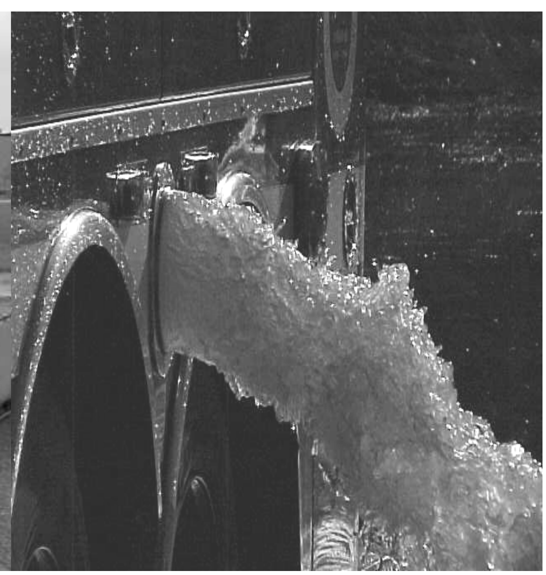
MONTGOMERY COUNTY FIRE AND RESCUE SERVICE

WATER SUPPLY WORKGROUP

FINAL REPORT

April 13, 2000

Introduction



The availability of an adequate and reliable water supply is paramount to effective fire suppression operations. The fire fighting water supply, be it from a municipal system, private system, cistern, or body of water, must be:

- Rapidly available
- Efficient
- Expandable
- Uninterrupted

This is necessary to sustain long-duration fire suppression operations. A water supply that falls short of these requirements will likely contribute to greater property loss and may contribute to the number and severity of fire-related casualties.

The issue of water supply for fire fighting in Montgomery County was addressed in the *Fire, Rescue, and Emergency Medical Services Master Plan,* adopted by the County Council in October, 1994. Recommendation C.2-1 states:

> ***"The Fire and Rescue Commission, in consultation with the corporations [local fire and rescue departments-LFRDs], should establish criteria for evaluating requests for alternative sources of water where service is not provided by WSSC, the City of Rockville, or the Town of Poolesville. Base information on the availability of public water service, taking into account existing geographic barriers, should be made available to corporations [LFRDs], if necessary."***

Water Supply Work Group

In response to this Master Plan recommendation, as well as related water supply concerns of the Fire and Rescue Commission (FRC), the FRC established the Water Supply Work Group in June 1998, for the purpose of conducting a comprehensive study of these issues and offering appropriate recommendations for improvements. The work group consisted of the following Montgomery County Fire and Rescue Service (MCFRS) personnel:

- District Chief Steven Lohr (Work Group Chairman), representing the Montgomery County Fire and Rescue Service, Division of Fire and Rescue Services

- Chief William ("Scotty") Cameron, representing the Montgomery County Fire Board
- Mr. Scott Gutschick, representing the Montgomery County Fire and Rescue Service, Fire Administrator's Office

Work Group Charge

Former FRC Chairman Giebel charged the Water Supply Work Group (WSWG) with the following multi-facetted tasks:

- Identify areas of the County without municipal water supply for fire suppression.
- Review the placement of existing water supply resources (i.e., tankers, dry hydrants, cisterns) to determine where additional resources are recommended or where current resources should be allocated.
- Review water supply for limited access highways and recommend needed enhancements such as new hydrants, siamese connections, preplanning (mapping), etc.
- Develop standardized operational procedures based upon minimum acceptable fire flow and standard response goals for rural water supply, to include tanker/water shuttle operations.
- Establish criteria for evaluating requests for alternative sources of water where water service is not provided.
- Review dispatch procedures for fire incidents in areas lacking a municipal water supply.
- Conduct an adequacy and reliability review of all hydranted areas.
- Determine the current requirements for rural fire flow in the ISO rating schedule.
- Review the requirements of NFPA 1231 – Standard for Water Supplies for Suburban and Rural Fire Fighting.
- Develop an overall water supply coverage map based upon available hydrants, draft supply points, and the fire department's ability to transport water.

- Develop an inventory of mobile water supply apparatus that is within a five-mile response coverage for any portion of Montgomery County.

- Develop long-range goals to maximize efficiency, minimize the level of unprotected risk, while exploring the insurance rating for Montgomery County.

- Identify pockets of areas without hydrants in areas generally served by municipal water supply, and recommend actions to improve response of water supply units to these areas.

Methodology

The WSWG began its charge in July 1998, with a comprehensive data and information collection effort. The group met with representatives of the various municipal and private water systems. Meetings with the various local fire-rescue departments (LFRDs) were initiated, and site visits were conducted at dry hydrant locations inside and outside of Montgomery County. Federal Government facilities with private water supply systems were evaluated. Important data and maps concerning water supply and fire incidents were gathered and analyzed. Copies of pertinent plans, standards, and reports were obtained. The group also met with the local Insurance Services Office (ISO) representative to discuss the county's ISO rating and to obtain fire flow requirements for properties in Montgomery County. In addition, the WSWG conducted a series of tests to determine the capabilities of the existing water tankers in the county. Input was also sought from the field in the form of a water supply questionnaire and a Standard Training Program session addressing hydrant locations and target hazard locations. The Life Safety Systems Section was contacted to receive input concerning past, present, and future initiatives.

After analyzing the vast array of data, maps, documentation, and related information, the WSWG formulated a list of recommendations for improvements to the fire fighting water supply system. These recommendations appear individually throughout the report, and together in Section VI-The Future.

Meetings

To obtain the most up-to-date information concerning water supply systems and static sources within Montgomery County, the WSWG arranged several meetings and site visits.

The group met with (or corresponded with) the following individuals representing municipal/private water systems, local fire-rescue departments, and the Insurance Services Office:

- Timothy D. Hirrel, Planning Manager, Water Resources Planning Section, Washington Suburban Sanitary Commission (WSSC)
- Daniel Pendergraft, Chief Water Plant Operator, Potomac Water Filtration Plant, Washington Suburban Sanitary Commission (WSSC)
- Edwin Woo, Civil Engineer, City of Rockville Public Works Department
- Wade Yost, Engineer, Town of Poolesville Public Works Department
- Fred E. Brower, Senior Field Representative, Insurance Services Office, Inc.
- Dennis Wenner, Safety Manager, PEPCO Power Plant, Dickerson, Maryland
- Tony Valez, Chief Engineer, Ogden-Martin Systems of Montgomery, Inc., Montgomery County Resource Recovery Facility, Dickerson, MD
- Chief Gary Hess, National Institutes of Health Fire Department, Bethesda, MD
- Chief Charles Elgin, Jr., Upper Montgomery County Volunteer Fire Department
- Chief Douglas Edwards, Hyattstown Volunteer Fire Department
- Former Chief J. B. Kline and District Chief Matt Montgomery, Laytonsville Volunteer Fire Department
- Chief Darron Long and line officers, Damascus Volunteer Fire Department
- Chief Alan Hinde and line officers, Rockville Volunteer Fire Department
- Chief George Brown and Deputy Chief Bruce Newcomer, Sandy Spring Volunteer Fire Department
- Chief James Seavey, Cabin John Park Voulnteer Fire Department
- District Chief Stanley Tetlow, Fire-Rescue Communications, Division of Fire and Rescue Services, MCFRS
- District Chief John Walters, MCFRS (Retired)

- Mark Deputy, Automated Systems Manager-CAD, Department of Information Systems and Telecommunications, Montgomery County, MD.
- Mr. Larry Davis, Fire Protection Water Supply Consultant
- Various MCFRS volunteer and career personnel

Site Visits

The WSWG visited the following sites to obtain first-hand information about private water supply systems, dry hydrants, static sources, and water supply systems for limited-access highways:

- PEPCO Power Plant, Dickerson
- Ogden-Martin Systems of Montgomery, Inc., Montgomery County Resource Recovery Facility, Dickerson
- National Institutes of Health Animal Research Center, Poolesville
- Naval Surface Warfare Center, Carderock
- I-495 American Legion Bridge at Cabin John - dry standpipe with FD connections
- Town of Barnesville – target hazards, underground water tank
- Clarksville Volunteer Fire Department, Howard County, Maryland
- Dry Hydrants in rural areas of Howard County, Maryland:

  Connected to 18,000 gal cistern, Highland Road 100 yards north of Rt-108
  Connected to private pond, Lime Kiln Road at Reservoir Road
  Connected to private pond, Lime Kiln Road west of Rt.- 216
  Connected to private pond, Rt-108 about one mile west of Ten Oaks Road

- McLean Volunteer Fire Department, Fairfax County, Virginia
- Prince William County, Virginia, Station 16
- Dry Standpipes along I-495 in Fairfax County, Virginia:
  Rt-193 overpass at I-495
  Rt-7 overpass at I-495

- The Winfield Volunteer Fire Department, Carroll County, MD. Winfield Mile, ISO Evaluation.

GIS Maps, Data, and Fire Incident Data

The WSWG made extensive use of the county's Geographic Information System (GIS) to obtain maps displaying water supply data. With outstanding support provided by Tim Taormino of the Department of Information Systems and Telecommunications' GIS Office, the Work Group was able to obtain the following maps:

- Hydranted vs. non-hydranted areas of the county
- Locations of WSSC hydrants
- 5-mile road network coverage of existing tankers
- 5-mile road network coverage of proposed tankers
- 5-mile road network coverage of proposed tankers, including a tanker at Clarksburg (1"= 5000 ft scale and 1"= 3 mile scale)
- Hydrants along I-495, I-270 and I-370, with 1000-foot intervals between overpasses noted

The maps allowed the WSWG to examine the extent of hydrant and tanker coverage throughout Montgomery County, which, in turn, led to several of the group's conclusions and recommendations.

The WSWG also obtained CY94-98 fire loss data from the National Fire Protection Association and the MCFRS, Life Safety Bureau, Division of Fire and Explosion Investigation Office. The information was analyzed by the WSWG to determine the year-to-year fire loss history nationwide and in the county, which directly relates to the county's ISO rating.

Reports, Plans, and Related Documents

As a result of the earlier mentioned meetings and research efforts, the WSWG obtained copies of a number of emergency operations plans, reports, and other information related to the work group's charge. A list of these items is presented below.

- Metropolitan Washington Water Supply Emergency Plan, developed by the Drinking Water Emergency Agreement Task Force, Metropolitan Washington Council of Governments, October, 1994

- Montgomery County Emergency Operations Plan, Annex U – Utilities, August, 1996

- WSSC Water Design Guidelines, Section 25 – Fire Hydrants, October 1995
- Report of fire hydrant testing in town of Poolesville, Kamber Engineering, Inc.
- Prince William County, Virginia, SOPs concerning water supply:
  "Incident Command/Water Supply Officer"
  "Rural Water Supply Operations"
  "Building Preplans/Water Supply"
  "Fill Site Preplans"
  "Tanker Task Force"
  "Tanker Radio Designations"
- "Compressed Air Foam for Structural Fire Fighting: A Field Test, Boston, Massachusetts"
- "Compressed Air Foam Systems In Limited Staffing Conditions": Robert G. Taylor, Morristown Fire Bureau, Morristown, New Jersey

NFPA Standards 1231 and 502

A copy of NFPA Standard 1231–1993 edition; Water Supplies for Suburban and Rural Fire Fighting, and NFPA Standard 502–1998 edition; Standard for Road Tunnels, Bridges, and Other Limited Access Highways was obtained by the WSWG. These standards are cited in the work group's recommendations, and addresses the following topics of specific interest to the WSWG:

- Determining minimum water supplies for various hazard/construction types
- Water supply for fire fighting
- Water supply transfer
- Identification and accessibility of water sources
- Water hauling
- Large diameter hose
- Secondary water supply
- Dry standpipes for roadways, bridges, and tunnels

Input from Field Suppression Forces

On July 27, 1998, the WSWG disseminated a memorandum to IECS - certified command officers seeking input on water supply issues in their respective station areas. The officers were given a questionnaire (see copy in

Appendix A) asking their opinion on minimum gallon per minute (GPM) flow requirements for initial attack and defensive attack for a series of common occupancy types. A house-rural setting, house-urban setting, barn, commercial building, school, and church were offered as potential scenarios. The officers were asked to recommend whether or not an elevated stream should be established for each occupancy type. In addition, the officers were asked for their opinion on minimum GPM flow requirements for initial attack, and extended defensive attack for two highway-related water supply scenarios: a propane tanker fire at the intersection of I-495, I-270, Route-355, and the METRO Red Line overpass in Bethesda; and a propane tanker fire on I-270 in Clarksburg.

Addressing the particular issue of rural water supply, the WSWG Chairman, in August 1998, distributed a Tanker Data Survey, (see Appendix B) to stations located in rural areas of the county. The tanker survey was sent only to those stations having tankers: Stations 9, 14 and 17. The tanker survey asked for information concerning tank capacity, vehicle dimensions and weight, discharge and fill capabilities, hose complement, appliances, etc.

The Rural Water Supply Questionnaire sought drafting points in non-hydranted areas such as lakes, streams, cisterns, etc. It specifically asked for locations, distance from fire ground, vertical lift, minimum water depth, all weather access, and dry hydrant data if applicable.

The Target Hazards Work Sheet was designed to identify three target hazards in each of the rural stations first due area, presumably worst case rural scenarios. The information was intended for use by the WSWG to calculate required fire flows for local worst case rural fire scenarios.

In addition to input obtained directly from the IECS-certified command officers, the WSWG also sought input from all MCFRS field personnel concerning hydrant coverage and target hazards in their first-due areas. By means of a Standard Training Program session occurring November 17-19, 1998, field personnel were provided GIS generated 600-scale maps of their first-due areas showing streets and hydrants. Using these maps, personnel were asked to highlight non-hydranted areas or any area requiring more than a two-pumper relay (assuming 600 feet between pumpers). They were also asked to flag any hydrants that had produced low flow/pressure during incidents, and to mark the locations of target hazards having fire flow requirements that exceed available water supply. Maps with the requested information were returned within six weeks and analyzed by the WSWG. A database was created identifying these items by station area and is included in Appendix C for review. A copy of the maps and the completed database were returned to DIST-GIS for corrections as noted.

The History


BARNESVILLE
SETTLED-1747
INCORPORATED-1888
A CARING COMMUNITY.

Insurance Services Office Grading Schedules

The Insurance Services Office, (ISO) is a national corporation providing advisory services to property and casualty insurance carriers. The ISO functions as an insurance rating organization, as an actuarial advisory organization, and as a statistical agent. In 1996, the ISO employed approximately 2,000 people and served nearly 1,300 affiliated insurance companies[1].

Approximately every ten years, or as requested, employees of the ISO apply the requirements of their Municipal Grading Schedule, (MGS) to municipalities, communities, and their fire departments for the purpose of classifying their fire defenses and physical conditions. This schedule provided a standardized, nationally accepted method for classifying municipal public fire protection defenses, and to establish base insurance rates for fire insurance purposes. With improved ratings, fire insurance companies that subscribe to the ISO rating system typically lowered residential and commercial insurance rates for their customers. Political officials proudly announced Class 1 ratings as a way to repay their citizens for the investments expended on municipal fire protection. The fire defenses in many areas of the country, including most large cities, were developed around the ISO-MGS requirements for obvious reasons. For many years, a favorable ISO class rating was the premier method to determine adequate or sub-standard fire department preparedness.

The 1974 edition of the MGS was specification based and designed to identify deficiencies from a published standard, with very little flexibility in the schedule. Therefore, communities that did not have traditional underground water mains supplied from a municipal system were unable to achieve other than a Class 9 rural rating in that evaluation. Montgomery County was last rated (see page 14) using this Municipal Rating Schedule.

In 1980, the MGS was updated and replaced with the ISO Fire Suppression Rating Schedule, (FSRS). Several significant changes occurred with this update that had a direct impact on areas similar to Montgomery County. For the first time, credits were extended to rural areas that did not have conventional underground water lines and hydrants. Therefore, areas like Montgomery County that are a mixture of urban, suburban, and rural communities now have the ability to lower ISO ratings in non-urban areas.

The 1980 FSRS is a performance based document designed to increase the flexibility of the schedule while crediting changing conditions and technologies exceeding the traditional MGS. The current FSRS is based on delivery performance only, without regard to the delivery method used. This schedule is

[1] Source: NFPA Fire Protection Handbook, 18th edition.

adaptable to crediting the delivery of water by other means (e.g. tankers). These credits can now be extended to areas without municipal water systems[2].

A second important change between the MGS and the FSRS is identified in the formula for needed fire flow. The 1974 schedule and its predecessors did not provide significant recognition of the decreased need for public fire suppression in large buildings and properties that are protected by automatic sprinkler systems. The FSRS recognizes this contribution by excluding all properties fully protected with standard automatic sprinkler systems from the development of needed fire flow calculations. This change speaks directly to the importance placed upon automatic sprinkler protection.

Finally, the 1980 revision increases the relative weight assigned to both water supply and the fire department. The relative weight for water supply is 40%, and the relative weight for fire department is 50%. Those numbers were 39% and 39% respectively for previous editions.

ISO Major Rating Items Comparison (percent)

Feature	**MGS (Pre 1980)**	**FSGS (Post 1980)**
Water Supply	39 %	40 %
Fire Department	39 %	50 %
Fire Service Communications	9 %	10 %
Fire Safety Control	13 %	0%
	100 %	100 %

In either evaluation, water supply delivery is critical to any Fire Department preparedness plan. It is important to understand that ISO classifications developed using the fire suppression rating schedule are only one of several elements used in the development of fire insurance rates. Individual insurance underwriters who choose to, may utilize this class rating as a primary method of determining rates for insurance premiums. However, each underwriter determines their own rates considering other factors, as well.

The ISO model is considered to be helpful to local officials when viewed in conjunction with more specific local needs. Any improvement in the ISO rating should translate into savings for individual property owners through reduced insurance rates. The WSWG acknowledges this reality and considers the FSRS requirements fundamental.

[2] Currently there are nine jurisdictions in the United States who have been able to earn a ISO Class-4 rural rating coupled with a Class 1 urban rating. DuBoise, Pa., and Fallon, Nevada serve as representative examples.

The following cities currently have ISO Inc., Class 1 fire department ratings. The date indicates when the fire department received its Class 1 rating.

1. St. Louis, MO	Pre-1964
2. Baton Rouge, LA	May 1, 1979
3. Santa Ana, CA	January 1, 1984
4. Stockton, CA	January 1, 1984
5. Macon/Bibb County, GA	June 1, 1984
6. Hialeh, FL	May 1, 1986
7. Springfield, IL	September 1, 1988
8. Anaheim, CA	November 1, 1988
9. Beverly Hills, CA	May 1, 1989
10. Las Vegas, NV	May 1, 1990
11. Vernon, CA	November 1, 1990
12. Greensboro, NC	February 1, 1992
13. Coral Gables, FL	November 1, 1992
14. Glendale, CA	November 1, 1992
15. Oak Lawn, IL	March 1, 1993
16. Arcadia, CA	August 1, 1993
17. Lisle-Woodbridge FD, IL	December 1, 1993
18. Clark County, NV	February 1, 1994
19. Hartford, CT	July 1, 1994
20. Culver City, CA	February 1, 1995
21. Skokie, IL	September 1, 1995
22. E. Bank Consol. FD, LA	September 5, 1995
23. Torrance, CA	May 1, 1996
24. Hoboken, NJ	July 1, 1996
25. Fallon, NV	August 1, 1996
26. Arlington Heights, IL	September 1, 1997
27. Syracuse, NY	January 1, 1998
28. Pembroke Pines, FL	February 1, 1998
29. Charleston, SC	June 1, 1998
30. Shreveport, LA	July 6, 1998
31. Dubois, PA	October 1, 1998
32. Plano, TX	October 1, 1998
33. Cambridge, MA	July 1, 1999

Montgomery County ISO Ratings

WSWG member William “Scotty” Cameron had copies of several Insurance Services Office (ISO) publications and reports dating back to the early 1970s pertaining to the history of the county’s ISO ratings. These, and later documents made available by local ISO representative Fred Brower, helped the

Work Group understand Montgomery County's ISO ratings over the past 20+ years. A list of ISO references reviewed by the WSWG appears below:

- "Public Fire Protection Report on Montgomery County, Maryland," October 1976.
- Letter (with attachments) to County Executive James Gleason from John Beilein, Manager, ISO, containing county's Metropolitan District ISO rating, November 1, 1976
- "Grading Schedule for Municipal Fire Protection," ISO, 1974.
- "Guide for Determination of Required Fire Flow," ISO, 1972.
- "Fire Suppression Rating Schedule," ISO, 1980.

The ISO municipal grading schedule was last applied to Montgomery County in October 1976. At that time, the City of Rockville, and rural portions of the up-county including the Town of Damascus were excluded from the study. The total deficiency points determined that Montgomery County earned a **Class 4** municipal rating and a **Class 9** rural rating.[3]

As part of their survey, the ISO calculates the needed fire flow for structures within a given community and compares those demands to the fire department's ability to deliver water within that community. A public protection classification is then assigned that is used by insurance companies to determine insurance rates for property owners.[4] Historically, municipal fire defenses have been structured and deployed to maximize the public protection classification, thereby lowering insurance rates for all property owners. However, the method used to determine this public protection classification has changed since the last Montgomery County evaluation. Suburban areas like Montgomery County with population greater than 250,000, are now statistically rated based upon previous fire loss. The ISO believes that this method better reflects a community's risk in that actual fire loss can be attributed to the components that drive fire loss such as water supply, communications, staffing, fire prevention, etc. Applying the traditional model to areas as large as Montgomery County is simply too labor intensive.

The following paragraph is taken from the 1976 report and is specific to the water supply section of the final report[5].

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[3] Any area greater than 5 miles from a fire station is automatically rated as ISO Class 10.

[4] Other factors beyond the scope of this report such as staffing, communications, and others are considered as well.

[5] The WSWG focused on this section of the report only. No consideration was given to the impacts of fire department, communications or fire safety control ratings since they are not included in the scope of this study.

"An adequate supply is available but there are several features of moderate unreliability even when considering storage and emergency supply. The arterial system is generally adequate and well arranged, except looping is incomplete in outlying areas and single mains supplying Montgomery Village, Germantown, the booster zones and several pressure-regulated zones. The gridiron of smaller mains is mainly good in the Bethesda, Chevy Chase, Wheaton, and Silver Spring areas except at service limits, but is irregular and incomplete in outlying areas. Most pressures are good to fair and well maintained fire flow tests, indicate that the quantities available are good in business, shopping center, and apartment districts and good to fair in industrial, institutional, and residential districts. Hydrant spacing is only fair to excessively wide in commercial districts and fairly good in residential districts. A moderate number of hydrants lack a valve in the branch connection; hydrants are in only fair to poor conditions"[6].

Current findings of the WSWG are largely consistent with the 1976 summary. Specifically, the implied problems regarding stored water capacity, hydrant maintenance, and looping of expanding water mains remain a concern. In the twenty-three years since this was written, many of the problems remain the same, but the problems have moved geographically. Instead of looping problems in the Gaithersburg-Germantown corridor, the concern is now in the Germantown-Clarksburg corridor. The WSWG is not aware of any cooperative efforts between the WSSC and MCFRS to address these on-going concerns. More importantly, the ISO ratings for Montgomery County remain the same as twenty-three years ago.

Needed Fire Flow

The amount of water in gallons per minute (GPM) required to suppress a fire in a given structure is most often referred to as needed fire flow, or required fire flow. Water requirements for fire fighting include the rate of flow, the residual pressure required at that flow, and the total quantity required.

