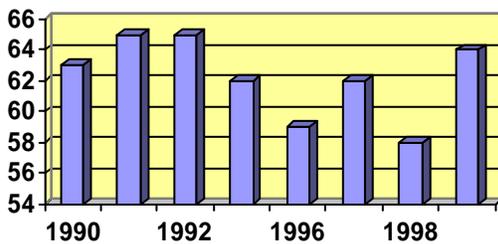
MEFF 1,000 GPM	OCCUPANCY LOW HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	62.3 PSI	61.0 PSI	61.0 PSI
FLOW AVERAGE @ 20 PSI	2523 GPM	3587 GPM	4971 GPM
FLOW CHANGE FROM OVERALL	-	29.7%	49.2%

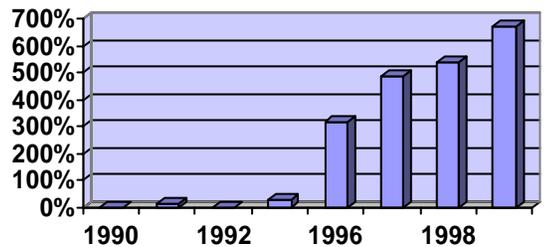
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H090 and the flow hydrant H092. The nearest water supply source (Water Treatment Facility) is about 3,650 feet away. The local mains are 8 inch and were replaced in the mid 1990's with Cement Lined Ductile Iron piping as part of the Bell Avenue project.

ANALYSIS

Static pressures have remained relatively consistent (~61 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 4,000 GPM. Average flow rate from 1984 has increased by up to 44%. This flow rate increase can be attributed to the replaced piping installed in the mid 1990's.

It is recommended that this Test Point be eliminated from the required list since Test Points 6 & 7 is relatively close in location and hydraulic results.

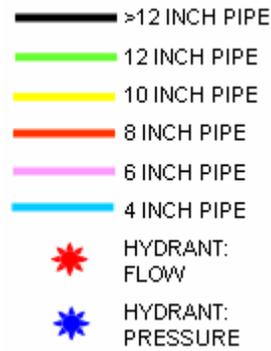
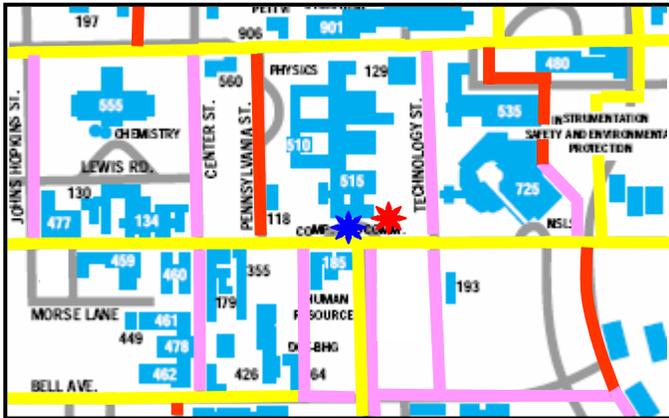
Occupancy is rated "Low Hazard" due to low fire loads in the area (Central Shops, Chilled Water).

Piping Condition is rated "Good" since the Bell Avenue piping was replaced and test results show relative health.

Flow Capacity is rated "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around site.

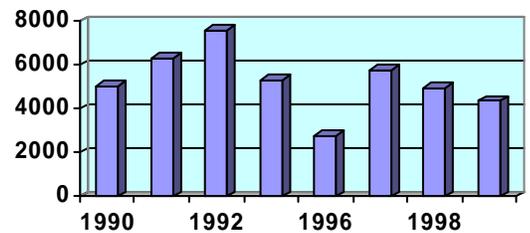
7.8 TEST POINT 8: BROOKHAVEN & ROCHESTER



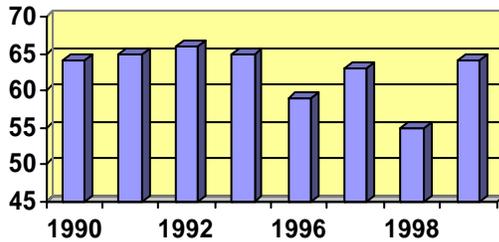
MEFF 2,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION FAIR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	62.6 PSI	61.2 PSI	59.5 PSI
FLOW AVERAGE @ 20 PSI	5264 GPM	4641 GPM	4656 GPM
FLOW CHANGE FROM OVERALL	-	-13.4%	-13.1%

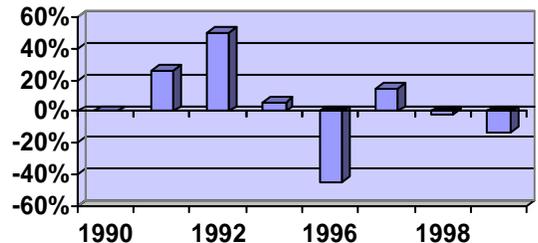
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H098 and the flow hydrant H097. The nearest water supply source (Water Treatment Facility) is about 2,150 feet away. The local mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping in this area is Cement Lined Ductile Iron.

ANALYSIS

Static pressures have remained relatively consistent (~60 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 4,650 GPM. Average flow rate from 1990 has decreased by 13%. This flow rate loss can be attributed to the age and size of the piping.

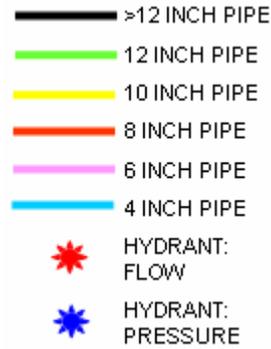
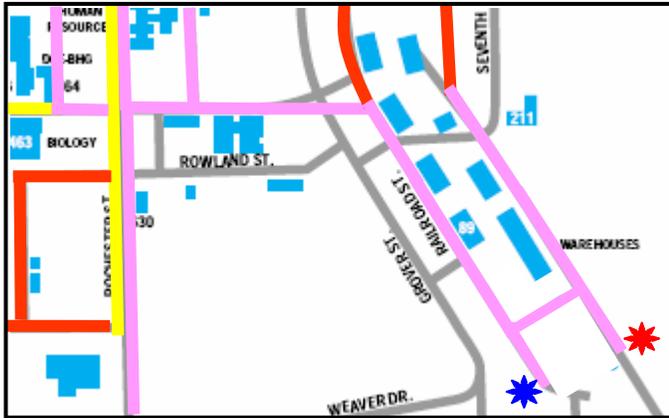
Occupancy is rated "High Hazard" due to large fire loads (multistory offices, basements with flammable gases, wood frame buildings).

Piping Condition is rated "Fair" due to a decrease in available flow by 13% in the last 13 years.

Flow Capacity is rated "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since this area can easily get water from multiple sources around the site

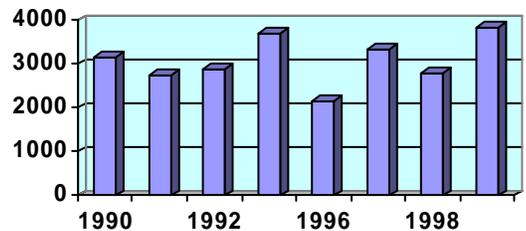
7.9 TEST POINT 9: WAREHOUSE AREA



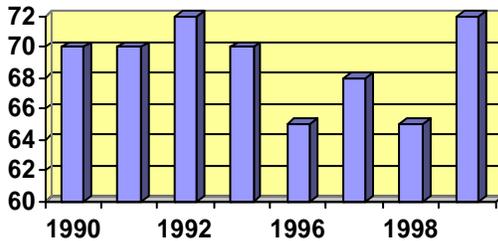
MEFF 3,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY LIMITED	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	69.0 PSI	68.0 PSI	68.5 PSI
FLOW AVERAGE @ 20 PSI	3076 GPM	3166 GPM	3307 GPM
FLOW CHANGE FROM OVERALL	-	2.8%	7.0%

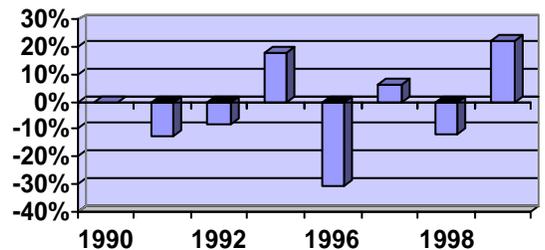
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H183 and the flow hydrant H122. The nearest water supply source (Water Treatment Facility) is about 3,900 feet away. The local loop mains are 6 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is Transite Cement Lined.

