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EVALUATION OF LEVEL III-A PILOT WATER SYSTEMS IN THE PHILIPPINES

WASH FIELD REPORT NO. 57

SEPTEMBER 1982

Prepared for:
USAID Mission to the Republic
of the Philippines
Order of Technical Direction No. 43

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September 17, 1982

Mr. Anthony M. Schwarzwalder
Mission Director
USAID
Manila

Attn: Mr. Carlos Crowe

Dear Mr. Schwarzwalder:

On behalf of the WASH Project I am pleased to provide you with 10 copies of a report on Evaluation of Level III-A Pilot Water Systems in the Philippines.

This is the final report by Emmett F. Lowry and is based on his trips to the Philippines from June 1981 to March 1982.

This assistance is the result of a request by the Mission on June 10, 1981. The work was undertaken by the WASH Project on June 17, 1981 by means of Order of Technical Direction No. 43, authorized by the USAID Office of Health in Washington.

If you have any questions or comments regarding the findings or recommendations contained in this report we will be happy to discuss them.

Sincerely,

Dennis B Warner

Dennis B. Warner, Ph.D.,P.E.
Director
WASH Project

cc: Mr. Victor W.R. Wehman, Jr
S&T/H/WS

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Prepared for the USAID Mission to the Republic of the Philippines
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Prepared by:

Emmett F. Lowry, P.E.

September 1982

Water and Sanitation for Health Project
Contract No. AID/DSPE-C-0080, Project No. 931-1176
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TABLE OF CONTENTS

Chapter		Page
	LIST OF ABBREVIATIONS USED	iii
	EXECUTIVE SUMMARY AND RECOMMENDATIONS	iv
	PHOTOGRAPHS	vii
	ACKNOWLEDGEMENTS	xi
1.	BACKGROUND	1
	1.1 Scope of Work	1
	1.2 The Barangay Water Program	1
	1.2.1 General Program Description	1
	1.2.2 Levels of Service	1
	1.2.3 Design Criteria	2
	1.2.4 Chain of Responsibility	2
	1.2.5 Financial Arrangements	2
	1.3 Level III-A	2
2.	MAJOR AREAS OF CONCERN	5
	2.1 Physical Aspects	5
	2.1.1 Restrictors	5
	2.1.2 Float Valves	6
	2.1.3 Fittings	6
	2.2 Hydraulic Aspects	6
	2.3 Social and/or Cultural Concerns	6
	2.4 Institutional	7
	2.4.1 Development Manpower	7
	2.4.2 Procurement	7
3.	FIELD OBSERVATIONS	8
	3.1 Itinerary	8
	3.2 Observations	9
	3.3 Manufacturers/Suppliers	10
	3.3.1 Pipe and Tubing	10
	3.3.2 Fittings	10
	3.3.3 Restrictors	10
	3.3.4 Float Valves	11

Chapter		Page
4.	CONCLUSIONS	12
4.1	General Comments	12
4.2	Components	12
4.3	Hydraulics	12
4.4	Community Acceptance	12
4.5	Financial	13
4.6	Institutional	13

REFERENCES

1 Section 5 (Detailed Planning-Technical) of the Barangay Water Program Administrative Procedures Manual

APPENDICES

A. Order of Technical Direction No. 43

B. Excerpt from Reference Section 5

C. BWP Financial Calculation Method

D. Reprint from December 1980 AWWA Journal

E. Tabulation of 14 Pilot Projects

F. Excerpt from Project Preparation Papers regarding Indirect Program Costs

G. Trip Reports

H. Components

LIST OF ABBREVIATIONS USED

BWP	-	Barangay Water Program
GPM	-	Gallons per Minute
LGU	-	Local Government Unit (Province or City)
LPS	-	Liters per Second
MLGCD	-	Ministry of Local Government and Community Development
USAID	-	United States Agency for International Development

EXECUTIVE SUMMARY AND RECOMMENDATIONS

The Barangay Water Program (BWP) of the Philippines is experimenting with low-flow, house connected water systems (Level III-A) as a potential replacement, for the conventional public faucet-type systems (Level II) for rural communities. This report is basically an evaluation of the status of that effort.

The observations, activities and conclusions of the consultant in response to the Water and Sanitation for Health Project Order of Technical Direction No. 43 can be summed up as follows:

1. The scope of work for the four visits to the Philippines under this Order of Technical Direction No. 43 are given in WASH Telex 071 (appendix A). It was modified by the Barangay Project Officer (Mr. C. Brady) after discussion with the AID Office of Health in Washington. The Consultant (Mr. E. Lowry) was unable to comply fully with Items 1, 2, and 3 of the scope of work because local authorities did not complete work on the Sapang Bato water system in time for him to: 1) assist in the start-up; 2) conduct performance tests, and 3) conduct post completion training of operators. The work called for in Item 6 (revision of a post-completion operational manual) was carried forward as far as locally available information would allow. The consultant kept the USAID Mission in the Philippines fully advised of the progress of the above mentioned facets of the project, and the Mission concurred in the modification of the scope of work and considered the work accomplished by Mr. Lowry as completion of his duties. All other parts of the scope of work were fully executed.

2. The performance of Level III-A systems is dependent upon the satisfactory performance of restrictors at each household connection. Local manufacturers and suppliers are not providing components such as restrictors, fittings, or float valves of acceptable quality. These products of proven performance, superior quality and lower cost are available in the United States and consideration should be given to importing these items.

3. A total of 14 communities have been selected for piloting Level III-A low-flow, house connected water systems. Of these, six are still under construction. Three have been put into operation with the restrictors removed and cannot maintain system pressure. The remaining five are fully operational within the restricted flow context.

4. All five systems functioning as designed for low household flow are performing in excess of expectations. The oldest system has been operational more than two years. Extensive questioning of users did not reveal any user who did not receive all the water they desired nor did they know of any user who did not receive all the water they desired.

5. Construction costs for Level III-A systems are less than those of the BWP for the construction of public faucet systems (Level II). Distribution system costs are up to 40 percent less. The cost per capita averaged for all fourteen Level III-A systems is $32.37, including source development and any required transmission lines.

6. Level III-A systems designed and constructed with pipe sizes as determined by the Barangay Water Program standard methodology are hydraulically capable of maintaining required system pressures on a continuous basis with all anticipated users connected and receiving service.

7. The ability of the systems to perform satisfactorily even when being greatly overloaded, indicates that further reductions in distribution costs are possible. System overloading is occurring where restrictors are not being used according to BWP standards, thus allowing above normal flow rates. It appears that the use of proper restrictors will control overloading and with judicious research, less conservative designs could be accomplished.

8. Experience shows that the users understand the concept of low-flow and individual accumulation of water after only one or two days of use. Until this understanding is reached, there is much controversy and anxiety. These reactions are very negative and can be destructive.

   It is possible to bring about a full understanding of the concept by a thorough educational effort at the community level or by having a demonstration system in close proximity.

9. The fact that implementation of Level III-A may improve health benefits and save money is not enough to assure its use. It requires substantially more effort to implement and will require closer monitoring in order to ensure its continued satisfactory operation.

   On a program basis, there is no built-in mechanism in the Barangay Water Program to serve as an incentive to conserve funds. The converse is actually the case. This is because the primary index for measuring success is expenditure, not service. In this light, serving more water to more people for less money could be regarded as a program slowdown.

10. Before any large numbers of Level III-A systems are constructed, an intensive effort should be made to refine the design parameters through investigative research to lower costs as far as practical, consistent with safety and health.

11. The financial arrangements of the Barangay Water Program are designed to establish the water charge for users based almost solely upon "ability to pay". The result of this is that no incentive exists at the community level to keep the cost of their system to a minimum.

12. Local Government Units are demonstrating a very poor capacity for sound procurement. This is due partly to the fact that personnel are not sufficiently experienced to be aware of all options open to them and partly due to cumbersome and inappropriate actions involving treasurers, auditors, and other officials not competent to assess technical components.

    The simple fact that procurement for such an extensive program is broken up into so many individual buying units, all with different policies and practices, makes it impossible for any supplier to realize large quantity sales. The result is a hardware store approach to procurement with little real quality control and lost savings.

RECOMMENDATIONS

The Barangay Water Program should undertake an expanded demonstration effort. Such an effort should be in one selected area with 20 to 30 subprojects implemented as rapidly as possible. For this effort the following is recommended:

1. Only proven components should be used in Level III-A systems. This refers particularly to restrictors, fittings and float valves. These may be imported from the United States at less than local cost. This will represent less than 5 percent of the total cost of the average system.

2. Thorough orientation should be given to each beneficiary community. This must be done only by persons who fully comprehend the concept. Aids should be used to demonstrate the low-flow concept. A working model demonstration, video taped presentations, and comic book-type explanations are only a few of the potential methods that may be used with effect. Sufficient effort must be made so that at least 75 percent of the housewives are given full orientation. It is not sufficient to address only the community leaders.

3. For the expanded pilot region, implement a financial formula which provides a positive incentive to hold system costs down. The system must make it clear to the beneficiary communities that any increase in cost above the estimated minimum must reflect immediately and fully in their monthly water charges.

4. Discontinue procurement of materials by Local Government Units. Employ bulk purchasing by BWP to rigidly enforce specifications. Materials should be warehoused by the supplier for package delivery on a community basis as called for.

5. Employ the services of a single contractor for the pilot effort to conduct all community contact, orientation, study, design, construction and training. This will comprise a turnkey effort except that materials will be supplied by BWP. All work is to be carried out in accordance with BWP administrative procedures.

6. At the conclusion of the enlarged pilot effort, a thorough evaluation should be made as to:

   - level of community satisfaction
   - hydraulic performance of piped systems
   - construction costs and time required
   - household per capita consumption
   - performance of system components

If the evaluation shows that the Level III-A systems are socially acceptable and provide more water in the household than Level II, BWP should consider adopting it as its standard piped water system. As a possible option in this event, BWP could permit construction of an alternate system provided the excess cost is born by the community and 100% amortization of the entire system cost is mandatory. If the evaluation shows that Level III-A is either unacceptable to the people or does not realize a savings in cost, it should be discontinued.

In the event Level III-A should become the BWP standard, it should not be attempted in any community without a thorough orientation similar to that conducted as part of the enlarged pilot effort.

Typical village street scene.

Between houses with storage outside.

Storage outside with piping to inside sink.

Storage inside in food preparation area. Note the traditional Tapayan next to the storage tank.

Partial view of the Barangay Sapangbato showing the riverbed that bisects the area.

Inside storage at sink area. The container is plastic and is furnished as a part of the standard service connection.

A public standpost on a level II system in the Barangay Bulwag-Comanci, Aklan. Each faucet cost 750 pesos in construction.

A line-up for water at a level II system not built by BWP. Serving a mountain community. Up to two hours wait is required.

Filter box at stream intake in the mountains above the Barangay Lamac, Cebu.

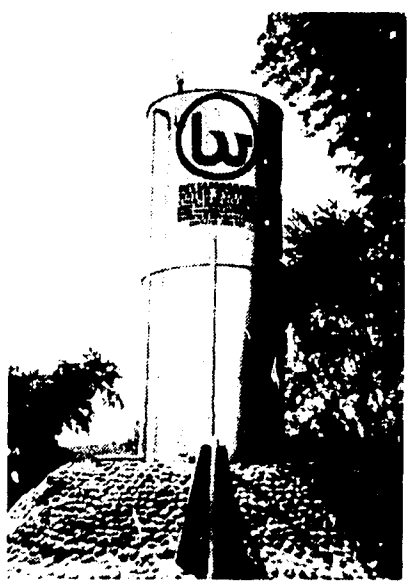
Aboveground steel transmission line to Lamac, Cebu.

The mountain community of Lamac, Cebu.

A connection made between steel pipe and plastic tubing at Calajoan, Cebu. Pipe was simply pushed into the tubing. This is an example of a certain future failure for which no repair parts will be available.

SYSTEM STORAGE TANKS

Buenlag, Calasiano, Pangasinan



Sapangbato, Angeles City

Loctugan, Roxas City

An example of a homemade service fitting using heat fused plastic pipe. No replacements will be available when needed. These fittings were used in Loctugan.

ACKNOWLEDGEMENTS

It must be noted that the original attempt to provide low-cost, house connected water systems in rural areas of the Philippines represents a significant departure from accepted approaches. The United States Agency for International Development Mission in the Philippines deserves a great measure of credit for undertaking the field trials of such an effort with its attendant potential for rewards in health benefits. Specifically supportive were the Mission Director, Anthony Schwarzwalder; Chief of Capital Development, Bill McDonald; and the Project Officer, Chuck Brady.

The Director of the Barangay Water Program for the Ministry of Local Government and Community Development is Engineer Gasper Nempomaceno, who also spared no effort to make the project effective.

Chapter 1

BACKGROUND

1.1 Scope of Work

The scope of work for the subject Order of Technical Direction No. 43 (see Appendix A) was aimed primarily at assisting with the completion phases of a piped water system for the Community of Sopangbato within Angeles City, the Province of Pompanga, the Philippines. Additionally, local manufacturers were to be assisted in the development of the hardware required for Level III-A water systems (described below) and the scope also directed the consultant to inspect each operational Level III-A water system with the purpose of rendering recommendations for improvement and/or modifications. All projects are being implemented under the Barangay Water Program (BWP) of the Government of the Philippines.

1.2 The Barangay Water Program

1.2.1 General Program Description

The Barangay Water Program is being executed in the Philippines under the purview of the Ministry of Local Government and Community Development (MLGCD) and funded by USAID. It has two basic aims. First is to improve the capability of local government units to plan and implement potable water improvement schemes for small communities. Second is to encourage sound construction, operation and maintenance of various types of water service for rural communities with a population of 10,000 or less. There are an estimated 43,000 such communities in the Philippines.

1.2.2 Levels of Service

The BWP recognizes that no single solution is appropriate for all Barangays. Some are very sparse while others are diversely populated. Some are relatively wealthy as compared to others. Some are located in areas where water is relatively scarce while others have several alternative natural sources to select from. Accordingly, different levels of service are available as described below.

LEVEL I. This is simply the provision of hand pumps at point sources. Each user is expected to pump his own water and fetch it to the place of use.

LEVEL II. This is a piped water system where water is produced and delivered under pressure to a minimal distribution system which is equipped with metered public faucets. These public faucets are to be placed in a manner convenient to the surrounding users at a desirable ratio of one faucet for each 10 homes.

LEVEL III. This is a conventional piped water system where the distribution system is designed to support individual household connections complete with meters. This level is not presently offered by BWP because it is considered too expensive.

LEVEL III-A. This level is considered experimental and, therefore, was only attempted in a limited scale for study purposes. It is described in detail in Item 1.3 below.