The American Water Works Association, (AWWA) defines required fire flow as **: *"the rate of water flow, at a residual pressure of 20 PSI for a specified duration, that is necessary to control a major fire in a specific structure*[7].**

Several different methods may be used to calculate needed fire flow for ***non-sprinklered structures***. The Iowa State University Method is the easiest to

[6] Source: ISO Public Fire Protection Rating for Montgomery County, Maryland; October 1976
[7] Source: AWWA M31 Distribution System Requirements For Fire Protection, AWWA, Denver, Co. 1958

apply and is most frequently used by Command Officers for a convenient method to estimate fire flow needs. Although not as complex as other formulas, the Iowa State formula is considered to be very reliable. This simple formula is:

$$GPM_{Required} = Length \times Width \times Height_{Of\ Structure} / 100$$

The Illinois Institute of Technology publishes a formula based upon a survey of 134 fires in the Chicago Area. This formula is not suitable for local needs.

The most widely recognized and utilized formula is contained in the Insurance Services Office Fire Suppression Rating Schedule. The flows calculated using this method are considered a good estimate. The ISO Method considers building construction, occupancy, adjacent exposed buildings and communication paths for fire spread between buildings.

The basic formula for needed fire flow is:

$$NFF_i = (C)_i(O)_i(X+P)_i$$

Where:

NFF_i = Needed Fire Flow in (GPM)
C_i = Construction Factor
O_i = Occupancy Factor
$(X+P)_i$ = Exposure Factor

Calculations are typically rounded to the nearest 250 GPM for flows under 2500 GPM and the nearest 500 GPM for larger flows. Additional adjustments are made for buildings with wood shingle roofs.

As a general rule both the American Water Works Association (AWWA) and the ISO recommend 3500 GPM as the upper limit for needed fire flow for normal public protection. These organizations have further established 500 GPM as the minimum needed fire flow. This is not to say that larger structures or facilities with severe hazards do not require additional fire flows. Calculated fire flows up to 12,000 GPM are not unusual for many buildings in older cities. However, data provided to the WSWG by the ISO shows that most non-sprinklered residential high-rise buildings within Montgomery County have a calculated required fire flow of between ***5,000 and 8,000* GPM**. Water supplies of 50,000 GPM are not unheard of, but designing public systems capable of flows that high is not cost effective or practical. Regardless, the needed fire flow should be available simultaneously with domestic consumption at the maximum daily rate.

Needed fire flow should be available for up to 10 hours. Many municipal water authorities place an upper limit of 2 to 4 hours on fire fighting water supply duration due to the economics of pumping and storing large quantities of water.

Of special interest to the MCFRS is the following table that summarizes NFF for groups of dwellings based upon separation distances of similar exposures.

The ISO recommends the following minimum fire flows for groups of structures.

Required Fire Flows for Groups of Dwellings

Exposure Distances (Ft.)	Required Fire Flow (GPM)
Over 100	500
31-100	750
11-30	1000
10 or less	1500

Due to the large number of garden apartments, townhouses, and other clusters of homes, ***the WSWG recommends a minimum quantity of fire fighting water in the 3000-3500 GPM range for townhouses, garden apartments and other groups of dwellings.*** This can be accomplished in areas with municipal fire hydrants utilizing the resources currently deployed on a structure fire response, providing sufficient supply lines are deployed above ground.

The ISO current required duration for needed fire flows are 2 hours for flows of 2500 GPM and less, 3 hours for flows of 2501-3500 GPM, and 4 hours for flows greater than 3500 GPM.

In contrast, water supply requirements for structures equipped with automatic sprinklers are required by code to meet the anticipated flow (design flow) of the sprinklers, plus an allowance for hose streams for manual fire fighting. Therefore, structures protected by automatic sprinklers are excluded from needed fire flow calculations[8]. The long-standing success of automatic sprinklers is well documented in the fire protection community.

A joint report of committees from the American Society of Civil Engineers, the American Water Works Association, and others suggested that the maximum general service demand on a waterworks system be taken as the peak hourly demand during a test year[9].

The occurrence of a fire or multiple fires should not affect domestic demands or vice versa. These assessments are important because as more and

[8] The specific requirements for structures containing sprinklers may be found in the NFPA 13 series of codes/standards that govern good practice in buildings containing automatic sprinklers.

[9] ASCE Bulletin #2, American Society of Civil Engineers, New York, 1951

more water is used in a given system for domestic needs, less water will be available for fire fighting.

NFPA 1231

NFPA 1231 The Standard on Water Supplies for Suburban and Rural Fire Fighting identifies minimum requirements for fire fighting water supplies in rural and suburban areas where reliable water supply systems do not exist. Every day adequacy and reliability is the primary focus of the standard.

The method used to determine the minimum water supply necessary in this standard deviates from the ISO Needed Fire Flow formula. Rather than determining a rate of flow in GPM, the NFPA guidelines are used to calculate a minimum water supply in gallons. This information is then used to recommend a minimum water delivery rate in GPM for fire department use. In many cases, this minimum water supply is intended to protect exposures only, and therefore not designed to extinguish a fire in the original building.

The basic formula for minimum water supply is:

$$\text{Minimum Water Supply} = \frac{\text{Total Volume of Structure}}{\text{Occupancy Class Number}} \text{ (Construction Classification \#)}$$

Where:

Occupancy Classification Number =

3 for Severe Hazard Occupancies
4 for High Hazard Occupancies
5 for Moderate Hazard Occupancies
6 for Low Hazard Occupancies
7 for Low Hazard Occupancies

And:

Construction Classification Number =

0.5 for Type I Fire Resistive Construction
0.8 for Type II and IV Noncombustible and Heavy Timber Construction
1.0 for Type III Ordinary Construction
1.5 for Type V Wood Frame Construction

Assignment of the various occupancies are pre-determined in NFPA 1231, although the Authority Having Jurisdiction can exercise professional judgement when applying the requirements of the standard based on other factors.

Calculation of the total water supply required in gallons is then used in the following table to determine the minimum rate of delivery by the fire department:

Total Water Supply Required (GALS)	Rate of Delivery (GPM)
Up to 2499	250
2500 – 9999	500
10,000 – 19,999	750
20,000 or more	1000

Source: Table 5-9(b), NFPA 1231

The reader should be careful not to confuse the requirements of the previous ISO recommendations with the NFPA recommendations. The ISO guidelines were originally developed for use in cities and municipalities where hydrants and water is readily available. The NFPA standard referenced here focuses on rural and suburban areas where water may not be as readily available. In either case, the recommendations in this report for Needed Fire Flow are supported by either of these methods.

Historical Fire Loss

The United States has a serious and substantial fire problem. Roughly once every two seconds an unreported fire occurs. Nearly once every minute, there is a home fire serious enough to warrant calling the fire department[10].

The rate of death from fire in the United States is significantly higher than in other industrialized nations. Fire in the United States kills more people than all natural disasters, such as floods, hurricanes, tornadoes, earthquakes and blizzards, combined.

Nationwide in 1998, an estimated $6.7 billion in structure fire property damage occurred as a result of fire. Sixty-five percent of that loss, or $4.4 billion occurred in residential occupancies[11].

The economic implications of fire loss extend beyond the direct losses associated with the physical losses of a structure and its contents. Other indirect costs that include loss of use of the property, loss of employment, loss of tax revenues, insurance costs, medical costs associated with death, injuries, and disabilities would inflate the direct losses considerably.

[10] Source: U.S. Fire Administration. "Protecting Your Family From Fire."
[11] Source: NFPA Journal, September/October 1999.

The National Fire Protection Association's "Survey of Fire Departments for 1994 through 1998 U.S. Fire Experience" identifies a number of statistics worth noting in this report. The average fire experience nationwide in similar communities with a population of 500,000-999,999 lists the following data:

National Fire Loss Statistics for Communities of Similar Size

Year	All Fires	Structure Fires	Civilian Deaths	Civilian Injuries	Dollar Loss
1994	5,157	1,703	9.50	73.94	$19,033,200
1995	4,537	1,498	10.39	71.94	$21,319,200
1996	4,306	1,462	9.82	67.64	$19,437,300
1997	4,058	1,417	8.73	75.69	$27,843,000
1998	3,634	1,133	8.76	68.55	$16,942,100

Source: National Fire Protection Association –Annual Fire Loss Statistics

In addition, the NFPA has determined that the number of fires per thousand population nationwide is 6.2 for communities this size. More importantly, in 1998, 74% of all structure fires occurred in residential structures. This ratio of residential fires to all structure fires is long standing in the U.S.

Montgomery County is home to approximately 850,500 people spread over 496 square miles of land area. Since Montgomery County is predominantly residential in composition, the ratio between residential structure fires and other structure fires has the potential to be even higher than the national average. Fire loss data for Montgomery County for calendar years 1994 through 1998 is shown below[12].

Fire Loss Statistics For Montgomery County, MD

Year	All Fires	Structure Fires	Civilian Deaths	Civilian Injuries	Dollar Loss
1994	3302	1089	11	91	$14,523,853
1995	2892	1016	10	50	$19,017,740
1996	3533	832	14	72	$18,671,387
1997	3147	1536	8	76	$19,926,100
1998	2613	641	3	71	$10,974,379

Source: Montgomery County, Maryland, DFRS Bureau of Life Safety Services, Division of Fire Investigations

[12] The Work Group believes that the number of structure fires and the resultant dollar loss is grossly under-estimated, particularly for 1998 in Montgomery County for two reasons: 1) there exists a significant non-compliance problem concerning personnel not using or misusing the Fire Incident Reporting Executive System (FIRES); and 2) historically, incident command and unit officers have under estimated actual fire loss by using codes that indicate "good intent fire, smoke scare, hazardous condition-other, etc." rather than "inside structure fire." This expedites the reporting process, however, under reports the actual fire loss statistics.

This loss experience is similar to the nationwide statistics in all areas except dollar loss. ***The WSWG recommends that the Fire Rescue Commission initiate immediate action to correct the problems with F-I-R-E-s compliance and fire loss estimation.***

The ISO now rates large municipal areas like Montgomery County using previous fire loss data, rather than a periodic survey of available resources. Therefore it is essential that data be as accurate as possible.

Since almost 80% of all fire deaths occur in the home, the key to reducing fire loss and subsequent fire deaths is to develop fire safety initiatives targeted at the home.

The Risks

Target Hazards

Traditionally target hazards are selected based upon the threat to human life rather than the potential to tax a fire department's water supply delivery system. For the purpose of this report, the WSWG focused on and examined buildings that would, in our professional judgement, tax the water supply delivery system. Historically, a very small percentage of fires occurring in Montgomery County account for the largest percentage of annual fire losses. This is true nationwide. Nevertheless, all fire departments are required to defend against potential large loss fires as well as smaller, routine fires. Our customers expect the fire service to defend them and their property in urban, suburban, and rural areas of the county. To adequately serve their customers, Local Fire-Rescue Departments (LFRD's) operating within Montgomery County have deployed resources to fight all types of fires, large and small.

As part of a water supply delivery system risk analysis, the WSWG distributed a target hazards survey to stations 4, 9, 10, 13, 14, 15, 17, 28, 29, 30, and 31. Completed worksheets were returned by stations 4, 9, 10, 13, 14, 15, 17, 28, and 40. Companies were asked to identify three target hazards in their first due area that met the following criteria for needed fire flow calculations.

- Municipal fire hydrants are not available
- Building(s) are not protected by an automatic sprinkler system
- Required fire flow would, intuitively, be greater than 500 GPM, and
- Exposures are a factor

After meeting with Mr. Fred Brower of the ISO, the WSWG was able to obtain computerized printouts of ISO needed fire flow calculations for buildings throughout Montgomery County. This Public Protection Classification batch report [13] provided the following information on hundreds of buildings throughout Montgomery County:

- Needed Fire Flow in gallons per minute, (GPM)
- Building height
- Address
- Building description
- Commercial statistical plan occupancy code
- ISO Rating #, construction, and protection class codes

This large database was used to formulate decisions regarding needed fire flows without the need for site visits and subsequent manual calculations for these selected hazards.

[13] The ISO batch report is too voluminous to include within this report, but is available for viewing within the WSWG reference file.

Residential Properties

A rapidly growing fire that seriously threatens the structure and its occupants occurs frequently in Montgomery County[14]. Nationally, the ratio of residential structure fires to all structure fires is approximately seventy-six percent. In other words, seventy-six percent of all structure fires occur in residential occupancies. More importantly, approximately eighty-four percent of all civilian fire deaths, and seventy-five percent of all civilian fire injuries occur in residential occupancies. The vast majority, sixty-seven percent of all fire deaths, and fifty-two percent of all fire injuries occur in one and two family dwellings. These ratios have held nearly constant in spite of increased use of smoke detectors, and advances in public education programs.

The MCFRS cannot ignore the risks presented by the many types of residential occupancies in Montgomery County, or the fire flows required to suppress fires in these occupancies. The prevalence of unusually large single family homes (in excess of 3,000 square feet) found in all areas of Montgomery County presents challenges not normally encountered by large municipal fire departments in other areas of the country. The threats posed to the occupants of these homes, and the opportunity for a rapidly spreading fire to consume the structure before suppression resources can assemble for large fire flows, is quite real. The MCFRS should recognize this challenge and take actions to reduce the associated risks. Suppression plans should not deviate significantly from well established strategies and tactics proven to mitigate fires in these structures. Multiple attack lines that are quickly deployed are necessary to safely extinguish fires in these structures.

Many times, first arriving units are faced with rapidly advancing, post-flashover fires that must be aggressively attacked to prevent the fire from totally destroying a given structure. The potential for this type of fire is great in almost all portions of the county, a significant change from just a decade ago. This is particularly true in rural areas of the county where unusually large homes in excess of 3,000 square feet are located on 1-25 acre land parcels. When fires occur in these homes for any reason, the potential for a dangerous, fast moving fire that requires large initial fire flows is significant.

Fires spread rapidly in single family structures for a number of reasons. First, single family dwellings are traditionally the least regulated in the code process. Built-in protection typically found in multi-family dwellings include non-

[14] Montgomery County Fire Rescue units responded to an average of 1,118 structure fires annually, (3/per day) during calendar years 1994-1997. Reported average annual fire losses during the same time period was $18,034,773.00; or $22.00 for each man, woman, and child residing in Montgomery County.

combustible tenant separation, height/area limitations, non-combustible stairwells, steel hallway doors with self closing hardware, and other features that contribute significantly to the control of fire spread and safe evacuation of the building's occupants. Conversely, in single family dwellings, where these fire control features are lacking, the structure itself is highly combustible and contributes to rapid fire spread. Newer construction that takes advantage of lightweight trussed construction epitomizes this problem.

Commercial and Industrial Hazards

With a few exceptions, Montgomery County is not an area where large industrial parks or other highly protected risks exist to the extent that fire service capabilities are unusually challenged. By and large, the commercial and industrial occupancies are arranged and organized such that existing response guidelines are adequate to protect these structures.

Strip shopping centers and several regional shopping malls provide challenges, particularly in established areas of the county. Many of these occupancies were built before sprinkler protection and other code-mandated safeguards were enacted. The potential for a large dollar loss fire is significant in these structures. In nearly all cases, adequate fire fighting water is available to extinguish a large fire, and protect adjacent exposures.

A previous work group recommended a comprehensive Risk Analysis, conducted at the station level, in February, 1998. Their report, titled: *"Fire, Rescue, and EMS Master Plan Priority Issues Study"* was adopted by the Fire Rescue Commission in 1998.

The WSWG recommends that the MCFRS move forward with the proposed risk analysis at the station level as soon as possible. The results of this analysis can then be used to formulate a more comprehensive assessment of residential, institutional, commercial and industrial hazards.

Limited Access Highways

In addition to large structure fires, the WSWG charge included the threats posed by limited access highways and the net affects of fires similar to those that have occurred either in Montgomery County or in other nearby jurisdictions[15].

[15] Two separate gasoline tanker fires, and a fire on the American Legion Memorial Bridge serve as representative examples.

Serious incidents involving a large volume of fire are always challenging since water is not directly available on limited access highways. For the purpose of this report, the WSWG included other major commuter routes in our discussion of limited access highways that may or may not have available fire fighting water. Route 29, River Road, Clara Barton Parkway, Mid County Highway, Great Seneca Highway, and Route 27 serve as prime examples. Nonetheless, the WSWG believes the county's greatest water supply risk to be on the interstate highways.

Fires that occur on limited access highways are usually of little threat to our citizens, other than those directly involved in the incident. Typically, several vehicles can be involved in collisions or other emergencies where people are threatened. The WSWG has received feedback concerning the unique challenges presented when providing suppression service on these highways. Many command officers believe that certain key interchanges that are critical to the day to day function of the entire metropolitan area deserve further consideration for water supply enhancements. For example, a serious fire that threatens the bridges at the points where I-495, Rt-355, and the Metro Rail overpass meet would so disrupt the transportation network in the metro area that the potential should not be ignored.

The WSWG reviewed NFPA 502,-1998 edition, "The Standard For Roads, Tunnels, Bridges, and Other Limited Access Highways". Specifically, recommendations regarding standpipes and other enhancements were compared to similar physical conditions in Montgomery County.

The NFPA standard recommends dry standpipes be provided on bridges, in tunnels, and on other limited access roadways when distances from municipal water sources exceed 400 feet. In addition, the standard recommends that where freezing temperatures are likely, the system should be of the dry type. Unique to the dry standpipe design, the standard recommends that water delivery to any hose connection on the standpipe be achieved in ten minutes or less, with a 500 GPM flow rate for a duration of one hour. Provisions should be included for complete drainage after use, and proper relief venting at established high points while filling. Where damage from vehicles is likely, proper protection should be provided to assure the integrity of the standpipe.

The WSWG believes that the MCFRS can not meet the ten-minute expectation under the best of circumstances. Since this standard was written for a variety of applications including air rights structures, the ten-minute goal is not currently achievable over great distances. However, enhancements can be initiated to improve the speed and efficiency for delivering water on limited access highways.

Clearly, the most efficient and cost effective method for water delivery on the various highways is to bring it on-board initial arriving units. Most often, this is accomplished using the booster tanks on fire department pumpers, and in many instances, tankers. The WSWG does not believe that an adequate, uninterrupted water supply can be provided in the event of another hazardous materials transportation emergency using hauled water alone. Montgomery County tankers are not deployed to provide a timely response to urban areas where the hazards are greatest. Although tanker coverage including limited access highways is discussed later in this report, the WSWG would like to emphasize that presently the tanker housed at Hyattstown FS-9 (1500 gallon capacity) has the only reasonably quick access to the interstate highway system. There are no tankers available south and east of Laytonsville. Therefore, enhancements that permit rapid expansion of water delivery to our highways, and deployment of Class B fire fighting foam, are needed if we are to successfully mitigate serious incidents involving transportation hazards from growing into disasters.

Most references on this subject recommend a minimum of 500 GPM needed fire flow at each point of flame impingement on a tank containing hazardous materials. These high flows are required to prevent a boiling liquid cryogenic material from detonating into a massive fireball. Some form of dry standpipe enhancement, reasonably spaced with appropriate access to hydranted water, will be necessary to accomplish this goal.

The WSWG recommends the MCFRS initiate a plan to strategically place six-inch dry vertical standpipes along Montgomery Counties limited access highways.



The Infrastructure

Water Sources for Fire Fighting


Municipal Water Systems

Montgomery County is served by three independent municipal water systems: the Washington Suburban Sanitary Commission (WSSC), the City of Rockville, and the Town of Poolesville. Of the three, WSSC has the largest network and serves the largest number of county customers.

In the absence of accurate data, the WSWG estimates that together, the three municipal systems serve approximately 80% of the county's residential, business and institutional customers. Graphically, these municipal systems extend across only about 55%-60% of the county's land area (see Appendix D). This estimate is constantly changing based upon development and expansion. In either case, a substantial portion of the county lacks municipal fire fighting water.

The adjacent WSSC and Rockville systems are linked, however, the Poolesville system, due to its isolation in western Montgomery County, lacks linkages to any other system. The WSSC system is also linked to the District of Columbia water system. There are several valves along WSSC mains that allow water to flow into these adjoining systems. Valves linking the WSSC and Rockville systems are predominantly hand-operated gate valves, however, there is one valve controlled by a pressure-reducing device which detects any drop in pressure downstream of the valve and automatically opens the valve to increase water pressure back to a predetermined normal pressure. Valves between WSSC and District of Columbia systems are gate valves that are normally closed and require manual activation when circumstances warrant their opening.

All three public systems serve a dual purpose: (1) to supply water for normal domestic demands and (2) to provide water to fire hydrants for fire fighting use and or to supply fixed fire protection systems such as automatic sprinklers, standpipe and other fire suppression systems. The various components of these systems determine the quantity and quality of fire fighting water available to units suppressing fires in Montgomery County. Other in place procedures, or lack of procedures, determine the reliability of this available water.

Like most municipal water authorities, those operating within Montgomery County regard fire protection water as a secondary importance to normal domestic demand. The systems are designed and maintained to deliver high quality drinking water to the faucets of paying customers. Issues like specific hydrant location, hydrant maintenance, enhanced stored water capacity, and others are not front burner issues for the various municipal water authorities. Without the input from the fire-rescue service, these issues will remain unresolved and secondary to domestic needs. ***The WSWG recommends that the MCFRS identify issues that affect our water supply delivery system and interact with the various water authorities to work towards resolving these issues on a continuing basis.***

Washington Suburban Sanitary Commission (WSSC)

The WSSC is a bi-county water and sewer authority serving both Montgomery and Prince Georges Counties (see map in Appendix E). WSSC is the primary supplier of municipal water to Montgomery County, serving the down-county (with the exception of a few isolated areas) and most of Gaithersburg, Germantown, Damascus, Olney, Sandy Spring, and Burtonsville. Overall, the WSSC system serves approximately 215,500 residential, business and institutional customers.

The WSSC water delivery system is supplied primarily from the 285 million gallon per day (MGD) Potomac River Filtration Plant at 12200 River Road, and, from the 54 MGD Patuxent River Filtration Plant in Laurel. Together, the two-filtration plants pump water through the bi-county area via a 5,000-mile network of pipes ranging in diameter from 100+ inches to 6-inches (and smaller in a few locations). With the exception of the Burtonsville area that is served by the Patuxent plant, the Potomac River Plant serves the remainder of the WSSC service area within Montgomery County.

WSSC operates a fully automated Operations Center that is staffed around the clock. The computerized system monitors water flows, pressures, pumps, valves, and storage facilities so that contingencies can be initiated quickly should system malfunctions or breaks occur. Many of the valves operate automatically, as well.

The distribution system serving Montgomery County consists of a "main zone" covering most of the down-county and a "high zone" covering the remainder of the WSSC service area. In supplying the full network within Montgomery County, the system must overcome an elevation differential of about 640 feet between the Potomac plant (elevation 265 feet above sea level) and its highest point in Damascus (elevation 908 feet above sea level). A series of strategically located pumping stations; valves, standpipes, and storage tanks allow WSSC to meet its average daily system-wide demand of 170 mgd, at a system-wide target pressure of 30 pounds per square inch (PSI). WSSC stores only a four-hour supply of water as a contingency based on a 2000-projected maximum daily consumption of 260 mgd. The WSSC storage/distribution system has the capacity to provide only a 4-12 hour supply of water in the event of a major system-wide emergency, depending upon the actual demand on a given day (see Appendix F).