ANALYSIS

Static pressures have remained relatively consistent (~68 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,300 GPM. Average flow rate from 1990 has increased by up to 7%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

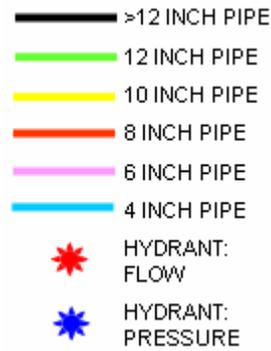
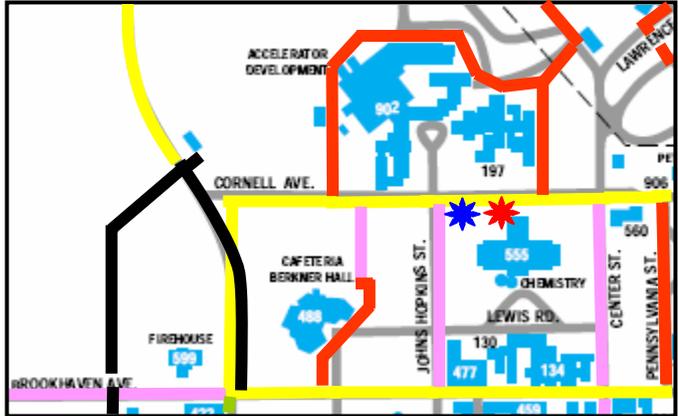
Occupancy is rated "High Hazard" due to large fire loads (wood frame warehouse buildings).

Piping Condition is rated "Good" due to an increase in available flow by 7% in the last 13 years.

Flow Capacity is rated "Limited" because of the limited flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since the test area can easily get water from multiple sources around the site.

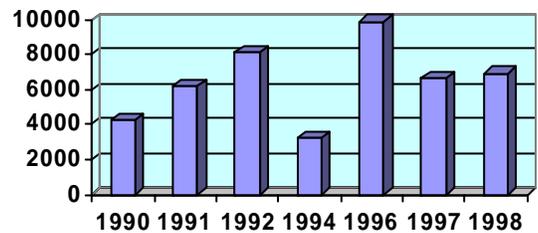
7.10 TEST POINT 10: WEST CORNELL AVENUE



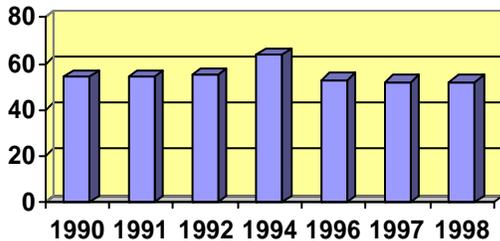
MEFF 5,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	54.9 PSI	55.3 PSI	52.0 PSI
FLOW AVERAGE @ 20 PSI	6489 GPM	6690 GPM	6947 GPM
FLOW CHANGE FROM OVERALL	-	3.0%	6.6%

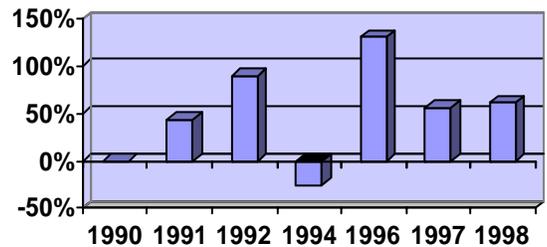
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



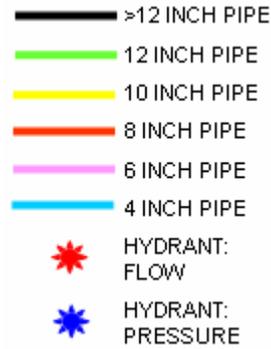
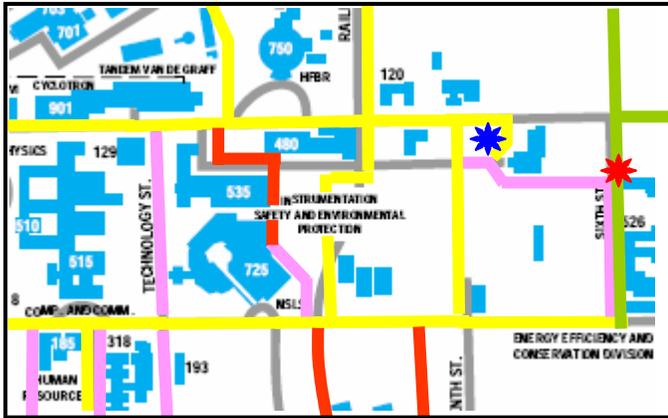
DESCRIPTION

The pressure hydrant was H055 and the flow hydrant H058. The nearest water supply source (Water Treatment Facility) is about 3,000 feet away. The local loop mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is Transite Cement Lined.

ANALYSIS

We were unable to conduct a flow test in 2003 due to hydrant H055 was out of service. Static pressures have remained relatively consistent (~55 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area. The average available flow is now about 6,900 GPM. Average flow rate from 1990 has increased by up to 6.6%. This flow rate increase can be attributed to the new piping added along Bell Avenue. **Occupancy** is rated "High Hazard" due to large fire loads (Chemical Labs, wood frame buildings). **Piping Condition** is rated "Good" due to an increase in available flow by 6.6% in the last 13 years. **Flow Capacity** is rated as "Good" because of the ample flow rate at current demand loading through the main piping network. **Piping Network** of water supplies is rated "Multiple Path" since can easily get water from multiple sources around site.

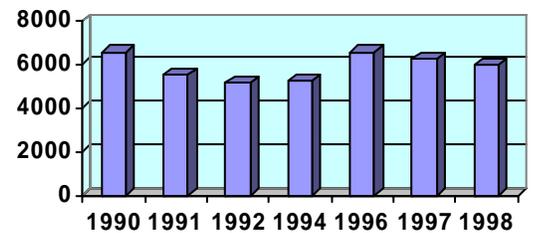
7.11 TEST POINT 11: SEVENTH STREET



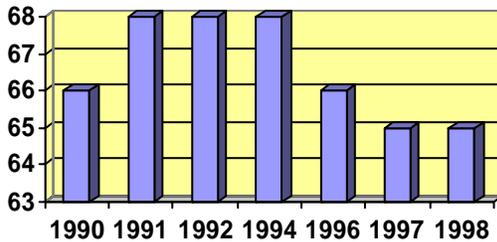
MEFF 5,000 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION FAIR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	66.6 PSI	66.0 PSI	65.0 PSI
FLOW AVERAGE @ 20 PSI	5878 GPM	5980 GPM	5946 GPM
FLOW CHANGE FROM OVERALL	-	1.7%	1.1%