1.2.3 Design Criteria

Section 5 of the Administrative Procedures Manual for the BWP (Ref. 1) sets forth the design criteria being utilized by the program. All piped system alternate designs are to be capable of delivering 15 gallons per capita per day (60 LPCD) with a minimum allowable system pressure of 5 PSI (3.5 meters). Appendix B is an excerpt from the referenced Section 5.

1.2.4 Chain of Responsibility

The Barangay Water Program is arranged so that the Manila Headquarters establishes the basic guidelines, criteria and standards of the program. The BWP also provides the funding for subprojects by reimbursing the participating Local Government Units (LGU) for work accomplished according to those guidelines. The LGU's receive both institutional and technical training from the BWP.

Each of the participating LGU's has the responsibility of performing all relevant tasks in the implementation of each subproject. This includes surveys, preliminary engineering, community organization, final design, materials procurement, contract administration, construction monitoring and operational training.

The BWP office monitors the performance of each LGU, reviews technical and financial procedures, and verifies construction conformance to standards. By annual recertification, the overall performance of each LGU is used as a basis for the establishment of the allocation of funds for the next year. Theoretically, each LGU can increase its funding allocation exponentially each year by sound implementation of program precepts.

1.2.5 Financial Arrangements

Section 4 of the above-referenced administrative procedures Manual sets forth a formulated method for establishing both the monthly charge to be levied for water service and the capital cost amortization structure (see Appendix C). This is accomplished by arriving at a monthly charge which is considered to be within the communities ability to pay. Anticipated operational and reserve funds are deducted from this amount and the balance is committed to loan repayment. The loan period is a maximum of 20 years. Capital costs not recovered through this schedule are considered as a grant.

1.3 Level III-A

Experimentation with a new level of service was prompted by the desire to overcome two basic weaknesses of the Level II systems.

Because water must be carried into the home from public faucets, the expenditure in human resources for water is exhorbitant, especially if the provision of 60 liters per capita per day is to be achieved. The end result is that

the consumption rate is actually less than 30 liters per capita per day. Also, in the act of transporting the water contamination is common, either because of human contact or the use of unclean vessels.

The second basic problem is that of cost recovery. It has been very poor. There is very little pressure, other than social, which can be exerted to prevent non-payment of water from a public faucet. The percentage of non-paying users is too high to be offset by those who do pay. Financial feasibility, even for operation and maintenance only, is highly problematical.

In addition, the experiences of the BWP has been that the users themselves are generally unsatisfied with Level II systems. In almost all cases before a Level II system is even complete many, if not all, of the more affluent members of the community make direct connections from the distribution system into their homes. Since these same persons are usually the members of the policy-setting board of the Rural Water Association, control over such actions to ensure equitable payment for usage is questionable. This has occasionally occurred to such an extreme that no public faucets were installed in the system. The result then is that the poor have no direct access to the system. It was also a goal of the III-A concept to avoid any increase in construction cost over the Level II system.

The physical aspect of the Level III-A system is to eliminate the greatly fluctuating flow rates that are characteristic of Levels II and III. These fluctuations are costly in that the system must be large enough to maintain the minimum system pressures even during the short periods of peak flow rates. The anticipated relationship between "average" flow and "peak" flow then determines distribution pipe sizes. Because of the relatively uniform nature of users within small rural communities and the consequent similar daily habits, it is likely that the percentage of public faucets being utilized simultaneously will be quite high. This fact could conceivably create higher peak factors in Level II systems than in Level III systems.

Level III-A attempts to deliver water directly to each household yet minimize flow fluctuations by artificially restricting flow to each household to a point where extraction will be almost continuous in order to receive the amount of water desired by each. By the application of a restrictor in the service line to each household, a nominal 1/10 GPM (.006 LPS) is delivered. Each household is furnished with a storage unit of at least 25 gallons equipped with a high water level float operated shut-off valve and a standard faucet outlet at the bottom.

By accumulating this low but continuous flow in the storage unit during periods of no usage, water is available for periodic usage up to 25 gallons at any one time. Theoretically, 144 gallons of water will be available each 24-hour period at each household. This is substantially more than the 15 gallons (60 liters) per capita which is the goal of the program.

The physical result of reducing the peak factor from, say 2.0 for Level II to an estimated 1.1 for Level III-A, is the drastic reduction of distribution pipe sizes and operational storage requirements.

Level II requires on the order of 20 percent of the total daily production to be stored to meet peak flow demands. Level III-A will require less than 5 percent to be stored since the peak demand is so much less.

To further clarify the III-A concept, the article printed in the December 1980 issue of the AWWA Journal is reproduced here in Appendix D.

With the development of this concept, the BWP decided to introduce it to a limited number of communities which would otherwise receive a Level II system. The purpose of the limited attempt was to prove or disapprove the principles involved and to identify any problem areas for resolution before any larger scale implementation could be considered.

Fourteen communities were eventually designated as candidates for Level III-A. A tabulation of these may be seen in Appendix E.

Chapter 2

MAJOR AREAS OF CONCERN

2.1 Physical Aspects

Implementation of the Level III-A concept required the use of materials and components which are not commonly used in the Philippines domestic water supply industry. Components of the type required have been in general usage elsewhere in the world and for other applications. In the original project design it was anticipated that these relatively simple components could be manufactured locally.

Each of the specific components of concern are discussed below.

2.1.1 Restrictors

Simple constant head flow tests were conducted on two basic designs of restrictors expected to limit flow to 0.1 GPM (.006 LPS). One was a simple orifice, the other was a pin captive in a hold creating an annular orifice. Both performed as expected under test and the pin-type was selected for two reasons. The plain orifice is a very small hole. Consistent accuracy in drilling such a hole is not as easy as it may appear and due to anticipated breakage rate of small drills, could be expensive. The pin-type utilized a 3/16 inch diameter brass rod whose outside diameter was reduced by turning on a lathe and then inserted into a 3/16 inch drilled hole. The difference in diameters would create an annular orifice which it was felt could be kept free from clogging since it would require many particles to close the orifice.

In actual practice it was found that no manufacturer even approached the actual design diameters. Extreme accuracy was not necessary but the actual variations were so great that flow rates could not be expected to conform to the design concept.

Actual events have proven the pin restrictor to be a poor selection under the conditions being encountered. There is much more particulate matter in the water from the new systems than was anticipated and the pins readily become clogged. This could perhaps be solved by furnishing cleaner water, but BWP has elected to change to orifice restrictions which are more effective.

For the same reason that pin restrictors were not manufactured with sufficient consistency, it may be expected that the manufacture of orifice restrictors will also be inconsistent. An additional area of concern is the applicability of fixed restrictors to deliver reasonably uniform rates of flow throughout a distribution system where residual pressures are at great variance. An attempt to address this problem was the use of three different fixed restrictors for the high intermediate and low pressure areas of the distribution system.

2.1.2 Float Valves

In the original concept of the III-A system each household would be provided with a container for the storage of water. The inlet of each container was to be equipped with a float-operated shut-off valve.

A very inexpensive yet highly reliable small float valve has been on the market in the United States for over 25 years. It has no present application in the Philippines and is, therefore, not available on the local market. It was a major concern as to whether or not the suppliers could provide a suitable product that was both reliable and inexpensive.

2.1.3 Fittings

The pipe industry has developed very well in the Philippines for the more conventional sizes. For 4 inch pipe and larger, a wide range of good fittings are available. The BWP project, however, requires almost exclusively 4 inch pipe and smaller down to 1 inch for mainline sizes. In these smaller sizes, the pipe manufacturers do not have ready stocks of proven fittings. It is necessary for them to either import fittings or attempt to manufacture them locally.

2.2 Hydraulic Aspects

All designs for Level III-A systems are based upon conventional hydraulic premises for given flow rates. There is, however, no precedent to guide a designer in the determination of what the actual flow rates will be. Individual flow rates may vary enough from the standard 1/10 GPM to cause different results. Also, there is no way of being sure what percentage of tributary users to any pipeline will be extracting water simultaneously.

In the development of the design methodology several assumptions were made and reasonable safety factors were applied to ensure that minimum system pressures would be maintained. This is considered to be vital since substantial contamination of the system would be the likely result if there are negative pressures.

2.3 Social and/or Cultural Concerns

In many of the remote areas of the Philippines the concept of pipe water supplies of any kind is not well understood. There existed a real concern that the average user would completely reject the idea of only 1/10 GPM inflow before he had a chance to grasp the potential of its accumulation.

Also, there was the fear that a people would not be able to resist removing the restrictors. If this occurred very often, the system would fail to maintain minimum pressures.

2.4 Institutional

Two separate areas of institutional concern existed. One is the man-hours required to implement each subproject. The other is the ability of Local Government Units to obtain adequate quality components at reasonable prices.

2.4.1 Development Manpower

The most effective means for counteracting probable rejection, of low-flow systems is education. It has been demonstrated that with sufficient time and patient effort, the concept will become well understood and accepted. This would require a significant amount of time of local government personnel who are trained in this type of work.

Appendix F is a breakdown of the estimated time required for any water system subproject in the Philippines. It shows that a total of 13.6 man-months is required for each subproject. Local government units are reluctant to accept this reality. The result of underestimating the time requirement is that insufficient time is allowed, and some activities are either ignored or given minimum effort. If this happens, the first area to suffer is that of community contact and organization. These are non-physical, are time-consuming, and relatively difficult to perform adequately.

2.4.2 Procurement

The Barangay Water Program is set up so that each LGU, as it implements each subproject, does the procurement of all materials or administers a contract whereby materials are furnished by an installing contractor. In either case, a supplier is only concerned at any one time with an order for a relatively small quantity of components. The prevailing economic climate for manufacturers is such that there is little incentive to expend significant funds for the development of new products unless large quantities are involved.

Chapter 3

FIELD OBSERVATIONS

3.1 Itinerary

As stated in Chapter 1, a basic aim was to assist in the proper completion of the Sapangbato water system. It had been hoped that making two separate visits would facilitate this. The first visit was to identify problem areas and establish a series of steps to be taken for completion. The second visit was intended to perform complete tests of the system and conduct operational training. Unfortunately, after as much as nine months after the first visit, very little real progress has been made and the most important of the initial recommendations had not yet been accomplished.

The second basic aim was to evaluate performance of the other Level III-A systems being piloted. In this regard, far more was accomplished. The following is a day-by-day accounting of the consultant's activities.

First Visit:

22 June '81 - Briefing at AID/MANILA and BWP office
23 through 25 June - in the field at Sapangbato
26 June - Buenlag, Calasiao, Pangasinah
27 June - Discussions with manufacturer (Moldex)
29 June - Calajoan, Cebu and Liburan, Car-Car, Cebu
30 June - At Lamac, Cebu
1 July - Loctugan, Roxas City
2 July - Solido, Aklan
3 July - Travel and debriefing at Manila

Second Visit:

24 August '81 - Sapangbato, Angeles City
25 & 26 August - BWP with manufacturers and representatives of Angeles City
27 August - Sopangbato
28 August - Visiting manufacturers facilities
31 August - BWP office
1 through 4 September - Sopangbato
7 September - Visit Luzon Foundry and Eastern Foundry
8 September - BWP office
9 & 10 September - Sopangbato
11 September - Debriefing at Manila

Third Visit: (Not scheduled or charged for)

19 November '81 - Sopangbato

Fourth Visit:

15 March '82	- AID and BWP offices
16 March	- Sopangbato
17 March	- Buenlag, Calasiao
18 March	- Calajoan & Mantalongon, Cebu
19 March	- AID & BWP offices
22 March	- AID office
23 March	- Travel to Kalibo, Aklan (delayed)
24 March	- Solido, Aklan
25 March	- Roxas City
26 March	- Travel and at AID office
29 March	- Debriefing at AID

3.2 Observations

Detailed trip reports are included in Appendix G. The following are encapsuled statements regarding the conditions observed at each Level III-A pilot community.

SOPANGBATO, ANGELES CITY. 1,063 households, estimated system construction cost P977,000 ($130,000) constructed by administration, deepwell source.

The distribution system is complete but contains substanital quantities of dirt and debris that have not been flushed out. Restrictors immediately plugged up and have been removed. The deepwell pump and booster pump have to be equipped with testing appurtenances and, accordingly, have not been tested. System is not yet operational.

SOLIDO, AKLAN. 148 households, system cost P223,000 ($29,700) constructed by administration, source is groundwater pumped from shallow well.

This system has been operational for two years with great success. Initially the system failed because restrictors were resisted and not used. System performance and individual deliveries are very close to program parameters. All users receive ample service.

Problems exist with consumers experiencing rust in the water as a result of the use of unauthorized and non-program standard materials. Steel service pipes and storage tanks were used where plastic was specified.

BUENLAG, PANGASINAN. 525 households, system cost was P501,766 ($66,900) constructed by administration, source is groundwater pumped from two deepwells with shallow levels.

Construction took more than two years and had been complete and fully operational for six months. All users are satisfied with service. Restrictors are oversized to the point where individual extraction rates are higher than the program standard of 1/10 GPM but system performance is still adequate.

MANTALONGON, CEBU. 170 households, system cost was P324,000 ($43,000) constructed by a general contractor, source is a spring approximately one kilometer distance.

The system is fully operational. The restrictors have been altered to drastically increase the individual flow rates. This was done before the system was activated and was the result of perceived concern rather than any unsatisfactory experiences. All users are content with the service. No instances were found of inadequate or intermittent delivery.

CALAJOAN, CEBU. 250 households, system cost was P674,000 ($89,900) constructed by a general contractor, source from deepwell.

The system is fully operational. Again, the restrictors were altered by the same people and for the same reason as at Mantalongon, but not to as great an extent. All users are receiving ample water and are satisfied with the service.

LUCTUGAN, ROXAS CITY. 206 households, system cost was P295,000 ($39,300), constructed by contractor, source from deepwell.

Time and travel constraints did not permit a visit after the system was activated. The system is not fully operational. All restrictors were removed and as a result the users located at the higher elevations and extremes of the system receive no service.

3.3 Manufacturers/Suppliers

3.3.1 Pipe and Tubing

The BWP standard call for polyethylene (PE) and polybutelyne (PB) to be used for all applications under 4 inch in diameter. Several local manufacturers in Manila have proven their ability to produce these products to meet stringent international standards. No problems are experienced in the field with these products when they are properly installed.

3.3.2 Fittings

The manufacturers and suppliers of the smaller diameter pipes are accustomed to their products being used exclusively for service lines and, accordingly, are only prepared to provide end fittings for that type of usage. To use these small pipes for mainline use such as Level III-A requires that tees, crosses and reducers be utilized. As a general rule, these items are not stocked by suppliers. They are reluctant to set up stocks for relatively small individual orders. The result is that most fittings are handmade.