The 73-acre Potomac Filtration Plant (see diagram in Appendix G) operates raw water intakes along the Potomac River adjacent to the plant and immediately downstream of the Watts Branch. Two pump houses, located above the 1000-year flood plain, pump raw water to filtration basins, from wet wells powered by up to ten 50-MGD pumps and two 25-MGD pumps. Raw water is then filtered through one of eight filter basins and then treated with chlorine[16]. The treated or "finished" water is then pumped to one of four covered reservoirs for distribution. A "Filtered Water Pumping Station," equipped with eight pumps having capacities ranging between 17 and 60 MGD each, pumps treated water into the Main Zone distribution system at a pressure of 110-130 PSI. A "High Zone Pumping Station," equipped with five pumps ranging in capacity from 16-28 mgd each, pumps treated water to the Montgomery County High Zone distribution system at a pressure of 185-200 PSI. Two on-site 69,000 volt PEPCO substations provide power to the pumps after passing through on-site transformers which reduce the voltage from 69 KV to 34.5 KV to 4160 V. There are no on-site emergency generators due to the vast number of units that would be required and the associated costs.

The WSSC water distribution system is adequate for supplying both domestic and fire suppression needs under normal conditions. Much of the system is looped, ensuring that water supply is not cut off to a large area should a main break or otherwise need to be shut down for a short period. One area of concern to the WSWG is the portion of the WSSC system north and northwest of the Route 27-Brink Road intersection. While that location has two WSSC storage tanks (totaling 11 million gallons) and a pumping station, there exists a single 16-inch main supplying Damascus and properties along Route 27, and a single 16-inch main supplying Clarksburg and properties along Route 355 north of Brink Road. In response to master plans calling for large-scale development in Clarksburg beginning in 2000, WSSC plans to connect the Damascus and Clarksburg feeder mains to form a loop. Plans also include adding a 1-million gallon elevated water tank near the State Highway Administration facility located west of the I-270/Route 121 interchange in Clarksburg. The tank would serve residential development and the Detention Center planned for that area. ***The WSWG recommends that the MCFRS monitor the expansion and looping of water mains in the Damascus-Clarksburg areas, and that to the extent possible, we support increased water storage capacity throughout the high zone.***

Responsibility for providing a network of water mains to serve WSSC customers is a joint responsibility of WSSC and developers. While WSSC has been responsible for laying the large feeder mains throughout the system, the developers have been responsible for laying the smaller mains to serve new developments. Developers have had the option of using their own contractor to design and lay mains (with WSSC providing design oversight and inspection), or using a WSSC contractor obtained via the bid process. Since July 1, 1999, each developer is now required to obtain a WSSC-issued System Expansion Permit following WSSC's review of a Subdivision Preliminary Plan[17]. Under the new process, the developer has sole responsibility for design and installation of system

[16] Up to 60 tons of chlorine are stored on-site, about a 15-20 day supply.

[17] The Subdivision Preliminary Plan is the point in the subdivision planning process at which WSSC first receives the request for extensions/connections to its distribution network.

expansions, while WSSC still has responsibility for inspecting and approving the expansion prior to assuming ownership.

WSSC's responsibility for providing a network of water mains to its customers ends at the street meter or property line of a given property. At that point, it becomes the property owner's responsibility to provide a line from the single point connection provided by WSSC to the building(s) on the property. As a building is constructed, the developer typically assumes this responsibility. In the case of a large property such as a shopping mall or office park, it is the property owner's responsibility to install and maintain an on-site distribution system (i.e., branches, loop) to meet its water supply needs, including that for fire suppression.

Fire Hydrants

18, 847 fire hydrants are located throughout the WSSC water supply system and are owned and maintained by WSSC. In residential areas containing single family homes, hydrants are spaced not more than 600-800 feet apart[18], as measured along an improved roadway. In addition, hydrants must be within 600 feet of the most distant corner of any single family dwelling, as measured along an improved roadway. For areas containing townhouses and garden apartments, hydrants are spaced not more than 300 feet apart, and hydrants must be within 300 feet of the most distant corner of any townhouse or garden apartment, as measured along an improved roadway . In areas containing high rise, commercial, and/or industrial occupancies, hydrants are spaced not more than 300 feet apart, and specific flow rates are determined per occupancy. The minimum flow rate for hydrants in single family dwelling neighborhoods is 1000 gallons per minute (GPM) at 20 PSI, and 1500 GPM at 20 PSI for multi-family dwellings.

The standard WSSC hydrant has two 2½ inch connections and one 4 1/2 inch "Steamer" connection; all connections have National Standard Threads. WSSC states that it inspects and maintains (i.e. paints / repairs / lubricates, as required) all of its hydrants on a two-year cycle, and that over a five year cycle the entire distribution system is flushed to remove sediment. The WSWG questions this claim believing that many hydrants are inspected and maintained far less frequently based upon the field experience of suppression forces throughout the county. Many times, hydrants are so difficult to open that hydrant wrench extension bars are employed to gain sufficient leverage to open the operating nut, or remove hydrant caps. WSSC strives to repair broken hydrants within seven working days.

Although WSSC attempts to maintain a residual pressure of 20 PSI throughout its water supply system and a minimum flow rate of 1000 GPM, there exist a few areas having hydrants which typically fall below these target levels.

[18] The 600 ft maximum spacing requirement applies to single family homes in urban/suburban settings, and the 800 ft maximum applies to single family homes in semi-rural settings.

At the WSWG's request, WSSC provided a list of these hydrants (see Appendix H). The WSWG also asked WSSC if it has the ability to boost pressure to a portion of their system in the vicinity of a working fire (assuming low pressure is a problem) if so requested by the Incident Commander. WSSC indicated that because of the vast size of their network, it is doubtful that it could positively impact a specific area of the system by increasing volume and pressure. Such action would, in general, "over-pressurize" the entire system, while the increased pressure/volume would likely be delayed in reaching the small portion of the network near the fire scene.

Water Emergencies and Contingencies

The WSWG posed several scenarios to WSSC concerning water emergencies and how WSSC would respond to them so that service is uninterrupted or minimally impacted. WSSC handles the most common scenario – shut down of a water main for repair or replacement – by isolating the affected main and supplying the affected service area from redundant mains in the vicinity. WSSC's ability to meet the average daily demand during this scenario, however, is somewhat dependent upon customers' conservation measures[19], as well.

In a related issue, the WSWG asked WSSC if there exists a procedure whereby WSSC is required to notify the MCFRS with plans/schedules for placing temporary above-ground water mains in service during extensive system repairs/upgrades taking several weeks or longer. The WSWG Chairman stated that the MCFRS, in general, has not been receiving advanced notice of these temporary mains and that firefighters may not know of their existence until they have arrived at a structure fire and find hydrants with low pressure/flow fed by these temporary mains. The WSSC Planning Manager indicated that he would address this issue with the contractor who performs the line replacement work so that advanced notice to the MCFRS occurs. This issue further substantiates the need to meet regularly with representatives of the WSSC to identify contingency plans for similar events well in advance of the construction.

For scenarios where the Potomac Filtration Plant cannot pump water into the distribution lines because of power failure, equipment malfunction, fire, chlorine leak, etc., WSSC would activate its Disaster Plan. WSSC cannot, however, declare a water emergency on its own; the County would have to make the declaration based on WSSC input. As stated above, the WSSC pumping/storage/distribution system has the capacity to provide only a four to twelve hour supply of water in the event of a major system-wide emergency, depending upon the actual demand on a given day. A four-hour supply assumes that WSSC customers are adhering to voluntary conservation measures, and continuous water supply associated with a longer duration outage assumes that mandatory restrictions are in place and being obeyed. Water supply disruptions

[19] WSSC's request for voluntary customer conservation measures would be accomplished via announcements on television and radio.

of up to four hours will normally have only a minor effect on the water supply, whereas outages between four and eight hours will result in a significant loss of pressure throughout the system. Outages of eight to twelve hours will cause a serious reduction in volume and pressure and would likely require WSSC to issue announcements restricting all domestic use in favor of reserving water use for fire suppression purposes. Supply problems would be expected to occur sooner than these time frames if a water supply disruption coincided with a high demand day for domestic water usage when conditions were hot and dry. These assumptions are based upon maximum daily demand. Any reduction in demand below maximum day, would result in increased storage supply duration for fire fighting purposes.

During the past 25 years, there have been at least four instances where the WSSC supply/distribution system had been severely affected by a major emergency. In 1977, a fire damaged the sole transformer[20] at the WSSC Potomac Filtration Plant resulting in a complete shutdown of the plant's pumps for several days until repairs were made. More recently, in 1996, a 96-inch main ruptured in Potomac causing major service disruptions throughout the southern portion of the county for 10 hours. During the incident, fire destroyed a Bethesda house, when low water pressure and a faulty hydrant hampered fire suppression operations. Full water service was restored to the affected area through use of a 48-inch feeder main elsewhere in the WSSC network as well as water supplied by the Patuxent plant. In 1997, a thunderstorm knocked out both of the 69,000 volt PEPCO feeder lines into the Potomac plant, resulting in a 9-hour disruption to the water supply system. Until power was restored, the distribution system was supplied by the Patuxent plant and the 100+ mg of stored water within the Montgomery County portion of the WSSC network, although low pressure still resulted throughout the WSSC network. Also in 1997, Hurricane Fran interrupted electrical power to the Potomac plant for six hours causing moderate water supply problems.

Any system failure/outage affects both Montgomery and P.G. Counties simultaneously. The topography of these two areas benefit Prince Georges County. Clearly, the Montgomery County High Zone will be affected first and most severely. Therefore, both counties would experience fire suppression water supply problems and, would be in need of tankers (both fire-rescue and private sector). In addition to the Potomac Filtration Plant, the smaller Patuxent Filtration Plant in Laurel is capable of pumping water throughout the entire WSSC system. The Patuxent Plant, however, has a maximum daily capacity of only 54 MGD, about 25-30% of the normal overall system demand. If the WSSC system was compromised during an emergency, the Montgomery County High Zone would be adversely affected first, before areas in the down-county and in Prince Georges County. The Patuxent Plant, may be expanded to 120 MGD, which would

[20] Presently, the Potomac plant has three interconnected transformers to ensure that power is available to pumps supplying both the Main and High Zones, should a transformer go off line.

positively impact this scenario. However, no improvement schedule is in place at this time.

Under a worst case scenario where severe drought threatens to bring the level of the Potomac River and or the Patuxent River to a point below which the filtration plants' intakes will not draw water, the WSSC would rely upon its backup water sources to raise the river level to allow for water intake. WSSC planners believe this situation may never occur because of a series of dams and reservoirs that are in place (e.g., Bloomington Dam near Paw Paw, WV, et al) as the result of efforts undertaken by the Interstate Commission on the Potomac River Basin. The reservoirs, including Little Seneca Lake, Triadelphia, and Rocky Gorge in Montgomery County, would release water into the Potomac River or Patuxent River (directly or via tributaries) above the two intake facilities. These reservoirs are expected to meet user demand during times of worst-case droughts until at least 2030, according to WSSC planners[21].

As this report is being written, the East coast is struggling with a 100 year drought. Water has been released from at least two reservoirs to raise the level of the Potomac. Newspapers across the State are suggesting that the Army Corp of Engineers revisit stored water capacities to deal with growing development that draws water from the Potomac River. Since many of these problems are beyond the scope and authority of the MCFRS, ***the WSWG recommends that a contingency plan be developed within the MCFRS that provides for adequate tanker coverage throughout Montgomery County during times of catastrophic failure of the WSSC, or other municipal water authorities.*** This plan should not include fire service tankers from neighboring jurisdictions that will be simultaneously impacted. The WSSC does not own water tankers, so this contingency option is not available, unless tankers were sought from outside sources. Military and other private contractors are logical choices.

New and Planned WSSC Service

To accommodate future expansion of its network, WSSC presently has the pumping capacity, and could easily expand its capacity, to serve large-scale new developments in the bi-county area. The factors that limit this expansion are local government policies and master plans that restrict growth. In Montgomery County, new large-scale County-approved development is underway in Germantown and is planned for Clarksburg. Both areas will be served by WSSC, with the exception of a few specific portions zoned RE-2 that will draw water from wells. In subdivisions currently under development as well as those of the future, the developers are responsible for laying new mains that will connect to the WSSC supply network, however, the engineering and inspection work will still be performed by WSSC.

[21] The WSWG is monitoring changing conditions due to the existing 100 year drought.

City of Rockville Water System

The City of Rockville water system, operated by the Public Works Department, serves properties within the city limits with the exception of a few areas which are served by WSSC (see map in Appendix I). The Rockville system serves about 11,650 residential, business and institutional customers.

The City of Rockville water delivery system is supplied from the city's 8 MGD filtration plant located on the Potomac River approximately 1½ miles downstream of the WSSC plant. The filtration plant pumps water through a 24-inch main to a distribution split on the west-side of the city's service area. From that point, the water is distributed throughout the service area via a network of pipes generally ranging in diameter from 24 inches to 6 inches, although several areas are served by 4-inch lines and a couple of streets by 3-inch lines. The City of Rockville water system, historically, has an average daily demand of 4.8 MGD and its maximum daily demand was 8 MGD. The Public Works Department attempts to maintain a minimum pressure of 30 PSI throughout the distribution network.

The city owns three storage tanks, which contribute to the system's ability to meet the daily demand as well as offering some system redundancy. The capacities of the gravity tanks are 8 MG (Glen Mill Road), 3 MG (Carr Avenue), and 1 MG (Talbott Street).

The City of Rockville's responsibility for providing a network of water mains to its customers ends at the street meter or property line of a given property. At that point, it becomes the property owner's responsibility to provide a line from the connection provided by the city to the building(s) on the property. In the case of a large commercial property, it is the property owner's responsibility to install and maintain an on-site distribution system (i.e., branches, loop) to meet its water supply needs, including that for fire suppression.

Fire Hydrants

Fire hydrants are located throughout the City of Rockville water supply system and are owned and maintained by the city. In residential areas containing single family homes and/or townhouses, hydrants are spaced not more than 500 feet apart. In areas containing commercial and/or industrial occupancies, hydrants are spaced not more than 300 feet apart.

The standard City of Rockville hydrant has two 2½ inch connections and one 4½ inch "Steamer" connection; all connections have National Standard Threads. The Public Works Department states that it inspects, flushes, and, if required, repairs all of its hydrants annually, between April and July. When long-term repairs or system upgrades are planned, the Public Works Department has a procedure to provide prior notification directly to Fire-Rescue Communications.

The Public Works Department was not aware of any hydrants having below normal pressure or flow rate on a regular basis.

Water Emergencies and Contingencies

For scenarios where the City of Rockville's filtration plant cannot pump water into the distribution lines because of power failure, equipment malfunction, fire, chlorine leak, etc., the city would rely upon its stored water totaling 12 MG. If the event was of sufficient duration, the city might also draw water from the nine interconnections[22] with the WSSC system and/or impose water-use restrictions. The Public Works Department informed the WSWG that the city has not experienced any water-use restrictions during the past 30 years.

The worst case scenario is severe drought that threatens to bring the level of the Potomac River to a point below which the filtration plants' intakes will not draw water (i.e., 152.5 feet above sea level). If this were to happen, the City of Rockville would impose water-use restrictions and rely upon its 12 MG of stored water. About ½ of the 12 MG are available at all times. The city could also draw water from the interconnections with the WSSC system. The city does not own water tankers, so this contingency option is not available, unless tankers were sought from sources outside the city government.

New and Planned Service

To accommodate future expansion of its network, the City of Rockville presently has the pumping capacity to serve additional development within its borders. While there are several single building construction projects underway in Rockville for which the city will provide water, the only large-scale development that is underway is the 440-acre King Farm which will be served by WSSC.

Town of Poolesville Water System

The Town of Poolesville water system, operated by the Public Works Department, serves properties within the town limits (see map in Appendix J). The Poolesville system serves a population of 4200 and has about 1600 residential, business and institutional customers.

The Town of Poolesville water delivery system is supplied from the city's eight wells located throughout the town. Together, they yield about 500 GPM. Individually, each well has a yield ranging between 30 and 220 GPM. The current

[22] Eight connections are controlled by manually-operated gate valves, and one is controlled by a pressure reducing valve.

system capacity is about 720,000 gallons per day (GPD). Average daily demand is 400,000 GPD and the maximum daily demand (to date) has been 600,000 GPD. The town is planning to drill one additional well to bolster its reserve capacity.

The system includes a 500,000 gallon storage tank on Wooton Avenue and a 1 million gallon tank along Jonesville Road. The tanks directly supply the water distribution mains. When the level in a tank falls below 34 feet, the pumps at the eight well houses automatically activate, raising the level back to the normal height of 38 feet. The main control panel for the eight wells and two above ground tanks is at the Public Works office at 18901 Fisher Avenue, and each well house has a backup pressure switch.

The town's water mains range in diameter from 16 inches to 2 inches. Static pressure throughout the system is normally maintained at 60 PSI. The point along the distribution system where the town's responsibility ends and the private property owner's begins is at the curb box. The entire system is looped to ensure that normal flow and pressure is uninterrupted or minimally impacted during temporary shutdown of any given main.

Fire Hydrants

About 300 fire hydrants are located throughout the Town of Poolesville and are owned and maintained by the town. The system-wide minimum flow rate for hydrants is 1200 GPM at a residual pressure of 20 PSI; normal static pressure is 60 PSI. In residential areas containing single family homes, hydrants are spaced not more than 600-800 feet apart. In areas containing townhouses or commercial occupancies, hydrants are spaced not more than 300 feet apart. For areas containing townhouses and garden apartments, hydrants are spaced not more than 300 feet apart.[23]

The standard hydrant in Poolesville has two 2½ inch connections and one 4½ inch "Steamer" connection; all connections have National Standard Threads. Wade Yost, Public Works Director, states that his department inspects and maintains all of the hydrants twice annually, including painting and lubricating them, as needed . The WSWG randomly inspected several hydrants to verify the excellent maintenance schedule. The WSWG believes these hydrants to be the best maintained in the county. When unexpected repairs or planned system upgrades occur, the Public Works Department has a procedure to provide prior notification directly to the Upper Montgomery County Volunteer Fire Department. The Public Works Department was not aware of any hydrants having below normal pressure or flow rate on a regular basis.

[23] Hydrant spacing information for the town of Poolesville was provided by Chief Charles Elgin of the UMCVFD.

Water Emergencies and Contingencies

For situations where a main has broken or has been shut down for repairs, there should be minimal disruption to service. As stated above, the entire system is looped to ensure that normal flow and pressure is uninterrupted or minimally impacted during temporary shutdown of any given main.

For a scenario where one or more of the Town of Poolesville's wells run(s) dry, the unaffected wells can supply the normal daily demand, according to the Public Works Director. Depending on the severity of the situation, residents would be placed under voluntary or mandatory water use restrictions, as well. Because the town is a considerable distance from other municipal water systems, it lacks the capability to draw water from other systems. The town does not own water tankers, so this contingency option is not available either, unless tankers were sought from sources outside the town government.

During August and September, 1999, the Town of Poolesville, as well as the remainder of the State, were under mandatory restrictions imposed by Governor Glendening due to a severe State-wide drought.

For scenarios where one or more of the Town of Poolesville's wells cannot pump water into the distribution lines because of power failure, equipment malfunction, fire, etc., the town would, likewise, rely upon its unaffected wells to meet normal daily demand. In addition, the town may impose water use restrictions to alleviate the situation.

New and Planned Service

Water mains are being installed to serve the future 73-home "Tama II" subdivision in the northern-most portion of town in the 19500 block of Jerusalem Road. There are no other proposed water main extensions. The town is planning to drill one additional well to bolster its reserve capacity when Tama II is fully developed.

Private Water Systems

Private water systems present a unique challenge to the MCFRS. Hydrants painted red or any other color than white located within areas normally serviced by the WSSC are private hydrants. These hydrants are frequently "supervised" (monitored for use electronically) and are available as extensions of the WSSC or other systems. Normally, the responsibility for these private mains and hydrants begin at the property line. The municipal water authorities listed above do not have responsibility or control of these systems. Therefore the MCFRS must consider private hydrant issues in any attempt to enhance service in the future. ***The WSWG recommends that the code enforcement section develop an inspection procedure for in service inspections that assures compliance with NFPA 25, the Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*** This in-service procedure would require property managers to provide documentation that the system(s) have been certified by a third party testing company. These systems are essential to proper fire protection. The MCFRS is dependant upon these systems to function properly.

PEPCO Power Generation Plant

The PEPCO Plant is located in Dickerson adjacent to the Potomac River, from which it draws water for the purposes of cooling its power generation systems as well as for supplying a portion of its fire suppression and domestic water needs. The plant includes a newer generation station, an older generation station ("Station D"), high voltage transmission lines/towers, administrative office, 10-million gallon fuel oil tank, 231,000 gallon fuel oil tank, and several ancillary buildings and storage tanks.

The plant, except for Station D, is served by two water storage tanks, each supplied by on-site wells. A 614,000-gallon water tank is dedicated solely for fire protection purposes. The second tank, which supports the plant's industrial and domestic needs, holds 15-million gallons of treated water and supplements the smaller tank, as needed, for fire suppression purposes. The plant's water distribution system has two independent loops, an "Outer Loop" and "Inner Loop," both having 14-inch lines. The overall fire suppression water demand has been calculated based on 200% of the highest demand associated with the 10-million gallon fuel oil tank (requiring a 3417 GPM flow at 91 PSI) and the main transformers (requiring 1330 GPM at 91 PSI). A jockey pump keeps the system pressurized at all times, and two diesel pumps and an electric pump activate automatically during fire suppression operations to produce a 2000 GPM flow rate at 125 PSI. Buildings 1, 2 and 3, containing transformers, are protected by deluge fire suppression systems. The two fuel oil tanks are protected by a 3% protein foam suppression system with fixed monitors.

Station D's water needs are supplied directly by the Potomac River, via a dedicated water main. A 1500 GPM diesel pump draws water from the river and pumps the water through a looped system at 112 PSI. The loop has a combination of 8-inch and 10-inch mains. A 1500 GPM electric pump is also available. The system serving Station D does not include stored water.

Fire hydrants are located throughout the plant, including Station D. Hydrants have two 2½ inch connections and one 4½ inch "Steamer" connection;

all connections have National Standard Threads. Hydrants are inspected and flushed quarterly.

While the plant does not own or operate fire suppression vehicles, an on-site fire brigade, trained for interior, structural fire fighting serves the plant. In addition, the industrial brigade is equipped and trained to mitigate a wide variety of confined space and hazardous material incidents that could occur readily at such a large industrial setting. PEPCO officials and the Upper Montgomery County VFD have an excellent on going working relationship that should serve as a county wide model for others to follow. Together the two entities have fostered a shared responsibility that takes full advantage of the resources from both organizations.

While the water distribution system is adequate for supplying water for manual fire suppression operations at the plant, the WSWG noticed that the on-site multi-story administrative office lacked an automatic sprinkler system. Whereas this building pre-dates the County's sprinkler system requirement, the combination of the number of occupants, number of floors, fire load, and distance from the closest fire station[24] points to the need for sprinklers. Considering the life safety and property protection issues associated with this occupancy, it is the WSWG's opinion that this building should be equipped with an automatic wet-pipe sprinkler system. This recommendation stems from no specific code requirement or retroactive application of a specific code requirement. The WSWG simply believes that automatic sprinkler protection is the best first line defense for this occupancy.

