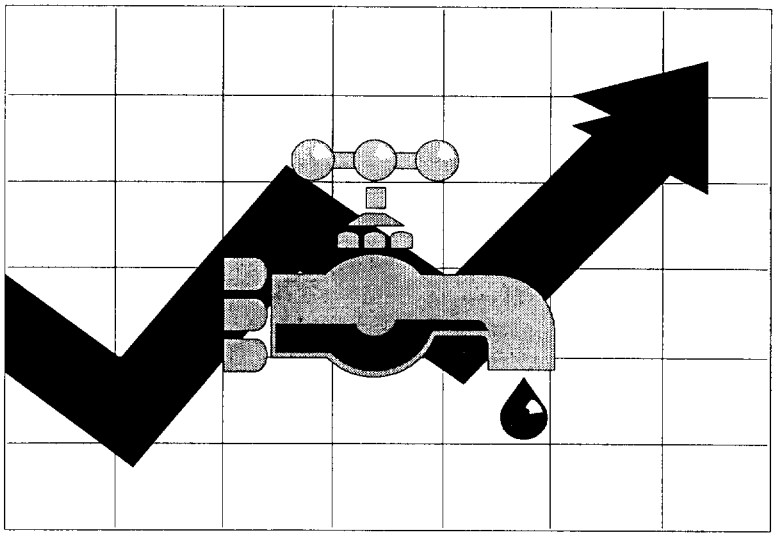
PN-ABY-643

TECHNICAL ASSISTANCE FOR LOCAL LEVEL
COMMUNAL SERVICES PRICING IN RUSSIA

Manual
Expanding Water Metering



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Chapter 1
Introduction to Expanding Water Metering

1.1 Introduction

PADCO, Inc. prepared this manual for the United States Agency for International Development (USAID) and the Government of Russia under the Shelter Sector Reform Program for the Newly Independent States.[1] It is based on the experiences and lessons learned of the USAID/PADCO team for Task Order 74. Between September 1995 and April 1996, that team assisted the Vodokanal (water/wastewater agency) of the City of Orenburg, Russia in improving its cost recovery, investigating tariff reform, and demonstrating the feasibility of expanded metering.

This manual, *Expanding Water Metering*, was prepared to serve as a primary training document in a seminar/workshop. The seminar/workshop would be one component of a training and technical assistance activity whose purpose would be to assist vodokanal and other local officials in Russia in expanding water metering to new customers. The manual was not designed to provide comprehensive treatment of all subjects discussed; some supplemental materials that, with permission, could be translated and used effectively in a workshop setting are listed in the footnotes. The manual contains *text*, *worksheets* to be completed by workshop participants, as well as illustrative *mini-case studies*, drawn from the Orenburg experience.

While the present manual focuses on expanded metering, one stresses that metering alone will not effect sustainable water service provision. Achieving lasting improvement in water service undoubtedly involves comprehensive reform — e.g., improvements in tariff-setting, billing, collection, and enforcement procedures[2] — in addition to a metering program. Even as part of a comprehensive reform effort, expanded metering may play only a limited role. That being said, however, there are circumstances in which expanded metering will help contribute to improved water service.

The role that metering may play in helping improve water service is explicitly recognized by the Ministry of Construction in its implementation of the largely World Bank-financed "Water Supply and Sewage Sector Project." This project, which is programmed to have a total value of $500 million, is designed to finance capital investment in water and sewer systems in Russia. When applying to participate in this project, vodokanals are advised that "metering the production and distribution of water should be evaluated."

For those reasons, the team thus hopes that the present Manual will, in a modest way, assist local officials not only in improving the sustainability of water services, but also (more specifically) in successfully applying for capital investment loans.

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[1] USAID/PADCO Contract No. CCS-0008-C-00-2057-00, Task Order 74.

[2] These elements of a comprehensive reform package are outside the scope of the present Manual.

1.2 What Is Metering?

While water metering may have different purposes, this manual focuses on metering as the measurement of the distribution and use of water, where "use" represents either direct consumption or else water lost. This information can be applied when billing customers.

Many water consumers in Russia (particularly residential consumers) are currently billed not on the basis of their actual water use, but rather on the basis of State-provided *norms*. A norm functions as an estimate of an end-user's (e.g., a household's) daily water use.[3] Norms are based on such factors as building design and the number of household members. Metering thus represents a switch from norm-based billing, which rests entirely on *estimates*, to billing that rests primarily on *actual measurements* of water use.

1.3 Why/When Meter?

The two major reasons why — in certain circumstances — a vodokanal would choose to meter customers are as follows.

1.3.1 Improving the Relationship between Service Provider and Customer

Metering customers to measure their use of water represents one step in a fundamental change in the relationship between a communal service provider (i.e., a vodokanal) and the consumer, vis-à-vis how water is treated and conceptualized. Metering makes it easier to treat water as an *economic good*. This is explained as follows.

When water use *is not* metered, a consumer will generally pay the same amount for water regardless of how much (or how little) water is actually consumed.[4] He/she will face no financial incentive to conserve water. A consumer may, for example, not bother to repair leaky water pipes and may, thus, consume more water than the "norm" dictates. This situation is considered *economically inefficient*. Society may have to devote a disproportionate share of its scarce resources to supplying drinking water. Most likely, the costs of providing water service will not be recovered. Because consumers will tend to use too much water while paying too little, many potential customers may have to do without water hook-ups for years, or may only enjoy running water for several hours a day.

When water use *is* metered, however, as part of a comprehensive reform effort, this situation can change. Market forces can operate. Consumers can confront the actual price of water per cubic meter. This price should signal the economic cost and relative scarcity of water. Consumers can then choose how much water they wish to consume based on a realistic price signal. This is illustrated (in a simplified manner) in Figure 1.1.[5]

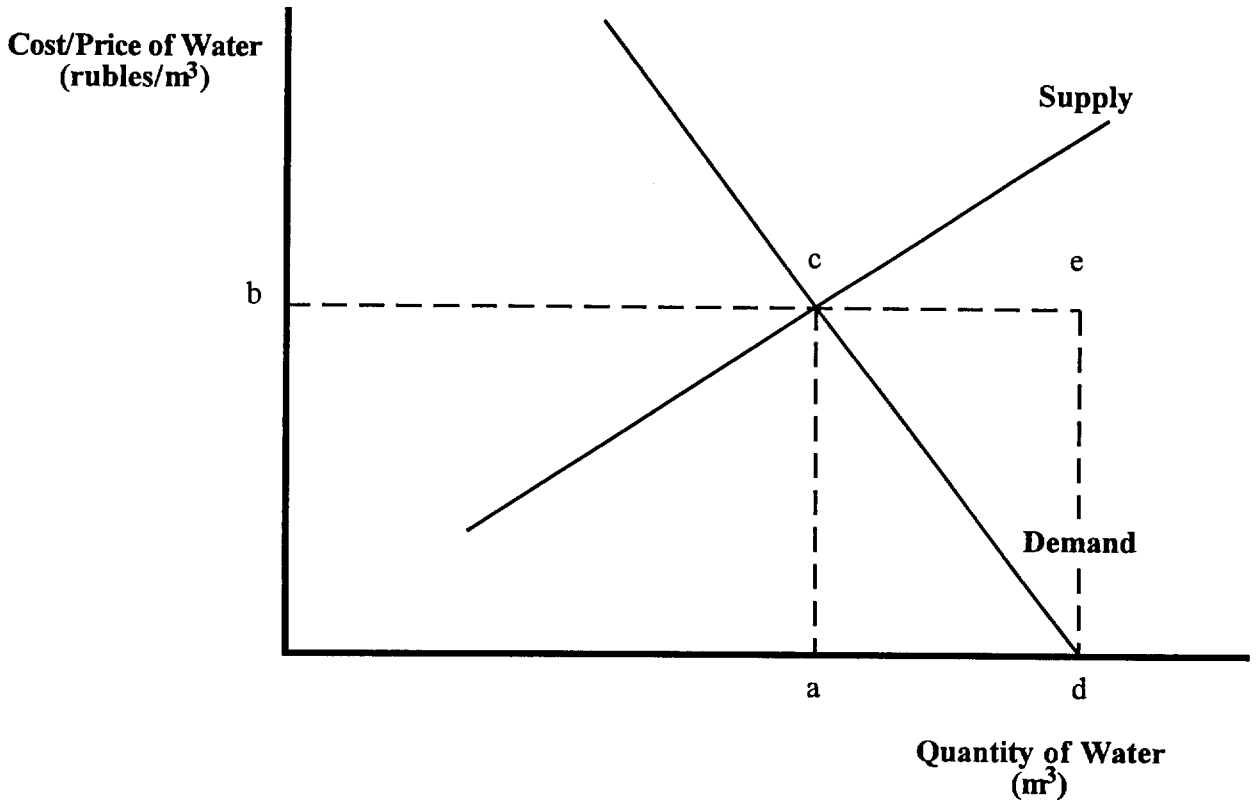
---

[3] Norms may also represent the maximum amount of water that an end-user "should" consume in a given time period. In practice, however, norms are most commonly used to derive presumptive estimates of water use.

[4] That is, customers will not face the *marginal costs* of providing water.

[5] The following discussion assumes that water is generally priced so as to reflect its true economic costs.