The attachment fittings for the small service lines coming off the main lines are very crudely produced. As a result, poorly fitting components are leaking and these leaks are very difficult, if not impossible, to completely stop.

3.3.3 Restrictors

No instances were found where the restrictors were manufactured in accordnace with the BWP drawings. Every conceivable discrepancy was found. The restrictor body in one case was plastic instead of brass. The drilled holes were oversized and not of uniform diameter. Pins were tapered instead of straight.

3.3.4 Float Valves

Only one supplier (Moldex) attempted to design and produce their own model float valve. Three different versions were attempted. None of them were reliable, although they were relatively expensive (P70). The other two suppliers elected to use toilet tank shutoff valves. These performed well but were also expensive.

Chapter 4

CONCLUSIONS

4.1 General Comments

The basic conclusions are: 1) that low-flow house connected water systems (Level III-A) are technically feasible, cost up to 40 percent less than Level II systems, and allow for cost recovery through effective enforcements of usage charge; 2) the problems which have been noted in this report are program-wide and not confined to any single level of service; and 3) the pilot effort should now be enlarged but with all noted problem areas addressed.

4.2 Components

It was a basic mistake to attempt to produce sound water systems with 100 percent locally produced components. Items such as restrictors, fittings and float valves represent a very small percentage of the overall system cost. Through their lack of performance, however, they adversely affect the entire program. Proven products of these types are readily available at much lower costs outside the Philippines.

Appendix H shows representative components made by manufacturers that have had upwards of 15 years experience and have produced millions of units. Costs are less than half that of the poor quality local compenents. Note that the illustrated restrictor is pressure compensated to produce uniform flow within a wide pressure range.

4.3 Hydraulics

The precepts under which the Level III-A systems were designed have proven to be workable. The observed instances were systems are capable of performing satisfactorily even when extraction rates are greatly increased attest to the conservative nature of the designs. Accordingly, it may be concluded that the use of very small distribution pipelines in accordance with BWP tabulations is adequate and has a substantial margin for safety.

4.4 Community Acceptance

The concept of a very small but continuous flow of water in a household and its storage is difficult to convey to most rural folk. With an adequate amount of time devoted to community education, however, it finally becomes understood and accepted.

Once this understanding is obtained, the advantage of Level III-A service over Level II (standpost) service is usually apparent to the users, particularly the women of the community.

4.5 Financial

The projected savings in cost, of up to 40 percent to construct the distribution system for Level III-A service as opposed to Level II service, is actually being realized (see Appendix D). The high level of conservatism being realized in Level III-A system performance gives further credence to the expectation that an additional savings can readily be achieved through sound research.

No savings are realized or were anticipated in the construction of sources or transmission facilities. This is because these are built to meet maximum day requirements which are treated the same by BWP for Levels II and III-A.

4.6 Institutional

With the prevailing financial structure employed by the BWP, the cost to build a system is not a factor in a community's comparison of systems since any amortization is based primarily upon "ability to pay" and not "cost". Either decisions of this type must be made on a program basis and not at the community level, or institutional changes should occur so that any decision by a community that increases system cost over the minimum will result in the additional costs being born directly by that community regardless of any "ability to pay" determination.

APPENDIX A

- Order of Technical Direction No. 43

- Instructions from C. Brady of 24 August '81

June 17, 1981

Water and Sanitation for Health (WASH) Project
Order of Technical Direction Number 43

TO: Dr. Dennis Warner, Ph.D., P.E.
WASH Project Director (Acting)

FROM: Mr. Victor W.R. Wehman, Jr., P.E., R.S. VWW
AID WASH Project Manager

SUBJECT: Provision of Technical Assistance Under WASH Project Scope of Work for USAID/Philippines

REFS: A) MANILA 10774 dated 14 May 81, B) WASH telex No. 061 dated 20 May 81, C) MANILA 12981 dated 10 June 81, D) Brady/McJunkin/Wehman telephone conversation on May 1, 1981, regarding use of Emmett Lowry for Sapangbato, E) Brady/Wehman telcon 22 May 81, and F) Brady/Arbuthnot telcon 22-25 May 81

1. WASH contractor requested to provide technical assistance to USAID/Philippines as per REF C, para. 2.A. and 2.B. Scope of Work.

2. WASH contractor/sub-contractor/consultants authorized to expend up to 52 person days effort over a three (3) month period to accomplish this technical assistance effort.

3. Contractor to provide draft final report to mission on all elements of REF. C, para. 2.B. before leaving Mission. Consultant to have USAID/Philippines project officer (Mr. C. Brady) send cable indicating degree of satisfaction with completeness of consultant's work before consultant finally leaves for next assignment. Consultant to return to WASH office in Rosslyn to complete final version of reports and for debriefing purposes before returning to consultant's home base. Final report due in DS/HEA and Mission within 30 days of consultant finishing mission in Philippines and leaving Philippines.

4. Contractor to coordinate directly with USAID/Philippines (Mr. C. Brady). Ensure that this OTD is provided to and discussed with Dr. Curlin (health officer-Asia Bureau); Mr. Hasan Hasan (Chief Engineer-Asia Bureau); ASIA/PD Philippines officer (Mr. Jay Nussbaum) and ASIA/PTB desk officer (Mr. Carl Penndorf) in an expeditious manner.

5. Fifty (50) person days of international or domestic per diem is hereby authorized.

6. One international airfare or travel from Thailand to Manila to Washington, D.C. to San Diego authorized.

7. Up to eight (8) round trips (domestic, Philippines) from Manila to Davao and return to Manila authorized during three month period of this OTD.

8. Local ground transportation - taxis, motorcycles, car or animal rentals authorized as necessary and appropriate.

9. Seven day work week authorized if necessary and proper and certified by USAID/Philippines project officer (C. Brady) and chief consultant, Mr. Lowry.

10. Miscellaneous expenses authorized, NTE $400.

11. Local graphics and reproduction costs and secretarial expenses authorized in addition to person days authorized in para. 2 of this OTD, NTE $1600.

12. WASH consultant required to take representative group of 35 mm color slides to adequately portray level III A typical system (design, O&M aspects, community acceptance aspects, and success/problem areas to date) and to use these slides or other materials for debriefing purposes in Washington for Asia Bureau and other interested Agency individuals.

13. Mission and consultant should be contacted immediately and technical assistance initiated as soon as possible or convenient to USAID/ Philippines. Ensure WASH consultant is properly backed up during period of technical assistance.

14. Appreciate your prompt attention to this matter. Note that Mission wants his services to start on 22 June 1981. Good luck.

VWW:ja:6/17/81

WASHAID 64552

OUR TLX 071

TO: MR. C. BRADY
USAID MISSION
MANILA

FROM: DENNIS WARNER
ACTING DIRECTOR
WASH PROJECT

SUBJECT: AUTHORIZATION FOR MR. EMMETT F. LOWRY, CONSULTANT TO WASH PROJECT, TO PROVIDE TECHNICAL ASSISTANCE TO USAID/PHILIPPINES ON THE BARANGAY WATER PROGRAM.

REF: MANILA 12981
WASH ORDER OF TECHNICAL DIRECTION NO. 43

PLEASE GIVE THE FOLLOWING MESSAGE TO EMMETT F. LOWRY:

YOU ARE HEREBY AUTHORIZED, IN ACCORDANCE WITH WASH ORDER OF TECHNICAL DIRECTION NO. 43, TO SPEND UP TO 45 PERSON DAYS OF TECHNICAL ASSISTANCE TO THE USAID MISSION IN THE PHILIPPINES ON THE BARANGAY WATER PROGRAM. THIS TIME INCLUDES TECHNICAL ASSISTANCE, TRAVEL AND DEBRIEFING. YOU ARE ALSO AUTHORIZED TRAVEL AND PER-DIEM FROM BANGKOK, THAILAND TO MANILA, PHILIPPINES TO WASHINGTON, DC AND TO SAN DIEGO, CALIFORNIA. YOU ARE REQUESTED TO SUBMIT A DRAFT FINAL REPORT TO THE MISSION BEFORE FINAL DEPARTURE FROM THE PHILIPPINES. MOREOVER, YOU ARE REQUESTED TO RETURN TO THE WASH OFFICE IN ROSSLYN TO COMPLETE THE FINAL VERSION OF YOUR REPORT AND FOR DEBRIEFING PURPOSES BEFORE RETURNING TO YOUR HOME. PLEASE CONFIRM THESE ARRANGEMENTS.

THE SCOPE OF WORK INCLUDES:

1. DIRECT OPERATIONAL START-UP AND DELIVERY OF SYSTEM,
2. CONDUCT PERFORMANCE TESTS OF SAPANG BATO WATER SYSTEM,
3. CONDUCT POST-COMPLETION TRAINING FOR SAPANG BATO WATER SYSTEM,
4. RECOMMEND DESIGN REFINEMENTS AND REMEDIAL MEASURES FOR SYSTEM DEFICIENCIES,
5. ASSIST LOCAL GOVERNMENT PERSONNEL IN THE ADAPTATION AND IMPLEMENTATION OF DESIGN REFINEMENTS,
6. REVISE POST-COMPLETION TRAINING MANUAL AS NECESSARY,
7. COORDINATE WITH LOCAL MANUFACTURERS IN THE DEVELOPMENT AND IMPROVEMENT OF RESTRICTORS, FLOAT VALVES, HOUSEHOLD STORAGE TANKS AND CHECK VALVES NEEDED FOR BROADER APPLICATION OF LEVEL IIIA WATER DELIVERY CONCEPT,
8. VISIT EACH OPERATIONAL LEVEL IIIA PROJECT IN ORDER TO INSPECT AND RENDER RECOMMENDATIONS FOR SYSTEM IMPROVEMENTS AND MODIFICATIONS.

LOCAL GROUND TRANSPORTATION AND APPROVED MISCELLANEOUSS EXPENSES ARE AUTHORIZED AS REQUIRED. SEVEN DAY WORK WEEKS ARE AUTHORIZED IF NECESSARY AND CERTIFIED BY YOURSELF AND USAID/PHILIPPINES PROJECT OFFICER (C. BRADY).

YOU ARE REQUESTED TO TAKE REPRESENTATIVE GROUP OF 35 MM COLOR SLIDES OF LEVEL IIIA SYSTEM (DESIGN, O + M ASPECTS, COMMUNITY ACCEPTANCE ASPECTS, AND SUCCESS/PROBLEM AREAS TO DATE) FOR USE IN DEBRIEFING IN WASHINGTON.

PLEASE KEEP THE WASH OFFICE INFORMED CONCERNING YOUR LOCATIONS, PROGRESS AND ANY POSSIBLE PROBLEMS.

Western Union International, Inc. Telex

FROM C. BRADY 24 AUG. '81

Emmett Lowry

As per our phone conversation on Monday, I would appreciate your doing the following for the two weeks that you are here: Basically, I would like for you to dedicate your entire time to Sapangbato and its related problems. Specifically, I would like for you to do the following:

1. Read the letters in the folder that Glo is holding for you. They explain the status of Sapangbato.

2. Travel to Angeles as soon as possible - Monday or Tuesday. Touch base with Romy and update yourself on remaining items to be accomplished. Not much in this respect has changed since your last visit. Procurement of satisfactory devices remains the principal problem.

3. Spend as much time as possible with the suppliers, particularly Gascom, and Moldex in an effort to work out problems peculiar to Sapangbato. Any time which you can spend with suppliers in general, the above two and Liberty, would be useful. The focus should be Level IIIA devices - floats and restrictors primarily.

4. There are 45 additional households (below the bridge and south along the riverthat have been added to the system in Sapangbato.)

   Please take a look at the engineering design for these additional houses and critique Romy's "Change Order" before he sends it in to BWP. I am trying to hold the line on the labor component. The figure mentioned in my letter to Romy is the "bottom line."

5. People near the Radar on the Northwest end of Sapangbato are being resettled to a point directly south and across the river from where they are now.

   Please discuss this with Romy and Ralph and do some comparative calculations on: a) extending the existing system to the resettlement area for up to 168 households, or b) doing a new small system at the resettlement site. My own rough estimates put the costs at around ₱250,000 for either alternative. Both propositions have some obvious advantages. Your opinion would be appreciated. Please do not, if possible, create the impression in Angeles that BWP can, or will, do either of the above alternatives, too many people have yet to agree to either proposal.

6. I would also like for you to try to spend a few hours with Alan Pashkevich of GTI. Please give him your views on Level I activities in the Philippines and your views on any limiting factors of the Batelle (AID) handpump.

Accomplishment of the above items and a brief "after action" report will keep you busy for the two weeks that you are here.

Sorry to miss you. Please keep Bill McDonald and/or Tom Rishoi informed of your whereabouts/activities.

Best regards.

Chuck

P.S.

I would appreciate your leaving copies of any devices that you might bring with you in my office when you leave. If they are not reimbursable under your WASH contract, I would be glad to make payment for anything you leave behind.

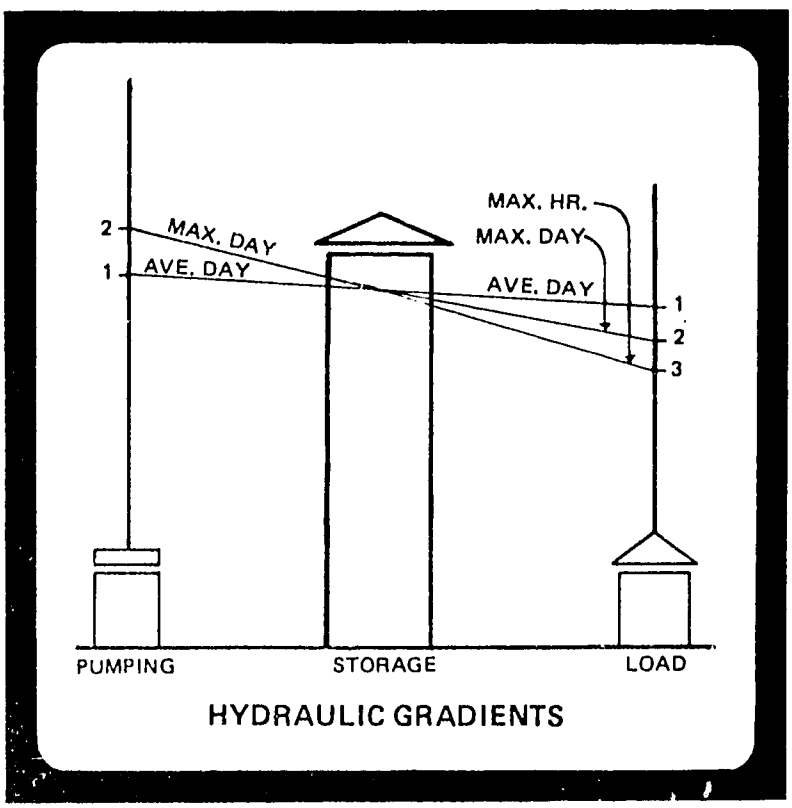
APPENDIX B

Excerpt from Reference Section 5

Ministry of Local Government and Community Development

BARANGAY WATER PROGRAM
Administrative Procedures

SECTION 5



HYDRAULIC GRADIENTS

SECTION 5

DETAILED PLANNING—TECHNICAL

5.1.2 Design Criteria

Initial designs should be constructed on the basic values provided below. As experience with these systems is accumulated and supporting data is gathered, they will be further refined to reflect actual operations.