County Resource Recovery Facility

The County's Resource Recovery Facility is located adjacent to the PEPCO Plant in Dickerson. The facility, operated by Ogden-Martin Systems of Montgomery, Inc., is comprised of a 7000-ton per day incinerator and a composting area. A water storage tank, supplied by private pumps using the Potomac River as the source, serves the 34-acre property.

Federal Government Facilities

While most areas having hydrants are served by one of the municipal systems described above, there are nine large facilities having hydrants that are part of a private water distribution system. Two of these facilities are located in Dickerson – the PEPCO Power Generation Plant and the County's Resource Recovery Facility, and seven are Federal Government facilities located

[24] Station 14 is approximately 3 - 3 1/2 miles from this particular structure.

throughout the county. The water system at each federal facility is described below.

Each of the seven major Federal Government installations in the county is equipped with its own network of water mains and hydrants, most of which are connected to the WSSC system at the property line. In general, the WSWG believes these facilities are adequately served by their respective distribution/hydrant systems. However, like all other private water systems, the maintenance and reliability of the systems is the sole responsibility of the occupants of those facilities. While the WSWG did not visit each of these federal facilities, the group obtained the following information concerning the fire suppression water supply system at each:

- **National Institutes of Health (NIH) –** The fire suppression water supply system serving the NIH campus in Bethesda is connected to the WSSC system. The on-site distribution/hydrant system is believed to be adequate to support fire suppression operations throughout the multi-building campus. Most buildings are high rise structures protected by automatic sprinkler systems. The NIH is served by an on-site federally-operated fire department (Station 51) and the federal fire station at the nearby National Naval Medical Center (Station 50), with automatic mutual aid provided by the Montgomery County Fire and Rescue Service (Station 20 is closest MCFRS station).

- **NIH Animal Center** (NIHAC) - The fire suppression water supply system serving the NIH Animal Research Center, located near Poolesville, is supplied by an on-site 150,000-gallon, 175 foot elevated tank. The tank is filled from four on-site wells having a combined flow rate of 166 GPM (9960 gallons per hour). The tank supplies a domestic demand of about 40,000 gallons per day and has sensors that automatically activate well pumps as water is being drawn. Water is distributed throughout the Center by an underground pipe loop, which supplies fire hydrants, sprinkler systems, and domestic needs. Fourteen hydrants are distributed throughout the Center, and they have a flow rate of 1000 GPM. The average static pressure is 70 PSI and average residual pressure is 60 PSI. Hydrants have two 2½ inch connections and one 4½ inch "Steamer" connection; all connections have National Standard Threads.

- The NIH Fire Department believes that the distribution/hydrant system is adequate to support fire suppression operations throughout the multi-building center. Furthermore, the NIH Division of Engineering Services has authorized use of NIHAC water supply resources by the MCFRS for off-site fires in the vicinity[25]. In addition to being served by the Bethesda-

[25] Should the MCFRS want to draw water from the NIHAC property during an off-site fire incident, the MCFRS ECC should notify the NIH Fire Department.

based NIH Fire Department, the Center receives automatic mutual aid from the MCFRS. Upper Montgomery County Station 14 is the closest MCFRS station, approximately 7 miles away.

- **National Naval Medical Center (NNMC) –** The fire suppression water supply system serving the NNMC in Bethesda is connected to the WSSC system. The on-site distribution/hydrant system is believed to be adequate to support fire suppression operations throughout the hospital/research center. Most buildings are high rise structures protected by automatic sprinkler systems. The NNMC is served by an on-site federally-operated fire department (Station 50) and the nearby NIH Fire Department, with automatic mutual aid provided by the Montgomery County Fire and Rescue Service (Station 20 is closest MCFRS station).

- **Naval Surface Warfare Center (NSWC)** - The fire suppression water supply system serving the NSWC in Carderock is served by an on-site one million-gallon tank and a series of fire pumps. The tank is connected to the 5/8-mile long ship-testing basin, should supplementary water be required for fire fighting operations. The on-site distribution/hydrant system is believed to be adequate to support fire suppression operations throughout the multi-building research center. Most buildings are protected by automatic sprinkler systems. The NSWC is served by an on-site federally-operated fire department (Station 52), with automatic mutual aid provided by the Montgomery County Fire and Rescue Service (Station 10 is closest MCFRS station).

- **Food and Drug Administration Campus (FDAC) –** This 130-acre federal property, located in White Oak adjacent to Fire Station 12, is the former site of the Naval Surface Weapons Center. This sprawling complex is now owned by the FDA and is slated to become the site of the future FDA Campus. The fire suppression water supply system serving the property is connected to the WSSC system. The on-site distribution /hydrant system is believed to be adequate to support fire suppression operations throughout the existing multi-building complex. As the FDAC is built, water supply system enhancements will likely be required to meet the needs of the campus. Some of the existing buildings are protected by automatic sprinkler systems, and it is anticipated that future buildings will also be equipped with sprinklers. The property was formerly served by an on-site federally-operated fire department (Station 55), but is now served by the Montgomery County Fire and Rescue Service, with mutual aid provided by the Prince Georges County Fire Department.

- **Walter Reed Hospital Annex (WRHA)** - The fire suppression water supply system serving the WRHA in Silver Spring is connected to the WSSC system. Portions of the on-site distribution and hydrant system are very old and believed to be less than adequate to support fire suppression operations throughout the complex. A few buildings are protected by automatic sprinkler systems, however many of the buildings are aged, poorly-maintained, non-sprinklered structures and are considered severe target hazards. It is likely that the required fire flow will exceed the available fire fighting water. A new high rise research facility is nearing completion and is fully sprinklered. The WRHA is served by an on-site federally-operated fire department (Station 54), with automatic mutual aid provided by the Montgomery County Fire and Rescue Service (Station 19 is the closest MCFRS station).

- **National Institute of Standards and Technology (NIST)** - The fire suppression water supply system serving the NIST complex in Gaithersburg is connected to the WSSC system. The on-site distribution/hydrant system is believed to be adequate to support fire suppression operations throughout the multi-building institute. Some buildings are sprinklered but many are not, including the 10-story administration building. A notable target hazard located at the NIST is the nuclear reactor. The NIST is served by an on-site federally-operated fire department (Station 53), with automatic mutual aid provided by the Montgomery County Fire and Rescue Service (Station 8 is closest MCFRS station).

Non-Hydranted Rural Areas

The map in Appendix D indicates areas within Montgomery County served by fire hydrants versus those areas that are not.

There are two major reasons why rural areas do not have municipal water service – cost of laying water mains to distant, sparsely populated areas; and land-use, zoning, and growth policies that restrict development and extension of water and sewer lines. The latter issue is heavily impacted by the County's desire to maintain agricultural and rural open space in an effort to preserve the county's agricultural heritage and to maintain undeveloped areas that contribute to the overall quality of life for all county residents. The legal mechanism for preserving agricultural and open spaces is based in the document titled ***"Functional Master Plan for the Preservation of Agriculture and Rural Open Space in Montgomery County,"*** adopted in 1980. The plan created an Agricultural Reserve of approximately 91,000 acres (see map in Appendix K). Through the application of preservation techniques (e.g., Rural Density Transfer Zone, Transfer Development Rights, etc.), this land has remained largely undeveloped, although limited types of low-density residential development is allowed in specific areas. Most dwellings and businesses within the Reserve are served by wells and septic fields, thus fire hydrants are non-existent throughout the vast majority of the Reserve.

Because of this preservation policy, high-density development in Montgomery County is taking place only in areas where water and sewer lines have been approved. For example, the extensive development planned for the Kingsview Village portion of Germantown and for the Town of Clarksburg is dependent upon the extension of WSSC lines into both areas. As stated by WSSC in meetings with the WSWG, developers will be responsible for the costs associated with the extension of water mains into these newly developed areas. As a result, the developers usually install the minimum, rather than the optimum resources to enhance the ability for the fire rescue service to deliver water. This could change with a joint working group that could focus on specific issues. It becomes immediately evident that fighting fires in areas where municipal water is not readily available complicates the job of the fire department exponentially. Non-hydranted areas must be served by some combination of fire department tankers, underground storage tanks, dry hydrants, cisterns, etc.

Small Non-Hydranted Areas within Areas Served by Municipal Water Systems

MCFRS has no responsibility or authority to approach the local water authorities for extending fire suppression water mains into specific areas. Water mains are extended into areas based upon domestic needs and demands, rather than for fire suppression purposes[26].

The WSWG has identified pockets of such areas throughout much of the hydranted portion of the county. Station areas 10, 30, 33, 40 are primary examples of areas having large pockets of non-hydranted streets adjacent to larger areas that are fully served by hydrants.

Some of these areas are part of designated park and recreation lands that will not be developed in the future. Other areas are a result of inadequate planning as water and sewer was extended into expanding areas of the county over the years. A smaller number of areas exist where groups of homeowners have chosen not to connect to public utilities for a variety of reasons. These areas were identified in a county-wide STP effort as part of this study. Non-hydranted areas within hydranted areas are particularly troublesome since they are an anomaly when designating response assignments through the computer aided dispatch (CAD) software at the Emergency Communications Center, (ECC).

[26] The WSWG has met with representatives of the Southeast Rural Olney Civic Association to discuss fire fighting water problems on Norbrook Drive as a result of a August, 1997 house fire where water supply difficulties were encountered.

Unless the Local Fire Rescue Departments have established separate box areas for these anomalies, a standard response will be dispatched by the ECC that does not include tankers for water supply. This has in the past caused a delay in the dispatch and subsequent response of tankers. At a minimum, ***the WSWG recommends that tankers be added to the structure fire response assignments for all streets in areas where municipal fire hydrants are not available.*** The WSWG further addresses this problem in the section of this report entitled dispatch procedures.

It is incumbent upon the local fire and rescue departments to identify these specific areas and to develop contingency plans for fire suppression water supply/delivery. ***The WSWG recommends that a county-wide plan for identifying pockets of non-hydranted areas within hydranted areas be immediately developed.*** It is imperative that each and every area where this situation exists is properly recognized by the computer-aided dispatch (CAD) software.

Rural Fire Suppression

Any fire department responsible for fire suppression in areas lacking municipal hydrants or other stored water must be able to establish a water shuttle quickly and maintain the shuttle for long periods of time[27]. In most departments this is accomplished using tankers, pumpers, and combination units known as engine-tankers. Each particular type unit offers advantages and disadvantages to the process of shuttling water to the fire ground. As long as large tankers are able to both load and unload quickly, they will almost always be the greatest contributor in a water shuttle.

Some departments falsely depend on their ability to establish a water supply relay using many pumpers and above ground hose lays to meet the ISO expectations. These relays are labor intensive and time consuming. Departments having solid standard operating procedures (SOP's) in place and who train frequently with water relays, nevertheless, encounter time consuming procedures.

Montgomery County should not expect to pass an ISO rural evaluation in the immediate future. Absence of standard water supply procedures, lack of regular training, and non-standard hose / hose appliance configurations all but assure that units within Montgomery County will not be capable of delivering uninterrupted water in quantities to achieve improved ISO rural ratings.

[27] The minimum expectation for a rural ISO rating is to deliver an uninterrupted supply of 250 GPM for a total of 2 hours within five minutes of the first arriving fire apparatus.

It would be very difficult to establish a minimum uninterrupted water supply of 500 GPM or more within five minutes of the first arriving apparatus, and then maintain that supply for at least two hours without interruption.

When water must be moved for distances greater than one-half mile, moving water via tanker shuttle is the most reliable way to deliver uninterrupted water to the fire ground. However, departments must discipline themselves to standardize operations and train together to meet a common goal. Traditionally, this has been difficult to achieve in Montgomery County.

Local fire-rescue departments that operate tankers in Montgomery County have not deployed resources to assure an uninterrupted water supply. Instead, they have equipped themselves to supply an initial attack of no specific rate or duration. They have learned to live with what was available, planning strategies and tactics to accommodate a variety of scenarios. Unfortunately, the present resources are a far cry from meeting the minimum expectations of the national models. More importantly, the traditional rural approach to fire suppression that encouraged conservation of water because it wasn't available is no longer acceptable. As growth and development expands further into the rural areas of the county, the MCFRS will need to face these issues.

A well-planned water delivery system must be in place throughout the county to efficiently provide fire fighting water to our suppression forces in rural suburban, and urban areas. Standard Operating Procedures that provide for efficient tanker shuttle water delivery must be a critical component in the MCFRS arsenal.

The WSWG recommends that tanker resources in the county be deployed so that first arriving suppression units can initiate an attack with 5,000 gallons of water for ten minutes. In other words, first arriving companies confronted with a growing fire will have the water supply necessary to deploy a 150 GPM initial attack line, a 150-200 GPM back-up line, and a third 150-200 GPM rapid intervention company line for ten minutes without fear of an interrupted water supply. Alternatively, the initial units could deploy a 500 GPM master stream in situations where an interior attack is ruled out. In either case, the 5,000 gallons of water would provide either scenario for ten minutes fire flow. This recommendation diverges from the much more conservative ISO and NFPA national models, which require a lower minimum fire flow for a much longer duration.

The 5,000 gallon recommendation regarding water delivery to the fire ground is predicated upon the minimum expectations of our own policies and procedures. Three 150 GPM lines is the minimum required by Fire Rescue Commission policy. The WSWG suggests that there is an element of common sense in this approach not accounted for in the national models. We have in effect created a separation of requirements for an aggressive interior attack from the requirements for a prolonged defensive attack requiring higher GPM fire flows.

The WSWG sees a number of important advantages to this concept. Delivering a minimum of 5,000 gallons of water to the fire ground will guarantee that units will be able to utilize effective streams and sustained fire flows for a short duration of time, well beyond the reach of fire hydrants and other water supplies.

With just a few enhancements to the current tanker fleet, this system of water delivery will be able to be implemented quickly, thereby providing the ability to bring most threshold fires under control before the need for a more complex relay system is required. Finally, S-O-P's based upon this recommendation will offer end users the widest possible flexibility to attack and extinguish fires in all but a few special structures in rural areas.

Static Water Sources and Drafting Sites

In areas where municipal water is not available, or where higher fire flows are needed to protect target hazards, some fire departments utilize suction supplies, or static sources for fire fighting water. Potential static sources include rivers, lakes, streams, ponds, cisterns, reservoirs, underground storage tanks, and swimming pools. In some instances, dry hydrants have been added as an enhancement to assist with access to these sources.

In August of 1998, surveys were distributed to local Fire-Rescue Department Chiefs and DFRS Station Commanders at fire stations 4, 9, 10, 13, 14, 15, 17, 28, 29, 30, 31, and 40. Responses were received from stations 9, 10, 13, 17, 28, and 40.

In Montgomery County, static sources are generally considered to be the fourth choice for fire fighting water supply. Municipal fire hydrants, storage tanks (underground or other), or water delivered by shuttle from fire department tankers and pumpers are preferred. There are several good reasons why static sources are the fourth choice.

Year round, all weather access is frequently a problem. Few drafting points are provided with hard surface roadways for fire department access. Preferably, all drafting points should be accessible via a hard surface roadway that extends to within eight feet of the water's edge. In addition, the hard surface must be wide enough to permit working space from and around the sides of the pumper. A minimum width of twelve feet is desirable. When a mid-ship mounted pump is employed, this width may have to be increased to allow for the curvature in the hard sleeve hose[28]. Front mount, or newly designed rear mount pumpers are clearly preferred in this situation[29]. Water supply that is only accessible during good weather is simply not adequate to guarantee suppression service and will not be credited by the ISO or other rating organizations.

Ownership of the access and water supply must be evaluated when considering the reliability of a static supply. Fire apparatus must have guaranteed access to private sources for emergency and non-emergency activities. Training, inspection, and maintenance of the sites are critical. The WSWG is not aware of any written agreements between property owners and the local fire rescue departments, or any agency in county government to assure that these conditions of usage exist.

Excessive vertical lift is another problem encountered at many drafting sites. No fire department or their equipment can overcome the fundamental laws of gravity that limits vertical lift (the distance between the water source and the centerline of the pump). Most texts on this subject recommend a practical vertical lift of ten feet for successful fire department operations[30].

Maintaining a minimum water depth of approximately eighteen inches over top of the strainer is considered necessary to prevent whirlpool effects when drafting at or near pump capacity. Because water is drawn into the strainer at a very large rate in this situation, less than the minimum amount of water over the strainer will likely entrain air into the pump, causing a loss of prime and a subsequent interruption in water delivery[31]. Low profile strainers are used by several departments in Montgomery County. These strainers permit drafting to as low as two inches of water on flat surfaces without losing prime.

Water quality is a consideration as well. Most mechanics will argue that only water suitable for drinking should be run through a fire pump. Anything else will likely contaminate and cause some sort of damage to the pump over time. Although this is an extreme view, the point is well taken. Any vegetation, sediment, debris, or large particles will likely interfere with pumping the rated

[28] All county spec pumpers are equipped with a front suction inlet to the pump. The pipe size is typically reduced from six to five inches in diameter to allow access around and through the various vehicle components. The reduction in pipe diameter and length of pipes and fittings will not permit rated capacity through these front inlets.

[29] The three front mount pumpers presently in use are limited by the size of their pumps. These units are equipped with 750 GPM pumps.

[30] Maximum theoretical vertical lift is 33.9 feet at sea level. To reach this lift requires a perfect vacuum. No fire pump can create a perfect vacuum. Further, the inventory of most pumpers in Montgomery County provides only two ten foot sections of hard sleeve hose.

[31] It should be noted that many fire departments have developed “tricks of the trade” to allow use of water supply points with less than the eighteen inch minimum. These enhancements are generally time consuming tasks requiring the assistance of several personnel. Nonetheless, twelve inches of water is an absolute minimum without special appliances.

capacity and cause serious damage to the critical pump components that lead to excessive and expensive down time.

Static source flow rate, capacity, and recharge rate must be factored into the final decision to utilize a given static water supply point for fire attack. Formulas exist to calculate the capacity of impounded static sources, (ponds, lakes, cisterns, tanks, etc.) as well as methods to predict the rate of flow in a moving body of water like a stream[32]. A critical portion of any such evaluation should consider average rainfall, seasonal variations, and normal usage from a particular site. If the site is to be certified as part of an ISO evaluation, the maximum flow rate available during a fifty-year drought period is required. Additionally, the ISO requires an available needed fire flow duration of two hours for fire flows up to 2,500 GPM, and three hours for a needed fire flow up to 3,500 GPM. This fire flow must be uninterrupted once established.

The results of the known and proposed drafting points developed by the field personnel, (see Appendix L), in the stations listed above were analyzed. One hundred seventeen different sites were identified in this survey. Many of these fail to meet the minimum criteria established by the WSWG for initial fire attack[33]. Of the 117 points identified, only 13 are equipped with dry hydrants that are available to enhance the ability of the fire department to utilize these drafting points. Another significant problem exists in that only four of the thirteen dry hydrants are equipped with 6" pipe and threads, the minimum necessary to achieve rated pump capacity for 1250 GPM or larger pumps. Finally, no standardized program to inspect and maintain these dry hydrants is in place. Several of the local fire rescue departments have a program in place to inspect these hydrants on an annual basis. However, the criteria for these inspections is non-standard.

The WSWG recommends that minimum criteria be established for ISO certified drafting points intended for use during initial fire attack. Those criteria should include:

- Year around all weather access be provided
- Vertical lift be limited to ten feet
- A minimum 12-inches of water is available over the strainer
- Capacity and flow rate will sustain a minimum 500 GPM fire flow for two hours
- If enhanced with a dry hydrant, the minimum pipe diameter is in compliance with the current edition of NFPA-1231, The Standard for Rural and Suburban Fire Fighting.

[32] Although time consuming, these methods should be developed for local certification of any source that would be included on a site plan / pre plan or for advertised drafting sites that will be developed for inclusion on water supply maps.
[33] Many of these sites have been identified for use as tanker fill sites rather than initial and sustained fire attack. Most are adequate for this purpose.

- All connections are modified to accept 6" National Standard male threads at the dry hydrant.[34]
- Water quality be such that interruption to water delivery will not occur within the two hour needed fire flow requirement or that damage will not likely occur to fire department pumpers.
- Develop standardized bi-annual inspections and tests for all dry hydrants and drafting sites with test records for each location.
- Develop a standard reflective sign that identifies the drafting point, the capacity of the site, and the distance from the roadway.

For drafting sites that do not meet the above criteria, ***the WSWG recommends that the <u>minimum</u> flow rate for any drafting site be established at 500 GPM.*** This should be the minimum fill rate for fire department tankers during a water supply shuttle. Although fire departments have been filling tankers at lesser rates for years using a variety of methods, low flow fill sites will not allow units to be filled quickly enough to sustain an efficient shuttle for fire attack. Mandating a minimum fill rate assures that tankers will fill quickly so that they can dump quickly. This concept is fundamental and can no longer be ignored.

A critical component for all fill sites is the marking of all drafting sites with a reflective road sign visible along the roadways that would identify the location of the various sites for incoming units that may or may not be familiar with the exact location of the drafting site. The Clarksville VFD in Howard County has initiated an excellent program to identify the drafting sites utilizing road signage. ***The WSWG recommends that all alternate water supply points be identified using reflective signs that list the address of the site, the capacity of the water source, and the distance from the posted sign.*** All alternate water supply points must be included in future GIS mapping efforts.

Dry hydrants are recognized in the insurance rating process, and have been proven to greatly enhance the time required to establish a water supply from draft. Therefore, ***the WSWG recommends that the MCFRS develop a plan to expand the use of dry hydrants in the rural portions of the county.***

Water Delivery Enhancements on Limited Access Highways

After a truck fire on the Legion Memorial Bridge in 1983, a horizontal dry standpipe system was installed the length of the outer loop of the bridge to enhance fire-fighting operations. The WSWG accompanied Cabin John Station 10 personnel to inspect the system and determine the utility of the standpipe as an enhancement to fire fighting operations. Together, personnel determined that the

[34] Some officers believe that all dry hydrants should be set up with male threads at the hydrant to eliminate maintenance of a female swivel connection at the hydrant. This requires the purchase of a 6" double female swivel appliance for each pumper. The WSWG does not support this concept.

standpipe system had limited utility based upon a number of problems encountered.

A 6 inch diameter dry-pipe extends the full ¾ mile (3,960 feet) length of the bridge with a 2 ½ inch gated standpipe connection located approximately every 200-ft along the span. On the Maryland side, a trimese supply connection exists just under and adjacent to the roadway[35]. This connection is to be quickly utilized by units operating from the Clara Barton Parkway some thirty feet below.

