SECTION 3- FLOW METER MANAGEMENT PLAN

3.1 General Objectives

In fulfillment of the contract scope of work, a meter management plan has been undertaken which evaluates all existing flow meter chamber locations, identifies the minimum number of meters required for billing purposes, proposes new locations and instrumentation for billing meters as required, and standardizes and streamlines the billing meter system.

In addition, the meter management plan also presents recommendations for a five-to-ten year long term regional management contract wherein a single party is responsible for calibration certification of the flow monitoring equipment within billing metering system. Budget costs for equipment upgrades over the long term contract are also presented.

General considerations in developing the meter management plan are outlined as follows:

- Assure that the plan meets user's needs and expectations
- Minimize cost of plan implementation
- Assure time requirement of plan implementation fits user group's needs
- Evaluate and optimize construction requirements
- Attempt phased implementation to reduce cost impacts
- Assure maximum life cycle of system
  - Employ telemetered communication
  - Employ telemetered data acquisition
  - Minimize potential for equipment and technology obsolescence
  - Use non-proprietary/open architecture
- Assure maximum credibility of system
  - Meet jurisdictional requirements
  - Assure maximum data accuracy
  - Use of data redundancy
  - Suitable security
  - Impartial reporting
- Determine ultimate caretaker of system
  - Assure all reporting requirements are met
  - Provide data accessibility for all users

3.2 Meter Plan Alternatives

3.2.1 Option #1, outlined below, represents a gradual long-term replacement and upgrade program of existing equipment at all existing flow monitoring chambers. No new meter site locations are proposed.

- The first step will be to standardize all billing meter data formats that are submitted by jurisdictions to DC-WASA by developing and distributing a spreadsheet template to all user jurisdictions. The templates will be customized for each individual jurisdiction's current data entry format. The template will convert the jurisdiction's data format to DC-WASA required format automatically. This will minimize the effort required for data submittal by the jurisdiction personnel while also reducing the level of effort required by DC-WASA.

- Data access from the metering sites for all jurisdictions will be available through DC-WASA monthly reports.

- Recommend repairs/replacement of inadequate flow monitoring equipment as identified during the field assessment phase using the priority system based on **Tables 11A and 12** and other information presented in Section 2 of this report, Field Assessment Results.

- As flow monitoring equipment is replaced over an assumed five year period, select and install suitable equipment to configure sites to allow automated, telemetered data transmission of flow and rainfall.

- Design and ramp up an automated data management system to interrogate meters, collect data, prepare reports, graphs, etc. via telemetry. The number of sites contacted via telemetry will increase over time as new equipment installations are performed.

- Recommend a plan for establishing a long term (5-10 yr) regional contract for calibration certification of all billing meters.

It is estimated that the typical cost for replacing and upgrading flow monitoring equipment will be on the order of $20,000 per monitoring site. An annual cost of $10,000 per site was established for maintenance, calibration and certification. Concept level cost estimates for the new automated data management system indicate that it will cost about $50,000 to develop and implement. Estimated cash flows and total costs are included in Subsection 3.3 below.

3.2.2 Option #2 outlined below, represents a fast-track, immediate replacement program which abandons all existing billing flow meter chambers. Instead of retrofitting existing flow meter chambers, new equipment will be installed at

twelve new locations strategically placed along the Potomac Interceptor system. A metering system with 12 flow monitoring locations represents the minimum feasible number of metering sites to ensure appropriate billing to each user jurisdiction. Minimizing the number of meter sites has the potential benefit of reducing compounding errors (increased accuracy) and reducing the annual costs for meter maintenance and certification activities.

- As an initial interim step while new monitoring sites are designed and constructed, standardize all billing meter and data formats that are submitted by jurisdictions to DC-WASA by developing and distributing a spreadsheet template to all user jurisdictions. The templates will be customized for each individual jurisdiction's current data entry format. The template will convert the jurisdictional data format to DC-WASA required format automatically. This will assure that no additional time or effort is required for data submittal by the jurisdiction personnel while reducing the level of effort required by DC-WASA.