1.	Minimum system pressure at peak hour with no fire flow		5 psi
2.	Maximum system pressure where the service area terrain is relatively flat (elevation differences do not exceed 100 ft)		50 psi
3.	Maximum system pressure where the service area terrain is hilly (elevation differences exceed 100 ft)		150 psi
4.	Per capita consumption (average)		15 gal/day
5.	Maximum daily demand		120% of ave. day
6.	Storage –	Level II	6.0 gal/capita
		Level III	4.5 gal/capita
		Level III–A	1.0 gal/capita
7.	Slow sand filter rate		0.3 sq/ft./capita
8.	Maximum allowable flow rate for any connection –		
		Level II & III	3 GPM
		Level III–A	0.1 GPM
9.	Design periods for:		
		Wells	10 years
		Surface water treatment	10 years
		Long transmission mains	20 years
		Storage	present
		Distribution network	present
		Pumping machinery	10 years

APPENDIX C

BWP Financial Calculation Method

4.2 Structural Survey

4.2.1 General

The purpose of the structural survey is to determine a target community's average household income, and, on the basis of this income level, establish whether the community's population is within the target beneficiary group of the Program.

As an instrument to gauge household income, the structural survey is premised on the assumption that the quality of a household's dwelling structure is indicative of its income level. This assumption is generally accepted as true but its degree of accuracy remains uncertain. Because of this uncertainty, the Program recognizes that in using the income-dwelling structure correlative approach, it sacrifices a bit of accuracy as a trade off for the manpower and time saved in conducting household interview-type surveys. The Program is willing to make such short term tradeoffs in the interest of expediting program implementation. Procedures discussed herein accomodate corrective actions that can be taken should a distorted income figure result.

The structural survey is a quick but diligent ocular inspection of the dwelling structures within the proposed service area. Houses are categorized or given "structural values" based on a scale of one to ten that progresses as the structure's size, quality of building materials and architectural treatment improves. The average "structural value" of the community which is computed by a simple averaging of all the structural values, is translated into an income figure by multiplying it with an income–structural value constant. The derivation of this constant is fully explained in section 4. 2. 3.

4.2.2 Procedures in Conducting the Survey

4.2.2.1 Preliminary Activities Prior to Actual Survey

4.2.2.1.1 *Meet with Barangay Captain.* Before conducting the actual survey, team should brief the Barangay Captain and other community leaders as to the purpose and mechanics of the survey, and, thereafter, seek their cooperation and assistance in developing a water resource profile and a topographic map of the barangay. The water resource profile should indicate the numbers and types of existing water supply sources, e.g., hand pumps, dug wells, spring. The map should show the political boundaries, road network and other important land marks within the barangay. A sample sketch of a barangay is shown in Figure 1.

4.2.2.1.2 *Determine the Service Area.* Based on the sketch of the barangay, the team shall conduct a quick ocular inspection of the community to determine the likely area to be served by the waterworks system.

4.2.2.1.3 *Assignment of Area Coverage.* If the survey will be undertaken by a team, each member should be assigned a specific area of coverage.

4.2.2.2 Conducting the Survey

4.2.2.2.1 Canvassing of the Barangay. Canvassing means travelling all the roads and trails from one housing structure to another while noting the description of each.

General rules for canvassing:

a. One should canvass the entire work area that he/she is assigned to.
b. Before canvassing one should examine his/her sketch and plan a route that will ensure coverage of all the dwelling structures.
c. Canvass all roads and trails in the designated work areas even if such roads, trails and paths are not shown on the sketch. These should be drawn on the sketch as the canvassing progresses.
d. While canvassing, be alert to structures that may be partially hidden.

Rules for Path of Travel:

The reason for the following concise rules is to assure that every dwelling structure is covered. These rules should be followed as closely as possible.

a. Begin canvassing at one boundary of the designated work area.
b. List and categorize household structures on the right side of the road as the canvass progresses along that road.
c. Keep to the right of any road or trail, enter it, keep to the right and continue the path of travel.
e. Depending upon the kind of intersecting road, follow these rules:

– Dead end road – Upon reaching the end of the road turn around and start back to the point of entry to that road, always stay to the right.(SeeFigure 2).

– Complex dead end road– if a dead end road is complex, that is, if it has branches, always keep to the right. Consider each branch to be a separate dead end road and follow the rule explained above. (See Figure 3).

F. Upon reaching a boundary, turn around and continue canvassing, keeping to the right.
g. If one encounters a river or a pond and there are structures on the other side that are in his/her work area, he/she should cross the river or pond and continue the survey.

If it is impossible to cross, make a note on the front of the listing book that these structures must be canvassed later. Then turn around and continue canvassing, keeping to the right.

4.2.2.2.2 *Listing of Dwelling Structures.* List all structures occupied for dwelling purposes only. These includes houses, huts, shacks, stores, or any other place being used as a living quarter.

Filling the listing sheet: (Annex A)

a. Block 1 - Province/City

Write in Block 1 the name of the province/city where the barangay is located.

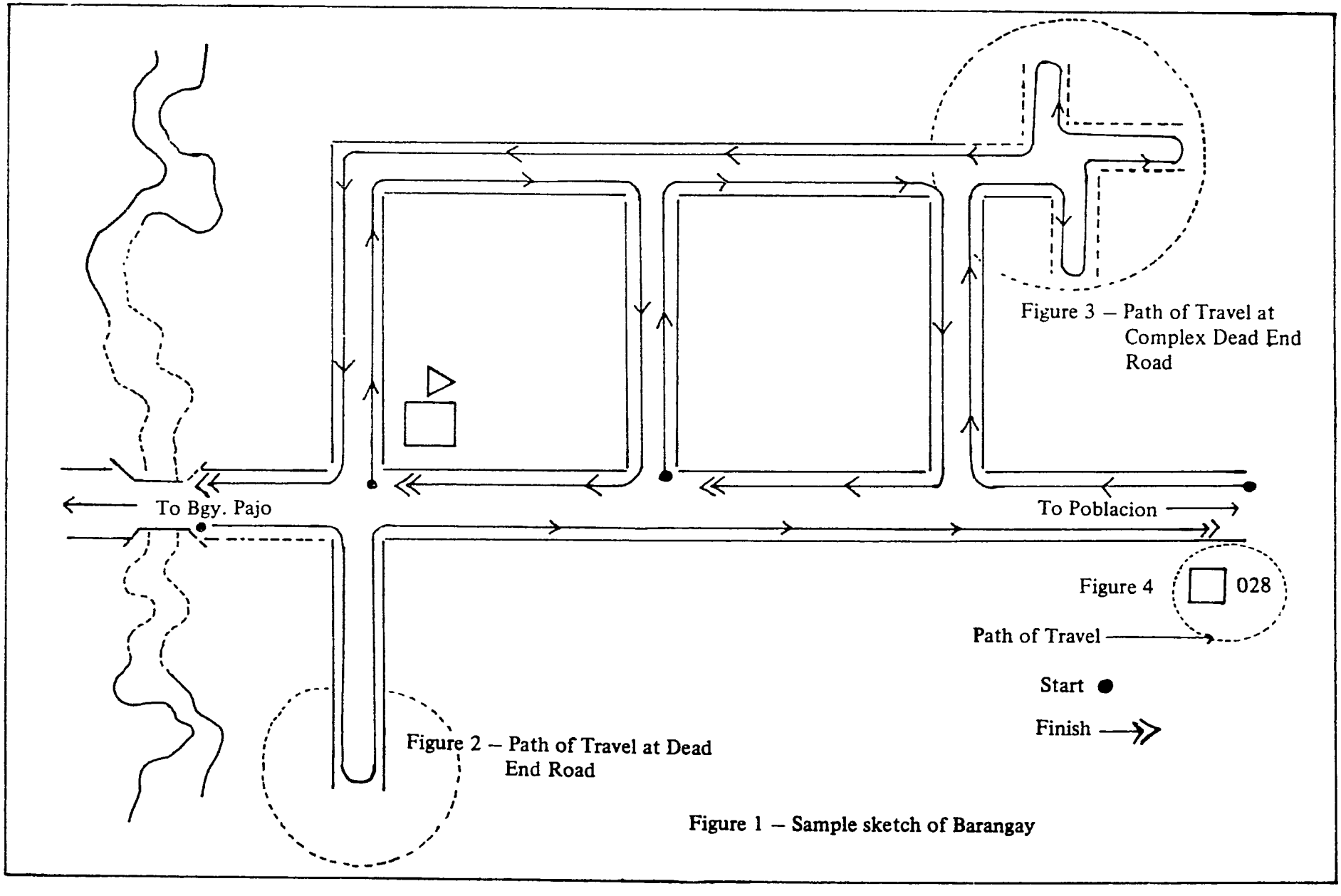


Figure 1 – Sample sketch of Barangay

b. *Block 2 – Barangay*

Write in Block 2 the name of the barangay where the survey is being conducted.

Block 3 – Municipality

Write in Block 3 the name of the municipality where the barangay is located.

d. Block 4 – Date Prepared

Write in Block 4 the date when the canvassing is made.

e. *Block 5 – Prepared by*

Write in Block 5 the name of the person doing the canvassing.

f. *Column 6 – Structure Number*

Write in Column 6 the assigned structure number. A structure number is assgned to each structure canvassed. It shall contain three digits. At the time areas of coverage are assigned, each team member shall also be given a number for the first structure that he/she will canvass. A structure number could be 002, 104, 340, etc.

g. *Column 7 – Category*

Write in column 7 the category of the household structure based on the following description:

Category	*Description*
1	Squatter type. Roof and walls of salvage material. No flooring.
2	Semi–squatter. Improved or semi-permanent roof and walls. No flooring.
3	Native structure. Bamboo or sawali walls. Raised floor. One room.
4	Same as 3 but multi-rooms.
5	Non-native materials. Wood walls, multi-room or unfinished hollow block, single story.
6	Multi-story, none architectural. Usually concrete lower floor and walls, wooden upper story walls.
7	Small (less than 30 sq. m.) decorated or architecturally treated. Either wood or concrete.
8	Medium (30 to 60 sq. m.) same as 7.

9	Large (60 to 100 sq. m.) same as 7
10	Very large (over 100 sq. m.) same as 7 or any commercial structure. Sari-sari stores in residences are not considered commercial

h. Column 8 – Condition

Write in Column 8 the condition value of each of the household structures listed according to the following criteria:

Value	*Condition Description*
-1	Poorly maintained, run down, dilapidated
O	Normal condition (clearly neither the above nor the below)
+1	Excellent shape, well painted, no deterioration evident

i. Block – Total

Write in block 9 the sum total of the category household structures listed under "category".

j. Block 10 – Total

Write in Block 10 the sum total of the condition values *of listed household structures.*

4.2.2.2.3 Map Spotting – Map spot each structure on your sketch after you accomplish the listing sheet. Each listed structure has a structure number. Write the structure number and draw a box on the sketch to show where the structure is located on the ground. For example in Figure 4, the structure with structure numbert 028 is map spotted on the sketch of the work area.

4.2.2.2.4 Identification of Household Structure

After the household structure has been map spotted, it will be identified by placing a mark indicating the structure number.

4.2.3 Tabulation, Analysis and Interpretation of Survey Data

4.2.3.1 Tabulation

The raw survey data contained in the listing sheets are tabulated and tallied according to their appropriate category. A separate tabulation and tallying is done for the structure's conditional value. Based on the tabulation and tallying, the total number of structures in each of the ten categories, as well as the total number of structures in each of the three conditional status, are entered in their appropriate spaces in the Financial Calculation Sheet page 4-19.

The average structural and average conditional values are computed using the following simple formulas:

$$\text{average structural value} = \frac{\sum_{n=1}^{10} n \times \text{total number of structures in category } n}{\text{total number of structures}}$$

Note: the numerator in the above formula should be equal to the sum in Block 9 of the Listing Sheet(s)

$$\text{average conditional value} = \frac{\left[\begin{array}{l}\text{total number}\\ \text{of poorly}\\ \text{maintained}\\ \text{structures}\end{array}\right](-1) + \left[\begin{array}{l}\text{Total number}\\ \text{of exceptionally main-}\\ \text{tained structures}\end{array}\right](+1)}{\text{Total number of structures}}$$

Note: the numerator in the above formula should be equal to the total in Block 10 of the Listing Sheet(s).

From the above computed values, the adjusted structural value is derived using the formula:

adjusted structural value = average structural value + average conditional value

4.2.3.2 Analysis and Interpretation

As mentioned earlier, the purpose of the structural survey is to determine whether the recipient community is within the lower 60% of the nation's income group. The adjusted structural value as obtained in the preceding procedures is the measure or barometer by which this is known,

As mentioned, too, in the introductory portion of this guide, the maximum monthly household income of the target population should be P392 (based on an annual income of P4,700). By dividing this amount with the income-structural value constant of P70 (pls. refer to step 19, Financial Analysis page 4-21 for the derivation of this constant), the "equivalent" structural value of this income level *(5.6)* is obtained. Therefore, all projects having an adjusted structural value of *5.6* or less are within the Program's target group.

The Program had earlier noted the limitations of the structural survey as a method of gauging the income level of a particular community. Of principal concern is the degree of accuracy of the income figure obtained from such an excercise. It is possible that a distorted income figure may have been derived because of an inaccurate income-structural value constant, or due to an error, unintentional or otherwise, in categorizing the dwelling structures. In any case, the structural survey-derived income figure may either be too high or too low compared to the true income level of the community.

There are two possible consequences of a distorted income figure. In the case of an overestimated income level, it may exclude from the Program communities who are otherwise really deserving or in need of program assistance. In this instance, program planners who

strongly doubt the accuracy of the survey results may undertake a more extensive socio-economic survey in order to check the results. Local government units who are not familiar with the methodology of this survey may ask the assistance of the BWP national staff in conducting the same.

Also, an excessive figure may have the effect of unreasonably increasing the amount of monthly water fee, much more than what the average household can really afford to pay. This situation, however, can be corrected immediately by the RWA itself through the regular semi-annual appraisal of water rate policies. It should become very obvious to the management staff that the present water rates are not within the means of the people to pay; in which case, the management staff should take the necessary steps to lower the rates to a more reasonable and acceptable level.