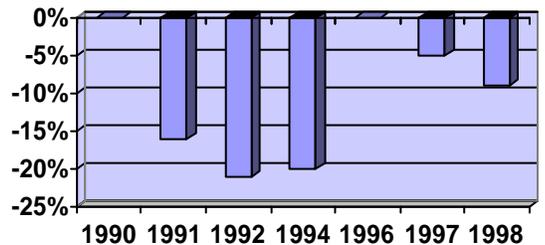
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



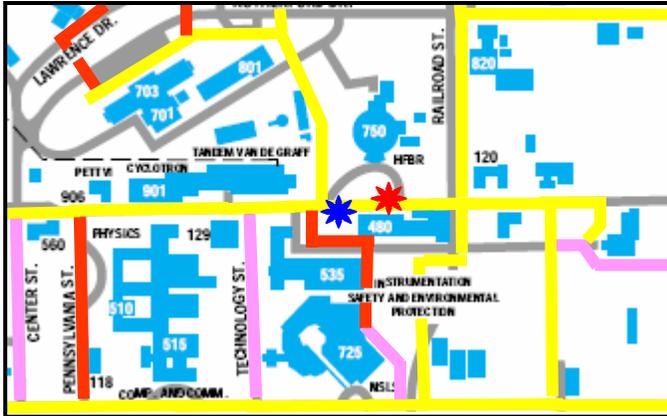
DESCRIPTION

The pressure hydrant was H132 and the flow hydrant H133. The nearest water supply source (1,000K Tank) is about 1,800 feet away. The local loop mains are 6 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is over 60 years old. The piping is Transite Cement Lined.

ANALYSIS

We were unable to conduct a flow test in 2003 due to hydrant H132 was out of service. Static pressures have remained relatively consistent (~65 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area. The average available flow is about 5,900 GPM. Average flow rate from 1990 has increased by as little as 1%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase. **Occupancy** is rated "High Hazard" due to large fire loads (fuel oil tank storage, wood frame buildings). **Piping Condition** is rated "Fair" due to the trend of individual negative flow changes over past 13 years and not having a flow test less than 5 years old. **Flow Capacity** is rated as "Good" because of the ample flow rate at current demand loading through the main piping network. **Piping Network** of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

7.12 TEST POINT 12: EAST CORNELL AVENUE

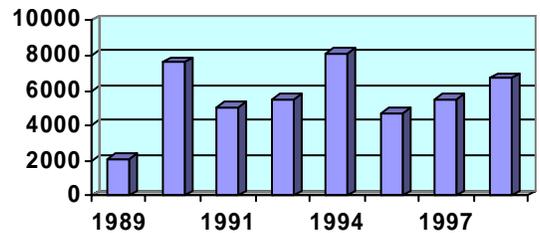


- >12 INCH PIPE
- 12 INCH PIPE
- 10 INCH PIPE
- 8 INCH PIPE
- 6 INCH PIPE
- 4 INCH PIPE
- ★ HYDRANT: FLOW
- ★ HYDRANT: PRESSURE

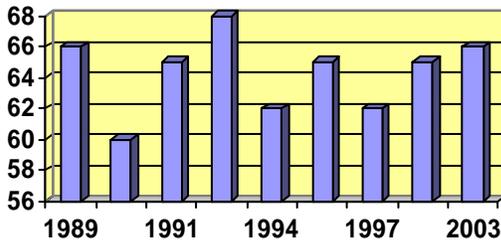
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	64.3 PSI	64.0 PSI	65.5 PSI
FLOW AVERAGE @ 20 PSI	5683 GPM	6280 GPM	6710 GPM
FLOW CHANGE FROM OVERALL	-	9.5%	15.3%

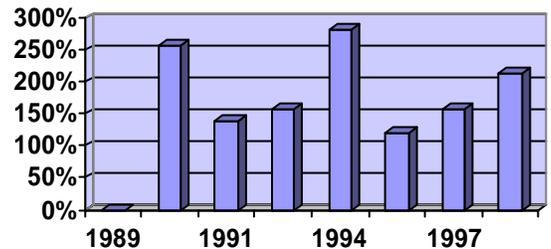
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1989



DESCRIPTION

The pressure hydrant was H113 and the flow hydrant H114. The nearest water supply source (Water Treatment Facility) is about 3,000 feet away. The local mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1989 and is over 60 years old. The piping is Transite Cement Lined. . .

ANALYSIS

Static pressures have remained relatively consistent (~65 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 6,700 GPM. Average flow rate from 1989 has increased by up to 15%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

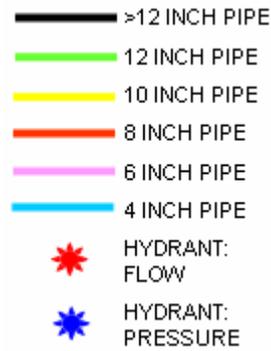
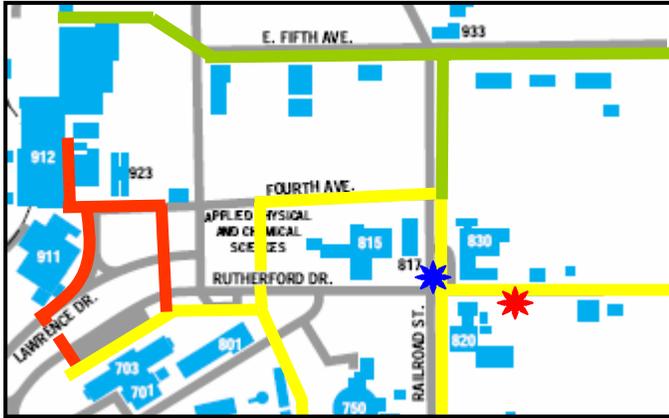
Occupancy is rated "High Hazard" due to large fire loads (HFBR, CFN studies and wood roof in building 480).

Piping Condition is rated "Good" due to an increase in available flow by 15% in the last 14 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

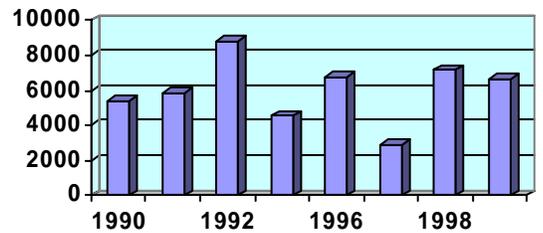
7.13 TEST POINT 13: RAILROAD ST. & RUTHERFORD AVE.



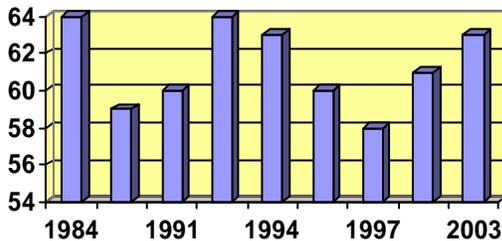
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	61.3 PSI	61.0 PSI	62.0 PSI
FLOW AVERAGE @ 20 PSI	5594 GPM	5583 GPM	6897 GPM
FLOW CHANGE FROM OVERALL	-	-7.4%	13.1%

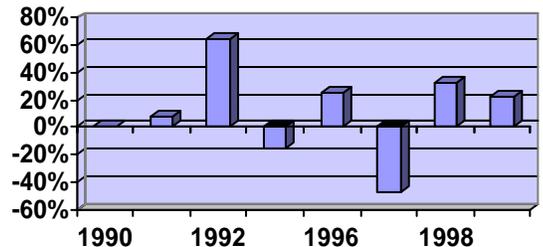
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H141 and the flow hydrant H138. The nearest water supply source (Well 10) is about 1,200 feet away. The local mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 50 years old. The piping is Transite Cement Lined and may consist of other unidentified materials.