Figure 1.1
Water Supply and Demand (Illustrative)



The horizontal axis of Figure 1.1 shows quantity of water supplied/demanded during a given period of time. The vertical axis shows the cost/price of water per cubic meter. On the graph itself, the **supply curve** shows that, as the quantity of water supplied increases, the cost per cubic meter of supplying that water also increases. This is largely because water suppliers often need to rely on progressively more expensive, harder-to-get-at sources of water. The **demand curve**, on the other hand, shows that, as the price of water rises, consumer demand will fall. As the price goes up, customers will choose to consume less water. In a well-functioning system, the point where the supply and demand curves cross ("c") should indicate the level of water supplied ("a"), and the price charged ("b").

Meters permit supply and demand to equilibrate at point c. If, however, customers are not billed based on actual consumption, but rather on an estimate or norm, customers will not confront the actual marginal cost of water, captured by the supply curve. They will use (i.e., consume or waste) more water than they would otherwise ("d"). Even if price is set at point "b," some of the costs of providing water (represented by area a-c-e-d) will not be captured.

Because metering — along with other reforms — permits consumers to be confronted with the true costs of service provision, it represents an integral part of an effective system of cost recovery — determining costs, setting prices, billing, and collecting so as to fully recover costs.

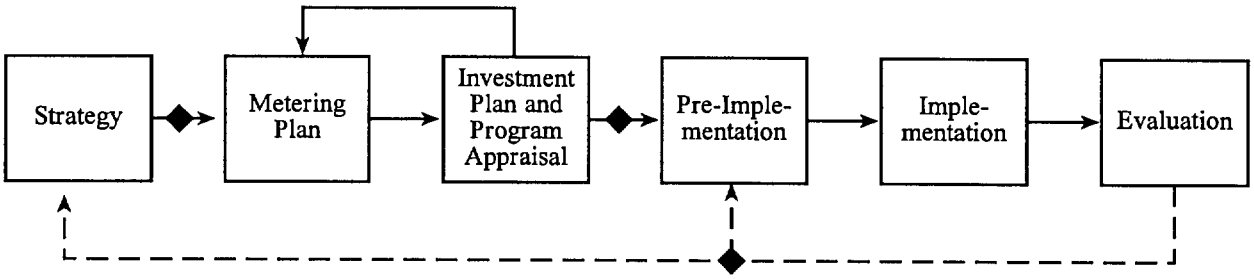
1.3.2 Increasing Revenue Generation

There is a second reason (closely related to the first reason) why water service providers may, under certain circumstances, choose to meter customers: to increase net revenue generation. In situations where customers routinely consume more water than the norm indicates, customers are being undercharged for water consumption. Thus, by metering those customers, vodokanals may be able to increase net revenue generation.

Whether or not net revenue generation actually will increase if metering is expanded is a function of various factors: the typical difference between actual water use and the norm; the costs associated with installing, operating, and maintaining meters; restrictions on water tariff levels; the effectiveness of the whole billing, collection, and enforcement system; etc. Depending on consumer demand characteristics, vodokanals may also find that metering yields benefits largely in terms of reduced costs (i.e., through reduced water consumption), rather than in terms of increased revenue generation. The following chapters provide guidance on how to analyze those issues in more detail.

1.4 Process for Expanding Water Metering

Expanding water metering is a relatively complex and expensive process, involving coordination across departments and among organizations. Metering new customers may also involve an up-front loan, and may be politically sensitive. As such, it makes sense to plan for and implement metering in a orderly manner. We suggest a six-step process, as follows.



(NOTE: ◆ = decision-making node)

- *Strategy*— involves making broad decisions about metering, including setting priorities for metering different customer sub-groups.
- *Metering Plan* — following strategy approval, entails turning the strategy into a program: breaking it down into phases and tasks, assigning responsibilities, and thinking through major problems.
- *Investment Plan and Program Appraisal* — consists of assigning costs to the metering plan's various tasks, proposing funding sources, and weighing the plan's projected costs and benefits. (Preparing the metering plan and appraising it represents an iterative process. The two steps go hand-in-hand.)
- *Pre-Implementation*— following plan approval, involves preparing to implement a particular phase of a plan.
- *Implementation* — consists of executing the plan, phase by phase.

- *Evaluation*— involves assessing the benefits of and capturing the lessons learned from each phase, before moving on to the next phase. When evaluations turn up very unexpected results, one may wish to reexamine the entire metering strategy.

Those steps are discussed, step by step, in the following chapters.

Chapter 2
Strategy

A *strategy* can be defined as follows.

> ***Strategy*** *— The approach that an organization takes to meet its goals. It involves understanding the current situation and setting goals and objectives. It then entails figuring out the steps that the organization needs to take to get from the current situation to the desired future state.*

To succeed, strategies must be vigorously implemented. Then, as implementation occurs, strategies should be reviewed and improved as necessary. Steps are as follows.

2.1 Define Goals

The first step is to define goals. Why would we wish to meter more customers? Some possible reasons were suggested in the previous chapter: generate additional revenues, bill customers more fairly (i.e., according to the water they actually consume), promote water conservation, etc.

At the same time we meter, we may be able to accomplish other goals as well. We may, for example, want to install cut-off valves while installing meters, permitting better enforcement of bill collection. The goals you define thus influence the entire planning and implementation process. Use Worksheet 2.1 to jot down your reasons for metering.

> ***Worksheet 2.1: Goals***
>
> *Write down your goals for expanded metering below.*
>
> _____
> _____
> _____
> _____
> _____
> _____

2.2 Understand Current Situation; Identify Customer Groups for Potential Expanded Metering

One of the most important decisions to make is which customer groups should be targeted for expanded metering. Metering certain customer groups will be more *cost-effective* than metering others. Metering is said to be cost-effective when the *benefits* (e.g., increased revenue generation, savings due to water conservation, etc.) substantially outweigh the *costs* (e.g., increased administrative or maintenance costs). Some metering may not be cost-effective at a given time.

In fact, in cases where actual water use is less than the norm for a particular household or building, metering could actually result in decreased gross revenues. For these reasons, it is important to try to predict the potential cost-effectiveness of metering different groups of customers. While we will examine this subject in more detail in Chapter 4, such analysis should begin with strategy formulation. Existing data can provide clues on potential benefits and costs. Below, we look first at: (1) different customer classes, and then focus in on (2) particular sub-classes of customers.

2.2.1 Potential by Customer Class

A *customer* is defined as an entity that is a legal recipient of water service. Customers sign agreements with providers of communal services, and shoulder responsibility for paying bills for services rendered. One "customer" may thus include a number of "sub-end-users" (e.g., households).

A *customer class* is simply a grouping of customers with shared characteristics.[6] Regulations governing communal services in Russia generally specify three customer categories: general population, budget organizations, and enterprise/industry. Slight variations in applying these definitions may exist at the local level.

The potential for generating net benefits by expanding metering to a particular customer class is a function of several key factors that are explored below: (1) current and future tariff structures, (2) relative numbers of customers and their water use characteristics, (3) collection rates, and (4) current metering patterns.

Tariff Structures. A water *tariff* is the price charged to a particular group of customers per cubic meter of water. The schedule of different tariffs is called a *tariff structure*. Under current practice, vodokanals apply different tariffs to the three customer categories. Please use the top half of Worksheet 2.2 to describe your current tariff structure.

[6] In Russia, those characteristics are generally based on a customer's *economic role in society* — for example, all enterprises/industries are in one customer class, the general population are in another class, etc. For this reason, in Russia all customers in one class may not necessarily share the same patterns of water use. Following western economic principles, however, western countries are more likely to group consumers into classes based on common *water use* characteristics, rather than on a customer's economic role in society.

Worksheet 2.2:
Customer Categories and Tariff Structure for _____ (Month and Year)

Customer Category ***Tariff (Rubles / Cubic Meter)***

_____ _____
_____ _____
_____ _____
_____ _____

What changes are expected over the next several years?

_____
_____
_____
_____
_____

Take a look at the tariff structure you have just spelled out. One notes that certain customer categories (e.g., enterprise/industry) currently may have to pay for water at rates many times higher than other consumers (e.g., general population customers). These relative proportions may change in the future. Federal Decree No. 935 (September 1993, amended December 1995), for example, set progressively higher levels of cost recovery for the general population.[7] Use the bottom half of Worksheet 2.2 to describe the changes in tariff structure you expect in your city over the next several years.

Number of Customers and Water Use. The three major customer classes differ in other key ways besides the water tariffs that they face. They also vary in terms of number of customers and total water use. Use Worksheet 2.3 to clarify these points for your city.

Worksheet 2.3: Customers and Water Use

	Customers		Water Use for Year	
Customer Class	**#**	**% of Total Customers**	**Cubic Meters**	**% of Total Volume**
General Population				
Budget Organizations				
Enterprise/Industry				
TOTAL				

[7] Also, Russian enterprise/industries have reportedly legally challenged high levels of cross-subsidies for water services as unconstitutional.

Collection Rates. Next, we need to understand current success at collecting from different customer classes. Collections can either be "cash" (i.e., money credited to a vodokanal's bank account) or non-cash (including promissory notes from the City and Oblast, treasury notes from the Federal Government, bartering of goods, or bartering of debt). From the Vodokanal's perspective, cash payments are undoubtedly the most desirable, simply because these resources can be applied to a wider variety of uses than can non-cash payments. Fill out Worksheet 2.4 for a profile of collections in your city.