The supply connection is installed in such a manner that will all but guarantee that the hoses connected to the trimese will kink, seriously restricting the available flow to the standpipe. Secondly, the nearest hydrant is located on the grounds of the David Taylor Naval Research Center behind a locked gate, approximately 1,350-ft away. Therefore, units from David Taylor must assist in a relay to this connection. The pre-plan provides for a pumper at the base of the I-495 bridge, two additional pumpers in relay between the bridge and the gate to the Naval facility, and an additional pumper on the hydrant on the naval complex. Conceptually, these pumpers would be supplying dual three-inch supply lines providing a delivered fire flow of approximately 800-1000 GPM. Once this is established, the attack pumper must continue to wait for the ¾ mile of pipe to expel air and fill with water. These tasks are simply too time consuming to support any kind of initial fire attack. Although well intentioned, this enhancement is not suitable for initial fire attack and should be recognized as such. If the bridge standpipe is to be utilized for fire attack, then the connections should be extended down to the Clara Barton Parkway for easy access, and a closer water source must be provided. Preferably a hydrant within fifty feet of the connection on the same side of the roadway would be ideal. ***The WSWG recommends that problems addressed with the Cabin John Bridge standpipe be addressed by the appropriate authorities.***

A previous working group initiated actions that resulted in a joint project with the Maryland Highway Administration. Fire Department siamese connections were installed through the sound barrier walls at regular intervals along the inner loop of I-495. These penetrations were an extension of earlier work performed in Prince George's County. The connections are custom designed to connect two hoses on either side of the connection, supplying pumpers on the beltway. Companies other than those on the initial assignment would be dispatched to residential areas or commercial neighborhoods and advance lines by hand to the connection. In most cases, these companies would be required to advance lines over tough terrain, through yards, and over obstacles several hundred feet in distance. In addition, doorways that permit suppression personnel to move between one side of the sound barrier wall and the other are locked. At this writing, personnel within the MCFRS are unclear as to who has copies of the keys, or who could open the doors in the event the connections were utilized. For these and other reasons, the practical utility of supporting an initial attack is

[35] A similar connection exists on the Virginia side of the bridge for access by Fairfax County units.

questionable. These tasks are formidable for the best-staffed and equipped companies. The concept has some utility for extended operations where a preventative water supply is needed to mitigate a hazardous situation, but is of little use for a rapid initial fire attack.

The WSWG chair met with DFRS employees assigned to FS-19 to discuss these standpipe connections. They raised several issues that need to be addressed to utilize these connections. Their recommendations are listed below:

- Create a database of available connections
- Post reflective signs on both sides of the sound barrier wall that includes a unique identifier number for that connection.
- Post the address of the nearest hydrant on the Beltway side sign to provide a failsafe method to direct water supply units to the appropriate location (units responding to the hydrant will likely be assigned to a greater alarm assignment and therefore unfamiliar with the area).
- Assure that the State Highway Authority keeps vegetation clear on both sides of the wall at all times. Many of the areas are so overgrown that access would be difficult if needed.
- Locate future connections, or move existing connections to areas where the terrain is relatively level. In some cases the drop from the connection to the roadway exceeds twenty feet.
- Strategically locate connections to properly support incidents on both the inner and outer loops of the beltway. Presently, connections are placed without regard for the expected direction of travel of the responding companies, or the need to shut down both loops to initiate a water supply.

The WSWG recommends that a working group be established within the MCFRS to prepare a working operational procedure for these existing standpipe connections.

The Virginia Department of Transportation (VDOT) in cooperation with the Fairfax County Fire Rescue Department, has installed six-inch vertical dry standpipe risers on a number of bridge overpasses along the Capital Beltway to facilitate fire suppression operations. These connections extend from the center of the bridge span to the center of the roadway (above or below) terminating with a fire department siamese connection at both ends. The WSWG believes that this design has much more utility for a number of reasons.

The connection is available in the median area between the inner and outer loops of the highway that permits pumpers to approach from either the inner or outer loops to complete a hose evolution.

The hose is deployed on predominantly level, hard surface roadways rather than the variety of terrain described earlier. This permits minimally staffed crews to deploy hose easily without the labor intensive and time consuming efforts necessary to move large supply line hose through yards, over fences, and around other barriers.

Companies completing the water supply from the crossover must complete the hose lay after laying line(s) to the first available hydrant on that given roadway. With proper coordination and planning, hydrants could be installed at one end of each bridge span to minimize the length of lay necessary, as done in Fairfax County.

Accurate pre-planning can be performed knowing the distances between bridge spans and the travel routes of arriving companies. Sample mapping strategies using 1,000 foot markers were explored using the GIS mapping system[36]. Command officers could determine at a glance, the number of pumpers needed to complete a given relay from the known location of an incident. This would result in the quickest possible dispatch of needed units to assure success.

The WSWG recommends that installation of dry vertical standpipes be adopted as the preferred method to establish expanded water supply relays on Montgomery County limited access highways. These standpipes should be included in the future mapping efforts outlined later in this report.

In addition to needed fire suppression water on limited access highways, the WSWG believes there is an immediate need for a county-wide fire fighting foam strategy. The hazards presented by fire on our limited access highways are certainly not limited to those that can or must be mitigated using water. In fact, the most serious incidents on I-495 and I-270 in Montgomery County have involved flammable liquid emergencies that required considerable foam resources.

[36] A set of 34 by 44 inch maps of this type were produced for interstates 495, 270 and 370. They are available for viewing within the WSWG reference file.



The Tools


Fire Fighting Water

An adequate and uninterrupted water supply is fundamental to the effective control of fire. Simply stated, water must be applied at rates (GPM) capable of absorbing heat faster than the fire can generate heat. In doing so, fire suppression forces lower the temperature of the fuel below its ignition point. For most fires in Montgomery County, this is accomplished with several hundred gallons of water applied quickly through pre-connected hand lines. In a smaller number of incidents, large amounts of water must be quickly delivered at rates necessary to overwhelm growing and rapidly spreading fires. In either case the MCFRS must be capable of delivering larger quantities of water rapidly when challenged with well-developed structure fires that threaten occupants and or adjacent exposures.

The WSWG has applied the requirements of two nationally recognized models to MCFRS operations to evaluate the ability to deliver fire-fighting water. These models are the Insurance Services Office Fire Suppression Rating Schedule, and NFPA 1231-1993, "The Standard for Rural and Suburban Fire Fighting Operations".

The majority of fire fighting in Montgomery County is done with fire hydrants in areas where more than ample water is available underground. In fact, a close review of our operations would identify that the fire department is limited not by the lack of water, but rather the ability to move the water above ground once it leaves the water source[37].

There are several reasons for this. First and foremost, fire departments are limited by their ability to move water through hose primarily due to the effects of friction loss. Secondly, the distance between the water source and the fire ground determines the number of pumpers necessary to move the water efficiently.

The WSWG submits that it is a logical and desirable approach to utilize water supply as the basis for fire suppression planning and deployment. To date, Montgomery County has relied heavily upon past significant incidents, historical data, and opinion surveys to determine resource allocation. The result is the continuation of past practices, some good and some not so good.

Fire Department Pumpers

The operational purpose of a pumper and its crew is to establish a continuous water supply and apply water to a fire. A variety of attack hose and

[37] In most instances where municipal fire hydrants are available, the fire department does not maximize the available water from the hydrant. Typically, the above ground hose lay is the limiting factor, not the available water supply when the fire fighter hollers "I'm out of water".

nozzle configurations that produce both spray (fog), and straight (solid bore) fire streams are carried to maximize versatility. Larger hose (supply line) is carried in sufficient quantities to deliver water from a wide variety of sources to the attack pumper(s). In some cases this requires the use of multiple pumpers over considerable distances to achieve the end result.

All pumpers manufactured for fire department use are rated, tested, and certified by a third party at the time they are built. Pumps are typically sized from 500 GPM to 2000 GPM based upon the purchaser's specifications. Beginning at 500 GPM, pumps are available in 250 GPM increments. A typical Montgomery County spec pumper is equipped with a 1250 GPM, two-stage, (dual impeller) mid-ship mounted pump and a 750-gallon water tank.

While Montgomery County purchases attack pumpers with a rated capacity of 1250 GPM, some specialty apparatus like the three front-mount pumpers in service at FS's 13, 14, and 17 are equipped with 750 GPM pumps. Ironically, these are the units planned for use at drafting sites in rural areas. Is is well known that the largest capacity pump must be placed at the water source to maximize the available water supply and to adequately supply pumpers down the line in a relay. The WSWG believes that a water supply delivery system built around these pumpers is doomed to failure by design. At the very least, two pumpers of similar capacity will have to be placed at the source to achieve higher flows at the end of the line.

Operating with apparatus that is minimally staffed, Montgomery County should strive to get the maximum use from each piece of apparatus. In other words, each pumper would be placed to deliver as much water as possible. In addition, each pumper should be capable of delivering their rated capacity at the lowest RPM's possible. A typical large scale fire in Montgomery County utilizes at least three attack lines averaging 150-200 GPM each, and one or more master streams that average 500-1000 GPM each. If exposure protection is required, this increases the demand further.

Understanding rated pump capacity is fundamental to the water supply delivery system. The ability of a given pump to deliver the rated capacity of water changes when operating from draft or hydrant pressure. Essentially, operating from draft is a worse case scenario. The pump is rated to deliver 100% of its rated capacity at draft at 150 PSI pump discharge pressure. At 200 PSI, the pump is rated to deliver only 70% of its rated capacity, and at 250 PSI, the rated capacity drops to 50%. Therefore it is critical to design evolutions and SOP'S that will limit the discharge pressure of pumpers to 150 PSI. This assures that quantities up to the rated capacity of the pump will be guaranteed when establishing water supply. However, when operating from hydrant pressure, or within a relay, the fire department pumper only needs to make up the pressure difference between what is already available and what is required. This is how a 1,000 GPM pump can, at times, deliver more than 1,000 GPM. For example, if a hydrant supplies 50 PSI to the pumper, and 150 PSI is required, the fire pump needs only to generate the difference, or 100 PSI. As a result, pumps can deliver in excess of their rated capacity when operating from positive pressure.

A typical Montgomery County pumper is equipped with two beds of 3" diameter supply hose, 800' long. This system is intended for crews to establish a water supply going in from the hydrant via one or two supply lines. A second pumper then picks up these lines and pumps them to maximize the potential of the delivery system. This works well in the vast majority of incidents where fire flows less than 800 GPM are required. However, fire flows greater than that amount, and or in situations where the length of hose needed is greater than 600-800 feet create obstacles that are difficult to overcome. In most cases, much more water is available in the hydrant system that is not utilized. Expansion of the water supply at this point in an incident usually relies upon relays from hydrants further away from the incident.

To achieve the maximum use of each pumper on the fire ground, several factors must be considered and planned for: available water supply, adequate pump capacity, hose diameters large enough to meet the required fire flows, and utilization of proper hose lays to deliver the required fire flow. Therefore, ***the WSWG recommends that future pumpers be purchased with 1500 GPM pumps with state of the art full flow valves.*** These pumps and valves are equipped with improved pressure control devices designed specifically for large diameter hose. Later in this report, conversion to 4-inch supply line will be recommended. 1500 GPM pumps will permit each pumper to supply two, 1,000-foot long 4-inch supply lines from draft.

Other potential enhancements that should be considered by those having authority include direct tank fills for all pumpers, and the addition of a third crosslay attack line for deployment of the mandated rapid intervention line. The direct tank fill will enable pumpers to be more effectively used to shuttle water in rural areas and on limited access highways. The addition of the third crosslay will permit easier deployment of a rapid intervention line that is now required by policy.

Fire Fighting Foam

Presently, most county spec pumpers are equipped with forty gallons of Class B fire fighting foam that can be applied through a single attack line no greater than 200 feet long[38]. The application rate for these foam lines limit the ability to handle anything involving more than an area of about 25 feet by 25 feet.

[38] Class B foam refers to products that are specifically designed to attack, extinguish and seal flammable liquid pool fires.

Units in the county have successfully used foam for small incidents for years. Improvements in foam technology have increased the extinguishment and hazard control ability for these smaller foam systems. However, they are not suitable for larger incidents where a well developed fire is in progress, or where large quantities of product is spilled and needs to be sealed. The MCFRS typically requests assistance from one of the regional airports when large scale incidents occur.

Several units within the MCFRS have additional around-the-pump foam capabilities. These units were developed to mitigate incidents where it is believed that additional flammable liquids hazards exist, and where greater foam resources are necessary. Bethesda E-261, Chevy Chase E-71, Gaithersburg E-281, and E-81 all have enhanced foam systems that will permit application of Class B foam for extended periods at greater rates. These units can be utilized to apply foam through multiple attack lines, including the master stream device. They are equipped with one hundred gallons of foam concentrate (E-71 has 250 gallons) and an auxiliary pick-up tube that permits drafting foam from other containers. However, the available foam for large application rates is severely limited unless additional foam concentrate resources can be provided rapidly. This is not presently available. Additional foam concentrate resources are delivered in five-gallon buckets that must be manually handled to deploy; severely compromising speed and efficiency.

The WSWG recommends that the MCFRS explore available Class B foam strategies and develop a plan to improve Class B fire fighting foam capabilities. It is certain that our last flammable liquid fire will not be our last.

Although foam and foam systems are not the primary focus of this report, the WSWG would like to share knowledge of one system presently in use in Dade County, Florida and other jurisdictions that provide additional foam coverage without the use of dedicated specialty vehicles designed for that purpose.

Foam is purchased in 275-gallon skid packs that are handled with tow motors and transported on utility type pick up trucks. These utilities respond with strategically located pumpers equipped with around the pump proportioners described above. They position adjacent to the pumpers, providing large quantities of concentrate through the auxiliary pick up tube eliminating the need to manually unload and dump foam buckets. On large incidents, all of the available units are deployed and utilized in concert.

This system is only one of many strategies that could be deployed at minimal expense to the service. Nonetheless, additional foam capabilities are required to mitigate larger, less frequently encountered incidents.

Tankers

The county's four tankers are housed in stations with predominantly non-hydranted first due response areas. Currently, tankers are housed at Hyattstown FS-9, Upper Montgomery FS-14, and Laytonsville FS-17, (two tankers are available from this location). The WSWG obtained data regarding the number of responses made by these four tankers for calendar years 1994-1998. The results are displayed in the following table.

CY94-98 Tanker Responses To Fire Incidents*

Tanker	1994	1995	1996	1997	1998	94-98 Total	94-98 Avg
9	N/A	N/A	N/A	46	43	89**	44.5**
14	35	55	34	70	22	216	43.2
17-1	54	56	45	75	61	291	58.2
17-2	N/A	N/A	N/A	18	27	45**	22.5**
Totals	89	111	79	209	153	641	128.2

N/A – Not applicable or not available
* Non-fire incidents (e.g., service calls) not included
** Figure based on less than 5 years data

On May 1, 1999 the Fire Rescue Commission enacted a change in the structure fire response that will increase tanker usage. Two tankers will automatically be dispatched on all rural structure fire responses in Montgomery County. Prior to that date, a single tanker could be dispatched at the discretion of the local fire rescue department[39].

Tanker Evaluations

To help identify gaps in tanker coverage, and evaluate our current tanker fleet, the WSWG sought the assistance of Captain Mark E. Davis, (DFRS FS-3A). Captain Davis has performed similar work in other portions of the country as a consultant, and was instrumental in designing improvements in Carroll County, MD that have been used to achieve better ISO ratings in an all rural portion of that county[40].

[39] The WSWG believes that the addition of the second tanker on structure fire responses will increase the number of tanker responses substantially.
[40] The Winfield VFD (Carroll County, MD), has undertaken a multi-year project to meet the ISO rural rating expectation of an uninterrupted 500 GPM continuous fire flow for two-hours using tankers in a shuttle operation supplied from multiple fill sites.

There are four tankers operated by three local fire rescue departments in Montgomery County. Hyattstown Tanker 9 is a 1992 KME with a 1500-gallon T-shaped tank, a 1250 GPM midship-mounted pump, and a 10 inch rear gravity dump. Upper Montgomery County Tanker 14 is a 1993 Freightliner/Walker with a 3000-gallon elliptical tank, a 1250 GPM midship-mounted pump, two air-operated 8 inch side gravity dumps and a 10 inch rear gravity dump. Laytonsville Tanker 17-1 is a 1993 Freightliner/Walker with a 3500-gallon elliptical tank, a 1250 GPM midship-mounted pump, two air-operated 8 inch side gravity dumps, and a 10 inch rear gravity dump. Tanker 17-2 is a 1984 Ford/Four Guys with a 1500-gallon elliptical tank, a 1000 GPM front-mounted pump, and an 10 inch rear gravity dump.

During December, 1998, Tankers 9, 14, 17-1 and 17-2 were each evaluated at the PEPCO Power Station test site in Dickerson. The PEPCO facility offered an ideal site for all test-related evolutions, including weighing (on-site scales), filling, off-loading, and traveling along a looped, measured course. Each tanker was put through four distinct tests, each having multiple test runs: ISO Fill Test, Continuous Flow Test, One-Minute Increment Off Load Test, and ISO Dump Test.

Four tests were conducted with each of the four Montgomery County Tankers at the PEPCO facility in FS-14’s area. The gross vehicle weight of each tanker was assessed. An off-load weight test was performed to determine the critical dump time for each unit, followed by the ISO dump test. An ISO fill test was conducted using two different fill methods; directly from a hydrant, and from a pumper connected to a water source. Finally, a continuous flow test was performed to evaluate each tanker in a real life water shuttle that accounts for travel time. This final test was run twice to gather data for a 1.6, and 3.2 mile run. This data was then extrapolated to predict continuous flow capabilities for 4.8, 6.4, and 8.0-mile round trips.

Gross Vehicle Weight (GVW) Assessment

An important safety issue with any large fire department vehicle is weight distribution. Weight distribution becomes critical with tanker vehicles because of the large quantity of water a tanker can carry and the expectation that the tanker must be able to operate safely under full-load, partial-load, and no-load conditions. As axle weights increase, so do the concerns over braking and handling ability. These weight concerns are important in the rural setting because tanker drivers are often faced with long response times, winding and narrow roads, and additional travel during shuttle operations. An overweight tanker can quickly develop braking problems given the nature of these operations.

Each of the four tankers was evaluated using a full tank of water and a one-person crew. Three weight measurements were obtained for each tanker, front axle, rear axle(s), and all axles combined. The tests were done using the certified scale at Montgomery County's composting facility next to the PEPCO power plant in Dickerson. The weight measurements on all four tankers were within reasonable limits, however, Tanker 9 had the highest rear axle weight: 26,420 lbs. which was 5000 lbs. more than the next highest weight (Tanker 17-1).

Off-Load Weight Test

The one-minute increment off-load weight test is used to evaluate a tanker's ability to off-load its total capacity as quickly as possible. The test shows that a full tanker off-loading in the gravity mode will initially start with a high off-load GPM, but as the off-load process continues, head pressure drops as does the off-loading GPM. During the test, a tanker is weighed full and then dumps water for one minute. The tanker is then re-weighed and a GPM flow is calculated. The tanker dumps for another minute and is then re-weighed and a second GPM flow is calculated. The test continues in one-minute increments until the tanker is empty. For example, if a 2000-gallon tanker dumps 1700 gallons in the first 1-1/2 minutes and it takes another 1 minute to dump the remaining 300 gallons, then the critical dump time for the tanker is 1-1/2 minutes. Using this concept in a continuous flow operation, the driver/operator of the tanker should only dump for 1-1/2 minutes before heading to the fill site.

Based upon test results, the following critical dump times (CDT) are recommended:

	CDT	Method	Total	% Dumped	Avg.Rate
T-9	1 min.	rear dump	1265 gallons	84.3%	1265 GPM
T-14	2 mins.	rear dump	2692 gallons	89.7%	1346 GPM
	1.5 mins.	side dump	2688 gallons	89.6%	1075 GPM
T-17-1	2 mins.	rear dump	3176 gallons	90.7%	1588 GPM
	3 mins.	side dump	3095 gallons	88.4%	1032 GPM
T-17-2	3 mins.	rear 4-1/2"	1243 gallons	82.9%	414 GPM
	2 mins.	rear 6"	1315 gallons	87.7%	658 GPM

Test results show that with the exception of Tanker 17-2, the tankers can easily dump at rates greater than 1000 GPM provided the driver/operators stop dumping at the critical dump times. Tanker 17-2 had two significant problems. First, the built-in "jet dump" was out of service and the driver indicated that no effort was being made to have the feature repaired. With the jet dump in-service, off-load time would be significantly reduced. Second, the rear gravity dump appeared to be 10-inches in diameter but was reduced down to 6-inches, then to 4-1/2-inches. The tanker was tested using the 4-1/2 inch and 6-inch openings but the adapter could not be loosened in order to test the 10-inch opening. The 10-inch opening would most certainly improve off-load time to a value similar to Tanker 9. Unfortunately, this hypothesis could not be tested, therefore, it cannot be expected to happen at the fire scene either.

ISO Dump Test

The purpose of the ISO dump test is to see how long it takes to dump the contents of the tanker when operating in the water shuttle mode. The ISO dump test is a national model used in the evaluation of a fire department's ability to deliver a fire flow in a non-hydranted area. The test time starts 200-feet prior to the dump site and ends 200-feet past the dump site so that the "making and breaking" of hose and adapter connections is factored into the overall dump time. Therefore, if a tanker has to connect to a threaded hose and pump-off its load of water, one can expect to see a longer dump time than a tanker that simply gravity dumps off the side of the vehicle. A tanker that is slow to dump and slow to fill will adversely affect the overall shuttle operation regardless of its tank size.

The ISO dump test was conducted at PEPCO's Dickerson power plant using a measured course. Tankers with both side and rear dumps were evaluated using a simulated off-load scenario. Testing the rear dumps required the drivers to stop and back the vehicles to a designated spot prior to off-loading water. This operation was used to simulate the time taken when using rear dumps at portable drafting tank sites. Side dumps were evaluated by simply pulling next to the designated spot prior to off-loading water.

Testing results show that none of the tankers match their off-loading abilities as indicated in the one-minute off-load weight test results. Tanker 9's best ISO off-load was 756 GPM. Delays were encountered in having to stop and back-up the vehicle. Tanker 14's best ISO off-load was 994 GPM using the rear gravity dump. Delays were encountered in having to stop and back-up the vehicle as well as attach a discharge chute. Tanker 17-1's best ISO off-load was 921 GPM using the officer's side, air-operated, gravity dump. Tanker 17-1's rear gravity dump would most likely have been quicker, but the driver had some difficulty attaching the discharge chute. Tanker 17-2's best ISO off-load was 431 GPM using the rear 6-inch dump. The rear 4-1/2-inch dump provided poor performance during this test.

In general, the ISO off-load test is a realistic model that takes into consideration the actions of the driver/operator, the layout of the dump valves, and the processes by which water is off-loaded. The test serves as a standard by which tanker performance can be fairly compared. No special preparations were made for the Montgomery County's tests, each unit arrived at the PEPCO site and was tested based upon a "what you see is what will occur at the fire scene" principle. With training and some modifications to the rear dump systems, the ISO off-load times for each tanker could be improved.

ISO Fill Test

The purpose of the ISO fill-test is to see how long it takes to completely fill the tanker when operating in the water shuttle mode. Like the dump test, the ISO fill test is a national model for comparing tanker performance. The test time starts 200-feet prior to the fill site and ends 200-feet past the fill site so that the making and breaking of connections is factored into the overall fill time. Therefore, if a tanker has to use threaded connections to load its water, filling will be delayed. Some departments are equipped to fill "over the top" using some type of fill pipe into a tank vent. It is important to note for this test, "full" meant the evaluator saw water discharging from the tank overflow.

Test results show that all four tankers were unable to refill faster than they had dumped during the ISO off-load test. These results indicate that in an extended shuttle operation, the tankers would end up in line waiting to refill at the fill site, the least efficient place to be in a continuous flow operation. <u>Tankers need to be able to fill as fast, or faster, than they dump</u>. Tankers are meant to be in motion, otherwise their overall GPM contribution is significantly reduced. It is important to note one exception, however, during a continuous flow operation, the shuttle capacity may actually exceed the fire flow needed, therefore tankers may be lined-up waiting to dump; this is preferred.

