4 Methodology for Development of Short and Medium Term Mitigation Strategies

4.1 Purpose

To provide relief from flood events in Bloomingdale and LeDroit Park, the Mayor's Task Force explored several short-term and medium-term mitigation strategies. The purpose of this section is to outline the methodologies and thought processes underlying each proposed option.

To identify short-term mitigation strategies, the Technical Committee sought out actions and programs that would provide immediate benefits for protection of properties against sewer backups and surface flooding. Ideally, these strategies could be employed over the course of the next calendar year. The implementation process may include a brief design development phase; however, for more complex projects it may be necessary to procure engineering and/or construction services. The execution of some strategies will require a review and revision of agency policy and procedures.

To identify medium-term strategies, the Technical Committee sought out engineering solutions that would provide a significant reduction in the number of properties that experience sewer backups and surface flooding based on a 5-year design storm. These strategies could be implemented in one to three years, assuming that funding is adequate.

4.1.1 Focus Area

Mayor Vincent Gray commissioned the Task Force on the Prevention of Flooding in Bloomingdale and LeDroit Park to study the causes of and solutions to street flooding and sewer backups in the Bloomingdale and LeDroit Park neighborhoods. Short and medium-term mitigation strategies are intended to focus primarily on these neighborhoods, and may include adjacent areas that contribute stormwater runoff to the Bloomingdale and LeDroit Park drainage areas. In some cases where justifiable and practical, the implementation boundaries of a particular short or medium-term mitigation strategy can be expanded beyond the target neighborhood boundaries. However, projects that will benefit properties that are both located outside of the target neighborhoods and which experienced flood-related issues only during one or two of the most severe 2012 storms may be harder to prioritize ahead of projects that benefit properties in Bloomingdale and LeDroit Park that were significantly impacted.

4.2 Rainfall Conditions

DC Water performed a rainfall analysis was performed to determine the return periods of the July 2012 storms. Data from the Bryant Street rain gauge, the closest DC Water gauge to Bloomingdale, was used for the analysis. The rain gauge is a tipping bucket gauge that reports water levels at 5-minute intervals. Using data from the Bryant Street rain gauge and recommended methodologies from the National Oceanic and Atmospheric Administration (NOAA), modelers assessed the return period.

Additionally, DC Water requested gauge-adjusted Doppler radar rainfall estimates in order to confirm the precipitation reported by the Bryant Street gauge. The radar rainfall analysis was performed by OneRain, Incorporated. When compared, the radar data produced similar intensities and quantities to the rain gauge results, but were either slightly higher or lower for the different storms.

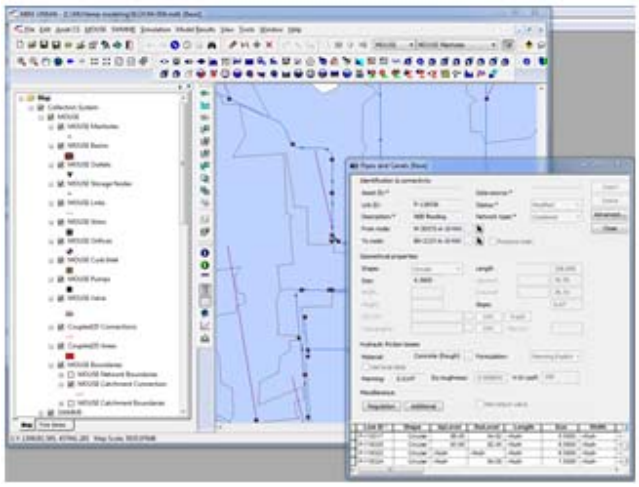
To adjust the radar rainfall results, OneRain used rain gauges from Fairfax County to the west and Howard County to the northeast, four airport gauges, and four DC Water gauges (Bryant Street, Brentwood Reservoir, Main Pumping Station, Rock Creek Pumping Station). In order to incorporate data from the available rain gauges, estimates were first produced for a larger area of land. Data was then extracted for a smaller, targeted sub-area. Rainfall levels predicted using Doppler radar were calibrated to rain gauge data recorded at these locations.

4.3 Future Development Assumptions

Short-term remedial measures will rely more on existing conditions as they will tend to focus on measures to protect individual properties. Remedial measures designed to address the medium-term timeframe must take into account proposed development that is under review or planned to occur during the next decade.

4.4 Modeling

The Mike Urban (previously MOUSE) runoff and hydraulic model was developed by the Danish Hydraulic Institute (DHI). The Mike Urban model has been used for a variety of applications to analyze the DC Water combined sewer system. The model was initially developed to assess combined sewer overflows and used in support of the CSO Long Term Control Plan (LTCP). It has been continuously augmented and improved to expand the range of issues the tool can be used to analyze.



Sample Screen Shot of Mike Urban Hydraulic Model

The Mike Urban modeling platform uses an ESRI ArcGIS interface to display model elements and manage model inputs. The GIS interface allows for direct incorporation of network elements from the DC Water GIS database, facilitating the addition of new elements to the pipe network and the correction of existing elements. This editing functionality allows existing elements to be represented in the correct geographic location. Additionally, the model incorporates real-time controls including inflatable dams and pump operations, as well as overflow and diversion structures.

In order to use the model to analyze flooding, a greater level of detail was added in areas of known flooding within the Northeast Boundary drainage area, specifically in the Bloomingdale and LeDroit Park focus area. In addition, a two-dimensional surface model was developed using Mike Flood to simulate surface flooding. In particular, pipe and hydraulic network details were incorporated into the model, and model catchments were refined and re-delineated at a higher resolution in areas where flooding is known to occur.