Worksheet 2.4: Annual Collections by Customer Class (End of 19__)

Customer Class	Amount Billed		Amount Collected						Total Collected as % of Total Billed
			Cash +		Non-Cash =		Total		
	R000	%	R000	%	R000	%	R000	%	
General Population									
Budget									
Enterprise/ Industry									
TOTAL									

Customer Metering. Finally, use Worksheet 2.5 to describe current metering by customer class. Use the "Comments" column to describe relevant details of metering, such as whether meters for a particular customer category: are largely functioning or non-functioning; are owned by the City, the Vodokanal, or are privately owned; etc.

Worksheet 2.5: Customer Metering

Customer Category	# Customers	# Metered	% Metered	Comments
General Population				
Budget				
Enterprise/Industry				
TOTAL				

Based on the above, one can make a tentative decision as to which customer classes are likely candidates for expanded metering. Expanded metering will likely be most feasible for customer classes where most or all of the following conditions hold:

- current and future tariff levels are/will be relatively high (Worksheet 2.2);

- customers consume relatively large quantities of water (Worksheet 2.3);
- there is room to improve collection rates, and metering would help (Worksheet 2.4); or
- relatively little metering has occurred to date (Worksheet 2.5).

For an example of a decision to expand metering, see Mini-Case Study 2.1, below.

Mini-Case Study 2.1: Orenburg Customers and Water Use

Before launching their demonstration project in Orenburg, the USAID/PADCO team sought to understand the current metering situation.

The team first looked at the tariff structure. At the time of the study, enterprise/industry customers paid seven times as much for a cubic meter of water as did general population customers. This, however, was expected to change. Following Federal Decree No. 935, rates for general population customers were expected to rise substantially over time.

The team next looked at water use and number of customers by customer class. General population customers consumed two-thirds of all water, and represented 99% of all customers (see below).

Customer Category	Customers		Water Use for Year	
	#	% of Total	Cubic Meters	% of Total Volume
General Population	127,000	99.2	35,407,000	67.5
Budget Organizations	270	0.2	5,400,000	10.3
Enterprise/Industry	798	0.6	11,640,000	22.2
TOTAL	128,068	100.0	52,447,000	100.0

The team assessed current collection rates. They noted the potential to improve cash payments from the general population.

Finally, the team examined current metering. Few of the general population customers were metered. By contrast, virtually all enterprise/industry customers of the Vodokanal were metered.

Based on this sort of analysis, the team and Vodokanal officials agreed that increased metering of general population customers should be further investigated (see Mini-Case Study 2.2, below).

Use Worksheet 2.6 to describe where you see the most potential for increased metering, by customer class. Back up your preliminary conclusions using data drawn from Worksheets 2.2-2.5.

Worksheet 2.6: Preliminary Conclusions: Potential for Increased Metering

_____

_____

_____

_____

_____

_____

2.2.2 Customer Sub-Classes

After tentatively identifying one or two customer classes as holding potential for increased metering, we need to investigate the selected class(es) in more detail.

A customer class in Russia is not necessarily homogenous — it may contain several sub-classes that differ greatly in terms of patterns of water use, potential for increased revenue generation, typical building layout, etc. General population customers, for example, may be broken down by building type (apartment vs. single-family detached); apartment buildings may be further disaggregated by type of service offered (warm and cold water service vs. cold water only). Enterprise/industry customers may vary greatly in terms of the volume of water consumed and other water use characteristics. Buildings found in different areas of your city, or constructed during different time periods, may also form distinct sub-classes. To disaggregate general population customers, fill out Worksheet 2.7.

Worksheet 2.7: Profile of Sub-Classes of General Population Customers

General Population Sub-Category	**# of Customers**	**# of Buildings**	**Units/Apartments**	
			#	**% of Total**
Apartments - Type 1: Cold Water				
- Type 2: Cold & Hot Water (noncirculating)				
- Type 3: Cold & Hot Water (circulating)				
Subtotal Apartments				
Other General Population (e.g., single-family dwellings)				
TOTAL				100

One notes that other ways exist to analyze the divisions within one particular customer class. For example, if the data are available, Worksheet 2.7 could be expanded to include information regarding current proportions of metering. Another approach would be to distinguish customers by geographical area and/or income level.

The amount of additional revenues that can potentially be generated from customers may vary greatly, from sub-category to sub-category. A clear example of this was found in Orenburg (see Mini-Case Study 2.2). The sort of information presented in the case study can be gathered through selective building metering, and used to help shape the metering strategy.

Mini-Case Study 2.2: Sub-Classes of General Population Customers in Orenburg

After deciding to focus on the general population category of customers for potential expanded metering, the USAID/PADCO team gathered the following data on sub-categories.

General Population Sub-Category	**# of Buildings**	**Units/Apartments**	
		#	**% of Total**
Apartments - Type 1: Cold Water	--	~32,500	20.7
- Type 2: Cold and Hot Water (noncirculating)	--	26,799	17.1
- Type 3: Cold and Hot Water (circulating)	--	62,536	39.9
Subtotal Apartments	2,206	121,835	77.7
Single-Family Dwellings	~35,000	~35,000	22.3
TOTAL	~37,206	~156,835	100.0

The team next installed meters in the different types of buildings, to see if actual water use really corresponded to State-mandated norms. Results of this test were as follows:

Mini-Case Study 2.2 (continued)

Water Consumption by Residential Building Type
(expressed in liters per person per day)

Apartment Type	(a) Norm	(b) Actual Readings	(c=b-a) Difference	% Greater than Norm
1. Cold Water Only	170	270	100	59
2. & 3. Hot and Cold Water	260	290	30	12

One notes that the difference between normed and actual water use is much greater for Type 1 than Types 2 and 3 apartment buildings. This suggests that metering a Type 1 building could yield more benefits than metering other types of apartment buildings — benefits in the form of: (1) additional revenues and/or (2) increased water conservation. For this reason, the USAID/PADCO team recommended to Orenburg that a residential metering program begin with Type 1 buildings, and then move on to Types 2 and 3 buildings.

2.3 Make Strategic Decisions/Recommendations

Once data have been gathered and analyzed, one can make strategic decisions or recommendations about a metering program. One basic principle that should guide these conclusions is cost-effectiveness. Key decisions include the following:

- goals of metering;
- customer classes/sub-classes to target for metering, and the most cost-effective sequence;
- regions of City to target for metering, and sequence;
- in the case of apartment buildings, whether to meter at the building or apartment level; and
- whether or not to test metering in a few sample locations, before advancing to a full-blown metering program.

Outline your tentative metering strategy in Worksheet 2.8, addressing the points raised above and other major issues you have identified. Be prepared to justify/back up your recommendations, using points generated from the previous Worksheets.

Worksheet 2.8 Tentative Metering Strategy

Addressing the points raised above, and based on Worksheets 2.1-2.7, sketch out your tentative metering strategy below. Use additional space if necessary.

Once a strategy is prepared, it can be discussed with decision-makers. If they demonstrate sufficient interest, one can proceed with the next step — developing a metering plan.

Chapter 3
Metering Plan

Once you have developed a strategy for extending metering and have developed a sufficient level of support among decision-makers for your approach, it is time to flesh out your ideas into a metering plan. Rather than being just an end in itself, the process of preparing such a plan can help you think through the relevant issues in a systematic way, avoiding later problems in implementation. Major issues that a metering plan should address are discussed below.[8]

3.1 Convert the Strategy into an Action Plan

Turning the strategy into action first involves becoming more concrete in your proposal, as follows.

Divide the strategy into phases, and describe the major tasks to occur during each phase. Your strategy probably proposed a sequence of customer sub-groups to target for expanded metering. Metering each sub-group could be considered as one phase of the plan. One could also consider a test phase at the beginning of program implementation, to confirm customer acceptance, meter quality, etc. Use the first part of Worksheet 3.1 to break out major phases and tasks of your plan. Give a brief description of what should occur in each phase, quantifying where numbers are currently available (e.g., number of buildings to meter per phase).

Set objectives for each phase. While we earlier determined the overall goals of a metering program, we may now want to set more specific objectives for each phase. For example, the purpose of one phase may be to test the cost-effectiveness of metering a certain customer sub-group, or to gauge customer reactions to metering, or to fine-tune a revised billing and collecting system, before proceeding to the next phase. Another objective could have to do with testing normed versus actual water use for a certain customer sub-class. As suggested earlier, yet another objective could relate to installing cut-off valves to facilitate collection enforcement, in addition to flow meters. Each phase may have a *benchmark* (i.e., a concrete, observable result) to be completed before proceeding to the next phase. Reviewing and capturing lessons before moving on to the next phase is suggested. You may find that setting objectives and benchmarks down on paper will help improve your program design (see Worksheet 3.1).

Assign responsibilities. During each phase, who will do what? It is not too early to begin to think about responsibilities. Different parts of the vodokanal (and possibly the city administration) will be involved in implementing key aspects of the plan. Those responsibilities should be discussed and preliminarily assigned (see Worksheet 3.1).