All four tankers were tested using two methods. The first method used a hydrant only as the fill supply and the second method used a pumper as the fill supply. The hydrant method simulated the tankers refilling directly from a hydrant without the assistance of a pumper while using the tanker driver only to make and break connections. The second method simulated the tankers filling at a drafting site with a pumper providing the necessary flow and pressure. The second method allowed both the pumper driver and the tanker driver to assist in the making and breaking of connections. The ISO fill tests were conducted at PEPCO's Dickerson power plant using a measured course.

	Hydrant Direct Fill	**Pumper Fill Through Pump**
Tanker 9	*303 GPM	337 GPM
Tanker 14	507 GPM	343 GPM
Tanker 17-1	614 GPM	422 GPM
Tanker 17-2	342 GPM	236 GPM

*Tanker 9 has no direct fill capability. Instead, it's 2 inch pump to tank fill line must be used to fill the tank.

Tanker 9 was the slowest tanker to fill, with a 303 GPM rate using the hydrant method. The problem with quickly refilling Tanker 9 is that there is no method to directly fill the tank. Refill operations must use the 2-inch pump-to-tank fill line via the midship mounted fire pump, the restriction in the piping and valving significantly impacts the ability for a quick refill. In addition, though the unit carries 4" LDH, it came to the test with no adapters to allow for a 4-inch line to feed from the hydrant (or pumper) to the tanker. When asked about using LDH to refill, Tanker 9's driver advised that Engine 91 had to be present to make that work. This is another example of the need for rural water supply training; it is not guaranteed that Engine 91 will always be the fill site engine filling Tanker 9. All connections made used threaded connections that took considerable time to make and break. Because of these problems, there was no significant difference between the hydrant fill and the pumper fill for Tanker 9.

Tanker 14's best ISO fill rate was 507 GPM using a 4-inch line from the hydrant into the rear direct fill connection. Again, threaded connections caused considerable delay in the filling process.

Tanker 17-1's best ISO fill rate was 636 GPM using a single, 3-inch line pumped into the rear direct fill connection. However, it must be noted that the 4-inch line from the hydrant into the rear direct fill resulted in a 614 GPM ISO fill rate. Again, the use of threaded connections caused considerable delay in the filling process.

Tanker 17-2's direct fill rate was the worst of the four tankers with a 342 GPM rate using a 3-inch line filling back through the rear dump. A test using the pump-to-tank fill line from the front mount pump was even slower at 236 GPM. Again, the use of threaded connections caused considerable delay in the filling process. There was some confusion over how to fill Tanker 17-2. The driver thought that the tanker could not be refilled through the rear dump, this was proven incorrect. Once again, this shows that more training is needed, because "what you see is what most likely will occur at the fire scene."

In general, the four tankers could all improve their refill capabilities. In the field of rural water supply, the general rule is that the smaller tankers are often faster to dump and fill, and in an extended shuttle operation, the small tankers will outwork the larger tankers. In Montgomery County, just the opposite is true. The two smallest tankers, absent any modifications to improve efficiency, will slow down the operation.

It is difficult to draw conclusions about what is the optimum size tanker. Nationwide, there is a wide variety of tankers and tanker operations. The key to tanker performance is the ability to off-load and refill equally fast. If a small tanker (1800 gallons or less) can dump and refill its tank each within a 90-second time limit, then that tanker's performance will most likely be maximized. Large tankers (greater than 1800-gallons) will provide optimum performance when they can dump and refill at a rate equal to, or greater than, 1000 GPM. Therefore, it is tanker design, not necessarily tanker size, that is critical to optimum performance.

Properly designed large tankers should outwork smaller tankers or combination engine-tankers. Future tankers should be purchased with capacities of at least 2500 gallons, designed to dump and fill at a rate equal to or greater than 1,000 GPM. This will require all gravity dumps to be at least 10”, an increase in tanker venting requirements, and the elimination of threaded connections on fill piping. We also suggest the addition of adequate lighting around all dump chutes for use by apparatus operators when positioning for dumping at night. End users have suggested that the Apparatus Sub-committee reevaluate the need for large capacity pumps on tankers and the addition of a pre-connected master stream device to make them self sufficient.

ISO Continuous Flow Test

The purpose of the continuous flow test is to evaluate the tanker in a “real life” scenario where travel time must also be figured into the water delivery equation. The test uses a dump site and fill site that cause the tanker to complete a round trip similar to a shuttle operation. Time starts when the tanker begins off-loading water, and ends, when the tanker returns to the dump site full. The contributing GPM is then calculated based upon the total time needed to complete the cycle. Of all the tests conducted, the continuous flow test provides realistic data on the capabilities of the tankers. The continuous flow test was conducted at PEPCO’s Dickerson power plant facility using a measured course. Each tanker was tested using a 1.6-mile round-trip and a 3.2 mile round-trip. From there, a linear equation can be developed to establish possible flow rates based upon round-trip travel mileage.

Test results showed that Tankers 14 and 17-1 provide the highest flow rate, 317 GPM and 386 GPM respectively for the 1.6-mile round-trip (248 GPM and 289 GPM at 3.2-miles). Tankers 9 and 17-2 were significantly lower with Tanker 9 providing 183 GPM at 1.6-miles and 128 at 3.2-miles. Tanker 17-2 provided 165 GPM at 1.6 miles and 113 GPM at 3.2 miles.

Extrapolation of test data provides the following delivery rates:

	1.6 miles	**3.2 miles**	**4.8 miles**	**6.4 miles**	**8.0 miles**
Tanker 9	183 GPM	128 GPM	73 GPM	18 GPM	0 GPM
Tanker 14	<u>317 GPM</u>	<u>248 GPM</u>	179 GPM	110 GPM	41 GPM
Tanker 17-1	<u>386 GPM</u>	<u>289 GPM</u>	192 GPM	95 GPM	0 GPM
Tanker 17-2	165 GPM	113 GPM	61 GPM	9 GPM	0 GPM

The data shows that it is difficult to maintain even a 250 GPM continuous flow using one of Montgomery County's big tankers if the round trip from the fill site to the fire scene back to the fill site exceeds 3.2 miles. Therefore, it is critical that more than one tanker be dispatched on the initial assignment if water supply is to be more than a support function.

The battery of test results show that half of Montgomery County's tanker fleet is inadequate in providing a 250 GPM fire flow for any extended length of time. The two large tankers performed reasonably well in most aspects of the tests, however, refill operations prove to be the weak link in the operation. The two small tankers possess the potential to be good contributors to an extended shuttle operation, but they are set up to fail by not providing the equipment or the processes by which to dump and refill equally as fast. The tests also indicated a clear need for training on the fundamentals of rural water supply operations; the information taught in the Pumps Course at the PSTA (Public Services Training Academy) is insufficient for understanding the demands of shuttle operations.

Supply Line Hose

In all areas of Montgomery County where municipal water is available, fire suppression water is provided by pumpers laying one or more supply line(s) to or from nearby fire hydrants. The amount of water available is dependant upon the number of lines layed, the appliances available to adapt to various hose combinations, and most importantly, the diameter of the hose lines.

No standard complement of supply line is required by any policy within MCFRS. Most pumpers in Montgomery County are equipped with 3" supply lines. Each Local Fire Rescue Department determines the hose compliment to be utilized on their apparatus. The WSWG has determined that a typical supply line configuration consists of two 800 feet beds of 3 inch hose, connected in the middle to permit a single long lay, or dual unconnected supply lines for larger flows. Some departments carry less than 800' and some carry up to 1,000' in each bed.

A single 3" supply line will accommodate fire flows in the 400 GPM range. Placing a pumper at the hydrant to boost the pressure and flow in the line can increase this flow. However, rated pump capacity will never be achieved since the final quantity of water available is limited to the amount that can be forced through one or two 3" lines. When higher required fire flows are necessary, dual lines are deployed to enable fire flows nearing 1000 GPM.

Existing procedures have served the system well except when units try to lay long lines creating excessive friction losses, or when flows greater than 800-

1000 GPM are expected. This problem is not limited to rural areas of the county. Montgomery County units rarely achieve the full potential of their pumping ability on the fire ground. Montgomery County utilizes material developed and published by the Maryland Fire Rescue Institute, (MFRI), University of Maryland, as the foundation for pump operator training. MFRI recommends that supply lines be limited to 600 feet in length when utilizing 3 inch supply line. Lays longer than 600 feet require pumpers placed at 600 feet intervals to relay water at net pump pressures that will assure adequate GPM flows. Units in Montgomery County frequently ignore this fundamental recommendation, and, therefore, fail to maximize the efficient use of available water, regardless of the water source[41].

The WSWG recommends that Montgomery County pumpers carry a standard hose complement that is designed to maximize the capability of the apparatus. Even though the risks throughout the county are diverse, the resources necessary for fire suppression units to deliver water rapidly and efficiently should be the same. This does not imply that one size fits all. It does imply that to be efficient, all units should work with similar, if not the same, hose complements, and that our procedures for implementing a water supply should be standardized to the point where we can uniformly train and share resources when required.

The WSWG recommends that the MCFRS move to a standard supply line complement on engines in both rural and urban areas of the county. We recognize that it may be necessary to carry different quantities of hose based upon local needs. The emphasis being that the MCFRS invest in the future by eliminating different hose diameters, appliances, couplings and such so that a well-honed, efficient water delivery system can be rapidly initiated and expanded anywhere in the county with any combination of available units.

Friction Loss In Fire Hose

It is well known that friction loss is the enemy of the fire department when moving water. Actual friction loss in fire department hoses is determined by a variety of factors that include materials used in the construction of the hose, manufacturing techniques, age, condition, and care of the hose, liners, and couplings. However, for the purpose of this report, we will limit our discussion to two primary factors. They are:

- The diameter of the hose, and
- The length of the hose lay

[41] Many pump operators and command officers believe that required fire flows can be delivered when excessively long lays are established. This is simply not true and the practice should be discontinued. Reasonable limits for length of hose lays must be established based upon the hose diameter being utilized, and the amount of water desired.

Pump operators are taught that the relationship between hose diameter and friction loss is exponential. Therefore, a small increase in hose diameter results in a large increase in available GPM flow and a considerable decrease in net PSI required to deliver the flow. This is a win-win combination that cannot be ignored. Simply stated, larger diameter hose will enable fire department units to move larger volumes of water over greater distances at lower pressures.

The NFPA 18th edition of the Fire Protection Handbook lists the following relative hose carrying capacities of different diameter hoses at normal operating pressures:

1-3 inch – supply line 350 GPM
1-4 inch – supply line 750 GPM
1-5 inch – supply line 1300 GPM

The following flows are achievable **at 150 PSI net pump pressure with 1,000 feet between pumps**[42]. These numbers are more applicable to our operations in Montgomery County since we deploy a pumper at the hydrant. They are:

1-3 inch – supply line 400 GPM
1-4 inch -supply line 800 GPM
1-5 inch - supply line 1,600 GPM

In other words, these are the flows that can reasonably be achieved when the length between pumps is limited to **1,000 feet** and the net pump pressure is restricted to approximately **150 PSI.** The MCFRS sometimes fails to account for these two critically important benchmarks. Frequently, units attempt to lay a single line that is too long for the required flow. The planned intent to violate this rule is evidenced by pumpers that continue to carry supply line hose in dual beds that are connected. Clearly, the expectation is to lay a single line longer than 800’-1000’, with no break in the middle for a relay pumper. In other instances, apathy and laziness prevent unit officers from deploying dual lines when higher flows will potentially be needed. By the time the need for additional flow is recognized, laying additional lines is impractical. The steps necessary to expand the water supply at this point are so labor intensive and time consuming, the fire gains too much headway to be properly managed.

Many times the water capacity of a hydrant system is blamed by fire service personnel for a shortage of water on the fire ground. In reality, most of these problems can be alleviated by a proper hose evolution above the ground. Because the intake gauge on a pumper reads “0 PSI” doesn’t necessarily mean that there is no more water available from the hydrant. Typically, the water is

[42] It is critically important to understand that these flows can vary considerably between hose manufacturers. It is not uncommon to experience actual flow tests that differ by plus or minus 20%.

"trapped" in the underground main because of an unrealistic hose evolution above the ground. Large diameter hose lays can help the fire department utilize this unused water. However, there are disadvantages to operating with large diameter hose.

Large Diameter Hose

The National Fire Protection Association considers any hose with an inside diameter larger than 3 ½ inch to be large diameter hose, (LDH). Four and five inch hose are the most common sizes utilized by municipal fire departments, even though current technology permits construction of hose up to 12 inch in diameter. Six-inch diameter LDH is gaining popularity in many industrial applications[43]. Many fire departments, including most of those in Montgomery County have strongly resisted the transition to large diameter hose.

As a general rule the flow doubles between 3 inchand 4 inch hose; and doubles again between 4 inch and 5inch hose. This is a powerful comparison that cannot be discounted. From the efficiency perspective, a single 4 inch hose line will accomplish what two 3 inch hose lines will. If the service is willing to adapt to the difficulties and limitations of 5 inch or larger hose this increase in efficiency is even more dramatic. Replacing dual 3 inch supply lines with a single 4 inch supply line can result in savings that can be utilized elsewhere.

The success of initial attempts to utilize large diameter hose in Montgomery County is still debated. The WSWG is describing those experiences in this report for completeness. We would recommend that any future evaluation of LDH and its working components are conducted from a fresh starting point for a number of reasons.

Improvements in the design, manufacture, and implementation of LDH systems have improved many fold in recent years. Early attempts to utilize LDH in Montgomery County dates to the 1970's. Rejection of the concept now based upon the problems encountered then would simply not be a clear and fair evaluation.

The Kensington Fire Department operated a converted reserve pumper running as Water Supply 21 that was specially equipped with 2,000 feet of 5" hose and a variety of appliances designed to accommodate a hydrant problem in Old Town Kensington. This unit was also available and sometimes utilized to expand water supplies for other departments who requested Kensington's

[43] Hose larger than 5 inches in diameter is normally considered to be too difficult to handle without apparatus specifically designed to deploy the hose. In addition, safety becomes a key variable when moving water through large diameter hose at pressures necessary for fire department use.

assistance. Most often WS-21 was requested by other departments on multiple alarm fires. The benefits of the LDH were rarely utilized early in an incident where the full potential of the LDH could be realized. Because the unit was a specialty piece of apparatus, other departments had a limited familiarity with the unit, or the proper utilization of the equipment. This unit is no longer in service.

The Gaithersburg Fire Department carried 1,000' of five inch supply line in the 2nd bed of E-81 to be used primarily as a means to supply the elevated master stream on Tower 8, and as a large flow supply line in limited areas where hydrants were not readily available. Problems encountered with dressing out the hydrant when laying dual lines, and lack of compatibility with neighboring units eventually led to the hose being moved to the reserve pumper at FS-8, and then to a military 4x4 for rural operations. The hose was finally taken out of service due to age and condition. Most employees recognized the benefits of the hose but were frustrated with adapting to the special appliances and handling characteristics necessary to set-up. As the work force became more transient, training became difficult to manage, and these problems were exasperated. The LDH was taken out of service in 1996.

Currently, 4" large diameter hose is in use at fire station's 2, 4, 9, 11, and 40.

Takoma Park FS-2 has utilized 4" hose in an urban environment since the early 1980's with good success. FS-2 pumpers operate with 1,600 feet of 4 inch supply line arranged in a single bed with storz connections[44]. Since FS-2 operates near several political jurisdictional boundaries, they carry several appliances that permit neighboring companies to adapt back and forth between conventional threaded coupling 3inch lines and the enhanced storz couplings. In addition to the 1600 feet of 4 inch supply line, several short lengths of 4 inch hose are carried to improve operational efficiency around the pumper. For easy access to FD connections, FS-2 units also carry 400 feet of 3 inch hose for a variety of other uses.

Sandy Spring FS-4 and FS-40 currently operate with dual 1,000 feet beds of 4 inch supply line on their pumpers. After an attempt to utilize 5 inch hose, the department chose to sell that hose and switch over to 4 inch. In a meeting with Sandy Spring personnel, they strongly recommend that two beds of LDH be available for use. Justification for this recommendation is based upon the ability for each pumper to be self-sufficient. Laying two lines from the same unit assures that each pumper can supply their rated pump capacity from separate water supply

[44] A Storz connection is a quarter turn coupling that does not have conventional threads. This is significant in that the ends of the hose are "sexless". The time required to make and break connections is reduced considerably. In addition, the need to adapt back and forth between male and female ends is eliminated.

points. This argument is not without merit and should be fairly considered in future evaluations of LDH systems. However, nearly every other application of 4 inch hose evaluated by the WSWG more closely reflects the Takoma Park model.

Hyattstown FS-9 carries 1,000 feet of 4 inch hose on Tanker 9 for rural use. The leadership at FS-9 have struggled to agree on the optimum utilization of the LDH and have moved the hose from E-91 to Tanker-9 and back on several occasions. The WSWG believes that predominantly rural areas can benefit significantly from the proper use of LDH. We must first however overcome the outdated notion that there is not sufficient water available to fill the hose.

The Glen Echo Fire Department currently carries 800 feet of 5 inch supply line on E-112 along with 800 feet of 3 inch line that is used as the primary supply line. No published SOP is available for its use. Few command officers are aware that this hose is available. Recently this unit and the LDH was utilized on a large mansion fire in a rural portion of Fairfax County, VA. Comments from end users reveal compatibility problems with other units, and lack of specific training on LDH capabilities and limitations.

The primary disadvantage of large diameter hose lies in the ability to handle the hose in a variety of applications. Personnel complain that it is more difficult to repack, difficult and sometimes impossible to move once filled with water, and that it weighs too much. Others argue that apparatus cannot cross the line once charged without special hose ramps. Still others believe that it is impossible to load the lines flat without trapping air in the line. These arguments are outdated in that new techniques, special appliances, and reels have been developed to mitigate these concerns. Most of our personnel who have operated with LDH have done so in an environment where the apparatus and equipment was non-standard. Training on the correct application and use of the hose was limited. Therefore, many departments utilizing LDH have not had the opportunity to use it to the full potential.

Safety arguments have been raised in the past regarding the integrity of couplings and the tendency for LDH to kink and twist at the end of the supply-line. These problems have been eliminated with locking safety lugs and swivel connections on the pumpers. New lightweight couplings have helped as well. Many end users are not familiar with these changes and regard LDH as an unacceptable component in the fire-fighting arsenal. In reality, the opposite is true. Using the locking, swivel type, storz connections, LDH improves both safety and efficiency.

Many departments choose 5" over 4" for high capacity above ground water delivery. The WSWG believes that 5" supply line would not meet the expectations of the service, particularly in urban areas where establishing a water supply from a hydrant is more common. Buy in from the end users would be difficult as experienced in the Sandy Spring, Gaithersburg, and Kensington trials of the past. This is not to say that a few specialty pumpers designed specifically for 5” or 6” LDH could not successfully be utilized, particularly in rural areas. However, the common request from all parties interviewed in this effort has been to standardize applications for increased efficiency and standard training. The WSWG strongly supports both of these requests and submits that 4” supply line is the way to accomplish these goals. It is the closest thing to a one size fits all solution presently available. ***The WSWG recommends that the MCFRS initiate a goal to switch over to 4” large diameter hose as the standard supply line.*** The MCFRS should expect a training liability if this recommendation is adopted. The majority of our workforce both volunteer and career has limited experience with the components of a large diameter hose system. Nonetheless, this should be easily achieved with a quarterly in service training schedule that is expanded to accommodate the volunteer employees as well.

In local departments where a hose replacement program is in place that meets recommended standards, hose is tested annually. Hose is replaced if it fails a static pressure test, or automatically at the end of ten years service. All fire fighting hose should be on a ten-year replacement cycle to meet the hose testing standard. Hose testing speaks directly to the reliability of our fire fighting operations. A burst section of hose on the fire ground can have catastrophic results. At this writing, the Division of Fire and Rescue Services is preparing a standard hose testing package that is fully NFPA compliant. Screw down type gate valves have been purchased for distribution to the five districts for use where local resources are not provided. ***The WSWG recommends that all fire fighting hose be tested annually in compliance with NFPA-1962, The Standard for the care, Use and Service Testing of Fire Hose, Including Couplings and Nozzles.***

Appliances

Appliances that adapt to and from the variety of water sources are necessary to assure efficiency on the fire ground. As proven in the tanker evaluation tests, time wasted making and breaking connections can have an adverse impact on overall efficiency.

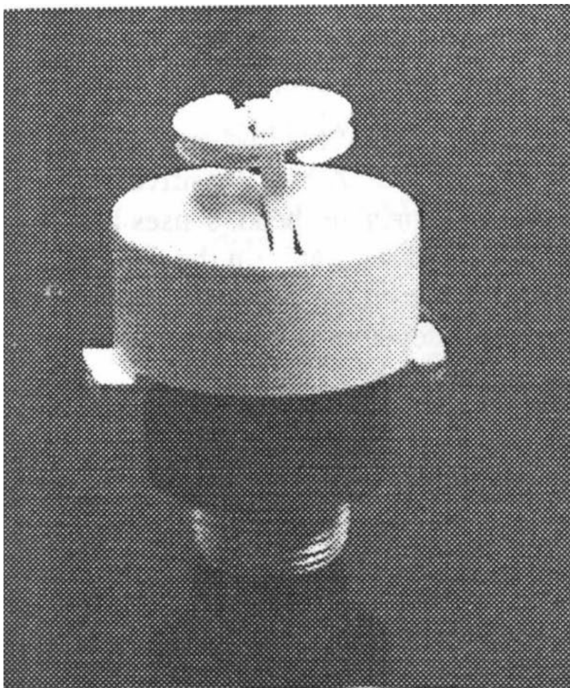
This is particularly true in Montgomery County where the components are non-standardized. Standardization of critical components in the past decade is slowly eroding by permitting Local Fire Rescue Departments to purchase apparatus, hose, and appliances that do not meet county specifications prepared by the Apparatus Specifications Committee. These changes create difficult training and certification problems for a transient workforce.

The WSWG recommends that all LFRD apparatus specifications prepared for purchase be reviewed by the apparatus specifications committee to assure that essential components are standardized.

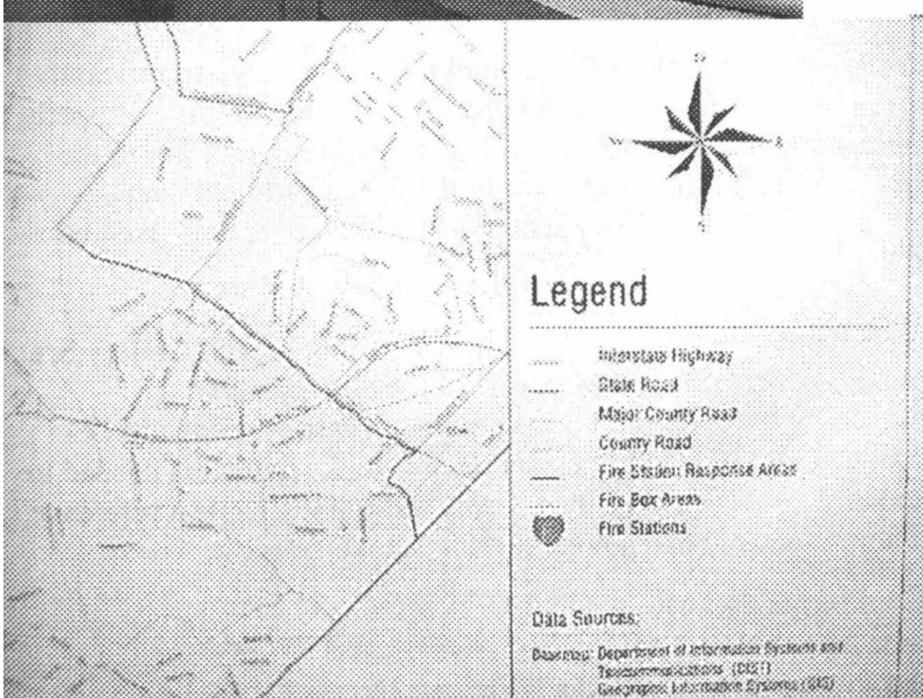
By far, the most time consuming process in establishing a water supply is the making and breaking of threaded hose connections. The fire service has overcome this problem with attack hose by pre-connecting lines around the apparatus to perform a variety of functions. However, when laying supply lines, this process slows the operation down considerably.