ANALYSIS

Static pressures have remained relatively consistent (~61 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 6,800 GPM. Average flow rate from 1990 has increased by up to 13%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

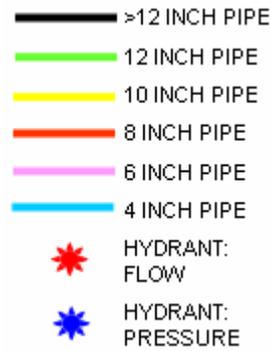
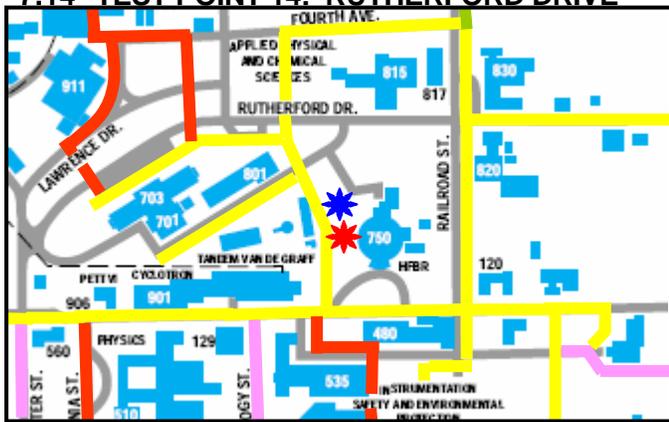
Occupancy is rated "High Hazard" due to large fire loads (Flammable liquid storage in chemical labs in building 815, hot cells in Building 830).

Piping Condition is rated "Good" due to an increase in available flow by 15% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

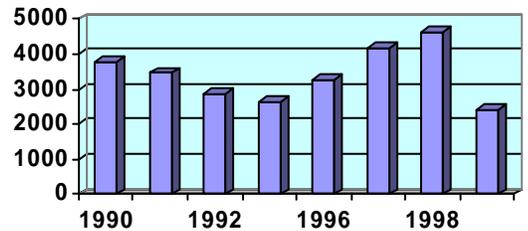
7.14 TEST POINT 14: RUTHERFORD DRIVE



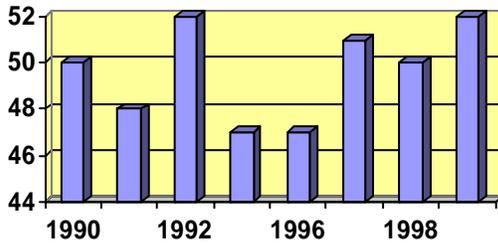
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	49.6 PSI	49.4 PSI	51 PSI
FLOW AVERAGE @ 20 PSI	3392 GPM	3410 GPM	3505 GPM
FLOW CHANGE FROM OVERALL	-	0.5%	3.2%

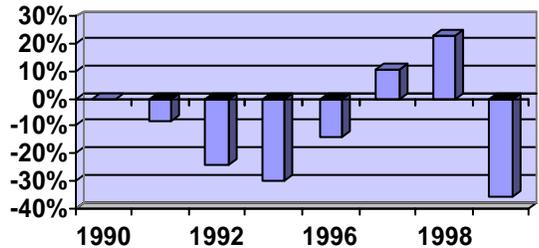
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H144 and the flow hydrant H247. The nearest water supply source (Well 10) is about 2,200 feet away. The local loop mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 40 years old. The piping is Cast Iron and may consist of other unidentified materials.

ANALYSIS

Static pressures have remained relatively consistent (~51 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,500 GPM. Average flow rate from 1990 has increased by up to 3%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

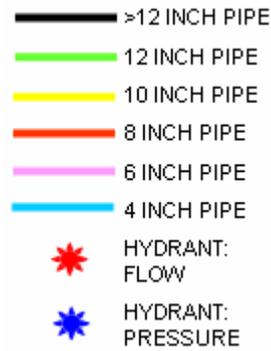
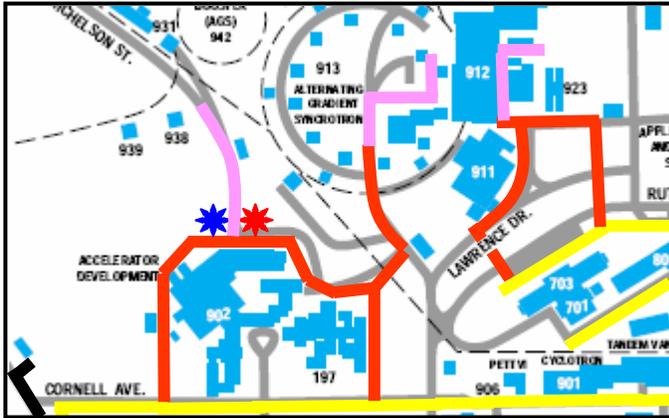
Occupancy is rated "High Hazard" due to large fire loads (HFBR).

Piping Condition is rated "Good" due to an increase in available flow by 3% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

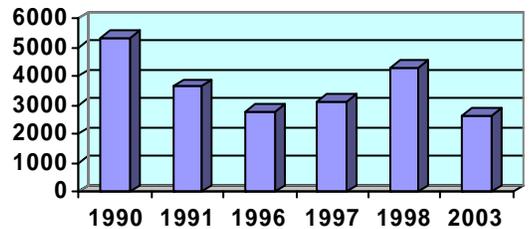
7.15 TEST POINT 15: COSMOTRON ROAD



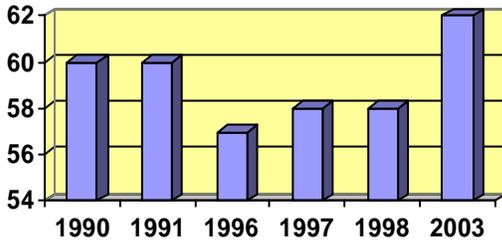
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION FAIR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	59.29 PSI	58.8 PSI	60.0 PSI
FLOW AVERAGE @ 20 PSI	3647 GPM	3228 GPM	3480 GPM
FLOW CHANGE FROM OVERALL	-	-13.0%	-4.8%

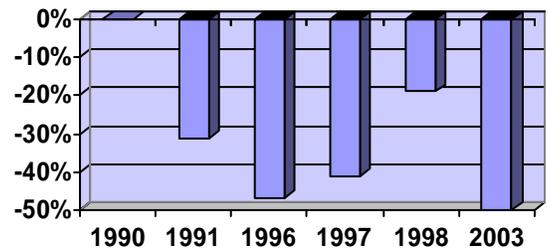
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H043 and the flow hydrant H205. The nearest water supply source (Water Treatment Facility) is about 3,900 feet away. The local loop mains are 8 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 40 years old. The piping in this area is Transite Cement Lined and may consist of other unidentified materials.

ANALYSIS

Static pressures have remained relatively consistent (~59 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,400 GPM. In individual years the flow peaked in 1990 and has diminished steadily down since then. Average flow rate from 1989 has increased by up to 4%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

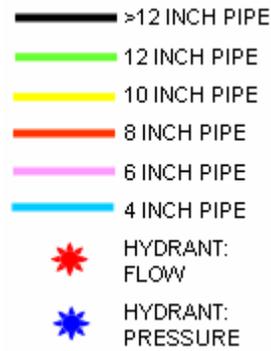
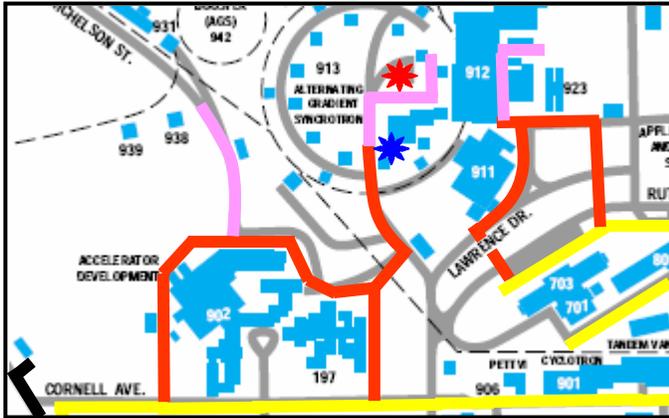
Occupancy is rated "High Hazard" due to large fire loads (combustible roof on building 902).