One shouldn't assume that the "best" agents to carry out different tasks are in the public sector. It may be more effective to contract with the private sector to provide certain goods and

[8] As noted earlier, a metering plan should be developed simultaneously and iteratively with an investment plan and an assessment of costs and benefits. These latter exercises are reviewed in Chapter 4.

services. The USAID/PADCO team in Orenburg, for example, identified at least three areas where private sector participation in a metering program was worth at least further investigation:

- supplying meters and associated hardware;
- installing meters; and
- inspecting/reading/monitoring meters once they were installed.

Options for private sector involvement should be identified and evaluated.

Set a timetable. Estimate — realistically — how long completing each phase should take. Use the last part of Worksheet 3.1.

Your thoughts on the above points will undoubtedly change as you investigate the subject in more detail. You therefore may want to revise Worksheet 3.1 after completing the rest of Chapter 3 and Chapter 4.

Worksheet 3.1: Metering Action Plan

Use the space below to briefly describe the major phases and tasks of your plan.

Phase #	Task	**Lead Actor**	**Time Period** (from/to)
1	a. b. etc.		
2			
3			
4			
etc.			

Next, describe the objectives of each phase in the space provided.

_____

_____

_____

_____

Finally, lay the phases out in bar-graph form on a timeline, below.

Ph 1

Ph 2

Ph 3

etc.

(month/year)

3.2 Design Typical Installations; Specify Goods and Services Needed

Next, we will want to begin to design typical installations for each phase, and specify the goods and services required for implementation.

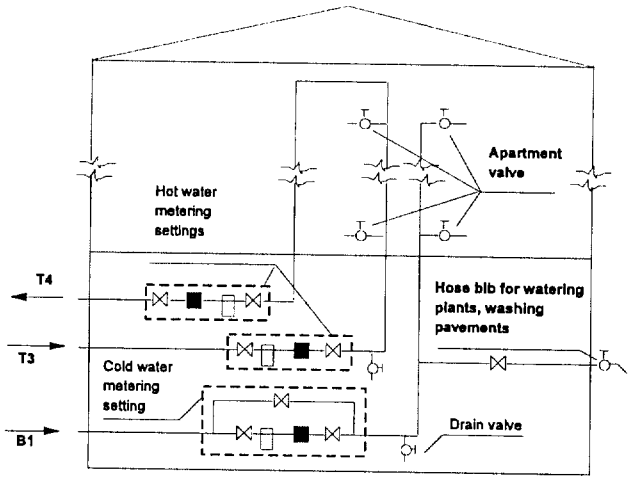
3.2.1 Conduct Sample Inspections

A good place to begin to determine hardware needs is by inspecting a few of the buildings targeted for each phase to determine physical conditions. To get an idea about the variety of existing conditions, try to visit a handful of buildings scattered around the city, in different neighborhoods both new and old. As an aid to installation design, one can prepare schematic diagrams of typical water connections and internal plumbing based on those visits (see Mini-Case Study 2.1 for example).

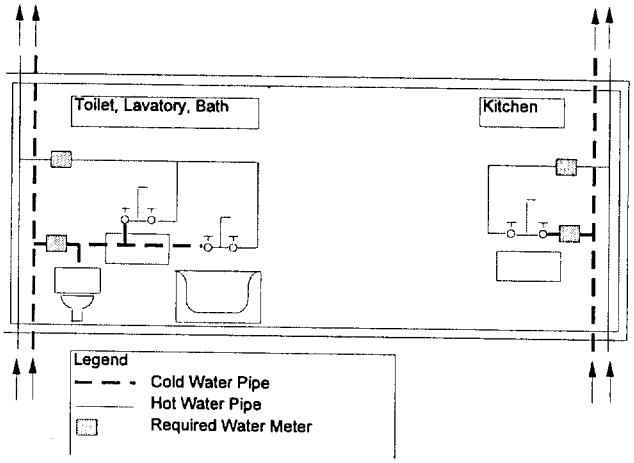
Mini-Case Study 3.1: Schematic Diagrams of Building Plumbing

In Orenburg, the USAID/PADCO team prepared schematic diagrams of buildings targeted for metering. (For comparison purposes, one or two schematic diagrams were also prepared at the apartment level. The project did not, however, end up metering individual apartments.) Examples of schematic diagrams are as follows.

Schematic Diagram of Apartment Building Type 3 (Hot and Cold Water with Hot Water Circulating to Heating Substation):



Schematic Diagram at Apartment Level: Typical Three-Plus Room Apartment Water Supply Diagram



When inspecting buildings, make a note of any hardware that pertains to a meter installation (e.g., water meters, bypass pipes, shut-off valves) that may currently be in place. Finally, when

inspecting buildings, make a note about the frequency and types of variations from the typical building and plumbing layout encountered. Installing meters in buildings that vary from the norm could entail additional costs that one should be aware of. One may then wish to disaggregate the phases initially defined in Worksheet 3.1, so that buildings with distinct features (e.g., apartment buildings with commercial areas) are metered during a distinct phase. For an example of the variations from the "typical" building that may be encountered, see Mini-Case Study 3.2, below.

Mini-Case Study 3.2: Variations from the "Typical" Apartment Building in Orenburg

When the USAID/PADCO team in Orenburg set out to meter apartment buildings, in addition to variations due to type of water service, they found substantial variations among apartment buildings in the installations that would be required. Out of 30 apartment buildings inspected, they found the following:

	#	%
Buildings with commercial areas:	*15*	*50*
Buildings with inadequate spacing or pipe configuration:	*7*	*23*
Buildings with "typical" spacing and pipe configurations:	*8*	*27*
TOTAL INSPECTED	*30*	*100*

Costs would have varied in metering these different types of buildings. In the end, the team decided to begin by metering the eight buildings with "typical" features. One notes that those buildings represented only about one-quarter of the initial customer class originally targeted for test metering.

3.2.2 Decide Where Typically to Install Meters[9]

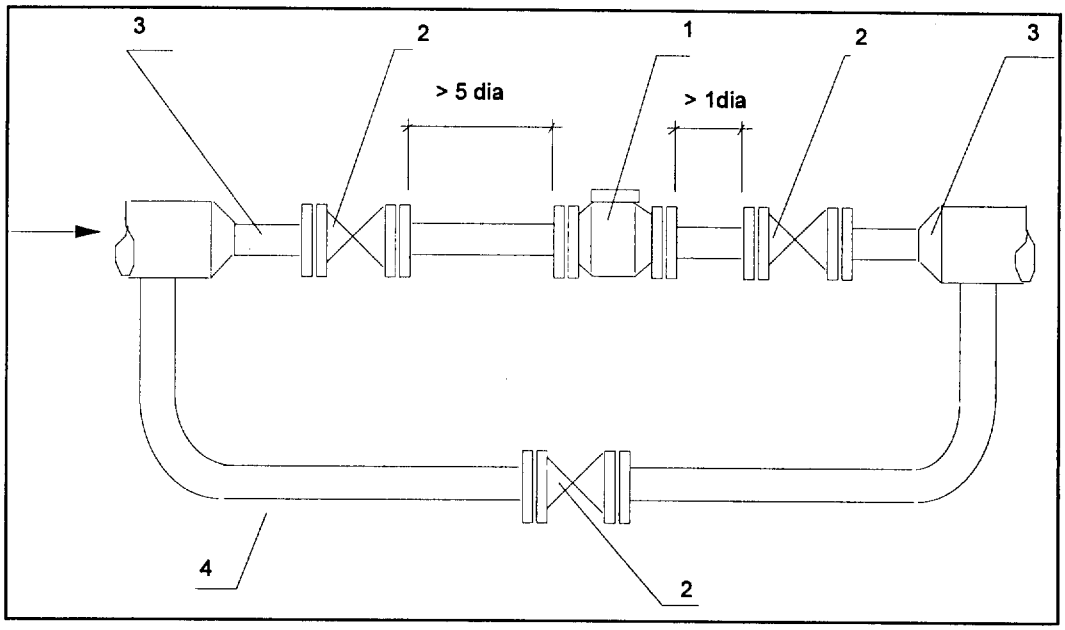
Installations necessarily correspond to building layout. The USAID/PADCO team in Orenburg decided to install meters *indoors* — in the basements of apartment buildings. Other configurations, including *outdoor* settings, may be possible in other building types. In an outdoor setting, the meter is installed underground in a pit or meter box, which may be located at the curb end of the service line. Outdoor settings are less common where severe winter weather may cause frost damage. In whatever location, the installation should:

- be leak-tight;
- provide an upstream shut-off valve of high quality and with low pressure loss;
- allow for the meter to be positioned horizontally for optimum performance;
- provide reasonable access for service and installation;
- permit easy reading;
- be protected against frost and mechanical damage;
- be secure from tampering; and
- not be an obstacle or hazard to customer or public safety.

[9] This Section draws in part from the American Water Works Authority (AWWA), *Water Meters — Selection, Installation, Testing, and Maintenance*, 1986, pp. 38 ff.

3.2.3 Design Typical Meter Installation

As shown below, a typical meter installation for apartment buildings will have several components.[10] The *water meter* (1 in Figure) measures water flow. The pipe immediately upstream of the meter should be swirl-free, of uniform flow velocity, for a length of at least five pipe diameters. Downstream, a length of at least one pipe length should be provided. Piping should be horizontal, and arranged so that the meter remains full of water at all times.