Large diameter hose is shipped with sexless ¼ turn couplings. Although these couplings are available from a number of manufacturers, they have become known by the trade name of one manufacturer, Storz. More recently, these couplings have been equipped with locking safety lugs and swivels that enhance safety, and prevent the line from twisting shut when charged.

The WSWG recommends that all future supply line be purchased with ¼ turn couplings, and equipped with locking safety lugs. In addition, we recommend connections on both ends of the hose lay be equipped with swivels to prevent the charged line from twisting closed.



The Future


Legend
Interstate Highway
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Major County Road
County Road
Fire Station Response Areas
Fire Box Areas
Fire Stations
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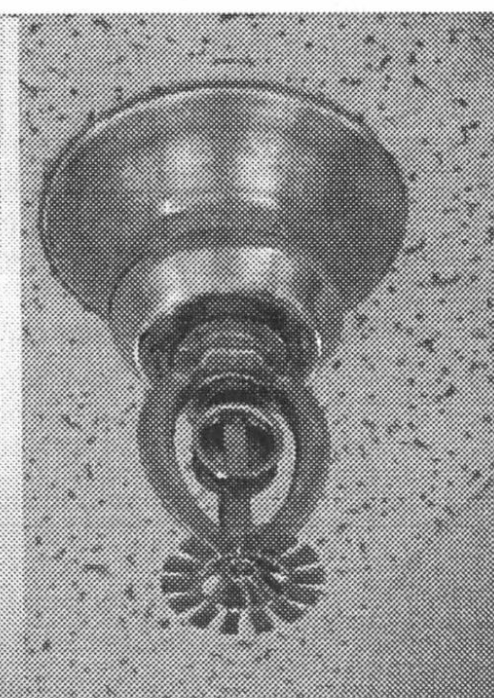

Automatic Sprinklers

Automatic sprinklers are temperature sensitive devices that open at a predetermined design temperature when exposed to heat. A heat sensitive element, either a fusible link, or glass bulb on each sprinkler head, senses heat from fires. After opening, the activated sprinkler releases water on the fire in quantities designed to extinguish or confine the fire until the fire department arrives. The ability of sprinklers to react early to a developing fire is critical to their well-documented success as a fire protection strategy.

Water is supplied to the heads by a system of pipes and valves, and in the case of homes supplied by wells, a water tank separate from the domestic water supply. Pipes are located overhead, or in side walls near the ceiling, while valves and tanks are located near the point where the domestic water line enters the home, typically in the basement.

Sprinklers were originally introduced in the late 1880's. They were used primarily in highly protected risks, (HPRs) such as warehouses, factories, and industrial plants. As improvements have developed, sprinklers have been increasingly mandated in other occupancies such as schools, nursing homes, prisons, places of assembly, and high rises of all types.

In recent years, quick response sprinklers with special low flow discharge characteristics and spray patterns known as residential sprinklers have been used to suppress fires in residential dwellings. They are proven to be very successful in fighting residential fires. Even though other interventions such as smoke detectors and public education have reduced U.S. fire losses considerably, residential sprinklers represent new and improved technology. Sprinklers add fire suppression capability to the early warning of smoke detectors.

Since their introduction in the 1970's, smoke detectors have significantly contributed to the reduction in fire deaths and property loss due to fire[45]. Properly installed and maintained smoke detectors provide early warning of a fire to the occupants who may take actions to escape, notify the fire department, and otherwise react to the event. While smoke detectors are effective, they must be properly installed and maintained.

From September of 1995 through June of 1999, Montgomery County fire fighters have approached 101, 893 homes as part of the *Safety In Our Neighborhood Program*. Of the 42,146 homes entered, batteries needed to be installed in 4,857 smoke detectors (11.5%) and entire smoke detectors needed to be replaced in another 5,446 homes (12.9%). Using these statistics as a reference, nearly 25% of all homes entered had a non-working smoke detector.

[45] Montgomery County's residential smoke detector law became effective in 1978.

Another consideration concerning smoke detectors involves the requirements for smoke detector coverage. Smoke detectors are required to be installed outside of all sleeping areas, and/ or on each level of the home depending upon the specific application. Traditionally there was no mandate to install detectors in every room based upon listed coverage of the individual smoke detector. However, smoke detectors are now required in every sleeping room and on every floor of one and two family dwellings in the latest CABO (Council of American Building Officials) One and Two Family Dwelling Code in use in Montgomery County. The NFPA Life Safety Code has additional requirements for smoke detectors in several occupancies. These requirements can be waived by the authority having jurisdiction when the building is fully sprinklered. The purpose of this requirement is to provide early warning for sleeping occupants whom must then react properly and escape, with or without the assistance of the fire department.

Residential sprinklers offer opportunities for improvement in the delivery of suppression services that are far broader than smoke detectors and other interventions.

First, sprinklers protect the lives of the building's occupants. Residential sprinklers are specifically designed to intervene before life-threatening conditions develop below the five-foot level in a room, (the height of the average adult's airway, when standing). Second, property is conserved. The structure and furnishings have increased probability at being preserved. Finally, sprinklers reduce the severity of a fire, reducing the danger to fire fighters. The National Fire Protection Association estimates that sprinklers can extinguish a typical residential fire in less than one minute. Further, they improve the chance of surviving a fire by ninety percent.

More importantly, residential sprinklers do not rely upon changed human behavior to prevent fires and subsequent losses. The majority of residential fires are attributed to behavioral causes like careless smoking, unattended cooking, or children playing with fire. Sprinklers help to control the results of the inappropriate behavior, and they are on-duty at all times. Sprinklers will generally protect the occupants of a building even when the batteries in the smoke detector have run out, or if the occupants are physically unable to escape. These impediments to fire survival have existed in residential occupancies for many years. At particular risk are the elderly and the very young, the two largest groups of victims who succumb to fire.

Residential sprinklers offer increased efficiency from a water delivery standpoint as well. In residential applications, systems are designed to provide either a 18 GPM, or a 26 GPM, required fire flow for a period of ten minutes. From a practical viewpoint, this means that homes not connected to public water need only store 260 gallons of fire fighting water, a tank about the size of a typical fuel oil tank. State of the art residential sprinkler heads have demand flows as low as 6

GPM per head. This lowers the stored water requirement to 180 gallons. In some cases, small pumps would be required to maintain adequate pressures to deliver the design flow. Presently, combination tanks and pumps are available to meet this requirement.

The WSWG turned to the experience gained in other jurisdictions to formulate conclusions regarding residential sprinklers. Collectively, these jurisdictions are able to share a large base of experience with residential sprinklers. Some of the more important benchmarks are listed here:

- In 1978, San Clemente, California was the first jurisdiction in the United States to require residential sprinklers in all new occupancies.
- “Operation San Francisco” served as a national pilot project for the application and testing of residential sprinklers.
- Scottsdale, Arizona passed the nation’s most comprehensive sprinkler ordinance in 1985, requiring automatic sprinklers in every room of every new building in the city.
- Neighboring Prince George’s County, Maryland has required sprinklers in all new residential construction, including single family homes, since 1987.
- Cobb County, Georgia has tested voluntary incentives for sprinkler installations resulting in reduced construction costs for builders.
- Port Angeles, Washington has tied their sprinkler requirements to the distance a given home is located from a fire station.
- International Association of Fire Chiefs “Operation Life Safety”[46] promotes the use of fast-response sprinklers.

In addition to this collective experience, the WSWG would like to note the increasing focus of the U.S. Congress that appears to support installation of residential sprinklers.

The Hotel and Motel Fire Safety Act of 1990, requires Federal employees on travel to stay in facilities equipped with smoke detectors and sprinklers that meet NFPA standards. In addition, the Federal Fire Safety Act of 1992 mandates sprinklers in all newly-constructed government-owned high rise buildings, in all newly leased Federal facilities, and in all multi-family assisted housing greater than four stories in height.

[46] Operation Life safety is a partnership of the International Association of Fire Chiefs, U.S. Fire Administration, and the private sector whose goal is to reduce residential fire deaths, injuries and property damage through promotion of fast response sprinkler systems, early warning detection and alarm, and public educational programs.

Major conclusions from the experience gained by these jurisdictions and others have determined that **residential sprinklers save lives, reduce property loss, and have the ability to reduce the insurance costs of property owners sufficiently to receive a return on their initial investment over time.** As technology is advanced, public awareness of the benefits of sprinklers is increased, and additional experience is gained, there is evidence that the costs associated with residential sprinkler installation can be reduced and offset.

In comparing the results of other jurisdictions to anticipated local needs, the WSWG identified two problems that may require additional study.

The marginal water supply requirements mandated for a typical single family dwelling may not directly transfer to the unusually large homes located in many areas of Montgomery County. Water supply design requirements mandated within the national standards are limited because it is expected that not more than two heads will activate simultaneously.

In 1987, Montgomery County adopted an Executive Regulation that requires a three-head design flow to deal with this problem in certain multi-family residential occupancies. It is believed that this regulation will adequately address the needs in single family homes within the prescribed limits of NFPA 13-D (single family detached) systems.

Secondly, fires that originate outside of the home, or in unprotected void spaces such as attics are likely to spread without the response of a residential sprinkler. In these cases, significant fire losses could occur. This loss potential is accepted in the code for single family dwellings. Clearly, the intent is life safety and survival, rather than suppression and extinguishment. However, a fire that extends into the home for any reason should activate sprinkler(s), delivering water to the extending fire and alerting the occupants if the system is equipped with an audible water flow alarm.

The WSWG recommends the MCFRS initiate actions necessary to introduce legislation to mandate the installation of quick-response, residential sprinklers in all new single family dwellings.

High-rise buildings present a unique fire safety challenge. The height of the building creates obstacles for the occupants and fire fighters. In an emergency situation, occupants have to utilize stairs to evacuate the building. For the elderly and physically challenged, this may be an impossible task. Many times smoke cannot be removed from the building creating untenable conditions in corridors and stairs, rendering the preferred exits unusable and trapping occupants. Therefore, occupants may have to remain in their apartment on the same floor as the fire.

High-rise fires are also difficult for the firefighter. The fire fighter must carry heavy tools and equipment up numerous flights of stairs to access the fire. Often this is accomplished while occupants are trying to evacuate through the same stairs. Even though additional resources are deployed at high rise fires, the time required to assemble these resources is considerable.

Montgomery County and the State of Maryland utilize the National Fire Protection Association's *Life Safety Code*, to govern fire safety features in buildings. The *Life Safety Code* is rewritten and updated every three years by the NFPA. Within the code, there are specific requirements for different uses of buildings. Requirements for new and existing construction are separate and distinct.

In the chapter addressing existing apartment buildings, the code requires existing high-rise apartments to be equipped with automatic sprinkler protection. Under State law, State officials do not enforce the "existing" chapters of the *Code*. Montgomery County, through local authority, can enforce more stringent requirements than the State and does enforce the "existing" chapters of the *Code*. Since the standard is rewritten every three years, both the State and County have to go through their legislative process to amend and adopt the newest edition. Each entity makes changes to the *Code* as they see fit.

In 1994 during the adoptive process, staff from the executive branch learned about the requirement for sprinklers in existing high-rise apartments. At the request of the County Executive, that particular requirement was deleted from the *Code*. During the 1998 adoption process, the Fire Marshal attempted to retain the sprinkler requirement for high rise apartments. Several groups representing apartment building owners expressed opposition to the requirement. Again, the proposal failed to pass. However, the Fire Marshal was directed by the County Council to prepare a response to questions raised at the hearing and be prepared to initiate the change at a separate hearing.

The Fire Code Enforcement Office has surveyed the existing high-rise apartment buildings in the County and determined that eighty of these buildings would require automatic sprinkler protection under the *Life Safety Code*. Of these eighty buildings, four are in the City of Rockville. All of these buildings are presently equipped with standpipes, which would lessen the financial impact of installing sprinkler protection.

The WSWG recommends that the MCFRS initiate actions necessary to retrofit existing high rise apartment buildings with automatic sprinkler protection as required by the Life Safety Code. This will significantly reduce the potential for the loss of life, injuries and property damage from fire in these occupancies. Sprinklers will also reduce the physical demands on fire service personnel by limiting the size of, or extinguishing, fires before the fire department arrives.

Tanker Deployment

After careful review of the tanker testing data, recommendations forwarded by the various LFRD's, and a time-distance analysis of tanker coverage, ***the WSWG recommends that four additional tankers be placed in service as soon as possible. Specifically, a tanker should be deployed at FS-31, FS-4, FS-30, and a reserve tanker added to the fleet*[47]*.*** (See maps in Appendix M).

The FS-31 area has the worse exposure of non-hydranted area next to Upper Montgomery FS-14. By placing a tanker at FS-31, we will be able to protect a large area of the county that is currently without water, and supplement the very large FS-14 area. FS-31 is the next closest station to most of the FS-14 area, clearly the largest exposure. Tanker 31 could also meet the established response goals for most of the rural portions of the Germantown FS-29 area.

The addition of a tanker at Sandy Spring FS-4 will fill a significant gap in existing coverage for a large portion of the county where large single family homes exist. This tanker would also serve the area of Montgomery County east of New Hampshire Avenue that is presently served by Howard County Tanker 5 which is too far away to contribute initially[48].

The addition of a tanker at Cabin John FS-30 will help to fill a gap in coverage for large, non-hydranted portions of Cabin John FS-30, Rockville FS-33, and Cabin John FS-10. Initial tanker coverage for these areas are presently served by Upper Montgomery Tanker 14, and Fairfax County Tanker 12 from Great Falls, Va, some 12 miles away. Neither of these tankers are able to fulfill initial response goals for any portion of these response areas. A tanker at FS-30 will also provide timely response to Interstates 495 and 270. Placement of a tanker at FS-31 will reduce the travel time for the first arriving tanker into FS 30, 33, and 10's areas, but will not provide adequate coverage to meet the 5,000 gallon goal in 10 minutes.

These areas are unique in that large portions of the areas are serviced by municipal water and adequate hydrants are available. However, there are also unacceptably large gaps in hydrant coverage that create a severe challenge to the departments providing fire suppression service to these areas. When needed, tanker coverage is simply too far away at present. Station and apparatus allocation is such that establishment of a rapid water relay from existing hydrants is not guaranteed.

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[47] Presently, Sandy Spring FS-4 and Cabin John FS-30 cannot accommodate a tanker due to facility limitations. Current CIP projections recommend FS-4 replacement, and FS-30 renovation or replacement.When these projects are completed, these stations should be able to accommodate tankers.

[48] Howard County Tanker 5 is five miles from the Montgomery County line, therefore it does not meet the minimum service expectations recommended by the WSWG.

The homes within these service areas are the epitome of large, unprotected, combustible structures, with limited access. The Cabin John Park, and Rockville departments have long recognized the special hazards presented by these unusually large homes. For a number of years, the house fire assignments had been altered to the full box alarm assignment[49] for inside structure fires in this portion of the county.

Currently, there is no replacement vehicle for any tanker in the fleet that goes out of service for any reason. This is unacceptable by any reasonable measure. Should the county purchase a reserve tanker, the Upper Montgomery VFD has expressed interest to the WSWG concerning housing and maintaining a reserve tanker. A proposed addition and expansion of an existing building adjacent to FS-14 could accommodate the unit. More importantly, FS-14 is in a unique situation in that there first due area is extremely large, (88.7 square miles) as compared to any other single station response area. Even if a tanker is added to the resources at FS-31, portions of the FS-14 area are unreachable from any other current station in a timely manner. A reserve tanker housed at FS-14 could be deployed as a second tanker in the FS-14 area when staffing is available. The proposed Germantown-West station is another possible site to house the reserve tanker.

The Hyattstown VFD currently operates the only combination engine-tanker in Montgomery County. This unit carries 1500 gallons of water and is dispatched as a tanker. Although the unit is equipped with a rear 10” gravity dump, Tanker 9 cannot dump from the sides, and is not equipped with a direct tank fill. As a result, Tanker 9 must be filled through the pump, and must take time to back into position when dumping. This significantly slows the continuous flow capability of the unit as compared to the larger elliptical tankers deployed elsewhere. More importantly, any combination of Tanker 9 and an engine will not meet the recommended goal of 5000 gallons of water on the fire ground within ten minutes. Therefore, when existing FS-9 units are replaced , the engine-tanker currently deployed at FS-9 should be replaced with an elliptical design tanker of similar capacity to the units deployed throughout the county. If station location recommendations are adopted, then locating the elliptical tanker at the proposed Clarksburg station would provide improved deployment of available resources. The existing Tanker 9 could then be moved to front line engine service at FS-9, providing enhanced suppression capabilities from that location.

Considerable discussion took place regarding the placement of a tanker at Bethesda FS-26 for interstate highway coverage in the down county corridor. The WSWG acknowledges that a tanker located at FS-26 is the best location for coverage of the limited-access highways that include I-495, I-270, and the I-270 spur. However, the WSWG believes that the greater need is served by placing tankers in areas where coverage for structure fires does not currently exist.

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[49] As of May 1, 1999, all house fires in the county receive a full box alarm assignment.

Therefore, the WSWG cannot support a tanker at FS-26 at this time. A reasonable alternative may be to place a tanker at Cabin John FS-10. This station has ready access to the interstates, but would provide less than optimum coverage for the gap in the Cabin John FS-30, and Rockville FS-33 areas. As stated above, FS-30 is the best location to provide tanker coverage to both the interstates and areas of Potomac lacking hydrants.

If the additional tankers recommended in this study are deployed, ***the WSWG recommends that the specifications for future tankers closely parallel the existing elliptical tankers in service at FS-14, and FS-17.*** Both of these units tested well and were the greatest contributors in a water shuttle. Future enhancements to the tanker fleet should include electric side discharge chutes, and removable rear discharge chutes so that precise positioning is not as critical when dumping. All units (tankers and or engine tankers) should be equipped with large capacity, direct-fill lines to expedite the filling process. To the extent possible, existing units should be modified to meet the minimum expectations outlined throughout this report.

Mapping

Presently, mapping efforts within the MCFRS exist at the discretion of the Local Fire Rescue Departments. In some stations, mapping is a top priority driven by new development. In other areas, streets and complexes seldom change.

Since fire department mapping has evolved over time, some stations manually draw maps, while others have incorporated the use of basic and sophisticated computer programs to produce dashboard maps for use on apparatus. It has been said that more time and resources have been expended on mapping projects than any other single project in the Montgomery County Fire Rescue Service.

The WSWG recommends that all hydrants, alternate water supply points, and other water supply enhancements, be plotted on the GIS system as the basis for future mapping strategies. Standardized hydrant maps, made available through the GIS, will allow unit officers to access accurate hydrant maps from the cab of their units, either in hard copy form in binders or, ideally, directly from mobile data terminals. The GIS maps will provide the unit officer the exact location of each hydrant. Accurate, uniform, high quality maps are the best way for firefighters to locate and utilize water supply points. This need is immediate and ongoing. Production of new maps should receive the highest priority available.

Essential components for the water supply points vary by location. The following components should be considered:

- Accurate hydrant location with a unique hydrant shaped symbol
- Address numbers for all hydrants
- Locations of all fire department connections with an identifier that graphically indicates Standpipe, Sprinkler, or both
- All drafting points
- Standard labeling of water supply points that include:
  - Address of the drafting or connection point
  - Source of water (lake, pond, stream, tank, cistern, etc.
  - Size and calculated capacity of the source
  - Type and size of the connection, if applicable

Standard Water Supply Procedures

Careful planning for standard evolutions can all but eliminate water supply problems on the fire ground. Reasonable limitations must be established for hose lays based upon known friction loss characteristics for the various diameter hoses. The goal should be to move the maximum amount of water through a prescribed hose layout while limiting net pump pressures to 150 PSI. This will assure that the rated capacity of the pump can safely be delivered providided that hoses of adequate number and diameter are in place. For a standard 1250 GPM pumper, this would require three-3" lines, two-4" lines or one-5" line.

The following fundamental rule is often overlooked when planning and implementing water supply evolutions: The maximum rated capacity of a pumper decreases as the net pump pressure increases. A standard pumper is rated to supply 100% of its rated capacity at a net pump pressure of 150 PSI, 70% of its rated capacity at 200 PSI, and 50% of its rated capacity at 250 PSI. Therefore, we should equip our pumpers and design evolutions to take full advantage of the pumper's design limitations.

Operations in urban areas where fire hydrants are available have become standardized over time by inertia. For the most part, apparatus and equipment is sufficiently standardized to permit uniform operating procedures for establishing water supply. However, criteria for multiple supply lines, alternate coverage, and expansion of existing water supply remains fragmented and non-standard. Some departments struggle with appliance and hose diameter compatibility problems, as well.

All local Fire-Rescue Departments operating routinely in rural areas of the county were asked to submit Standard Operating Procedures for rural fire fighting operations. Only one department (Laytonsville) had committed their rural operations to an operational Standard Operating Procedure. Subsequent follow up visits to Upper Montgomery, Rockville, Cabin John, Sandy Spring, and Hyattstown determined that most of the pre-plans and standard operating procedures were in the heads of the various chief officers operating in those departments. Although some similarities exist, collectively, the strategies, tactics, and resource deployment is fragmented and non-standard. Clear expectations for rural operations have not been delegated to the end users. This is particularly true with the transient DFRS career work force. Most DFRS employees have little or no practical experience in rural fire fighting operations. The WSWG believes that this situation is unacceptable.

Since rural operations generally involve more than one engine and tanker from more than one department, Montgomery County units need Standard Operating Procedures to work together effectively. These Standard Operating Procedures will require detailed planning, outlining the roles and responsibilities for all personnel, including mutual aid departments from neighboring counties. Incident commanders must receive this training so that tactical strategies are selected from this standard menu. More importantly, regular training and drills in the various areas should be conducted to assure competency and readiness.

The WSWG recommends that all operational personnel receive new training on fire department water supply. This training is essential for a number of reasons.

First and foremost, water supply is so fundamental to successful operations on the fire ground that every member of the service should be closely familiar with the needs and expectations throughout the county. Secondly, our present pump operator and incident command training falls short of the mark to assure that our personnel understand the tactical requirements of our fire ground strategies. Additionally, like it or not, our work force is transient. The employee working at FS-1 today can be the wagon driver at FS-14 tomorrow. Our expectations are for this employee to perform flawlessly at either work site. Finally, incident commanders are permitted under the IECS to function anywhere in Montgomery County. We owe it to these people to provide them with sound, fact based procedures as a platform from which to conduct operations.