- Data access from the metering sites for all jurisdictions will be available through DC-WASA monthly reports.

- The minimum number of meters and best locations to measure flows from contributing jurisdictions will be determined. Locations for new meters, optimum meter types, and any construction requirements will be determined.

- Construction and installation of suitable equipment at the new sites will be performed to configure the sites to allow automated data transmission of flow and rainfall.

- Design and implement an automated data management system to interrogate meters, collect data, prepare reports, graphs, etc. via telemetry

- Recommend a plan for establishing a long term (5-10 yr) regional contract for calibration certification of all billing meters.

It is estimated that the typical cost for development of the new metering sites, including construction of chambers, installation of equipment and electrical/telephone services, will be on the order of $150,000 per site. An abandonment cost of $5,000 per site is included for the existing metering sites that would be abandoned. As with Option #1, an annual cost of $10,000 per meter site is estimated for maintenance, calibration and certification, and a capital cost of $50,000 is indicated for the new automated data management system. Estimated cash flows and total costs for Option #2 are included in Subsection 3.3 below.

3.3 Present Value Analysis

The table on the following page provides a summary of expected cash flows and calculation of the respective present values for Options #1 and #2 over a ten-year time frame. This table is based on the estimated costs noted above in Subsection 3.2. It is intended to provide an indication of the relative costs of the two options in order to facilitate a selection between them. It is emphasized that the cost estimates are conceptual in nature, presented for comparative purposes, and should not be used for establishing future capital project budgets. The costs listed in the table represent year 2000 costs. It is assumed that all cost elements will be subject to similar rates of inflation, so inflation will not affect the relative costs. As such, no allowance for inflation is included in the table.

Of the 54 existing flow monitoring sites which were included in the meter assessments performed in this study, the present value analysis considers only the 35 sites which are part of the Potomac Interceptor system. For Option #1, it is assumed that the equipment at these sites will be replaced or upgraded at the rate of seven sites each year, such that the complete upgrade occurs over a five year period. Option #2 assumes that all 35 of these existing sites will be abandoned in the first year.

Based on the stated assumptions, the present value analysis indicates a cost of $3.6 million for Option #1, compared to $3.0 million for Option #2. The sensitivity of this result was tested by varying the discount rate, per site estimates and timing of expenditures within a reasonable range, and the analysis consistently favored Option #2. However, this result is highly sensitive to the assumption that all 35 of the existing sites will be abandoned. If more than eight of these sites are kept in service, at the assumed annual cost of $10,000 per site, Option #1 becomes increasingly more favorable from an economic perspective.

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Option 1 - Gradual Replacement/Upgrade

Assumptions

Discount rate		6%
Number of sites		35
Sites replaced per year		7
Replacement cost per site	$	20,000
Maintenance and certification cost per site	$	10,000

Year	0	1	2	3	4	5	6	7	8	9	10
Number of monitors replaced	7	7	7	7	7	-	-	-	-	-	-
Replacement cost	140,000	140,000	140,000	140,000	140,000	-	-	-	-	-	-
Data management cost	50,000		-	-	-	-	-	-	-	-	-
Maintenance and certification cost	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000
Total	540,000	490,000	490,000	490,000	490,000	350,000	350,000	350,000	350,000	350,000	350,000
Present Value of Option 1	**$ 3,601,145**										

Option 2 - New Sites

Assumptions

Discount rate		6%
Number of new meter sites		12
Construction/installation cost per new meter site	$	150,000
Number of existing sites to be abandoned		35
Abandonment cost per site	$	5,000
Maintenance and certification cost per site	$	10,000

Year	0	1	2	3	4	5	6	7	8	9	10
Abandonment costs	175,000	-	-	-	-	-	-	-	-	-	-
Construction/installation cost	1,800,000	-	-	-	-	-	-	-	-	-	-
Data management cost	50,000	-	-	-	-	-	-	-	-	-	-
Maintenance and certification cost	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Total	2,145,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Present Value of Option 2	**$ 3,028,210**										

3.4 Long Term Regional Flow Monitoring Equipment Calibration Certification Program

3.4.1 Background

This section describes a scope of services for a long term 5 – 10 year regional program for certification of Flow Monitoring equipment calibration, based on the assumption that the existing metering sites will continue to be used. This program is tailored to the existing 54 flow monitoring locations addressed in this report. In developing this program, it has been assumed that the data collection and reporting tasks will continue to be performed by DC WASA staff with the assistance of the jurisdictional flow reporting templates which are being developed as part of the wastewater flow meter analysis and management plan. In addition, it has been assumed that the routine flow meter maintenance and calibration procedures currently in place will continue to be performed by jurisdictional personnel.