Legend
1. **Water Meter**
2. **Gate Valve**
3. **Connecting-Transition Pipe**
4. **Bypass Line**

The meter should be bounded on both sides by *gate valves* or isolation valves (2 in Figure). It is recommended that either a temporary or permanent *bypass pipe* arrangement (4 in Figure) be provided to permit uninterrupted customer service during periodic testing or routine maintenance. See actual manufacturing recommendations for installation when preparing to install meters.

[10] Meter installation configuration provided is based on USAID/PADCO experience in Orenburg, and addressed residential apartment buildings. This configuration was, in turn based in part on *Ibid*, pp. 44-5. Actual configurations used should be modified to reflect manufacturer design specifications and appropriate engineering practices.

3.2.4 Set Meter Specifications

Specifying the meters required involves thinking about two variables: type and size.[11] Choosing a meter *type* — and there are choices available — means realizing there are trade-offs among different criteria. The ideal meter would feature, among other things, all of the following:

- accuracy;
- long life;
- simple design;
- moderate up-front cost; and
- ease of maintenance.

Other factors to consider when determining meter type are: the range of flow rates, plus allowable pressure loss and possible safety requirements (such as fire-service regulations). Meters should, of course, be able to function under local pressure conditions — pressure may be generally lower in Russia than in other western countries. Meters that measure flow in hot water pipes need to meet different standards than those used for cold water only.

To be realistic when setting specifications, one should be aware of the choices available in the marketplace. Meters may be available from local, regional, national, or international suppliers. One should obtain some sample spec sheets from manufacturers and carefully consider the options.

Regarding *size* of meter, one should ideally size the meter to meet projected demand characteristics.[12] This is not necessarily the same as the size of existing pipes, as pipes may be oversize. If a 3-cm. meter in a 6-cm. line is sufficient, do not use a 6-cm. meter. As one authority advises, such a practice, "would be unnecessarily expensive, heavy to handle, and probably not as accurate under overall conditions of usage. However, . . ." the author continues, ". . . it is advisable to provide extra space in the pipeline and in the meter pit so that a larger meter can be installed later if usage increases."[13]

A final option to be aware of is the alternative of installing a battery of smaller meters, rather than one large meter. This option provides alternate paths of flow that can be used during maintenance situations. On the other hand, as one authority cautions, under this option, ". . . considerable care must be taken in the design and valve adjustment to ensure equal water distribution through all branches under normal service conditions."[14]

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[11] The following paragraphs draw upon, and in some cases quote, material presented in the American Water Works Association manual, *Water Meters — Selection, Installation, Testing, and Maintenance*, 1986, pp. 25 ff.

[12] Determination of customer water demand characteristics is outside the scope of this Manual.

[13] *Ibid*, pp. 25 ff.

[14] *Ibid*, p. 43. Concepts and procedures for calculating the effects of water-flow friction, increased usage, and pressure losses on service adequacy, are available elsewhere, and are outside the scope of the present Manual.

3.3 Plan for Institutional Changes Relating to Billing, Collection, and Enforcement

As noted in Chapter 1, metering promises to transform the relation between a vodokanal and its customers. For this to happen, however, certain institutional changes that affect the ways in which customers are billed and collected from may have to occur. For billing-related processes to adjust when meters are installed, coordination must occur between various departments — both between the city administration and the vodokanal, as well as within the vodokanal itself. The broad beginnings of this coordination should take place during the planning stage. A couple of broad issues to consider are as follows.

Revenue collection. In Russia, revenues collected for water and wastewater service are often received by City governments along with payments for other communal services. Those total collections are then divided up among the various communal service providers according to some procedure, formula, and/or set of priorities. In other words, the vodokanal does not control every aspect of the entire billing and collection cycle. This means that, when metering begins, not every additional ruble of revenues billed for and collected may actually wind up in the hands of the vodokanal.

This condition is problematic for couple of reasons. It weakens the relation between customer and water service provider, increasing skepticism over whether paying consumption-based water bills will actually result in improved service. From the standpoint of a lending institution, considering whether or not it would benefit from a loan to finance a meter program, it makes such a proposition appear much less feasible financially. For those reasons, the outset of a metering program may be the time for a vodokanal to try to negotiate some changes in the collection process that will give it increased autonomy. Also, when calculating the revenue gains that will actually accrue to a vodokanal from expanded metering, one should consider this circumstance (see Chapter 4).

Bill calculation. Bills will need to be calculated based on actual meter readings rather than norms. This has implications regarding: number of employees who bill and read meters, procedures for meter reading, the format of bills, transportation of meter readers, scheduling, coordination between vodokanal departments, etc. Those implications should be thought through.

3.4 Propose Changes in Local Legislation

One should review the current legal framework, to determine whether any changes in local legislation, regulations, or policies are required. To cite some examples: a new local legislative act or policy statement could, if necessary:

- assert a city council's resolve to shift to consumption-based metering, and to charge based on consumption when metered readings are available;
- pave the way for increased vodokanal autonomy and responsibility, particularly in the areas of collection, billing, and enforcement (see Section 3.3, above);
- require that new buildings be equipped with water meters (following certain guidelines) before occupation;
- establish a position regarding the private ownership/installation of meters;

- clarify under what circumstances service shut-offs can occur (e.g., when bills are a certain number of months late, during non-winter months, after certain procedures have been followed, etc.); or
- authorize or confirm a vodokanal's right to take out a loan to finance a metering program.

3.5 Briefly Describe Implementation Process

At the plan stage, it helps to think through and offer a brief description of the program implementation process. This will in particular help those preparing the investment plan (see Chapter 4). The process includes tasks related to program pre-implementation, implementation, and evaluation, as discussed in Chapters 5 and 6 of this Manual.

Chapter 4
Introduction to Investment Plan and Program Appraisal[15]

A metering program is just one of many activities to which scarce resources can be assigned. It entails costs and benefits, and should be thought of as an investment. Financing the activity would probably draw on several revenue sources. As such, one should develop an *investment plan* — an estimate of expenditures required for installation, plus an outline of how the program should be financed. At the same time, the program should be *appraised*, i.e., evaluated for its feasibility.[16]

The present Chapter introduces the development of an investment plan and the appraisal of projects/programs. Information developed along the lines suggested below can be used not only to assess, but also to improve the feasibility of the initial program design. Thus, Chapters 3 and 4 go hand in hand. Conversely, if the program is shown to be completely unfeasible, the analysis can serve to curtail the wasteful expenditure of scarce resources by canceling the program.

Central to both the program appraisal and the investment plan is a spreadsheet, eventually developed into a cash flow statement. The spreadsheet can be thought of as expressing the financial dimensions of the Metering Plan developed earlier. The spreadsheet's format (simplified) should be as follows:

Time Period	**1**	**2**	**3**	**4**	**5**	**etc.**
Receipts						
Cash Inflow						
Expenditures						
Cash Outflow						

Net Cash Flow (receipts - expenditures)

As shown, the final spreadsheet shows gross receipts and expenditures of the project over time. Those amounts are then combined to yield net cash flow. Feasible projects often show a negative net cash flow during the installation phase, followed by a period of positive cash flow. A typical cash flow profile of a feasible project over its lifetime could appear as follows.

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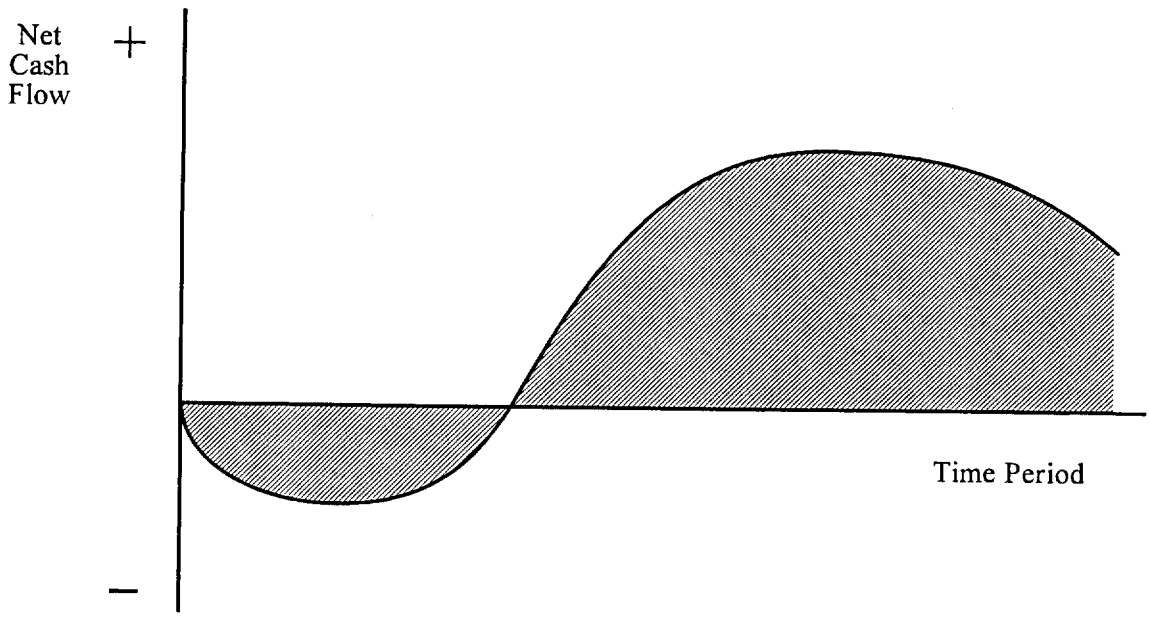
[15] The following discussion is introductory, with a focus on major concepts; it is not designed to be comprehensive.