The Mike Urban and Mike Flood models simulate the water cycle from rainfall to eventual transport throughout the DC Water combined sewer system. Inputs to the model include rainfall and boundary

flows from outside of Washington, D.C. Rainfall is subject to losses, including evaporation and infiltration into soil, which reduce the surface runoff and are based on site-specific information obtained from a variety of GIS databases. The model is lumped into catchments that represent small areas (roughly on the block-to-neighborhood scale) that have similar physical properties, such as soil type, slope, and impervious surface percentage. Runoff estimates from each catchment are then transferred to the pipe hydraulic model. Any flows in excess of the total inlet capacity of a catchment do not enter the pipe network and are instead routed to the Mike Flood two-dimensional surface model described below. Flows entering the pipe network are simulated using Mike Urban's fully dynamic hydraulic calculations that account for factors such as flow splits, open-channel and pressurized flow, backwater effects, and energy losses. Any flow that exceeds the surface elevation is transferred to the Mike Flood two-dimensional surface model for routing along the surface. Surface flows reenter the system when capacity is available.

Development of a hydrologic and hydraulic model such as Mike Urban requires calibration to increase the model's predictive accuracy. The calibration process makes minor adjustments to the model to ensure that modeled results are close to monitored results for a known time period. After calibration, another time period is used to verify that the model-produced results continue to be close to monitored results. The DC Water model was calibrated several times during the LTCP development process based on regularly-updated rainfall and flow monitoring data. For use as a flood and pipe capacity model in the project area, model verification was performed based on anecdotal reports of flood conditions due to a lack of available calibration data. Because of the limited availability of verification data, the model is best suited for providing guidance on the relative difference in pipe capacity and flood depths for different modeled scenarios. Consequently, the DC Water hydraulic model is used as one tool in conjunction with sound engineering practices to develop and analyze mitigation strategies for the Bloomingdale and LeDroit Park area.

4.5 Basis for Cost Estimating

To help decision-makers weigh the relative costs and benefits for each of the proposed mitigation measures, planning-level cost estimates were developed for each of the strategies identified in this report. Estimates were based on cost information from a variety of sources, including bid prices for recent projects, published construction cost data, budget-level prices for equipment items, cast-in-place concrete costs, and budget quotes for specialized services from vendors.

Where available, actual bid prices from similar projects were used to estimate costs for items such as sanitary sewers, manholes, lateral sewer connections, surface restoration activities (seeding, pavement replacement, curb and sidewalk replacement), and green infrastructure. Bid prices from on-going construction projects or projects completed within the past year were utilized as the basis for the Bloomingdale and LeDroit Park cost estimates.

Cost information from RS Means Heavy Construction Cost Data was employed to estimate costs for larger diameter sewer and force main installations, as well as for excavation, backfill, sheet piling, and concrete demolition. RS Means has been actively engaged in construction cost publishing and consulting since 1942. Their construction estimation database is the most commonly used reference system in the United States and provides comprehensive construction cost data based on up-to-date labor, material and overhead costs.

Budget quotes were obtained for equipment items such as pumps and motorized sluice gates. Additional cost factors were developed based on previous construction projects, and were then applied to the equipment costs to estimate installation costs for equipment items. Allowances for mechanical, HVAC, and electrical work were based on past construction cost history, where appropriate, to estimate the overall construction cost for facilities included in each mitigation option.

Unit costs for cast-in-place concrete, also generated from past construction projects, were used to estimate costs for concrete associated with pump stations, flow diversion structures, and reinforcement of existing concrete structures. The unit costs developed from previous project pricing include formwork, concrete, rebar, and labor.

Budget costs were obtained from vendors that provide specialized services, such as bypass pumping, concrete cutting/coring of existing structures, pneumatic material removal, and pipe jacking using tunnel boring machines. Bypass pumping quotes included costs for pumps, above-ground force mains, and operation/maintenance services while the facilities are in place. Pipe jacking costs included tunnel boring machine rental charges, the cost of pipe installation, bore pits, and receiving pits.

Upon completion of the construction cost estimates for the identified mitigation measures, a construction contingency percentage was added to the estimates to account for items that cannot be quantified at the planning level. An allowance for project costs appropriate to the DC Water service area was also added to account for engineering, permitting, legal issues, rights-of-way, project management, and program management costs associated with each alternative.

4.6 Basis for Schedule Development

The schedule for short and medium-term remedial measures must be in line with the community's expectations for implementation of projects that provide relief, as well as the constraints of City agency budget cycles, conceptual development and detailed design processes, procurement, and construction or deployment of relief programs. For short-term remedial measures, the total implementation schedule should not exceed six months. This timeframe supports the urgent nature of relief that is expected by the community. City agencies must use existing funds or divert funds already approved for the current budget year. There may not be time for normal procurement methods, and existing contracts may need to be accessed through modification or extension of scope in order to expedite project implementation.

For medium term remedial measures, the total implementation schedule should occur in one to three years. These are larger, more complex projects or programs that require a more detailed planning effort before funds can be committed. Projects that take longer than three years are not considered favorable, as they don't meet the relatively immediate needs for relief and offer diminishing benefits compared to the long term solution (Northeast Boundary Tunnel) which would be completed only a few years later. While there is more time available to plan and design the projects, there remains a need to rely on fast-track contracting methods such as design-build. Funding needs should be evaluated very quickly so that funding for FY 2014 and 2015 activities are in place.