On the otherhand, an underestimated income figure will enable non-deserving communities to avail of Program assistance. The BWP hopes that these incidences will be avoided or at least minimized by its undertaking of random socio-economic surveys in all of the provinces and cities. These random surveys will not only be used as checks to dissuade local government units from intentionally manipulating the results of the structural surveys, but will likewise be utilized to verify the accuracy of the income-structural value constant.

It is highly probable though that thru an honest mistake a few number of non-deserving communities will still be able to avail of program assistance if the mistakes is discovered too late through the random socio-economic survey. In such cases, the only fair and reasonable solution is to require these communities to repay much more than the capital cost of the water systems.

In the case of communities that really fall within the target group but who are amortizing less than what they can and should repay as a result of unrealistic, structural survey–derived income figures, these communities will be asked to pay the appropriate amortization rate based on the income figure derived from the socio-economic survey.

4.3 Preliminary Engineering Report

The function of the preliminary engineering report (PER) is to make a cursory examination of the proposed sub-project in sufficient detail to establish a rough cost estimate and to assure its physical capability.

The following checklist will accomplish this purpose. Each item on the checklist is discussed for guidance in accomplishing the preliminary engineering.

1. Present Population. This should be a relatively accurate figure of the total existing population that the intended water system will serve.

2. Population in year 10. This is needed to estimate source requirement. Normal population growth nationwide is on the order of 3%per year compounded. If this figure is used, the population in year ten will be about 33% greater than the present population.

3. Population in year 20 This is needed to estimate any possible transmission pipeline costs. A growth rate of 3% over 20 years will increase the present population by about 75%.

4. Present number of Households. This should be established by actual count. It serves as a check on the population figure and also permits an estimate of cost for service connections.

5. Minimum Source Flow Rate. This is based upon a continuous flow that will, over a 24 hour period, provide sufficient water for 15 gallons per capita plus *20%* allowed for maximum daily use for the expected population in year ten.

6 – 7 – 8 & 9. These provide basic data that are helpful in judging the probability of success in attempting to utilize the groundwater as a source.

10 through 19 develops the total cost if the groundwater were utilized as the source.

20 through 26 develops the total cost if a gravity source is utilized. In the event it is only a spring, the treatment would simply consist of a chlorination facility. If the source is to be surface water, the treatment facility would also include slow sand filtration.

27. Obviously identifies the most viable choice for the water source.

28. Establishes whether the community is to be considered flat or not. This will reflect the total system cost and also dictate the siting requirement for the storage.

29. Is used to establish density and overall cost since it is assumed that pipelines will generally be along the roadways.

30 Through 34 develops a single multiplier that is made up of all significant factors that determine the expense of a water system.

35. Is based upon the estimate that if all factors where 1.0, then 15 lbs. of pipe would be needed for each household. This is increased by the various factors which will yield an increased cost estimate.

36. This figure will be gained by experience or by receiving quotations from qualified suppliers. It does not include any allowance for valves, fittings or wastage.

37 Through 40 develops a rational means of estimating labor cost and will reveal any unusually inefficient labor operations by reducing it to the work expected per work day.

41. Provides for a 15% allowance for valves, fittings and wastage.

42. Is labor and materials combined.

43 through 46 establishes the storage LOL not only relative to the community as a whole but also relative to the ground elevation upon which it must be erected.

47. Uses the tabulated solution to determining tank size depending on the present size of the community.

48 through 52 is an exercise that is designed to establish the least expensive method of providing the required LOL. Either by using an earth mound to elevate the tank or by erecting a taller tank.

53 through 58 provides data as to the ability of the project to meet the desired BWP standards and also provides cost data.

59 through 62 provides cost data for household connections with individual storage. Note that no cost for the labor of installing the service pipe is included. This work is to be performed by each user.

63 through 67 provides data on the office to be provided for the community.

68 through 73 summarizes all costs.

PRELIMINARY ENGINEERING REPORT CHECKLIST

NEEDS

*1. Present Population _____

2. Population to be served in Year 10 _____

3. Population to be served in Year 20 _____

*4. Present No. of Households _____

5. Minimum Required Flow Rate of Source _____ GPM

$$\frac{\#2 \times 15 \times 1.2}{1{,}440}$$

SOURCE

*6. Distance from the center of the Community to the nearest well producing acceptable quality water _____ M.

*7. Static Water Level of that Well _____ M.

*8. Pumping Water Level of that Well _____ M.

*9. Normal Production Flow _____ GPM

*10. Distance from the center of the community to the most promising site for a new Deepwell _____ M.

11. Cost to Construct a New Deepwell with flow rate from #5 ₱_____

12. Cost of Transmission Line for Pumped Water ₱_____

$$\left(\frac{\#3 \times 15 \times 1.2}{1{,}440} \text{GPM} \right)$$

13. Estimated Pumping TDH _____ M

14. Cost of Pumping Machinery ₱_____

15. Annual Replacement Reserve for Machinery ₱_____

(#14 ÷ 10 years Life)

16. Annual Power Bill ₱_____

(#5 x #13 x 3.3 x ₱_____/kwhr)

17. Present Worth Factor from Table 4 – 1 _____

18. Present Worth of Annual Expenses ₱_____

(#15 + #16) Times #17 ₱_____

19. Present Cost for Well Source ₱_____

(#11 + #12 + #14 + #18)

*20 Distance from the center of the Community to the nearest gravity Source flowing at Least $\frac{\#3 \times 15 \times 1.2}{1{,}440}$ GPM _____ M

21. Cost of Transmission Line for Gravity Flow of GPM given in #20 ₱ _____

22. Cost of Diversion Structure ₱ _____

23. Cost of Treatment Facility ₱ _____

24. Annual Cost of Chemicals ₱ _____

25. Present Worth of Annual Expense (#17 x #24) ₱ _____

26. Present Cost of Gravity Source (#21 + #22 + #23 + #25) ₱ _____

27. Least Cost #19 or #26? ₱ _____

DISTRIBUTION SYSTEM

*28. Maximum Elevation Difference of Community _____ FT.

*29. Total Length of Roadway Within the Community _____ FT.

30. Terrain Factor: _____

If #28 is 5 ft. or less = 1.2
If #28 is over 5 ft. = 1.0

31. Density Factor: _____

If #29 ÷ #4 is less than 35 = 1.0
If #29 ÷ #4 is between 35 & 70 = 1.25
If #29 ÷ #4 is greater than 70 = 1.5

*32. Construction Factor: _____

If roads are concrete = 1.5
If roads are not concrete = 1.0

33. Service Factor _____

If Level II = 2.0
If Level III A = 1.0

34. Combined Distribution Factor: _____

#30 x #31 x #32 x #33

35. Estimated Weight of Distribution _____ LBS.

Pipe Materials = 15 lbs. x #34 x #4

36. Expected Cost of Pipe, Delivered ₱ /LB. _____

37. Ft. of Excavation and Backfill per Man Day of Labor _____ FT.

4–14

38. Cost Per man Day of Labor ₱_____

39. Estimated Footage of Pipe to be laid _____FT.

(#29 x #32)

40. Computed Labor Cost ₱_____

(#39 x #38 ÷ #37)

41. Computed Material Cost ₱_____

(#35 x 1.15 x #36)

42. Estimated Distribution Cost (#40 + #41) ₱ _____

STORAGE

*43. Ground Elevation at storage Site _____FT.

44. Longest Pipeline Distance from the Storage site to the edge of the Distribution System ("L") _____FT.

45. Proposed Hydraulic Grade Slope ("S") for the Line _____

46. Proposed LOL (Above Ground Elevation) _____FT.

47. Tank Diameter (From Table 4–2, depending upon level of service) _____FT.

48. Cost of 20 ft. High tank placed on an Earth Mound: ₱_____

49. Cost of Earth Mound Construction: ₱_____

5 ft. High Mound If LOL = 15 ft.

10 ft. High Mount If LOL = 20 ft.

50. Cost of Combined Tank and Mound ₱_____

(#48 + #49)

51. Alternative Cost of Full Height ₱_____

Tank without Mound (LOL + 10 ft.)

52. Least Cost, #50 or #51 ₱ _____

CONNECTIONS (LEVEL II ONLY)

53. Total Number of Proposed Public Faucets _____

54. Maximum No. of Houses Dependent on One Faucet _____

55. Minimum No. of Houses Dependent on One Faucets _____

56. Maximum Distance from a Member's House to a Faucet _____

57. Full Estimated Cost for Each Metered Public Faucet Including Labor and Material ₱_____

58. Connection Cost (#53 x #57) ₱_____

CONNECTIONS (LEVEL III–A ONLY)

59. Total Number of Connections _____

60. Full Estimated Cost for Materials only for each Low Flow Service Including Household Storage Tank ₱_____

61. Estimated Labor Cost to Tap the Distribution Line for each User ₱_____

62. Connection Cost (#60 + #61) x #59 ₱_____

RWA OFFICE

63. Proposed Floor Space Area _____ sq. m

64. Cost of Land (if any) ₱_____

65. Estimated Building Construction Cost ₱_____

66; Cost of Furnishings and Equipment ₱_____

67. Total Office Cost (#64 + #65 +#66) ₱_____

SUMMARY

68. Source from #27 ₱_____

69. Distribution from #42 ₱_____

70. Storage from #52 ₱_____

71. Connections from #58 or #62 ₱_____

72. Office Bldg. from #67 ₱_____

73. Total Direct Cost ₱_____

All items on the checklist marked with asterisk (*) must be learned in the field.

TABLE 4 – 1

PRESENT WORTH FACTORS

Current Interest Rate *For Long Term (20 Yr.) Loans*	Present Worth *Factors*
6%	11.469
8%	9.818
10%	8.514
12%	7.469
14%	6.623
16%	5.929
18%	5.353
20%	4.840
22%	4.460
24%	4.110

TABLE NO. 4 – 2

10' High Tank Storage: Diameter-- FT.:	Number of Households		
	Level of Service		Storage
	II (6 gal. per cap)	III (4.5 gal. per cap)	III–A (1 gal. per cap)
2	6	8	40
3	15	20	90
4	26	35	150
5	40	55	250
6	60	80	350
7	80	110	475
8	105	140	630
9	135	175	800
10	165	220	1000
11	200	265	
12	235	315	
13	275	370	
14	320	425	
15	370	490	
16	420	560	
17	475	630	
18	530	710	
19	590	790	
20	625	875	
21	722	960	
22	790	1050	
23	865		
24	940		

4.4 Financial Analysis

4.4.0 Purpose

Unlike the standard financial analysis of revenue-producing projects whose objective is to determine the financial viability of a project in terms of its profitability, financial analysis as used by BWP does not consider the profit factor but seeks only to determine whether the recipient community is financially capable of underwriting the operational expenses and, possibly, amortizing a portion of the capital costs of a water system. Accordingly, the principal data output of the financial analysis includes water fee, operational expenses, annual loan amortization and loan amount. All these data can easily be determined by using the fill-in-the blank, step-by-step procedures discussed in the subsequent section. The first few steps of the procedures are directly related to the structural survey. Brief explanatory remarks on some of the steps follow the procedures.

4.4.1 Step by Step Procedures

Financial Calculations

1. Total number of structures of category one _____
2. Total number of structures of category two _____
3. Total number of structures of category three _____
4. Total number of structures of category four _____
5. Total number of structures of category five _____
6. Total number of structures of category six _____
7. Total number of structures of category seven _____
8. Total number of structures of category eight _____
9. Total number of structures of category nine _____
10. Total number of structures of category ten _____
11. Total number of #10 that are commercial _____
12. Total number of structures _____
13. Average structural value _____
14. Total number of poorly maintained structures _____
15. Total number of normally maintained structures _____
16. Total number of exceptionally well maintained structures _____
17. Average conditional value _____

[(#14 x (-1)) + (#6 x 1)] ÷ #12

18. Adjusted structural value (#13 +#17) _____

19. Assumed average monthly income per household _____

(#18 x ₱70.00)

20. Available for monthly water payment (5% of #19) _____

21. Maximum monthly water bill per BWP policy ₱15.00

22. Monthly water fee to be adopted _____

(least value #20 or #21)

23. Estimated number of member households _____

(assume 90% of total household within service area)

24. Monthly operating expenses for salaries and wages _____

(#23 x ₱ 1.50)

25. Monthly power bill (from design guide # 16) _____

26. Monthly chemical cost (from design guide #24) _____

27. Monthly reserve for replacement, r & m, training,

miscellaneous costs and contingencies _____

(40% of sum of #24 + #25 + #26)

28. Total monthly operating expense _____

(#24 + #25 + #26 + #27)

29. Available for monthly amortization payment _____

(#22 x #23) - (#28)

30 Annual amortization (#29 x12) _____

31. Total loan amortization (refer to subsection 4.4.2) _____

32. Repayment period (refer to subsection 4.4.2) _____

33. Estimated capital cost (From design guide #73) _____

Steps 1 - 18:

The significance of and the methodology for determining the adjusted structural value

were thoroughly discussed in the preceding section on structural survey and, therefore, need no further elaboration.

Eligibility:

The adjusted structural value obtained in step 18 should be compared to the BWP range of accepted values, which are from 1.0 to 5.6. If the resulting value falls within this range, then, it can be safely assumed that the community belongs to the targeted, economically depressed sector of the rural population. If, however, the value is outside of the accepted range, the community is not eligible for project assistance per program policy. That is, the community is either too economically and financially poor that it will not be able to operate and maintain much less amortize the capital costs of a system of the type categorized by level II or level III A, or it may indicate that the community is relatively well off that it does not merit finanacial assistance from the Program.

Step 19:

In determining the income–structural value constant of ₱70.00, a comprehensive socio-economic survey was undertaken in Barangay Buenlag, Calasiao, Pangasinan, a typical BWP project area. Using a structured questionnaire, respondents were personally asked income-related questions, the answers to which were used as basis for estimating the average monthly household income within the community. Concurrent with the socio–economic survey, a structural survey was conducted to determine the appropriate structural value of the community. The constant was then obtained using the simple formula.

$$\text{Constant} = \frac{\text{Average monthly household income}}{\text{Structural Value (adjusted)}}$$

Because the constant (₱70.00) was derived based on a survey of only one barangay, the BWP feels that this figure, if applied to other rural areas in the Philippines, may not accurately reflect their true economic anf financial situations. Regional differences in customs, habits, availability of indigenous and common building materials, and other socio–cultural, and geographical factors peculiar to a particular region or province tend to distort the true income-structural value correlation. This fact was borne out by a statistical analysis of available income and housing data obtained from a number of barangays from different provinces. The results of the analysis showed that for the same type of housing structure, households in one province had an appreciably higher income than those in another province.