Developing a rigid, single method for rural water supply delivery is controversial and counter productive. Instead, ***the WSWG recommends a FRC operations policy entitled "Fire Department Water Supply" that would encompass standard operating procedures for all areas of the county.*** This policy would establish parameters for operating in areas with fire hydrants and areas without fire hydrants. A separate policy should be devoted to Water Supply Command. Apparatus should be uniformly equipped, and personnel properly trained to perform any of the following fire ground functions:

Standard Water Supply Evolutions In Areas With Fire Hydrants:

1. Direct Lay-Single Line
2. Direct Lay-Dual Lines
3. Split Lay-Single Line
4. Split Lay-Dual Lines
5. Reverse Lay-Single Line
6. Reverse Lay-Dual Lines
7. Initiate Relay Operations
8. Operations on Limited-Access Highways

Standard Water Supply Evolutions In Areas Without Fire Hydrants:

1. Direct Water Supply From a Tanker
2. Supply From a Static Source Pumper
3. Supply From a Nurse Tanker
4. Supply From a Single Portable Tank and a Draft Pumper
5. Supply From Three Portable Tanks and a Draft Pumper
6. Continuous Water Supply From a Tanker Shuttle
7. Tanker Fill Site Operations
8. Operations on Limited-Access Highways

Utilization of one or more of these S-O-PS will enable incident commanders to take advantage of as many of the available water supply points as possible. Personnel can operate from known standards using consistent terminology and expectations. Publication of a well-designed water supply delivery system will provide the opportunity to increase our effectiveness on the fire ground. These procedures will also establish primary contingency plans for loss of any municipal water supply.

Dispatch Procedures

On May 1, 1999, the Operations Committee of the Fire-Rescue Commission initiated a standard structure fire response to include 4 engines, 2 trucks, 1 rescue squad, an ambulance and 2 command officers. This dispatch assignment replaces the urban and rural dispatches that were non-standard. In areas that are pre-determined to be rural by the local fire rescue departments, two tankers are automatically dispatched, as well. Prior to this change, some departments requested only one tanker initially.

In addition to the two initial tankers, ***the WSWG recommends that a separate dispatch assignment be established called a "Water Supply Task Force" that comprises 2-tankers for water shuttle, a front-mount pumper to***

pump from a static or hydranted fill site, and an additional command officer to be dedicated to the water supply function. Similar to the existing "Safety Dispatch", and "Task Force" assignments, this new assignment would enhance the water supply delivery system by placing two tankers on the road initially, and at the command officer's request, place two additional tankers enroute to expand the water supply. The command officer would be dedicated to the water supply function as a sector officer who would report to the incident commander.

Justification for this increase in tanker usage lies in the test results for continuous fire flow as documented in the WSWG findings dated January 20, 1999. Utilizing any combination of Montgomery County Tankers, a 500 GPM continuous flow can be expected at 1.6 miles, and a 250 GPM continuous flow can be expected for the 4.8 mile shuttle. If longer shuttles and or, higher fire flows are required, additional tankers may be dispatched as required. The Water Supply Task Force is simply a more efficient way to have the CAD system recognize and recommend additional resources.

In spite of these recommended enhancements, the WSWG has identified a significant problem that will take the combined efforts of all elements of the MCFRS to correct. Presently, geographical box areas are established by the various LFRDs that pre-determine whether or not tankers are assigned to a given structure fire dispatch. This system needs improvement because pockets of areas without hydrants contained within a urban box area have resulted in the failure to dispatch tankers initially on a structure fire assignment. These areas have been identified as part of this report through a system-wide Standardized Training Project (STP) conducted in November 1998.

A house fire in the Sandy Spring FS-40 area in August of 1997 serves as a representative example of this problem. Norbrook Drive is located within an urban box area even though no hydrants are available on the street. The urban house fire assignment was dispatched, and units responded to a working fire. In the direction of travel, the closest hydrant was located a mile away. Tankers were then requested. Other attempts to secure water using alternate supply points were unsuccessful. Tankers were too far away and delayed due to another incident. Attempts to establish water from the hydrant one mile away was simply too time consuming to be effective. Units were eventually able to establish a water supply using a hydrant that was located through a wooded area in an adjacent neighborhood that did not appear on the reference map on board fire-rescue units.

Other potential examples exist throughout the county. For instance, Box Area 8-5 is classified in CAD as an urban box area by the LFRD. An area lacking hydrants known as Prathertown is located within that box area. The CAD software recommends a structure fire response without the addition of tankers in this entire box area.

Extending this example, River Road begins in Glen Echo, FS-11's area and terminates in the Upper Montgomery, FS-14 area after passing through FS-10, FS-30, and FS-31's areas. River Road passes through a total of 20 box areas. Many portions of River Road are without hydrants, or hydrant spacing is such that tankers should be recommended at dispatch.

The WSWG met with representatives of the Emergency Communications Center to discuss this problem. As a result, two potential solutions were recommended.

The WSWG recommends that separate box areas be established for areas where entire streets without hydrants can be identified. By doing so, affected streets can be isolated within CAD assuring tankers will be assigned to the incident immediately. Using the examples above, Norbrook Drive and Prathertown Road would be assigned a unique box number.

In areas where the non-hydranted portions of a roadway change along the length of the road, (i.e.- River Road), then the "Block Face Node" feature of CAD should be employed. Specific and unique address ranges without hydrant coverage must be identified. Using the River Road example, each break in hydrant coverage throughout the twenty different box areas must be uniquely identified by address range using a separate "block face node" in CAD.

The WSWG recommends that separate block face nodes be established for areas where entire street without hydrant coverage can be isolated using separate geographical box areas.

Individual streets without hydrant coverage were identified in the November 1998 STP project however, specific address ranges were not part of that project. Therefore the first step in correcting this problem will be to create a database that will identify separate address ranges for non-hydranted streets. This process will be time consuming and labor intensive. Accurate data must be gathered at the first-due response level, and then this data must be entered into the CAD system. ***The WSWG recommends that a project be initiated to identify all non-hydranted areas that will include specific and unique address ranges.***

Plans for a new 800 MHz Public Safety Radio and Mobile Data System are in place at this writing. The MCFRS should assure that the information gathered in this process will be transferred to the new radio system components and the software that drives the system. Creation of smaller *Fire Demand Zones*[50] will allow many more specific response assignments to smaller areas, optimizing the assignment of available resources to a given incident.

[50] Fire Demand Zones are proposed to be six square block areas much smaller than existing geographical box areas.

Hydrant Identification

To increase the visibility of fire hydrants to aid firefighters en route to incidents, many fire departments in the United States employ various marking systems or signs. While their use has been limited in Montgomery County to date[51], the WSWG was asked to address whether markers/signs would have a practical application in the county, possibly on a widespread basis[52].

The WSWG believes that quick identification of fire hydrants can be accomplished through two means – standardized hydrant maps using GIS and mobile data technology, and use of markings and signs to the greatest extent possible.

Related to this issue, the WSWG has identified the need to identify all municipal fire hydrants with a separate and unique identifier, possibly a five-digit number. This is necessary to utilize an existing hydrant file database within the CAD system so that the MCFRS can be properly notified when hydrants are taken out of service for any reason. Using this file will assure that the end users, (stations, and station personnel) will be able to identify alternate water sources when needed. This process should occur electronically and transfer to any planned GIS enhancements in the proposed radio/mobile data system. ***The WSWG recommends that a unique identifier be established for all fire hydrants in Montgomery County, including private hydrants.*** An integrated database available to the end users is an essential future consideration.

Hydrant Markers

Markers consist of reflective devices or material that are placed either on or next to hydrants, or in the roadway adjacent to hydrants. As apparatus approach marker-equipped hydrants in darkness, their headlights are reflected, thus aiding firefighters in finding them. Markers may be as simple as strips of Scotchlite™ attached to the hydrant, or distinctive reflectors embedded within the road surface. The latter device typically employs a distinctive blue lens that sets it apart from the standard amber lens found in highway lane markers. The blue reflectors can be seen up to 1000 feet away, according to manufacturer's sales literature. One model is designed to allow snow plows to pass across the device without causing damage. The WSWG obtained a sample of a *Fire-Lite Hydrant Spotter*™, but did not conduct a comprehensive field test to assess its effectiveness other than to set it on top of (vs. embedded within) the road surface during a night-time trial run to witness its reflectiveness.

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[51] The hydrants along Oak Drive in Damascus, for example, have reflective green tape on their bonnets.
[52] While not part of the WSWG's original charge, this task was added by the Fire Administrator.

Another type of marker that is employed by some fire departments outside Montgomery County is a reflective stake either attached directly on, or immediately next to, a hydrant. The primary purpose of these stakes is to mark a hydrant's location when snow has covered the hydrant, although the stakes are also useful in locating hydrants in darkness. The WSWG obtained a sample device of this type (known as *FlexStake FH*™; see Appendix N), composed of an orange-colored polycarbonate material with a reflective decal on top. The device is 4 feet high and can be attached to the hydrant bonnet or to the ground. According to the sales literature, the FlexStake is very flexible yet difficult to break and stands up to any weather conditions. The WSWG did not conduct a field test to assess the effectiveness of the FlexStake but believes that a device of this type may have limited application within hydranted semi-rural sections of the county.

The WSWG has learned that District Chief Tom Carr, in 1997, had begun researching the in-road reflective markers and had spoken to the Department of Public Works and Transportation about the possibility of installing hydrant markers as part of their on-going lane marking project. While the concept of hydrant markers was not supported, at that time, by senior Fire-Rescue Service management, ***the WSWG recommends that reflective hydrant markers be explored as a pilot test in both a rural and urban area.***

Hydrant Signs

A reflective sign posted near a fire hydrant is another means to quickly identify the locations of hydrants. In Howard County, Maryland, for example, reflective signs are in place to identify the locations of dry hydrants. The District 5 - Clarksburg Volunteer Fire Department has installed signs of this type near the 20 dry hydrants in its district. In addition to signs immediately adjacent to the dry hydrants, signs indicating the distance to each hydrant are posted at intersections along main roads to further assist fire department water supply apparatus. The signs were custom made by a local sign company in Sykesville. ***The WSWG recommends that similar signs be purchased and posted near all existing and future underground water tanks/cisterns and dry hydrants in Montgomery County.***

The addition of standardized reflective signs for all fire department connections is another enhancement that could significantly benefit apparatus operators and officers charged with locating FD connections to complete water supply evolutions. Similar initiatives have been instituted in other jurisdictions. Locally, the University of Maryland, College Park campus uses high profile reflective signage to identify FD connections. The symbols used are those recommended by the NFPA.

Service Testing of Pumpers

Every front line attack pumper should be capable of delivering rated capacity safely and efficiently. Pumpers should undergo annual service tests that demonstrate that the pump-engine combination is capable of meeting the performance requirements of the original certification[53]. At the present time, this is not being done in Montgomery County. An underground tank and discharge port exist at the PSTA that is not fully utilized for this function. Performing this test annually, and after major repairs, is essential to providing reliable equipment that will meet the expectations of the end users.

In addition to pump capacity, the annual service test assures that:

- the pressure control device can control the discharge within prescribed limits
- all gages and flow meters are accurate
- the engine is capable of reaching its no load governed speed at rated capacity.

The WSWG recommends that the MCFRS develop a plan for the service testing of all fire department pumpers. NFPA 1911, The Standard for Service Testing of Pumps on Fire Department Apparatus calls for annual testing. ***The WSWG recommends a tri-annual test for fire department pumpers less than 5 years old, a bi-annual test for pumpers less than 10 years old, and an annual test for pumpers greater than ten years old.*** This will meet our local needs, while recognizing the need to conserve expenditures and still guarantee that the apparatus with the greatest need will be tested more frequently to assure the reliable operation of the pumper over the entire service life of the pumper. If this recommendation is adopted, a given pumper will be tested at manufacture, year 3, year 6, year 8, and year 10. Pumpers older than 10 years will be tested annually.

Future Insurance Ratings

As explained on page 14 of this report, the ISO has moved away from the Fire Suppression Rating Schedule in cities and municipalities serving 250,000 people or more. Montgomery County has a current population of approximately 855,000 people and therefore is affected by this change. Application of the full Fire Suppression Rating Schedule is very labor intensive. Because of the detailed site visit and inspection requirements, the ISO has achieved favorable results with a computerized statistical rating based solely on fire loss statistics provided by the

[53] NFPA standard 1911-1997 edition: "Service Tests of Pumps on Fire Department Apparatus" outlines the requirements and procedures for the annual service testing of fire department pumpers.

various insurance underwriters. Therefore, insurance ratings are now primarily determined by past annual fire loss history for a given area rather than a detailed evaluation of local capabilities every ten years.

The net results of an inadequate water supply, poor hydrant maintenance, or non-certified rural static sources cannot be ignored. The MCFRS should respond to this changing dynamic by assuming a leadership role in developing an on-going, working relationship with the WSSC, City of Rockville, and the Town of Poolesville to assure that fire protection needs are met. Sufficient attention can be directed to existing problems and future problems can be prevented. More importantly, a working relationship can be developed that could provide enhanced input in determining hydrant locations, hydrant inspection, defect reporting, and other issues that determine water supply reliability. ***The WSWG recommends that an ongoing relationship be developed with the various municipal water authorities to take full advantage of all opportunities to improve planning and technology changes.***

Seizing this opportunity to improve rural ratings, ***the WSWG recommends that resources be allocated and deployed to identify and certify all rural water supply points.*** This information should then be transferred in a standardized format that can be utilized in current and future mapping efforts. Alternate water supply resources could be strategically located in rural areas to: 1) reduce tanker shuttle time, and 2) provide initial fire attack water for groups of structures in various communities to improve future insurance ratings.

Class A Foam

Unlike Class B foam discussed earlier in this report, Class A foam is designed for use on wood and other Class A materials. Developed originally for forestry use, the technology has been improved to the point where more and more departments are exploring the use of Class A foam for inside structural fire fighting.

Specifically, pumper enhancements that produce a special type of Class A foam known as CAFS, (compressed air foam system) is reported to increase the effectiveness and efficiency of plain water for fire suppression. The driving force in many departments is to utilize CAFS as a method to reduce staffing on suppression units, or to reduce the number of suppression units necessary by decreasing the workload of busy units by increasing their efficiency.

CAFS technology was introduced to the structural fire fighting force nationwide around 1990. After nearly a decade, the technology has failed to gain wide spread acceptance. This is most likely due to the associated costs of the equipment necessary to produce compressed air foam. Current estimates suggest that the system will add approximately thirty-five thousand dollars to the cost of a pumper, plus the costs associated with maintenance of the system and foam replenishment.

The focus of this evaluation is strictly limited to the ability of CAFS to enhance plain water to suppress fires, and therefore conserve limited water resources.

Empirical trials and tests conducted by a variety of municipal fire departments across the nation and cited in the U.S. Fire Administration's Report 083 (1996) by Jeff Stern and J. Gordon Routley listed the advantages of CAFS for structural fire fighting as follows:

- CAFS foams allow faster fire suppression than plain water
- CAFS foam increases efficiency and conserves water
- CAFS foam can be produced at a relatively low cost
- CAFS attack lines are lighter than plain water attack lines
- CAFS attack streams can reach twice as far as normal attack streams

It is further estimated that CAFS will extinguish a given fire in one-quarter of the time using only 30 percent of the water needed when plain water alone is applied. This makes it very difficult to ignore the potential of compressed air foam systems.

Any technology that extends the useful life of fire fighting water by seventy percent should be explored further. The potential for this technology to benefit the MCFRS, particularly in rural areas where water is limited, is obvious.

The DFRS apparatus specifications committee has considered a pilot test with CAFS on a single unit in the past. The concept was rejected because of up front costs associated with unproven technology. ***The WSWG recommends that a future pumper be purchased and equipped with a Compressed Air Foam System to pilot test the technology.*** This unit should be deployed in an area that provides a mix of urban, suburban, and rural hazards with a busy suppression workload. Stations 28, 29, or 31 may be appropriate.

Summary of Recommendations

The Water Supply Work Group has formulated 32 specific recommendations for enhancing the County's ability to provide an adequate, reliable, uninterrupted and expandable water supply for fire suppression. While all of the recommendations are important, the WSWG has identified ten select recommendations of greatest significance. The "top ten" recommendations, presented in order of priority, are listed below.

TOP TEN RECOMMENDATIONS

1. Initiate legislation mandating installation of quick-response, residential sprinklers in new single-family detached dwellings, and retrofit existing high-rise apartment buildings as required by the Life Safety Code.

2. Deploy resources and create SOPs that will enable first arriving suppression units to initiate a fire attack with at least 5,000 gallons of water for ten minutes (i.e., 500 GPM minimum fire flow for ten minutes).

3. Place four additional tankers in service at Fire Stations 31, 4, and 30, and a reserve tanker at an appropriate location.

4. Develop a MCFRS operations policy and training program addressing all aspects of fire department water supply, encompassing standard operating procedures for urban, suburban and rural areas.

5. Add tankers to the structure fire response assignment for all streets in areas where municipal fire hydrants are not available.

6. Develop Geographic Information System maps and diagrams indicating the locations of all hydrants, fire department connections, and static water supply sources.

7. Develop an inspection procedure that assures compliance with NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems."

8. Service testing of all MCFRS pumpers on an approved schedule.

9. Replace current 3-inch supply hose with 4-inch large-diameter hose equipped with quarter-turn connections.

10. Develop a contingency plan that provides for adequate water supply for fire suppression during times of catastrophic failure of any of the three municipal water systems serving the county.

WSWG Overall Recommendations

The following is a summary of WSWG recommendations, organized by category. The recommendations include those stated individually in the body of the report as well as others that are general in nature addressing a number of water supply issues, collectively.

Legislative Issues

1. The MCFRS should initiate actions necessary to introduce legislation to mandate the installation of quick-response, residential sprinklers in new single-family detached dwellings, and the retrofitting of existing high-rise apartment buildings as required by the Life Safety Code.

Equipment and Apparatus

1. Place four additional tankers in service in the immediate future, including three front line units and one reserve unit. Specifically, a tanker should be deployed at Fire Stations 31, 4, and 30, and a reserve tanker added to the fleet and housed at an appropriate location.

2. Service test all MCFRS pumpers on an approved schedule.

3. Replace current 3-inch supply hose with 4-inch large-diameter hose equipped with quarter-turn connections and locking safety lugs. In addition, connections on both ends of the hose lay be equipped with swivels to prevent the charged line from twisting closed.

4. All fire fighting hose should be tested annually in compliance with NFPA-1962, "The Standard for the Care, Use and Service Testing of Fire Hose, Including Couplings and Nozzles."

5. Pumpers purchased in the future should be equipped with 1500 GPM pumps.

6. MCFRS pumpers should carry a standard hose and hose appliance complement that is designed to maximize the capacity and efficiency of the apparatus.

7. The specifications for future tankers should closely parallel the existing elliptical-type tankers in service at Stations 14 and 17 with additional improvements as listed. In addition, all local fire and rescue department apparatus specifications prepared for purchase should be reviewed by the Apparatus Specifications Committee to assure that essential components are standardized.

8. The MCFRS should initiate a cooperative effort with the State Highway Administration and County's Department of Public Works and Transportation to strategically place six-inch, dry, vertical standpipes on key highway overpasses along limited-access highways in Montgomery County. Guidelines stated in NFPA 502, "Fire Protection for Limited Access Highways, Tunnels, Bridges, Elevated Roadways, and Air Right Structures," should be incorporated as appropriate.

9. A pumper equipped with a compressed-air foam system should be purchased to enable pilot testing of this new technology.

<u>Training, Tactics and Operation</u>

1. MCFRS resources should be deployed and rural SOPs be established that will enable first arriving suppression units to initiate a fire attack with at least 5,000 gallons of water for ten minutes (i.e., uninterrupted 500 GPM minimum fire flow for initial ten minutes).

2. A MCFRS operations policy should be established addressing all aspects of fire department water supply, encompassing standard operating procedures for all areas of the county – urban, suburban and rural. In addition, all MCFRS operational personnel receive updated training on fire department water supply, addressing new tactics, equipment, and technology implemented as a result of the overall recommendations of the Water Supply Work Group.

3. Tankers should be added to the structure fire response assignment for all streets in areas where municipal fire hydrants are not available. To designate these areas, separate block face nodes should be established within the computer-aided dispatch system and assigned separate fire box areas.

4. Suppression forces should deliver a minimum required fire flow of 1500 GPM for townhouses, garden apartments, and other groups of dwellings.

5. Adopt minimum criteria established by ISO for certified drafting points in non-hydranted areas intended for use during initial fire attack. This recommendation does not apply to tanker fill sites.

6. A new and distinct dispatch assignment should be established for a supplemental "Water Supply Task Force" that comprises two tankers for water shuttle, a pumper to pump from a static or hydranted fill-site, and an additional command officer to be dedicated to the water supply function.

7. Develop improved coordination, training, and maintenance for use of existing sound barrier standpipe connections along portions of Interstate 495.

8. Identify alternate water supply sources by means of standard reflective signs along main roads, indicating the source's location, capacity, and distance from the posted sign.

9. Installation of dry vertical standpipes should be adopted as the preferred method to establish expanded water supply relays on limited-access highways. [Tied to Recommendation #8 under Equipment and Apparatus]

10. Initiate a pilot test of fire hydrant marking systems in both urban and suburban areas.

Planning and Technology

1. Develop standardized Geographic Information System/AutoCAD maps and diagrams indicating the locations of all hydrants, fire department connections, and static water supply sources. When the mobile data terminal (MDT) system goes online, ensure the inclusion of these maps and diagrams and tie to them data files concerning access, ownership, and specific operational tactics regarding each water supply source. In the interim until the MDT is implemented, develop and place on-board fire suppression units hard copy plans that include the same maps, diagrams, and information.

2. The MCFRS Office of Fire Code Enforcement should develop an inspection procedure for use during in-service inspections for all buildings equipped with an automatic sprinkler system, standpipe system, and/or fire pump, that assures compliance with NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems."

3. A contingency plan should be developed by the MCFRS that provides for adequate water-supply for fire suppression throughout Montgomery County during times of catastrophic failure of any of the three municipal water systems serving the county.

4. The MCFRS should develop a program to expand the use of dry hydrants in the rural portions of the county, incorporating NFPA 1231 guidelines as appropriate.

5. The MCFRS should explore available Class B foam strategies and develop a plan to improve Class B fire fighting foam capabilities. Included in this plan should be a county-wide foam strategy for suppressing flammable liquid fires on limited-access highways.

6. The MCFRS should move forward with the proposed risk analysis to be performed at the station response area or fire box area level, in order to fully identify fire-related risks.

7. The Fire Rescue Commission should initiate immediate action to correct the problems regarding "EMBERS" compliance and the process for estimating fire loss.

8. The MCFRS should monitor the expansion and looping of water mains in the Damascus and Clarksburg areas, and, to the greatest extent possible, support increased water storage capacity throughout the WSSC high zone.

Inter-Agency Coordination

1. Improve planning and working relationships with the three municipal water authorities serving Montgomery County.

2. Coordinate with the three municipal water authorities MCFRS review of their hydrant flow records on a regular basis.

3. Encourage the WSSC to improve maintenance efforts regarding fire hydrants throughout their system, and to update the process for notifying the MCFRS of out-of-service hydrants.

4. The problems concerning the dry standpipe running the length of the American Legion Bridge at Cabin John should be addressed by the MCFRS, State Highway Administration, and other appropriate authorities.