Piping Condition is rated "Fair" due to the individual year flow trend which is down each year since 1990.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since can easily get water from multiple sources around the site.

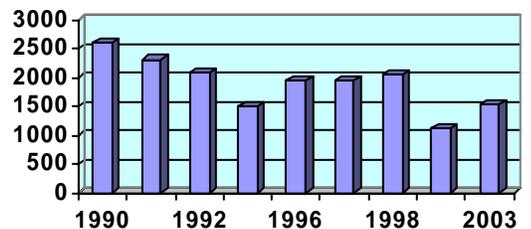
7.16 TEST POINT 16: COCKCROFT STREET



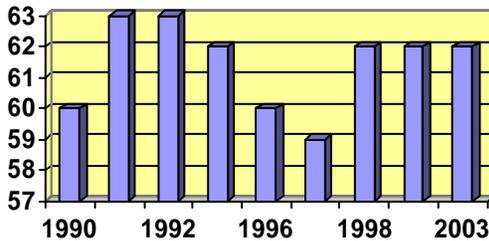
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	61.4 PSI	61.2 PSI	62.0 PSI
FLOW AVERAGE @ 20 PSI	1899 GPM	1684 GPM	1334 GPM
FLOW CHANGE FROM OVERALL	-	NA	NA

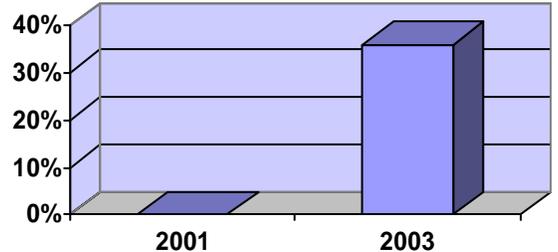
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 2001



DESCRIPTION

The pressure hydrant was H166 and the flow hydrant H168. The nearest water supply source (Water Treatment Facility) is about 3,900 feet away. The dead end main is 6 inch. The piping in this area was a 6 inch loop main that went under building 912 due to activation concerns of the potable water by beam lines in building 912. Main was closed in January 2002. The piping is about 40 years old. The piping is Transite Cement Lined and may consist of other unidentified pipe types.

ANALYSIS

Static pressures have remained relatively consistent (~61 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. These constant static pressure readings cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the trend.

When the looped 6 inch main was made into two dead end mains the relevant flow and pressure tests prior to 2001 were eliminated. Starting in 2004, flow trend analysis can begin based on the latest piping configuration.

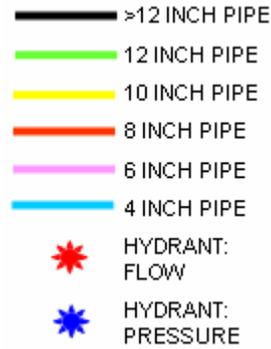
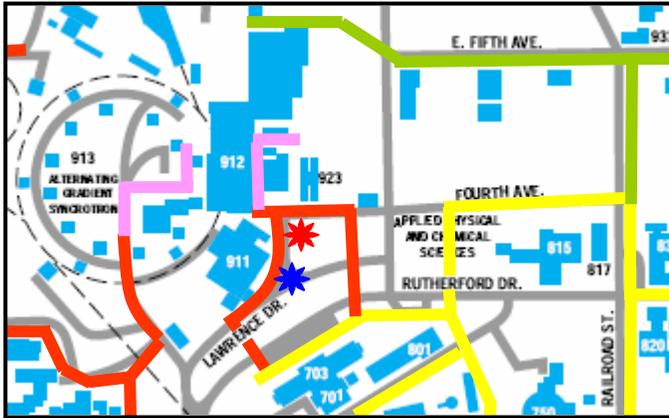
Occupancy is rated "High Hazard" due to large fire loads (cable trays in building 912, wood frame support buildings).

Piping Condition is rated "Poor" since the 6 inch looped piping was made into a dead end condition and the 2003 flow test result with respect to the MEFF demand.

Flow Capacity is rated as "Poor" because of the limited flow rate at current piping conditions.

Piping Network of water supplies is rated "Dead End" since this area can only get water via the small dead end pipe to the water sources.

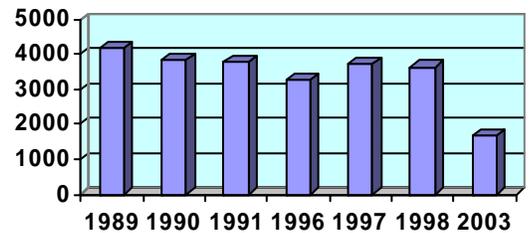
7.17 TEST POINT 17: LAWRENCE DRIVE



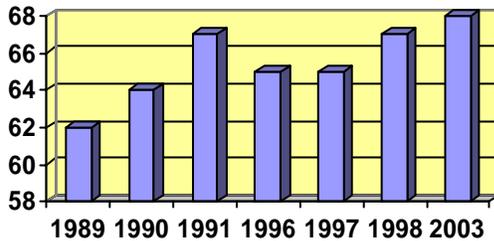
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	65.4 PSI	66.3 PSI	67.5 PSI
FLOW AVERAGE @ 20 PSI	3444 GPM	3071 GPM	2650 GPM
FLOW CHANGE FROM OVERALL	-	-12.3%	-30.0%

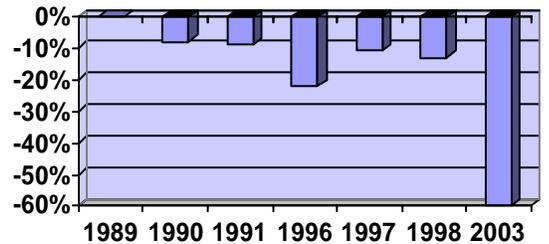
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1989



DESCRIPTION

The pressure hydrant was H164 and the flow hydrant H165. The nearest water supply source (Well 10) is about 2,800 feet away. The local loop mains are 8 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 40 years old. The piping is Transite Cement Lined and may consist of other unidentified materials.

ANALYSIS

Static pressures have remained relatively consistent (~68 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 2,650 GPM. Average flow rate from 1989 has decreased by 30%. This flow rate loss can be attributed to the age, size and configuration of the piping.

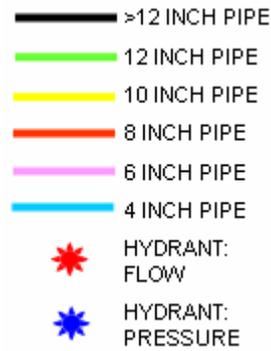
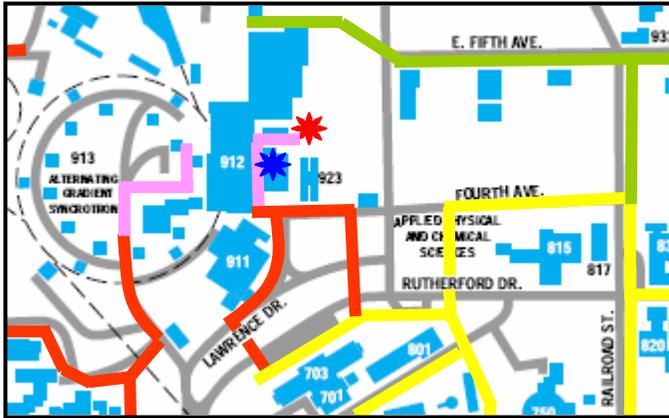
Occupancy is rated "High Hazard" due to large fire loads (AGS warehouses, multistory buildings).