However, and in spite of the constant's lack of precision at this point, the cities and provinces are asked to use ₱70.00 in their financial analysis until such time that the degree by which the aforementioned regional differences affects the constant is more definitely known. In the near future, the Program intends to conduct additional surveys in order to confirm the accuracy of this constant and as a means for developing more accurate constants. Concerned local government units shall be appraised of the results of these studies as soon as more valid data are obtained.

Steps 20 - 22:

The Program has two ways of estimating the maximum monthly water fee per households in a given barangay. One way is to fix it at five percent of the average monthly income, and the second is to peg it at ₱15.00.

The first method is in consonance with a program policy that limits the maximum

monthly water fee to not more than five percent of the average monthly household income. This policy is based on the experience derived from rural water programs in other countries as well as on the recommendations of recognized authorities in the field of rural water supply development.

On the other hand, the first two-years experience of the Philippine Program has demonstrated that ₱15.00 is generally the maximum amount that rural people can afford and at the same time are willing to pay for water supply service. A fee higher than ₱15.00 would normally be beyond local financial means and is very difficult to collect.

Step 23:

The 90% assumption is based on the experience of the Program with its completed and on-going projects wherein a minimum of 90% of the total households within the service areas have freely elected to join the systems at the outset of the project. It is also felt that if fewer than 90% of the population underwrites the project there may be adverse financial implications for the system's viability. It is further worthy to mention that it is extremely difficult to monitor the members versus non-members use of the public faucets (the BWP standard design) when there are large numbers of non-system members co-inhabiting the service area.

Step 24:

The salary factor of ₱1.50 was arrived at through a combination of analysis of existing cost data, field observation of operating systems, and dialogue with management staffs as well as with member households.

Step 27:

The monthly reserve margin of 40% is programmed for replacement of capital equipment, e.g., pumps, motors, etc., training activities, repair maintenance, and other contingencies.

4.4.2 Loan Calculations

Under the Barangay Water Program, a recipient community is obliged to shoulder the operational maintenance and repair expenses of the installed water system. If a prior financial analysis of the project indicates that revenues can be generated in excess of the aforementioned fixed expenses, then the community will also be required to amortize a portion of, if not the entire capital cost of the project. The exact amount will depend upon the financial capability of the community and the relative cost of the project.

The community's share of the capital cost will be in the form of a loan by the PWA to the local government. As stated earlier, the loan amount will vary from 1 – 100% of the project's capital cost, to be repaid within a period of 10 to 20 years at an interest rate of 4% per annum. The surplus revenue during the system's first year of operation will be the loan's fixed annual amortization payment.

The procedures for computing the exact loan amount and repayment period are as follows:

Basic Formula:

$$\text{Loan Amount} = \frac{\text{Annual Amortization}}{\text{Capital Recovery Factor (CRF)}}$$

Note: At 4% per annum, the capital recovery factor for 10 – 20 years are as follows:

Amortization Period	*Capital Recovery Factor*
10	0.123 291
11	0.114 149
12	0.106 552
13	0.100 144
14	0.094 669
15	0.089 941
16	0.085 820
17	0.082 199
18	0.078 993
19	0.076 139
20	0.073 582

Step by Step Procedures

1) Given annual amortization (From Step 30 of financial analysis), assume loan amount as equal to capital cost of project (step 33), then compute for CRF. In effect this is computing for the repayment period.

2) If repayment period is:

   2a. Equal to or greater than 10 years but less than or equal to 20 years, then the final loan amount will be the capital cost of the project, and the repayment period will be that as originally computed.

   Note: If the computed CRF does not tally exactly with any of the repayment period in the table (which means that the repayment period based on the computed CRF is not a whole number), use the next lower CRF in the table and compute for the adjusted annual amortization. The adjusted annual amortization should be lesser than the original amount as taken from Step 30.

Example 1:

Capital Cost = ₱ 300,000

Annual Amortization = ₱ 27,750

$$CRF = \frac{₱\ 27{,}750}{₱300{,}000} = 0.0925$$

Computed CRF (0.0925) is between 0.089941 (CRF for 15 years) and 0.094669 (CRF for 14 years).

Following Step 2a,

Repayment Period = 15 years, use CRF of 0.089941

Loan Amount = Capital Cost = ₱ 300,000

∴Adjusted Annual Amortization = ₱ 300,000 x 0.089941

= ₱ 26,982

Example 2:

Capital Cost = ₱ 456,000

Annual Amortization = ₱ 39,000

$$CRF = \frac{₱\ 39,000}{₱456,000} = 0.085\ 526$$

Computed CRF (0.085526) is between 0.085820 (CRF for 16 years) and 0.082199 (CRF for 17 years).

Following Step 2a,

Repayment Period = 17 years

Loan Amount = Capital Cost = ₱ 456,000

∴Adjusted Annual Amortization = ₱ 456,000 x 0.082199

= ₱ 37,482

2b. Less than 10 years, then compute for adjusted annual amortization using final loan amount equal to capital cost of project and repayment period equal to 10 years

Example 3:

Capital Cost = ₱250,000

Annual Amortization = ₱ 36,000

$$CRF = \frac{₱\ 36,000}{₱\ 250,000} = 0.144$$

Computed CRF is greater than 0.123291 (CRF for 10 years which means that the repayment period is less than 10 years.)

Following Step 2b,

Repayment period = 10 years

Loan Amount = Capital Cost = ₱250,000

Adjusted Annual Amortization = ₱ 250,000 x 0.123291

= ₱ 30,822

2c. Greater than 20 years, then peg final repayment period at 20 years and compute for final loan amount.

Example 4:

Capital Cost = ₱ 325,000

Annual Amortization = ₱ 20,000

$$CRF = \frac{₱\ 20{,}000}{₱325{,}000} = 0.0615380$$

Computed is CRF is less than 0.073582 which means that the repayment period is greater than 20 years.

Following Step 2c,

Repayment Period = 20 years

Annual Amortization = ₱ 20,000

$$\text{Loan Amount} = \frac{₱\ 20{,}000}{0.073582\ (CRF_{20})}$$

= ₱ 271,805 or ₱ 272,000

4.5 Feasibility Report Format

The results of the structural survey and financial analysis shall be presented using the format in Annex B, Feasibility Statement. This single page document along with the required attachments, i.e., financial calculations, system drawings, cost breakdown, and design guide checklist, shall constitute a simplified project feasibility study. Standard formats for project cost breakdown and design guide checklist are presented in this manual.

4.6 Annual Implementation Plan

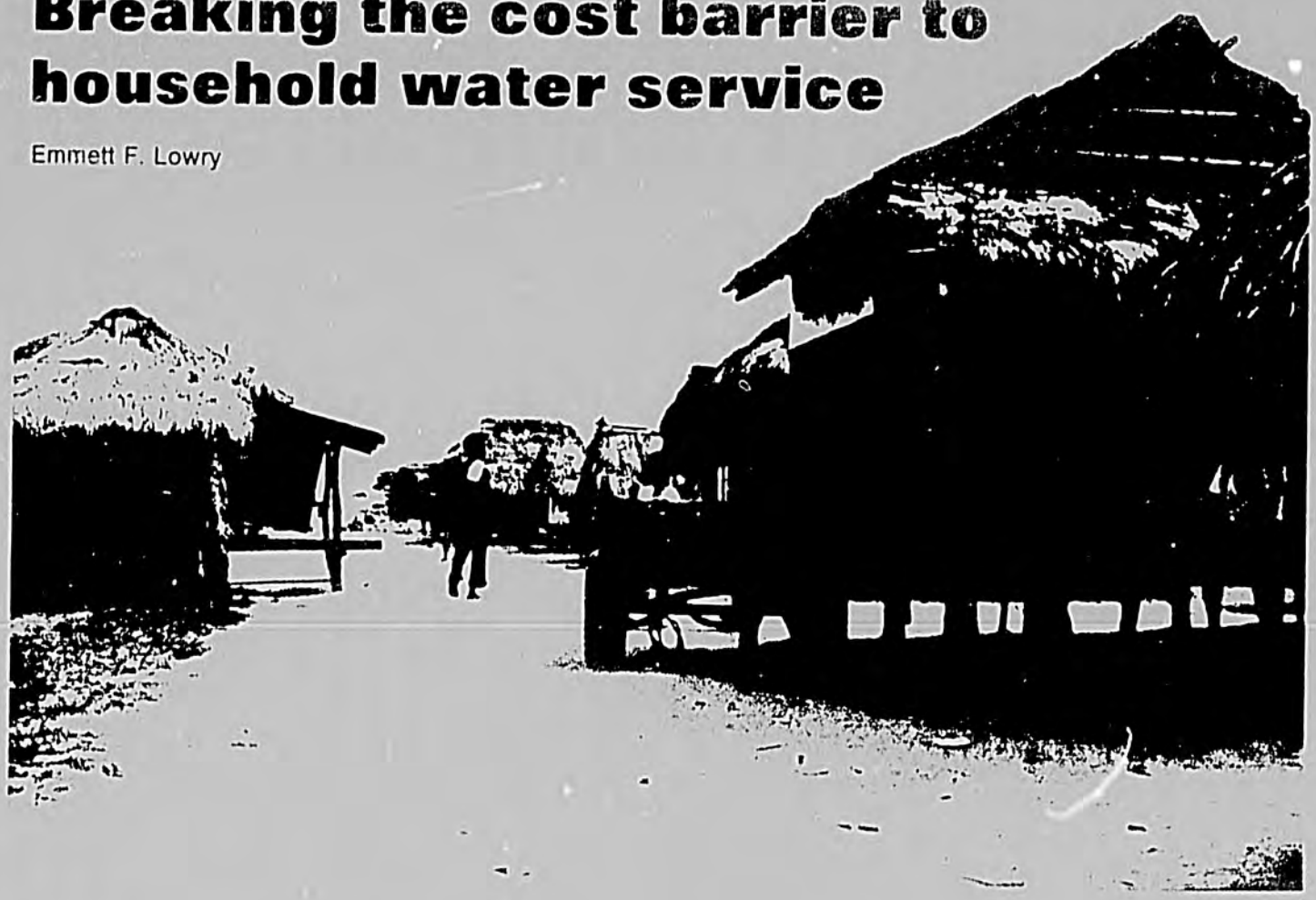
The Annual Implementation Plan (AIP) is a listing of waterworks projects that an LGU will implement during a particular year under the Barangay Water Program. These projects should have

APPENDIX D

Reprint from December 1980 AWWA Journal

Breaking the cost barrier to household water service

Emmett F. Lowry



Providing economically feasible household-connected water systems to the rural, low income areas of a developing nation is a task of almost overwhelming magnitude. The Barangay Water Program in the Philippines, however, is on the way to accomplishing just that. A check of early system installation practices uncovered some surprising facts and ultimately led to several economically viable alternatives to conventional system design.

Potable water is a universal necessity for all people, but it is not a universal reality. The critical problem of safe water for the rural areas of developing nations has been recognized by the United Nations General Assembly with the proclamation of 1981–1990 as the Drinking Water and Sanitation Decade. Simply bringing a cleaner supply to a rural community (i.e., providing clean water from a public faucet rather than from a polluted well) does not necessarily imply increased water consumption and better hygiene. The water still must be carried from the source of supply to the home: there is no reduction in the time required to draw and carry the water, the only change is in the quality of the water. The crux of increasing water consumption among rural populations seems to be household-connected supplies. But for developing nations whose rural populations have very low incomes, across-the-board household supply connections may not be economically feasible.

Recognizing the needs of its rural citizens, but also aware of the fiscal constraints to household connections, the Republic of the Philippines initiated a program to provide water service to individual barangays (the smallest community unit in the Philippines). The ultimate goal of the Barangay Water Program (BWP) is to develop replicable methods that will enable potable water service to be improved throughout the rural areas of the nation. The program created to achieve this goal was funded by a loan from the US Agency for International Development.

One of the key aspects of the program is to reduce the per capita construction cost as much as possible. Although this discussion is focused on the cost aspect, it should not be misconstrued that this is the dominant factor of the program. The institution-building aspect is of greater import. This is emphasized because far too often the institutional aspect receives only lip service and then even beautifully conceived and implemented projects quickly deteriorate.

Levels of water service in Phillipine barangays

There are 42 000 rural barangays in the Philippines in which 20 million Filipinos reside. Almost all of these communities need improved potable water service.

Some barangays are so small and sparsely populated that a piped water system is not justified. In these cases the traditional small well and handpump are provided.

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This configuration is referred to as level 1 service. The main thrust of the BWP, however, is the provision of piped water systems.

Level 2 service is defined as a piped system with strategically placed public faucets. At the beginning of the BWP three years ago, the average cost to construct level 2 systems was $57 per person.

Level 3 service is the conventional household-connected system, complete with meters. Until recently, the BWP constructed only level 2 piped systems. This is because the total cost of nationwide installation of level 3 systems is too high to be justified by the relatively low rural incomes. Another factor working against the nationwide installation of level 3 service is the unlikelihood that household meters would be maintained in good working order in remote areas.

It was also deemed unmanageable to attempt to supervise the design and construction of so many projects in far-flung places through a centrally based group of engineers. Since each province maintains its own engineering staff, the BWP enlisted their assistance in performing these functions.

The problem of providing potable water

There are two basic facets to the problem. First, the cost to construct piped water systems was still too high even for level 2 systems. The price tag to build water systems nationwide would amount to somewhere between $600 and $900 million. Second, while level 2 systems definitely improve the local situations by making safe water readily available, they still necessitates the use of water carriers. This has two serious disadvantages. The time and energy devoted to carrying water could be better used to raise food or improve the economic position of the family. But even more important, water hauling tends to restrict the amount of water used to an unhealthily low level. Hand-carried water would normally total from 1500 to 3000 litres per month for a family of six. This small volume cannot provide for basic sanitation needs.

Each of the two stated aspects of the problem was attacked individually. First, every effort was made to achieve maximum economy in the design and construction of level 2 systems. Second, a search was launched for nonconventional designs of house-connected systems that would not require expensive meters.

Cost reduction

Close examination revealed that the systems constructed early in the program were substantially overdesigned. Pumps were large enough to pump the maximum daily demand in four hours. This was four times as expensive as needed. Also, the oversized pumps required oversized wells. Storage tanks were large enough to provide more than 50 percent of the daily demand—double the normal operational requirement. Storage elevations were higher than necessary to maintain minimum system pressure. Pipe sizes were larger than required by prevailing hydraulic conditions.

Formulated system design. Engineers in developed or industrialized countries are constantly in contact with colleagues who have had substantial experience in water system design and construction. It must be appreciated that this is rare in the developing world.