[16] For ease of presentation, this Manual does not distinguish between program design and appraisal at the pre-feasibility and feasibility stages. However, particularly for relatively large metering programs, separating out the pre-feasibility and feasibility stages of design and review may make sense.

Figure 4.1
Typical Financial Cash Flow Profile of Project



The spreadsheet shown above should be built up gradually, over the following steps.

4.1 Prepare Investment Plan[17]

As noted above, an investment plan contains two elements. First is a listing of all expenditures required for the installation of the program in its different phases, before those phases become operational. These expenditures reflect the tasks and phases developed earlier in the metering plan (see Chapter 3 worksheets). Expenditures should be grouped into major groups in rows. Major groupings may include goods versus services; materials vs. labor vs. equipment; etc. Interest during installation is often also included. Expenditures should also be broken down by time period (columns).

The investment plan should also contain an outline about how those expenditures should be financed. Sources of financing could include a loan, a City's general revenues, grants, etc. One should investigate areas where there is uncertainty. For example, would financial institutions conceivably lend to a Vodokanal or a City? If so, under what circumstances? When drafting a financial plan, provide comments on probabilities of success, obstacles, etc.

The financing portion of a simple investment plan for a medium scale public sector project could appear as follows.[18]

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[17] The following discussion was drawn principally from Jenkins, Glenn P.; and Harberger, Arnold C., *Manual: Cost-Benefit Analysis of Investment Decision*. For potential supplementary workshop materials, see Jenkins and Harberger, p. 3.2 ff.

[18] Adapted from *Ibid*, p. 3.2 ff.

	Year (000s of dollars)	
	0	1
Total Expenditure	2,100	3,689
Financing		
Government Equity	2,000	1,189
Government Loan (short term)	100	500
Foreign Loan	0	2,000
TOTAL FINANCING	2,100	3,689

It may make sense to finance a metering program simultaneously with a water sector capital investment program (CIP). A full discussion of the various potential financing sources available for a metering program and/or a CIP is outside the scope of this Manual.[19]

4.2 Appraise Program

4.2.1 Scoping Out the Appraisal

Program appraisals can be simple or complex, with correspondingly small or large price tags attached. Given scarce resources, it makes sense to tailor the size and design of the appraisal to the particular situation. One common-sense rule of thumb is that the larger and more expensive the metering program, the more thorough the appraisal that may be appropriate. On the other hand, some level of appraisal is probably merited for even the smallest metering program.

When scoping out the appraisal effort, it is crucial to understand the needs of different decision-makers. It makes no sense to waste a lot of resources on a comprehensive appraisal if everyone would be satisfied with a more narrowly scoped appraisal. A poorly scoped appraisal could be expensive and yet not truly get at the issues of concern.

Use Worksheet 4.1, first, to list out the major decision-makers and groups to be consulted. This will no doubt include Vodokanal, City, and Oblast officials. It may well include representatives of financial institutions. If officials plan to schedule a public hearing, or if citizen or consumer interest groups are otherwise involved in the decision-making process (recommended), those groups should be listed as well.

Next, use interviews to understand the appraisal or informational needs of those different groups. For example, what are the needs/concerns of local officials regarding a metering program? Are

[19] Supplemental materials potentially useful for a workshop/seminar may be found in Raftelis, George A., *Comprehensive Guide to Water and Wastewater Finance and Pricing*, Part I: "Financing Water and Wastewater Services."

they concerned with achieving positive cash flow even under worst-case conditions? Or are they more preoccupied with the impact of the metering program on different constituent groups? What information are they used to having when making programmatic decisions? What data would they like to have? Regarding potential investors, on what basis do they compare investment alternatives? Could they, in fact, lend to the Vodokanal or the City? Record the results of your interviews in Worksheet 4.1.

Worksheet 4.1: Appraisal Needs of Different Decision-Makers

Use the space provided to record: (1) the different decision-makers and interest groups that will review your metering program, and (2) their appraisal needs.

Decision-Makers and Interest Groups	Their Appraisal Needs

Depending on the needs defined above, as well as budget constraints, program/project appraisal can take encompass several different areas. Jenkins and Harberger define the following broad types of investment appraisal for public sector projects:[20]

- *Marketing or demand module* in which the demand for the goods and services, and the prices or the relative needs of social services, are estimated, quantified, and justified;
- *Technical or engineering module* in which the input parameters of the projects are specified in detail and cost estimates developed;
- *Manpower and administrative support module* in which manpower requirements are specified for the implementation as well as the operation of the project and sources of manpower identified and quantified;
- *Financial/budget module* in which the financial expenditures and revenues are evaluated, along with an assessment of the alternative methods of financing;
- *Economics module* in which the economic adjustments are made to the financial data, and the project's costs and benefits are appraised from the point of view of the economy; and
- *Social module* in which the project is appraised from the point of view of who receives the benefits and who pays the costs of a project.

Some consideration was given to the issues raised in modules 1, 2, and 3, above, in Chapter 3. We briefly discuss modules 4, 5, and 6 in the respective sections below.

[20] Source: Jenkins, Glenn P.; and Harberger, Arnold C., *Manual: Cost-Benefit Analysis of Investment Decisions*, 1995, p. 2.4.

4.2.2 Pro Forma Financial Analyses of Operation[21]

In Chapter 3, we defined goods and services required to implement a metering program once installation was complete. Expenditures associated with those items, as well as receipts that the program will yield during operation, should be analyzed, first from a financial perspective. The *financial* analyses are concerned with project performance from a cash point of view. Financial analyses use prices as they actually appear to people in the market. Such analyses are important when considering the implementing agency's liquidity. Those interested in the financial analysis of a metering program would include the Vodokanal, the City, a Government (e.g., Oblast) budget office, and (if a loan is sought) a lending officer.

While "pro forma" (i.e., prospective) financial analysis statements can include balance sheets, income statements, profit and loss statements, etc., the cash flow statement (illustrated at the beginning of this Chapter) is the most relevant for the purposes of project appraisal. As was discussed earlier, one should break receipts and expenditures down into groups (rows) that make analytical sense. Receipts should only include expected cash transactions, not accounts receivable. Use information generated while working through the previous chapters as a basis for defining expenditures. Use Worksheet 4.2 to begin to estimate gross receipts from a metering program.

Inputs into the financial cash flow analysis are based on *estimates* of revenues and expenditures under future conditions. As such, one should be conservative in making projections. An analysis of the sensitivity of the results to different assumptions is appropriate. This involves testing key inputs. For example, if the amount paid by customers as a percentage of amount owed (Column H in Worksheet 4.2) dropped by 20 percent from initial projections, would the project still yield an acceptable cash flow? Or, if the Government backed off on its policy that favors the gradual increase of tariffs paid by the general population (reflected in Column E in Worksheet 4.2), would the project's feasibility be hurt?

The columns in the financial cash flow analysis represent different time periods, e.g., years or half-years. Time periods should be chosen that reveal the program's different phases, as well as debt service patterns. For example, if two project phases are scheduled to occur during one year, or if debt service occurs at half-year intervals, the project's net revenue stream is best illustrated using 6-month (rather than 12-month) time periods.

As suggested above, a metering program should be thought of as just one potential investment, competing with other potential activities for scarce resources. To compare different alternative investments,[22] analysts have developed different approaches, including net present value (NPV) criterion, benefit-cost criterion, and internal rate of return (IRR) criterion. Appropriate criteria

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[21] The source for much of the following is *Ibid.*

[22] Such comparisons can be appropriately made at the financial stage of program/project appraisal only if there are no significant economic distortions to contend with. See following section for discussion.

should be used based on decision-makers' needs. Definitions of those criteria and discussions of their relative merits are outside the scope of this Manual.[23]

Worksheet 4.2: Gross Revenues from Metering Program

In estimating gross revenues from the metering program, one must remember that not all potential revenues will actually wind up as receipts to the Vodokanal. To estimate revenue generation, first calculate the maximum new revenue generation (per phase, per month) as follows (see Column F).

Phase	(A) # of Households Metered under Program (Per Phase)	(B) Avg. Household Water Use per Month According To Norms (Liters)	(C) Avg. Actual Household Water Use per Month (Liters)	(D = C-B) Avg. House-Hold Water Use Currently Unbilled (Ltrs)	(E) Tariff Per Liter (R000s)	(F=A*D*E) (R000s) Max. Potential New Rev. Gen. Per Month
1						
2, etc.						

One must then factor the maximum potential new revenue generation by several factors, to arrive at actual monthly expected receipts per phase, as follows (see Column J).

Phase	(F) (R000s) Max. Potential New Revenue Generation	(G) Reduction in Potential Rev. Gen. due to Water Conservation (%)	(H) Amount Paid in Cash by Consumers to Collectors as % of Amount Owed	(I) Amount Paid in Cash to VKL from Collectors as % of Total Amount Collected	(J = F*(1-G)*H*I) Actual Estimated Monthly Receipts (R000s)
1					
2, etc.					

One should use actual estimated monthly receipts (Column J results) in financial cash flow analyses.