Piping Condition rated "Poor" since the flow trend is losing capacity at roughly 30% over the last 14 years.

Flow Capacity is rated as "Poor" because of the limited flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Dead End" concern since this area can only get water via the single length of pipe to the water sources.

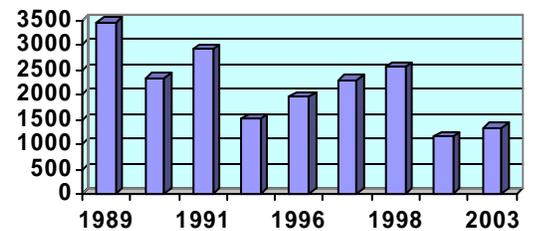
7.18 TEST POINT 18: EAST OF BUILDING 912



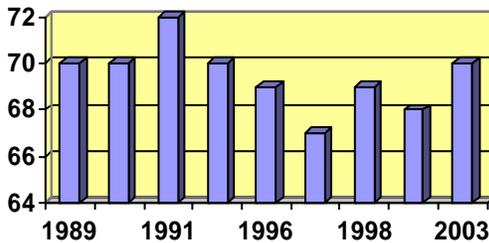
MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	69.5 PSI	68.8 PSI	69.0 PSI
FLOW AVERAGE @ 20 PSI	2166 GPM	1799 GPM	1238 GPM
FLOW CHANGE FROM OVERALL	-	NA	NA

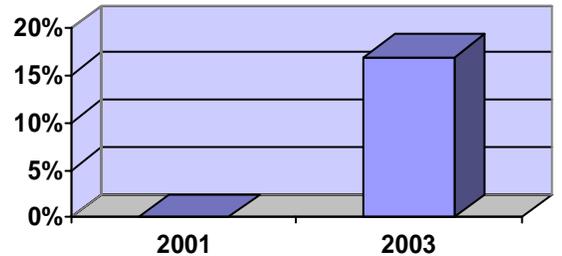
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 2001



DESCRIPTION

The pressure hydrant was H167 and the flow hydrant H193. The nearest water supply source (Well 10) is about 3,400 feet away. The dead end main is 6 inch. The piping in this area was a 6 inch loop main that went under building 912 due to activation concerns of the potable water by beam lines in building 912. Main was closed in January 2002. The piping is about 40 years old. The piping is Transite Cement Lined and may consist of other unidentified materials.

ANALYSIS

Static pressures have remained relatively consistent (~69 PSI). These constant static pressure readings cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the trend.

When the looped 6 inch main was made into two dead end mains the relevant flow and pressure tests prior to 2001 were eliminated. Starting in 2004, flow trend analysis can begin based on the latest piping configuration.

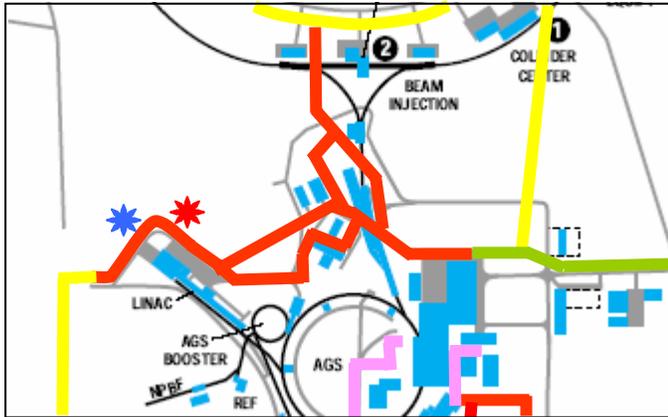
Occupancy is rated "High Hazard" due to large fire loads (target halls for AGS, large AGS buildings).

Piping Condition is rated "Poor" since the 6 inch looped piping was made into a dead end condition and the 2003 flow test result with respect to the MEFF demand.

Flow Capacity is rated as "Poor" because of the limited flow rate at current piping conditions.

Piping Network of water supplies is rated "Dead End" since this area can only get water via the small dead end pipe to the water sources.

7.19 TEST POINT 19: WEST FIFTH AVENUE

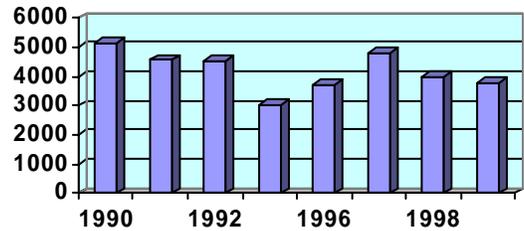


- >12 INCH PIPE
- 12 INCH PIPE
- 10 INCH PIPE
- 8 INCH PIPE
- 6 INCH PIPE
- 4 INCH PIPE
- HYDRANT: FLOW
- HYDRANT: PRESSURE

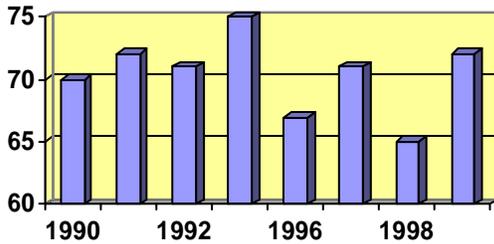
MEFF 2,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION POOR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	70.4 PSI	70.0 PSI	68.5 PSI
FLOW AVERAGE @ 20 PSI	4187 GPM	3858 GPM	3870 GPM
FLOW CHANGE FROM OVERALL	-	-8.5%	-8.2%

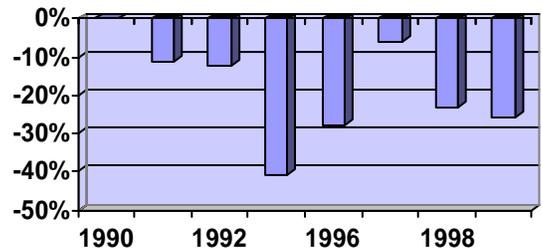
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H202 and the flow hydrant H201. The nearest water supply source (Water Treatment Facility) is about 2,500 feet away. The local loop mains are 8 inch while the feed from the Water Treatment Facility is 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 40 years old. The piping is Transite Cement Lined and Black Steel.

ANALYSIS

Static pressures have remained relatively consistent (~68 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,850 GPM. Average flow rate from 1990 has decreased by 8%. This flow rate loss can be attributed to the age, type and size of the piping.

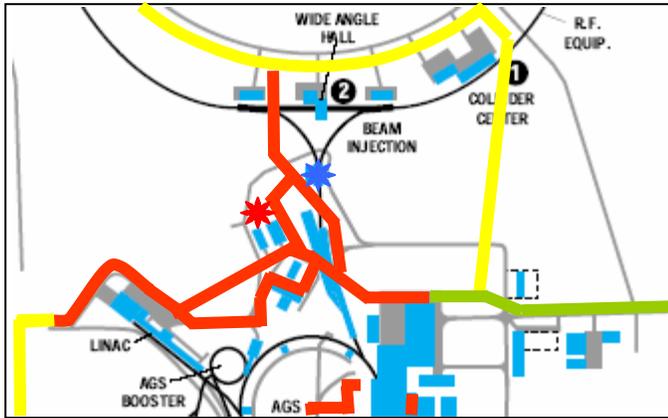
Occupancy is rated "Ordinary Hazard" due to non combustible buildings with combustible contents, cable trays.