It has further been assumed that the frequency of maintenance and calibration visits performed by each jurisdiction during the time frame of the field inspections, and summarized below, will continue unchanged.

JURISDICTION	FREQUENCY OF MAINTENANCE VISITS	FREQUENCY OF CALIBRATION VISITS
Dulles	Once/Week	Once/Week
Fairfax	Once/Month	Once/Month
Herndon	Once/Week	Once/Week
Loudoun	Twice/Week	Twice/Week
Vienna	Once/Week	Once/Month
WASA	Once/Month	Once/Month
WSSC	Once/Week	Once/Month

3.4.2 Flow Meter Instrumentation Calibration For Open Channel Locations

It is recommended that calibration certification of flow meter depth sensors at all sites and velocity sensors, at the few sites using the continuity equation, be performed on a quarterly basis.

The specific tasks performed at each location during the quarterly certification will be specific to the equipment configuration in place at the locations. In general, the procedure will include, but not be limited to, the following:

Perform safety assessment and atmospheric testing to assure safe entry of the site;

Where flumes are present, check the approach channel, the converging, throat, and diverging sections of the flume, and the pipe immediately downstream of flume for debris, sediment, and blockages and clean as necessary;

Obtain manual field measured depth readings and compare to meter readings;

Clean depth sensor as necessary;

At sites using the continuity equation, obtain manual field measured velocities using a hand held velocity meter or other appropriate procedure and compare to meter readings;

Clean velocity sensors as necessary;

Perform adjustments to any of the sensors as necessary;

Document adjustments with "as found" and "as left" measurements for use in flow corrections which may be required;

Check and verify the proper operation of electrical and mechanical components present at the location such as power, battery back-up, wire connections, mounting hardware, chart drives, etc., repair and/or document conditions.

The annual costs for quarterly calibration verification of the depth, and where applicable, velocity instrumentation of the 47 open channel locations is estimated to be approximately $100,000.00. This is based on approximately 56 days of field crew involvement at a total estimated cost of $84,000.00 plus engineering and reporting costs of approximately $16,000.00.

3.4.3 Primary Device Calibration For Open Channel Locations

It is recommended that calibration certification of the primary device itself be performed on an annual basis. The annual calibration of the primary devices would generally be accomplished by installing temporary continuous recording area - velocity flow meters immediately upstream or downstream of primary device. The flow meters would remain in operation for a period of 1 week. During that time, the proper operation of the meters would be verified a minimum of three times. The verification would include obtaining manual flow depth and velocity measurements at the temporary flow meter site. In addition, manual flow depth and, where applicable, velocity measurements would be obtained at the primary device. Dye dilution techniques may also be used in lieu of, or in conjunction with, the temporary flow metering equipment.

The annual cost for primary device calibration of the 47 open channel locations is estimated to be approximately $100,000.00. This is based on approximately 56 days of field crew involvement at a total estimated cost of $84,000.00, plus engineering and reporting cost of approximately $7,000.00, plus temporary flow meter equipment rental costs of approximately $9,000.00.

3.4.4 Calibration Of Closed Channel Flow Monitoring Locations

Of the five locations using venturi tubes, only one, the Rock Creek 48" site, will facilitate a relatively straight forward procedure for verifying calibration. The estimated cost for annual calibration of this site is approximately $8,000.00.

At the other four sites, Anacostia P.S. East, Anacostia P.S. West, Cabin John 1, and Cabin John 2, it will be very difficult to verify calibration. The sites will require either extensive construction to install corporation stops if possible, or possibly dye dilution techniques.