When completed, financial analyses should answer several basic questions, including:

- Does the project have a large enough net cash flow for it to be financially feasible?
- Does the project provide effective debt service coverage during all time periods?
- Is the conclusion of financial feasibility strong/robust? That is, even with changes in key assumptions, would the project still appear feasible?
- What is the minimum net cash flow required from this investment to continue operations without requiring an external injection of funds?

[23] A supplemental source of information that could be translated with permission and used in a workshop/seminar is Jenkins, Glenn P.; and Harberger, Arnold C., *Manual: Cost-Benefit Analysis of Investment Decisions*, 1995, Chapter 4.

4.2.3 Pro Forma Economic Analysis of Operation[24]

An *economic* appraisal examines the program's benefits and costs from the wider viewpoint of the entire economy's point of view, rather than from the more narrow perspective of individual investors. Economic appraisal involves adjusting the results of the financial appraisal to account for *market distortions*, such as taxes and subsidies. One must also take into account *externalities* — the benefits and costs that the project confers outside the project area. Economic appraisal also considers the *opportunity cost* of capital — that is, the activities that had to be foregone when scarce resources were diverted to the project.

4.2.4 Social Appraisal of Operation[25]

A *social* appraisal takes the analysis one step further. It is concerned with identifying and, to the extent possible, quantifying the impacts of the program on different groups in society — in other words, who receives the benefits and who pays the costs. Results of this calculation are particularly useful when they are compared with the social goals initially defined for the metering program.

4.3 Adjust Program Design to Improve Feasibility

As noted earlier, performing the above analyses would yield information that could help improve program design in one of two ways. First, the *scale* of the project could be adjusted. For example, initial program design could have called for the eventual metering (at the building level) of all residential customers. However, analysis of the cash flow could have indicated that metering certain customer groups (e.g., hot-and-cold water customers) would yield less in increased revenues than other groups (e.g., cold water customers). Program feasibility could perhaps be increased by eliminating the metering of the hot-and-cold water customers.

A second way in which the program could be made more feasible would be in the *timing* of individual phases. For example, the immediate metering of residential customers may be financially unfeasible under current tariff structures. However, in several years, if the real tariffs paid by residential customers increase as planned, metering those customers may become feasible. Under those circumstances, we could improve program feasibility by rescheduling the metering of residential customers for a later date.

Based on results of your feasibility analyses, revisit Chapter 3 to see if your program design can be improved. The metering program and its investment plan, along with any program appraisals conducted, should then be reviewed and approved by decision-makers before proceeding to the next step — the pre-implementation stage.

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[24] Source: *Ibid.*

[25] Source: *Ibid.*

Chapter 5
Pre-Implementation

Once decision-makers have approved a metering plan and a financial plan, it is time to begin pre-implementation activities. We have identified the following areas of focus, discussed below: (1) making procurement/bidding procedures more competitive; (2) preparing for meter purchase, etc.; (3) designing a publicity campaign; and (4) revising earlier budget and cash flow estimates.

5.1 Make Procurement and Bidding Procedures More Competitive

During earlier steps, the Vodokanal identified certain goods or services that should be acquired or performed by outside agencies. To help ensure that the Vodokanal gets the goods/services that it requires at the lowest price, one should now review the procurement and bidding procedures to ensure that they will produce *competitive* bids. While a full discussion of bidding and procurement procedures is outside the scope of this Manual, we can offer a few tips.

5.1.1 Bid Document/Request for Proposals

A competitive procedure for *goods* often begins with the preparation of a *bid* (or procurement) *document*. Likewise, when acquiring *services*, one should generally begin by preparing a *Request for Proposals* (RFP). These documents should serve a variety of purposes, including satisfying legal requirements, explaining bidding procedures and method of payments, etc. One major purpose, however, is to clearly communicate to prospective bidders what the client (e.g., the vodokanal) wants. This involves thinking through what exactly is desired and how to achieve that end. For example, to ensure that the work is completed as requested, one may require the contractor to deposit cash in a bank account at the outset of the activity (e.g., monies worth 25 percent of the total value of the contract), and to provide the client with recourse to those resources in the event of unsatisfactory work performance. Guarantees that hardware purchased will continue to function within a certain period (e.g., six months, two years) are also worth considering.

The bid document or RFP should signal how the bids/proposals will be evaluated. One should make selection criteria (e.g., firm experience with similar assignments) explicit.

After specifying what exactly is called for in a bid document or RFP, one should then make the document available to interested parties. This involves publicity, e.g., notices in trade journals. One issue to decide is how wide to throw the net — how large the target audience should be — and the minimum number of bids that are desired (e.g., minimum of three). In Orenburg, because flow meters of acceptable quality were available locally, and because the demonstration project required only small quantities of goods, the USAID/PADCO team decided just to advertise locally for bids. Under most other circumstances (e.g., a larger procurement), and depending on legal restrictions, a vodokanal could choose to advertise regionally, nationally, or even internationally. The target audience chosen will affect the content of the bid document or RFP. To provide competitive bids, international firms, for example, would require different information than local firms. Finally, the bid document or RFP should provide contact information should prospective bidders have additional questions.

5.1.2 Bid Policies and Procedures

Other aspects of bidding and procurement that do not necessarily have to be included in the bid document/RFP should also be made explicit and transparent. The Vodokanal may, for example, wish to provide written guidelines to employees on what information should and should not be communicated to prospective bidders. Those additional policies and procedures should also be reviewed with an eye to promoting free and open competition.

5.2 Prepare to Purchase, Test, Install, Operate, Monitor, and Maintain Meters

After reviewing procurement procedures, one should prepare to buy meters and other hardware.

Information System. An information system represents a fundamental management tool for vodokanal directors. This stage of preparing for program implementation may be a good time to consider whether your current system best meets your needs. An information system is comprehensive. It includes policies, procedures, responsibilities, hardware, software, forms, etc. A system that integrates information using a computer network offers many advantages over a manual information system. Furthermore, a system that ties data to geographic coordinates aids a water service provider in keeping track of assets in active use, etc. Changing from a manual to a computerized system, on the other hand, is a large undertaking that requires substantial resources. Information systems for infrastructure are outside the scope of this Manual.[26]

Hardware. When preparing bid documents associated with a metering program, one will need to specify what hardware (meters, etc.) are required. Depending on needs, the bid can either refer to one phase of plan implementation or several phases. One will want to acquire:

Assets necessary for phase or program installation	+	Assets desired for stockpiling	=	Total procurement

The hardware necessary for immediate installation is calculated by the number of buildings of each type that exist, times the number of different items that are typically required per building (see Section 3.2, above). Because the specific hardware actually required for installation is still an estimation, one should consider a staged plan for purchase, i.e., purchasing hardware phase by phase, to avoid supply shortfalls or excesses. One should also determine whether stockpiles of certain items are necessary and the quantities required. While large stockpiles help ensure continuous service, they also tie up scarce resources that could be used for other ends.

Initial Meter Testing. After purchase, meters should be inventoried, tested, certified, sealed, and stored before installation. Initial meter testing is important, to ensure that the cost of water service is equitably distributed among all customers, as well as to avoid loss of revenue to vodokanals through inaccurate readings. Confirm the Federal Government's process for certifying meters in your area. New meters are typically tested for accuracy of registration. Meters may be tested at given flow rates and given flow quantities, for their accuracy within a given range.

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[26] For supplemental materials that could be translated and included in a seminar/workshop, see UNDP/UNCHS/World Bank, *Utility Mapping and Record Keeping for Infrastructure*, Urban Management Programme, 1993.

In addition to the federal certification process, a vodokanal may have or wish to establish its own testing policies or criteria for new purchases, to avoid accepting substandard or non-functioning equipment.

Ongoing Meter Testing. Besides initial testing, a program for ongoing meter testing is recommended. One should look for a reasonably optimal period for testing meters. This involves balancing the costs of meter testing with the costs that result from billing based on inaccurate meter readings. Likewise, the costs and benefits of meter repair vs. replacement should be weighed. Ongoing meter testing represents part of a meter maintenance program.[27]

Meter Reading. Planning for meter reading involves setting up a procedure. The procedure involves a vodokanal meter reader visiting a building, inspecting the meter, and recording water consumption since the last reading. Water consumption is then calculated and reflected on bills. Employees should read meters on a routine basis, i.e., around the same day every month. Meter reading generally follows the billing cycle; that is, if a customer is billed monthly, his/her meter should be read monthly.[28] For an example of a form that records meter reading and water consumption data, as used by the USAID/PADCO team in Orenburg, see Figure 5.1.

Figure 5.1
Example of Meter Reading and Water Consumption Computation Form

Address: Chkalova 57/1 790 tenants

3/2/96

Date/Time	READINGS						Total consumed, cu.m.	Period, hr	Average per person 24 hr	Average, cold	Average, hot
	Cold water, meter	Cubic m, cold	Hot water meter, supply	Cubic m, hot, supply	Hot water meter, return	Cubic m, hot return					
2/28/96 14:30	914.5		767.8		2427.2						
2/29/96 12:00	1056.4	141.9	1093.3	325.5	2678.7	251.5	215.9	21.5	0.305	0.201	0.105
3/1/96 8:30	1196.3	139.9	1411.8	318.5	2926.8	248.1	210.3	20.5	0.312	0.207	0.104
Total/Average		281.8		644		499.6	426.2	42	**0.308**	0.204	0.104

Monitoring. Water service providers should also plan for meter monitoring. This involves gathering any information besides what was collected during meter reading that is necessary to complete the objectives for the program phase. Monitoring the feasibility of metering is

[27] For potential supplemental workshop materials, see AWWA, *Water Meters — Selection, Installation, Testing, and Maintenance*, 1986, pp. 46 ff.