Piping Condition is rated "Poor" due to a decrease in available flow by 8% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since this area can easily get water from multiple sources around the site.

7.20 TEST POINT 20: THOMPSON AVENUE

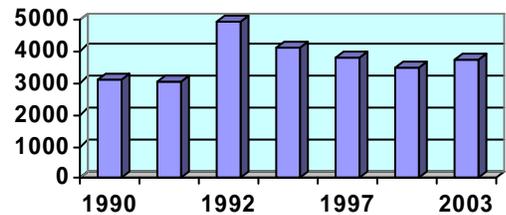


- >12 INCH PIPE
- 12 INCH PIPE
- 10 INCH PIPE
- 8 INCH PIPE
- 6 INCH PIPE
- 4 INCH PIPE
- ★ HYDRANT: FLOW
- ★ HYDRANT: PRESSURE

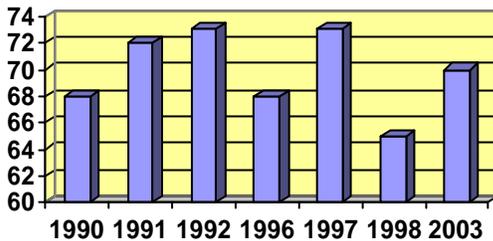
MEFF 2,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION FAIR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	69.9 PSI	69.0 PSI	67.5 PSI
FLOW AVERAGE @ 20 PSI	3722 GPM	3746 GPM	3571 GPM
FLOW CHANGE FROM OVERALL	-	0.6%	-4.2%

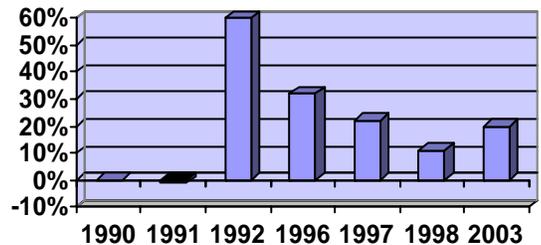
CALCULATED FLOW AT 20 PSI (GPM)



STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



DESCRIPTION

The pressure hydrant was H234 and the flow hydrant H211. The nearest water supply source (Well 10) is about 2,600 feet away. The local mains are 8 inch. The piping has not been altered since the first relevant flow test in 1990 and is about 40 years old. The piping is Transite Cement Lined and Cast Iron.

ANALYSIS

Static pressures have remained relatively consistent (~68 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,550 GPM. Average flow rate from 1990 has decreased by 4%. This flow rate loss can be attributed to the age, type and size of the piping.

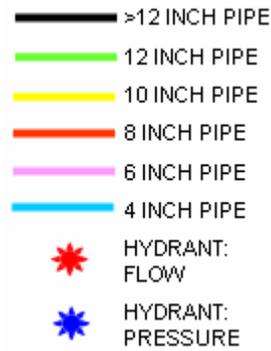
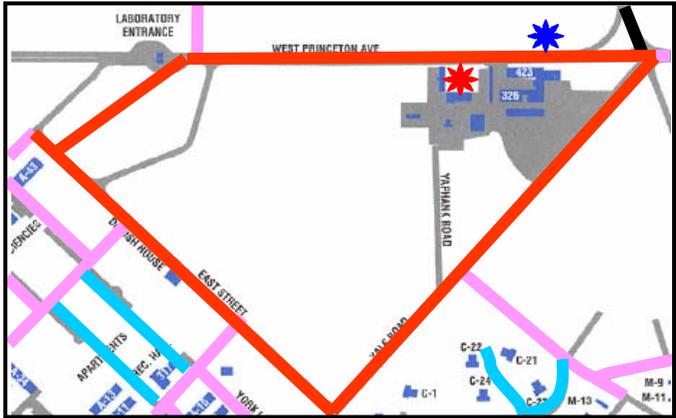
Occupancy is rated "Ordinary Hazard" due to non combustible buildings with combustible contents.

Piping Condition is rated "Fair" due to a decrease in available flow by 4% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since this area can easily get water from multiple sources around the site.

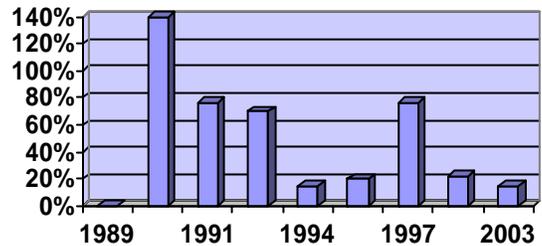
7.21 TEST POINT 21: WEST PRINCETON AVENUE



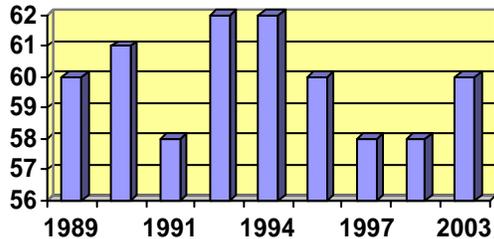
MEFF 3,000 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION POOR	FLOW CAPACITY POOR	PIPING NETWORK DEAD END
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	59.9 PSI	59.6 PSI	59.0 PSI
FLOW AVERAGE @ 20 PSI	4069 GPM	3557 GPM	3247 GPM
FLOW CHANGE FROM OVERALL	-	-14.4%	-25.3%

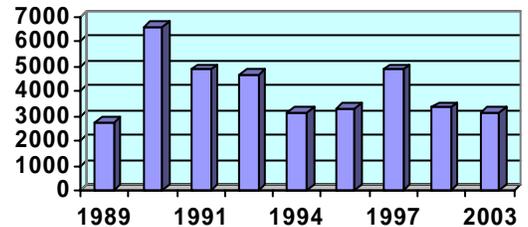
PERCENT FLOW CHANGE FROM 1989



STATIC PRESSURE (PSI)



CALCULATED FLOW AT 20 PSI (GPM)



DESCRIPTION

The pressure hydrant was H027 and the flow hydrant H026. The nearest water supply source (300K Tank) is about 1,600 feet away. The local loop mains are 8 inch. The piping in this area has not been altered since the first relevant flow test in 1989 and is over 60 years old. The piping is Transite Cement Lined.

ANALYSIS

Static pressures have remained relatively consistent (~59 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 3,247 GPM. Average flow rate from 1989 has decreased by 25%. This flow rate loss can be attributed to the age and size of the piping.

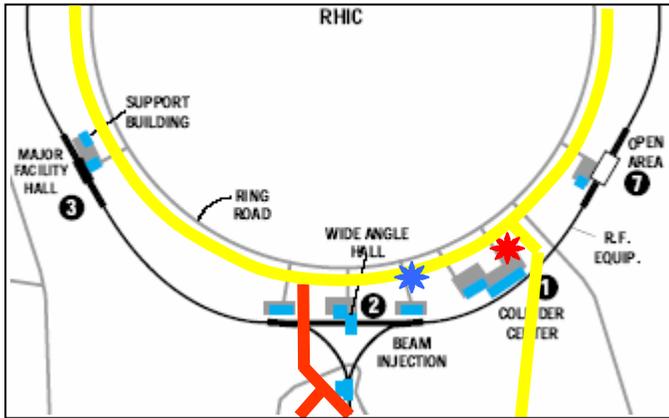
Occupancy is rated "Ordinary Hazard" due to the wood frame buildings with flammable liquids, but low importance to BNL programs.

Piping Condition is rated "Poor" due to a decrease in available flow by 25% in the last 14 years.

Flow Capacity is rated as "Poor" because of the limited flow at current demand loading through the main piping network.

Piping Network of water supplies is rated "Dead End" since all water must enter via the isolated 8 inch loop. The two six inch feeds have to be investigated by hydraulic modeling to see if can support the area by themselves.