The Mag meter at the MD Potomac upper level meter location will also be very difficult for verifying calibration and will require either extensive construction or possibly the use of dye dilution techniques.

The costs for calibration using dye dilution techniques if deemed applicable after additional evaluation, could easily exceed $20,000.00 per site.

Also, the Blue Plains effluent meter will be very difficult for verifying calibration and will require the use of dye dilution or other appropriate techniques. The costs for calibration at this site could easily exceed $20,000.00.

3.4.5 Summary Of Annual Calibration Costs

A summary of estimated annual costs for the calibration tasks described in sections 3.4.2 through 3.4.4.

SECTION	DESCRIPTION	ANNUAL COST
3.4.2	Quarterly calibration verification of depth and, where applicable, velocity sensors at the 47 open channel locations.	$100,000.00
3.4.3	Annual calibration of primary device at the 47 open channel locations.	$100,000.00
3.4.4	Annual calibration at the closed channel meter at the Rock Creek 48" location	$8,000.00
3.4.4	Annual calibration at the remaining 6 closed channel locations using dye dilution or other appropriate methods. *May require installation of corporation stops where possible.	$120,000.00
	TOTAL COST	**$328,000.00**

3.4.6 Strategies For Long Range Flow Monitoring Equipment Upgrades

This section addresses the eventual need for replacement of existing equipment to reduce the frequency of maintenance visits, improve data acquisition methods, and facilitate straight forward, repeatable calibration certification methods.

The initial criteria for prioritizing equipment upgrades should be based on eliminating the requirement for weekly maintenance visits and providing telemetry at all meter locations. This includes the meter locations listed below:

AREA	LOCATION	REASON
Dulles	Dulles Airport - MH 83	7 day chart, needs weekly service, no telemetry
Dulles	Dulles Airport - MH 87	7 day chart, needs weekly service, no telemetry
Vienna	Creek Crossing	7 day chart, needs weekly service, no telemetry
Vienna	North Side	7 day chart, needs weekly service, no telemetry
WSSC	Rock Run - MH 20	7 day chart, needs weekly service, no telemetry
WSSC	Watts Branch - Mont Co. - MH 20	7 day chart, needs weekly service, no telemetry
WSSC	Little Falls	7 day chart, needs weekly service, currently serviced weekly, telemetry in use
WSSC	Muddy Branch 24"	7 day chart, needs weekly service, no telemetry
WSSC	Muddy Branch 36"	7 day chart, needs weekly service, no telemetry
Herndon	Tree Side (Cuttermill)	No telemetry
Loudoun	All Sites	It has been reported that Loudoun County has replaced the instrumentation at their meter chambers with equipment that is compatible with monthly field maintenance. If the original instrumentation were still in place the data loggers would have sufficient memory for monthly maintenance. However, the redundant 7 day charts would require weekly servicing.

It is estimated that equipment upgrades at each open channel flow monitoring sites will be approximately $25,000.00.

A second criteria for prioritizing equipment upgrades should be to address those locations with primary devices and instrumentation where calibration can not easily be verified. This would include the meter locations listed below:

AREA	LOCATION
WSSC	Anacostia P.S. East
WSSC	Anacostia P.S. West
WSSC	Cabin John CJ1
WSSC	Cabin John CJ2
WSSC	MD Potomac Upper Level
Blue Plains WWTP	Blue Plains Effluent #1 & #2

These sites will not lend themselves to straight forward instrumentation replacement tasks similar to those performed at the open channel locations. Rather, extensive design and construction may be required to modify or replace the original primary devices. The development of detailed design and construction pricing is considered beyond the scope of this memo. However, a cost in the range of $150,000.00 per site would not be unrealistic.

Further prioritization should be based on continuing observations by the meter maintenance crews as time progressed regarding accuracy and reliability of equipment at each site. In addition, locations where the annual calibration verification indicated that the permanent flow metering equipment was out of specification would be identified as time progressed. Finally, the availability in the future of new, more accurate, versatile, or cost effective equipment would be considered.