[28] Some water agencies may read meters less frequently than they bill customers. For example, they may bill customers monthly but read meters quarterly. For those months when current meter readings do not exist, a presumptive level of water use may be calculated for billing purposes. This estimate is then adjusted when actual data are available.

especially critical if a test phase is contemplated. For an example of preparing and implementing a monitoring activity, see Mini-Case Study 5.1.

Mini-Case Study 5.1: Monitoring Water Use in Orenburg

One of the objectives of the metering demonstration project in Orenburg was to estimate, based on samples, the water actually consumed by persons versus water lost through leaks. Meeting that objective involved monitoring water use.

To complete this exercise, after installing meters the team first prepared a meter reading form (see Figure 5.1, above). Next, the team read meters on a routine basis, recording the time and date of meter reading.

To distinguish water consumption from water loss, the team measured water use between 1:00 a.m. and 4:00 a.m. They reasoned that virtually all water used during this period would be water loss due to leaky pipes.

Based on findings, the team concluded that about 20 percent of all water that reached apartment buildings was not consumed, but was lost due to leaky pipes.

5.3 Design Publicity Campaign

As presented in Chapter 1, metering involves a fundamental change in the relation between the water consumer and the service provider. As such, a successful program will involve preparing customers for the change.

Customers should first be made aware of the upcoming program and the benefits of metering. A well-advertised public hearing may be appropriate. The metering and investment plan, along with the program appraisal, offer a focused topic for public review and comment before the plan is approved. Citizen concerns can act as a useful input into plan design. Following plan approval, a TV or radio campaign may be appropriate. Benefits and costs should be realistically described. The need for water conservation should be stressed.

Following such general informational activities, specific customers will need to be notified as meters are installed in particular buildings. For residential customers, a door-to-door leaflet campaign a week or two before meter installation may be the best way to communicate information. Leaflets should contain all relevant information, such as the number for a customer service representative ("ombudsman") at the vodokanal who can provide further information and answer questions, as well as help mediate disputes.

5.4 Revise Budget and Cash Flow Estimates

All of the above activities have implications regarding the use of the work force, shop support, information systems, transportation, etc. Those implications should be thought through during the pre-implementation phase.

Completing the tasks described above will generate data that will help you refine your earlier estimates of costs and revenues. Before starting the next step, revise your estimates accordingly.

Chapter 6
Implementation and Evaluation

As discussed below, after completing the pre-implementation stage one should first (1) implement, then (2) evaluate each program phase.

6.1 Implementation

Organize for Implementation. Organize to implement the program first by setting up an inter-departmental working group, charged with coordinating program implementation. Directors of all departments (both within the vodokanal as well as outside) that are involved in program implementation should participate. The group should meet regularly (e.g., once every week or two) during crucial parts of program implementation.

An initial task for such a working group would be to develop a detailed action plan and schedule of how the program will be implemented — a more detailed version of Worksheet 3.1. Areas of responsibility should be clearly defined. This would involve all directors thinking out their own schedules, and how their departments' activities should coordinate with other actions. This should help Directors develop a personal commitment to the program.

Implement Bidding/Section Process. The appropriate vodokanal department(s) should implement the bidding and selection process, to procure those goods and services that are to be contracted out. This involves finalizing the bidding document and criteria for selection, publishing notices, receiving and evaluating bids, selecting and signing a contract with the winning contractor(s), etc.

Launch Publicity Campaign. The appropriate department should also implement the publicity campaign designed earlier (Section 5.3). To be most effective, officials should coordinate this closely with meter installation (see below). That is, customers should be notified in a timely manner of any temporary service cut-offs or changes in billing procedures.

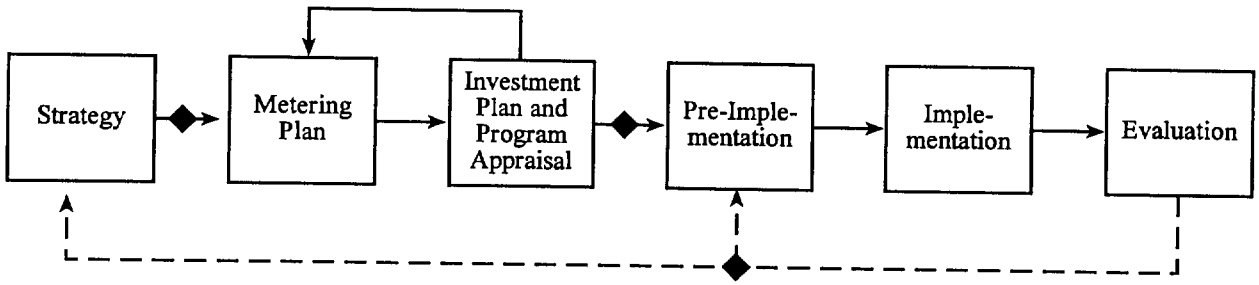
Install Meters. For a particular building, meter installation will likely involve completing several tasks. First, visit each site to determine its specific hardware and installation requirements. Modify generic schematic diagrams of installation prepared earlier as necessary. Next, assemble necessary hardware, visit the site, and install the meters. Finally, revisit the site to ensure that the installation is functioning properly. Replace non-functioning equipment.

Read/Maintain Meters. After installation and any initial testing, one should begin to read the meters on an ongoing basis for billing purposes. At the same time, one should begin an ongoing program of meter maintenance (see Section 5.2, above).

Implement Modified Billing/Collection Procedures. Once meter reading data becomes available, one should begin to implement modified billing procedures.

6.2 Introduction to Evaluation

Evaluation marks the final step in the six-step process that we introduced at the beginning of the Manual.



(NOTE: ◆ = decision-making node)

As shown, evaluation is typically performed after implementing a particular program phase, and before proceeding to the next phase. Results are reviewed and lessons are captured. Evaluation can involve answering the following types of questions:

- Did the phase accomplish its objectives? If not, why?
- Did installation take longer than anticipated? If so, why?
- Did installation cost more than expected? If so, why?
- What problems emerged in implementing the project, for example, problems to do with changed billing procedures, consumer acceptance of metering, hardware, coordination, etc.
- What are the implications of the above regarding implementation of future phases? What lessons were captured that can be applied in the future?

As with program appraisal, the scale and design of the evaluation exercise should correspond to what is needed. A simple evaluation could include the following three-part exercise.

1. Develop one or more "indicators" of the program phase's success. Take as a starting place some quantifiable piece of data, for example, total increased monthly revenue generation. For this measure of program success, actual revenues collected can be compared to target collection benchmarks. This difference can be expressed as a ratio. One might conclude, for example, that after three months, total revenue generation only increased to 80 percent of target levels, rather than to 100 percent of targets. Such a ratio thus serves as an indicator of a program phase's success.

2. Disaggregate findings/analyze results. Next, analyze why the results are better or worse than original expectations. This may involve disaggregating the initial global indicator developed. When we break down the total results by apartment building, for example, we may find out that revenue generation is only lagging in a couple of buildings. Or we may want to trace what happens at different points in the billing and collection system. Perhaps revenues collected have increased substantially, but those increased revenues are not reaching the Vodokanal in the form of cash. Or metering may be producing benefits in the form of water conservation, rather than in the form of increased revenue generation as was originally projected.

3. Capture lessons/draw conclusions and recommendations. Based on your findings, you have to make a fundamental decision: go on with the next phase of the metering program making improvements as necessary, or rethink the whole strategy? As an input into that decision, you may want to revise your projections of program revenues and expenditures. If you decide to go on to the next round of implementation, what lessons have you captured that you can apply in the future?

Program evaluation can become a much more elaborate exercise than the straightforward approach outlined above. For additional supplemental materials that could be used in a workshop/seminar, see Bamberger and Hewitt.[29]

[29] Bamberger, Michael; and Hewitt, Eleanor, *Monitoring and Evaluating Urban Development Programs*, World Bank, 1986.

Selected Bibliography/
List of Potential Supplementary Training Materials

Several documents were noted in the text as potential supplemental training materials. With permission, and depending on training design, those materials could be translated and used to supplement this Manual with a more comprehensive treatment of specific topics. The materials cited in the text are as follows:

American Water Works Association, *Sizing Water Service Lines and Meters*, Manual M22, 1975.

American Water Works Association, *Water Meters — Selection, Installation, Testing and Maintenance*, Manual M6, 1986.

Bamberger, Michael; and Hewitt, Eleanor, *Monitoring and Evaluating Urban Development Programs*, World Bank, 1986.

Jenkins, Glenn P.; and Harberger, Arnold C., *Manual: Cost-Benefit Analysis of Investment Decisions*, Harvard Institute for International Development, 1995.

Pickering, David; Park, Jonathan M.; and Bannister, David H.; *Utility Mapping and Record Keeping for Infrastructure*, UNDP/UNCHS/World Bank Urban Management Programme, 1993.

Raftelis, George A., *Water and Wastewater Finance and Pricing*, 1993.