Recent water system design, construction, and maintenance in developing countries has been so sporadic that real experience is a scarce commodity. The result is often gross over-design with its attendant wastage of precious funds. Civil engineers in the Philippines are no exception. They are well educated but generally lacking in practical experience. To help solve this problem, a formulated approach to system design has been developed. It leads the designer step by step through each community problem. A two-day training program is required to familiarize engineers in groups of 25 with the methodology. Thereafter, a design can be worked up for an average community with one day of field work and four hours of office application. No formal drawings are required; sketches are adequate.

The methodology does not extend to source determination other than the comparison of alternatives. Location of groundwater is still a subject that is not readily reduced to a cookbook solution. Fortunately, there are few areas in the Philippines where the groundwater situation is not relatively well known.

Standardized system design criteria. The Barangay Water Program under the Ministry of Local Government and Community Development has reduced this methodology into a technical manual. It sets forth the design criteria that will be used, determines the size and location of storage, selects pipeline sizes, presents materials specifications, and arranges a bill of materi-

als, complete with cost estimates, ready for procurement. As a result, sound, economical designs are now being created throughout the Philippines by engineers who have had no previous experience. The results have been dramatic. Before the implementation of this methodology, each provincial engineer's office performed design as it considered appropriate.

The standardization of design criteria alone has been responsible for much of the cost reduction that has been achieved. A sensitivity study was made on several model communities in an effort to determine the overall cost effect of various system pressures. It was determined that a low pressure system was definitely more economical than a high pressure system in flat terrain. The higher pressure system was achieved by the use of higher (and thus more expensive) elevated storage tanks. This additional expense plus the added energy cost was substantially greater than the savings that would be realized by the use of smaller pipelines that the steeper hydraulic gradient allowed.

Standardization of storage facilities. A third significant factor in cost reduction was the standardization of storage in a standpipe configuration instead of the conventional elevated storage tank. Most of the storage requirements called for a low water level of 6 m (20 ft) above ground level and a higher water level of 9 m (30 ft). Under such conditions the lower standpipe shell is cheaper than a structural steel support. Further, no foundations are required for the standpipes. They stand freely on a flat gravel bed. In areas where good sandy soil is readily available, low-cost local labor can erect a 3-m (10-ft) high earth mound on which the standpipe can be placed. In these cases, the standpipe is shortened by the 3-m (10-ft) height of the mound. The end result is that storage is achieved for approximately 50 percent of the cost of the conventional elevated configuration. As an additional bonus, the standpipe makes the normally unused water stored below the lower operational level available for such emergency uses as fire fighting or the frequent power failures.

Cost-effective materials selections. The last but very significant factor in cost reduction is the choice of materials. It had been the practice in the Philippines to use schedule 20 galvanized iron water pipes. Aside from the fact that it is not cheap, its life expectancy is on the order of ten years.

Specifications were written that require the use of modern, high quality plastic pipes. The smaller sizes are either polyethylene or polybutylene and the larger sizes are PVC. The use of plastic pipe has reduced the cost of piping materials by more than 40 percent. Installation and assembly of the plastic pipe is being done by unskilled local labor with good results.

As a result of these efforts, level 2 water systems are now being built for an average of $33 per person. Compared to the early systems built three years ago at an average cost of $57 per person, this is a reduction of more than 50 percent when inflation is factored in.

Household delivery

As previously stated, the real potential benefits of safe water cannot be realized unless water is available in the home in sufficient quantity. In a conventional system, household delivery increases the cost substan-

COST BREAKDOWN FOR LEVEL 2 SERVICE
FOR A TYPICAL BARANGAY

Number of Households 120 Population 768

1. SOURCE
4 in. diameter well 300 ft deep ₱50,000
Spring box and holding tank ₱
Surface water diversion ₱
Slow sand filter ____ sq ft ₱ — ₱50,000

2. PUMPING MACHINERY
10 gpm at 150 TDH & 1 hp — ₱2,000

3. DISTRIBUTION MATERIALS
____ ft 3/8-in. tubing • ____ lb
240 ft 1/2-in. tubing • 288 lb
____ ft 3/4-in. tubing • ____ lb
2050 ft 1-in. tubing • 390 lb
____ ft 1 1/4-in. tubing • ____ lb
1100 ft 1 1/2-in. tubing • 440 lb
160 ft 2-in. tubing • 320 lb
850 ft 2 1/2-in. tubing • 850 lb
300 ft 3-in. tubing • 675 lb
____ ft 4-in. tubing • ____ lb
Total 2940 lb x 1.05 • 3300 lb
at ₱20.00 per pound x 1.10 for valves & fittings — ₱62,990

4. TRANSMISSION PIPELINE
____ ft of ____ diameter pipe • ____ lb
at ₱____ per pound • ₱

5. LABOR
5460 ft total pipeline ÷ 12 ft of excavation per man day • 455 man days, plus equal man days for installation and backfill • total of 910 man days at ₱15.00 per man day — ₱13,650

6. STORAGE
10 ft diameter standpipe 26 ft high •
5898 lb at ₱15.00 per pound • ₱88,470
____ ft-high earth mound (if any) • ₱6,000 — ₱94,470

7. CONNECTIONS
13 Level 2 standposts at ₱500.00 each • ₱6,500
____ Level 3A connections at ₱____ each • ₱ — ₱6,500

8. OFFICE BUILDING
25 sq m at ₱600.00 sq m • — ₱15,000

Total direct cost ₱234,526
₱33 per capita

COST BREAKDOWN FOR LEVEL 3A SERVICE
FOR A TYPICAL BARANGAY

Number of Households 120 Population 768

1. SOURCE
4 in. diameter well 300 ft deep ₱50,000
Spring box and holding tank ₱
Surface water diversion ₱
Slow sand filter ____ sq ft ₱ — ₱50,000

2. PUMPING MACHINERY
10 gpm at 150 TDH & 1 hp — ₱2,000

3. DISTRIBUTION MATERIALS
6,000 ft 3/8-in. tubing • 360 lb
____ ft 1/2-in. tubing • ____ lb
____ ft 3/4-in. tubing • ____ lb
3,650 ft 1-in. tubing • 694 lb
400 ft 1 1/4-in. tubing • 120 lb
500 ft 1 1/2-in. tubing • 240 lb
800 ft 2-in. tubing • 320 lb
____ ft 2 1/2-in. tubing • ____ lb
____ ft 3-in. tubing • ____ lb
____ ft 4-in. tubing • ____ lb
Total 11,394 lb x 1.05 • 12,000 lb
at ₱____ per pound x 1.10 for valves & fittings — ₱43,500

4. TRANSMISSION PIPELINE
____ ft of ____ diameter pipe • ____ lb
at ₱____ per pound • ₱

5. LABOR
5400 ft total pipeline ÷ 12 ft of excavation per man day • 450 man days, plus equal man days for installation and backfill • total of 900 man days at ₱15.00 per man day — ₱13,500

6. STORAGE
4 ft diameter standpipe 20 ft high •
2668 lb at ₱15.00 per pound • ₱39,020
5 ft-high earth mound (if any) • ₱2,000 — ₱39,020

7. CONNECTIONS
____ Level 2 standposts at ₱____ each • ₱
133 Level 3A connections at ₱150.00 each • ₱19,950 — ₱19,950

8. OFFICE BUILDING
25 sq m at ₱600.00 sq m • — ₱15,000

Total direct cost ₱184,970
₱237 per capita

Providing an easily accessible potable water supply to the rural areas of developing nations is of tremendous importance. Benefits emanating from water range from increased personal hygiene and sanitary conditions to greater opportunity for economic expansion.

Because metallic piping would have dramatically increased the cost of providing level 3A service, plastic piping was the material of choice. The photograph at the right shows a ⅜-in. service line before laying.

tially over a public standpost system. This runs counter to the basic goal of reducing cost.

A physical combination was developed that achieves household delivery while actually reducing the system cost over the public standpost systems. The key was found to be in the term "utilization."

In conventional systems, it is common practice to design the source and transmission facilities to meet maximum day demands while the distribution system is designed to meet peak load conditions. The operational storage facility is usually the place of transition from maximum-day to peak-hour flow rates. Since peak conditions only occur for a brief period each day, the distribution system is not being fully utilized at other times.

Relocating the maximum-day to peak-hour transition point closer to the user permits a much higher degree of utilization of the distribution system. To accomplish this, two physical changes were required. First, the operational storage had to be relocated and placed in each individual household. Second, a physical restriction had to be placed at each service lateral to preclude peaking from the main lines.

Households in the rural Philippines average six persons. The BWP attempts to build systems that provide 57 L/day (15 gpd) per capita. This translates into 340 L/day (90 gpd) at each household connection. A theoretical continuous flow rate that provides this amount is 0.0040 L/s (0.0625 gpm). To allow for a minimal amount of peaking, the desired flow rate was increased to 0.0064 L/s (0.1 gpm).

Because no hard data were available on precise household consumption patterns, estimates were made for these patterns. It turned out that the storage factors required to meet these demands were almost identical with the storage factor of 25 percent that had been developed previously for communities.

Creating a new level of service

The net result is a distribution system that is extremely small and inexpensive. Also, the amount of system storage required is insignificant. The usual elevated tank is replaced by a simple pipe that provides a water column for pressure regulation.

For identification purposes the BWP refers to this type of system as level 3A. Cost breakdowns shown on page 674 illustrate the relationship between level 2 and level 3A for a typical barangay. Level 3A service represents a savings on the order of 40 percent over level 2 service.

Physical considerations. Level 3A service requires several physical features that are not commonly found in water systems. Each household is provided, as part of the system, with a 95-L (25-gal) storage tank equipped with a float-controlled inlet and a faucet outlet. The minimum pressures designed into all BWP systems will permit the storage container to be placed 2.4 m (8 ft) above ground. This will allow members of the household to shower and thus conserve water, as opposed to limiting them to bathing directly out of containers.

Each main connection is equipped with a restrictor that is designed to pass approximately 0.0064 L/s (0.1 gpm). The restrictors are deliberately placed underground to discourage any attempt to tamper with them. While BWP water systems are normally under relatively low pressures, the differences are still enough to significantly affect the flow rate through fixed restrictors. To compensate for this, all systems are divided into high, intermediate, and low pressure zones and restrictors are used that correspond to the respective zones.

Potential consumption patterns

The standard unit of measure for water in the barangays is the kero can (a 5-gal kerosene can). This is the way water is normally transported by carriers. As stated earlier, it is rare that more than two cans at any one time would be in a house using level 2 service.

Level 3A service, however, starts the day out with the equivalent of five cans in storage. Since these systems are under continuous pressure, with the first usage of water

TABLE 1
Typical water consumption pattern

Time of Day	Household Activity	Consumption L	Consumption gal
5:00 AM	showers	18	10
6:00 AM	cooking and cleanup	18	10
7:00 AM	laundry	18	10
8:00 AM through midmorning	miscellaneous—gardening, cleaning, piggery	56	20
Noon	cooking and cleanup	18	10
Mid-afternoon	miscellaneous	18	10
5:00 PM	showers	18	10
6:00 PM	cooking and cleanup	18	10
8:00 PM	showers	56	20
9:00 PM	miscellaneous	18	10
	daily usage total	450	120

in the home, the float valve opens and water comes into the home at the rate of 23 L (6 gal) per hour.

In the tropics and the Philippines in particular, personal cleanliness is given very high priority. Several showers a day are desirable. Household laundry is done each day regardless of how small the amount.

The combination of 95-L (25-gal) storage, full in the morning, and a 23-L (6-gal) per hour replenishment rate will allow a consumption pattern on the order of the one exemplified in Table 1.

Areas of concern

To realize the maximum potential of such a system will require a certain amount of household discipline. This is not a simple thing with an easy-going people such as the Filipinos. But more importantly, the concept itself is completely alien to the rural population. By definition, anything alien is suspect. It is felt that, after there are several successful examples, level 3A will become accepted as a normal matter of course. It has already been established that once the concept is understood, it is warmly received by the rural population. The difficult part is bringing about that understanding. A substantial initial investment in time must be made to gradually introduce the concept to villagers. If this is not done, resistance may be great even though the advantages are real.

A second area of concern is the tendency for an occasional individual in the barangays to alter the system for personal advantage. This could result in tampering with a restrictor to obtain a higher flow rate. In this instance the system is very vulnerable. A removed restrictor can allow delivery of as much as 0.18 L/s (3 gpm). This is the equivalent of 50 normal connections. The abnormal load concentrated at one point will adversely affect all surrounding consumers. The countermeasure to this is education among the controlling personalities in the barangay as to the seriousness of the problem, ultimately bringing peer pressure to bear on any potential offender.

Current status of level 3A service

As of May 1980 level 3A systems were under construction in eight diverse locations around the Philippines. The first system was scheduled to go into operation in June of 1980. There is substantial pressure to construct many more level 3A systems in places where level 2 systems are programmed. This pressure is being resisted by BWP until the pilot systems are operational so that sufficient time is allowed to assure that cultural and physical obstacles are all identified and satisfactorily dealt with.

Future direction

The BWP is cautiously optimistic concerning level 3A. In the event that cultural resistance proves to be either light or nonexistent, the likelihood is that level 3A will completely replace all level 2 service. Given the potential cost difference of up to 30 percent between the two levels, the construction of level 2 systems would be an unwarranted squandering of funds.

As regards costs, the systems now being built incorporate such a degree of conservatism in design that further savings are possible. It is not unrealistic to expect an additional 10 percent reduction in costs. Development work is under way on lower-pressure pipe systems, mass-produced household storage units, and simpler system pressure regulation and construction methods.

The end result of these efforts is expected to be piped water systems in the rural areas delivering 450 L (120 gal) of water daily in the home for less than $21 per capita construction cost.

An annual conference paper selected by the JOURNAL, authored by Emmett F. Lowry (Active Member, AWWA), consulting engr., San Diego, Calif

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APPENDIX E

Tabulation of 14 Pilot Projects

LEVEL III-A PILOT BARANGAYS

Barangay	Province/City	Population	No. Of Households	Direct Construction Cost	$/Capita	Status As Of March '82
Liburon	Cebu	792	132	$ 45,500	57.45	No power - non-operational.
Mantalangon	Cebu	1,275	170	43,000	33.72	Operational with oversized restrictors.
Calajoan	Cebu	1,500	250	89,900	59.93	Operational with oversized restrictors.
Nueva Caceres	Cebu	1,818	303	91,700	50.46	Under construction.
San Remegio	Cebu	2,022	337	106,700	52.75	Remote, not visited. Reported operational.
Lamac	Cebu	1,280	230	43,500	33.96	Remote, not visited. Reported operatonal without restrictors.
Stateresita	Cagayan	2,950	460	101,300	34.35	Under construction.
Casanayan	Capiz	1,750	247	54,300	31.00	Under construction.
Bansud	Mindoro Or.	2,717	319	66,400	24.43	Under construction.
Solido	Aklan	889	148	29,700	33.41	Fully operational.
Buenlag	Pangasinan	3,232	525	66,900	20.70	Operational with oversized restrictors.
Sasayan	Bataan	1,130	207	37,200	32.92	Under construction.
Loctugan	Roxas City	1,236	206	39,300	31.80	Operational without restrictors. Inadequate system pressure.
Sapangbato	Angeles City	4,590	1,063	130,000	28.32	Operating without restrictors. Intermittent system pressure.