7.22 TEST POINT 22: RHIC RING – EAST FEEDER

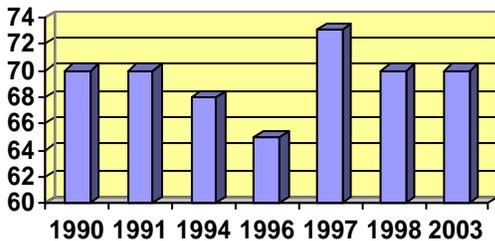


- >12 INCH PIPE
- 12 INCH PIPE
- 10 INCH PIPE
- 8 INCH PIPE
- 6 INCH PIPE
- 4 INCH PIPE
- ★ HYDRANT: FLOW
- ★ HYDRANT: PRESSURE

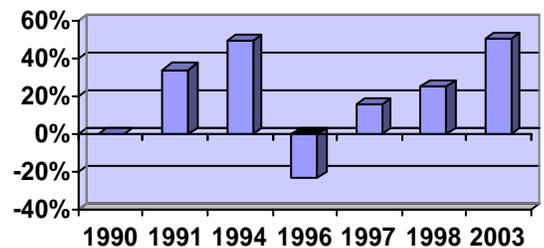
MEFF 2,500 GPM	OCCUPANCY ORDINARY HAZARD	PIPING CONDITION GOOD	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	69.4 PSI	69.2 PSI	70.0 PSI
FLOW AVERAGE @ 20 PSI	4310 GPM	4376 GPM	4888 GPM
FLOW CHANGE FROM OVERALL	-	1.5%	11.8%

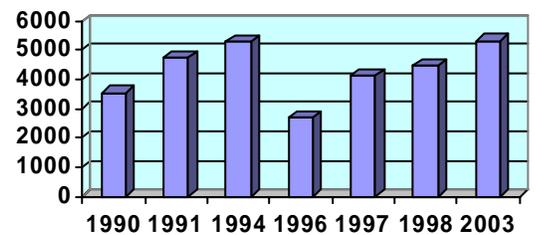
STATIC PRESSURE (PSI)



PERCENT FLOW CHANGE FROM 1990



CALCULATED FLOW AT 20 PSI (GPM)



DESCRIPTION

The pressure hydrant was H226 and the flow hydrant H225. The nearest water supply source (Well 10) is about 2,700 feet away. The local loop mains and feeder are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 15 years old. The loop piping is Cement Lined Ductile Iron and the feeder is Cast Iron.

ANALYSIS

Static pressures have remained relatively consistent (~69 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 4,900 GPM. Average flow rate from 1990 has increased by up to 11.8%. This flow rate increase cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the increase.

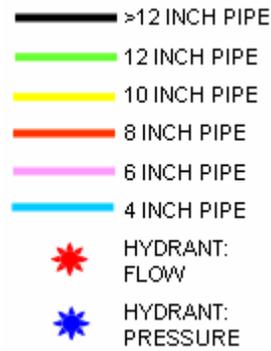
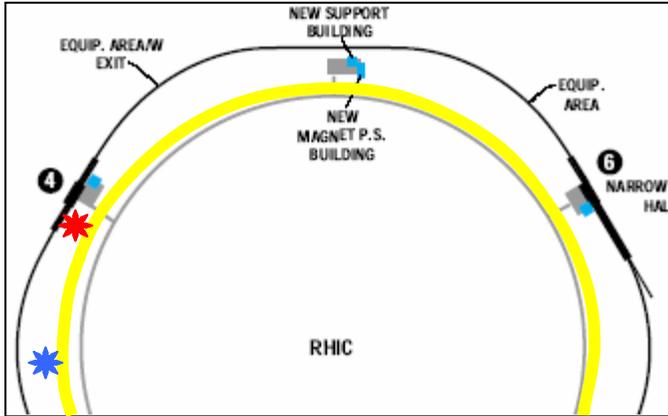
Occupancy is rated "Ordinary Hazard" due to non-combustible facilities with high programmatic contents.

Piping Condition is rated "Good" due to an increase in available flow by 11% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

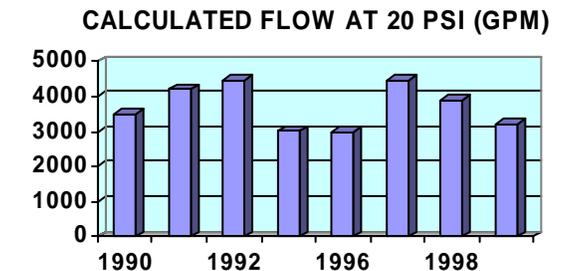
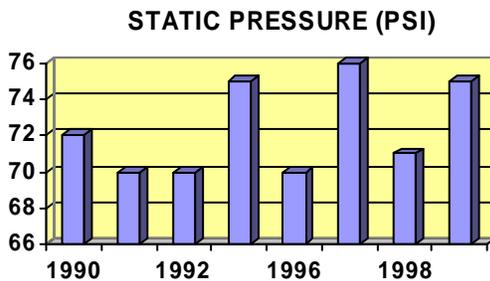
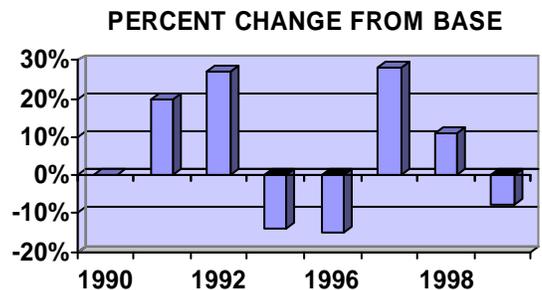
Piping Network of water supplies is rated "Multiple Path" since all water must enter via the isolated 8 inch loop. The two feeds into the ring has to be investigated by hydraulic modeling to see if can support the area by themselves.

7.23 TEST POINT 23: RHIC RING



MEFF 2,500 GPM	OCCUPANCY HIGH HAZARD	PIPING CONDITION FAIR	FLOW CAPACITY GOOD	PIPING NETWORK MULTIPLE PATH
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SUMMARY TABLE	OVERALL	10 YEAR	5 YEAR
STATIC PRESSURE AVERAGE	72.4 PSI	73.4 PSI	73.0 PSI
FLOW AVERAGE @ 20 PSI	3716 GPM	3515 GPM	3557 GPM
FLOW CHANGE FROM OVERALL	-	-5.7%	-4.5%



DESCRIPTION

The pressure hydrant was H230 and the flow hydrant H219. The nearest water supply source (Well 10) is about 5,000 feet away. The local loop mains are 10 inch. The piping in this area has not been altered since the first relevant flow test in 1990 and is about 20 years old. The piping is Cement Lined Ductile Iron. . .

ANALYSIS

Static pressures have remained relatively consistent (~68 PSI.) The consistent readings can be attributed the large diameter grid supply piping network. It appears that that overall site wide water demand changes have no major effect on the water supply in this area.

The average available flow is now about 4,650 GPM. Average flow rate from 1990 has decreased by 4.5%. This flow rate decrease cannot be explained by apparent changes in either piping condition or day to day water demands. Further investigation by means of a hydraulic flow model study is required to understand the decrease.

Occupancy is rated "High Hazard" due to the densely populated wood frame construction buildings.

Piping Condition is rated "Fair" due to a decrease in available flow by 4% in the last 13 years.

Flow Capacity is rated as "Good" because of the ample flow rate at current demand loading through the main piping network.

Piping Network of water supplies is rated "Multiple Path" since all water must enter via the isolated 8 inch loop. The two feeds into the ring has to be investigated by hydraulic modeling to see if can support the area by themselves