APPENDIX F

- Excerpt from Project Preparation Papers regarding Indirect Program Costs

Indirect Costs

It is necessary that each local government unit maintain a staff to implement the subprojects under the BWP. The cost of this should be included in evaluating the worth of the program.

The employees are members of either the "Development Office" or the "Engineering Office". Both of these offices are also engaged in many other activities. For this reason, it is necessary to examine the manhours required for each subproject and apply a reasonable "overhead" factor in order to arrive at a relatively accurate administrative cost. The activities of these offices fall into the following basic categories.

- studies
- community contact
- preliminary examination
- community organization
- engineering
- procurement
- contract administration
- construction supervision
- training

Studies: This involves an inventory of the water resources and the population makeup of the local government unit. This is used to develop a Capital Improvement program (CIP). It also involves the development of an Annual Implementation Plan (AIP). After a community has been identified as a potential beneficiary, a local study must be conducted to verify that the community meets the program requirements.

The water resource inventory, the CIP and the AIP are not dependent on the number of subprojects being pursued. The annual manpower requirement for these items is on the order of two man months. If it is assumed that there will be an average of five subprojects per year, this spread to 0.4 man months per subproject.

The local study requires staff work on the order of one-fourth man month for each subproject. This allows for a structural survey and a cursory check as to degree of community need and probably water source.

Together then, 0.65 man months of staff work per subproject is attributed to studies.

Community Contact: After study has established that a community needs and is eligible for a BWP subproject, the community is contacted. This is for the purpose of informing the people about the program, with all of its ramification and also to establish the degree of their willingness to participate. The staff work to accomplish this at each subproject is estimated to be 0.3 man months.

Preliminary Examination: This is the development of a Preliminary Engineering Report (PER). It requires measuring distances and elevations but not to survey standards of accuracy. Each structure must be located. This can be accomplished in a community of average size and complexity with 1.0 man months of staff work.

Community Organization: This entails the formation of a Water Service Cooperative. There is a certain amount of training that must be conducted in the community. Staff time on the order of 0.5 man months is required for each subproject.

Engineering: This entails final source determination and final system design. Engineering staff time for an average subproject is 0.5 man month.

Procurement: Staff must assemble the appropriate material and service specifications and prepare the documents. Substantial follow-up is required through auditors and treasurers. Delivery inspection and certification is also required. There are usually four separate contracts involved. Well drilling, piping materials, storage tanks and office building construction. Staff time involved in preparing, evaluating and awarding these contracts is on the order of 1.0 man months per subproject.

Contract Administration: Each of the above contracts absorbs a certain amount of time in their execution such as dealing with contractors, negotiations and change orders. This may require 0.3 man months per subproject.

Construction Supervision: Virtually continuous supervision is required during the time work is underway. This can require as much as 6.0 man months of staff time per subproject.

Training: As the construction nears completion there are two types of training programs which must be presented to the appropriate community personnel. One covers the records keeping and financial affairs. The other is for operation and maintenance of the system. These training programs require 0.5 man months per subproject:

Summation of Staff Input

Studies	0.4 man months
Community Contact	0.3 man months
Preliminary Examination	1.0 man months
Community Organization	0.5 man months

Engineering	0.5 man months
Procurement	1.0 man months
Contract Administration	0.3 man months
Construction Supervision	6.0 man months
Training	0.5 man months
Total	10.5 man months per subproject

Overhead Factors

In addition to the straight staff time required to implement subprojects, there are several factors which are relatively proportional but not so obvious that nonetheless increase the overall cost. They are basically three. Supervision, support, and aborted subprojects.

Supervision can be assumed to be 25% of direct time, which is 2.6 man months.

There will be subprojects that will absorb staff time right up through engineering but for some reason or another, not be implemented. This would represent 2.7 man months which must be spread over the five subprojects that a local government will proceed with. This is 0.5 additional man months.

The above two factors add up to 3.0 man months which, when added to the direct staff time of 10.5, sums up to 13.6 total man months per subproject. Items such as office space, supplies, transportation, secretarial assistance, communications and training expense constitute support overhead that is assumed to be at least 150% of staff expense.

Summation of Indirect Costs

Indirect costs per subproject are estimated to be equivalent to 34 man months staff salary expense. Based upon an average of ₱800.00 per month salary, this is ₱27,200 per subproject.

Conclusion

From the technical standpoint, BWP II is definitely feasible. Design methodology has been demonstrated to be effective in providing sound designs at very low unit costs. Costs per capita for system construction is among the lowest in the world due to minimum wastage. The program fills a vital need nationwide. It even has the potential of constituting a breakthrough with worldwide application in providing low cost but adequate rural water systems.

APPENDIX G

Trip Reports

NESTE, BRUDIN & STONE INCORPORATED / Civil Engineers
P.O. BOX 28100 • 10920 VIA FRONTERA • SAN DIEGO, CALIFORNIA 92128 • TELEPHONE • 714/485-1500 - 714/578-7140

MEMORANDUM

TO: Mr. C. Brady, Philippine Project Officer

FROM: E. F. Lowry, Consultant

DATE: July 15, 1981

SUBJECT: PROGRESS REPORT - WASH ORDER OF TECHNICAL DIRECTION NO. 43

In accordance with your instructions, I spent the two-week period from June 22, 1981, through July 3, 1981, monitoring the progress of the BWP water systems being implemented in the Level III-A mode. In the limited time available I was able to visit all but one of the systems which have made significant progress, with an emphasis on Sapangbato. The time and transportation limitations prevented me from visiting the Sasayon system in Bataan, but I am informed that the Province there is not presently making any progress on that system due to a paucity of funding on their part. A detailed report on the observations and activities at the other sites is listed below.

SAPANBATO-ANGELES CITY

Condition found at time of arrival, June 23, 1981, was as follows:

- Distribution pipe system 100% installed.
- Well completed and equipped with pump.
- Booster pump being installed.
- Approximately 300 service taps made (30%).
- No household storage had been permanently placed.
- Both system storage tanks erected and connected.

Mr. Tony Cabrerra, in the position of system operator, was in the process of making the remaining taps. The suppliers (Moldex) had provided two different types of saddles. The ones for the smaller sized mains were of ¼" thick strap steel and galvanized. These were provided with a thin, relatively firm rubber sheet for gasketing. The saddles for larger pipes were made of cast iron and had a raised tapping boss to receive the fitting and a large rubber "O" ring for sealing. The fitting to house the restrictor and connect the plastic service tubing to the saddle clamp was the wrong type. It was, in reality, a tubing union with identical

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straight threads and flare configuration on both ends. The saddles were tapped with straight threads to receive this fitting. A tapered pipe thread is required for such pressure conditions. Because the strap steel saddles are only ¼" thick, the straight threaded connector screws down its full length and protrudes well past the saddle into the main line. This then requires that an extremely large hole be tapped to allow the fitting to pass. This large hole will be difficult to handle when making repairs under pressure.

A meeting was held with the Barangay captain and the six Purok leaders. I explained to them that the household storage tanks must be solidly supported and the service lines fully protected from sunlight and physical damage. It was their contention that the people would do this as soon as they see water coming. I was inclined to agree with them, but to insure proper action, it was agreed that the Purok leaders would go to each house individually to inform the people.

It was decided to pressurize the system to expose defects. This was done on Wednesday, June 24. (Coincidentally, this is the feast day of Saint John and it is traditional in the Philippines for the people to throw water at each other on this day.) As could be predicted, most of the service tap fittings leaked at the straight thread. Very erratic conditions were found at the household connections. Some were observed to be flowing at 5-7 gallons per minute. It must be assumed that the restrictor is missing. Many houses had no flow at all that were said to have been connected. A plugged-up restrictor could be the culprit, but that is unlikely since <u>some</u> water would be seen. More likely, there is no tap through the pipe or the clamp was offset. Some taps were definitely found to be plugged with foreign material. Tapping of the restrictor allowed the proper flow rate. Most of the houses receiving restricted flow were measured to be very near 0.1 gallons per minute. Usually any substantial deviation was found to be on the low side. The high flowing connections being in the order of 50 times the desired flow could be accounting for the low flows due to the unusually high friction losses.

Most of the float valves were found to be ineffective in shutting off the flow when the household storage tank fills. This valve is very crudely produced.

Mr. Cabrerra manually turned off the well because he said the tank indicated full but the automatic float switch did not function. The problem was the indicator. It is misplaced so that it shows three feet of water in the tank when it is actually empty. Accordingly, when it shows the tank to be full, it is still three feet short of being full.

As predicted by the Purok leaders, as soon as water was evident, everybody took the protection of their service line and storage tank seriously. The work was still not as good as it could have been, but it was adequate for safety.

The failure of the crude float valves had been anticipated, and a supply of small manual valves were made available to allow use of the system manually.

It was decided to keep the system pressurized even in view of the leaks in order to encourage the householder's efforts to proceed and that water will be available. The community immediately was transformed into a laundry. By the end of the day, the entire south side was festooned with drying laundry. Because the booster pump was not yet installed, no taps had been made yet on the north side.

It was further decided to halt the tapping until the thread problem was solved. I met later that day in Manila with Mr. Mercado of Moldex. He agreed to effect three changes immediately. First, all connector fittings with restrictors would be replaced with a type using a pipe thread to the saddle clamp. Second, all clamps would be reworked with a pipe thread. Third, an improved float valve would be provided.

As regards pumps, very little could be done at that time. During the installation of the deepwell submersible, the discharge valve was altered. For some reason not fully clear to me, the valve disc was removed and the handwheel turns meaninglessly. Testing cannot be done until this valve can be closed. The booster pump was being installed without the appropriate valves. Mr. Cabrerra was advised of where to place a discharge valve and a test valve. This pump was started but had to be stopped because of a burst fitting. The galvanized steel line crossing the river was found to leak at many joints.

In retrospect, the malfunctioning float valves can be seen as a blessing. It demonstrated very forcefully that at the low flow rate there is still more water than the people knew what to do with. They will be thankful for a manual shutoff valve.

Apparently, the earth mound for the south tank was not compacted. It is evident that the earth settled at least one inch due to simple rainfall. The riprap is now too high.

The system was left with the following sequence of things to be done.

- Place small straight valves at the inlet to the household storage tanks.
- Replace all saddle clamps with pipe threaded ones.
- Replace all restrictor fittings with pipe threaded inlet ends.
- Continue making new taps with the new clamps and fittings.
- Search out and stop leaks.
- Flush dirt from the system.
- Replace float valves.
- Test float switch pump controls.
- Equip both pumps for testing.
- Cut down riprap and reslope surface adjacent to the south tank.

BUENLAG, CALASIAO, PANGASINAN

Conditions found at time of visit, June 26, 1981, were as follows:

- Distribution system 100% installed.
- All household taps made.
- Both standpipes in place but without accessories.
- Pumps received but no motor controls on hand.

Approximately 80 household storage containers have not yet been delivered. For this reason, further work has been delayed. I advised the PDS to proceed with the other installations and start up the system as soon as possible. The unreasonably long delays in the construction of this system do not appear to have an obvious reason. Either it must take a very low priority with other provincial activities, or there is no sufficient incentive to complete it. Obviously, the factor of providing a service to the community is not sufficient incentive.

The two system storage tanks have been erected but are unfinished, and not yet connected. There are no level indicators or float switches provided on the tanks. A separate pipeline has been installed from the sources to the tanks. Apparently, this was done at the instructions of the local A & E. It is not necessary

and will deprive the system of the pressure benefit when the pumps are running. BWP standard is to pump direct to the system with the tank floating on the line.

The float valves are commercially produced and will probably be very satisfactory, although they are also somewhat more expensive than is desirable.

The restrictors are the ones I had made last year and had furnished to them. None of these items have been put to use yet, therefore, it is too early to evaluate them.

The only recommendations left with the PDS were to use a common inlet-outlet storage line and to pressurize the system as soon as possible rather than wait for the remaining household storage containers.

CALAJO-AN, CEBU

Conditions found at time of arrival, June 29, 1981, were as follows:

- Distribution system nearing completion.
- Storage tank fabrication in place and almost complete. No accessories installed.
- No service taps or household storage delivered, hence, none made.
- Well drilled, but top of ground surface not yet finished.

The supplier will be Moldex, hence, it will be important to assure that proper materials are furnished. Particularly, that the service saddles and fittings utilize pipe threads and that adequate float valves are utilized.

The storage tank was placed upon a bed of rocks instead of gravel, as specified. This is undesirable, but probably will not be critical. Of major importance is that the contractor is making plastic to G.I. pipe connections by heating the plastic pipe and forcing the G.I. pipe inside. This distorts the plastic pipe considerably. When questioned about it, the contractor states that he intends to place clamps around the plastic, although no clamps were in evidence at the three joints I observed. He also says this system is recommended by the Moldex technician. This is extremely doubtful since the valves are provided with pipe to plastic connectors of a high caliber (pack-joint type from Ford Meter Box Co.).

One item complicating the system is that the Cebu PEO has specified that the plastic pipe be changed to G.I. pipe at each roadway and driveway. This is making for a lot of transitions. It also introduces a lot of pipe with less flow capacity than plastic. It would be worth looking into to determine if the head loss due to friction will now be too high.

LIBURAN, CAR-CAR, CEBU

Conditions found upon arrival, June 20, 1981, were as follows:

- Distribution system 100% installed.
- All taps made and household storage tanks in place complete.
- The well is drilled, finished and equipped, but not yet connected to the system.
- The storage tank is almost complete except for painting and connecting.

The distribution materials are supplied by Liberty Pipe Co. The cast iron service saddles are of good quality. The connecting piece is brass with 3/8" pipe thread on one end and a barbed insert on the other end to fit inside the 3/8" service tube. A small clamp goes on the plastic. This is a standard method of connecting industrial hoses and should be very adequate. The restrictor is placed in the inlet end of the fitting. It is entirely of plastic material including the pin. It is doubtful that the pins or bushings are accurately machined. This would be very difficult to accomplish with polyethylene. By eye sighting through the restrictor, a substantial ring of light was observed. This must be tested for proper flow rates.

All household storage units are placed outdoors on a very substantial and uniformly constructed wooden stand. There is resistance to moving them inside due to the smallness of the homes. This should change rather quickly once the people become accustomed to plentiful water. At present, no homes have sinks, etc. With water readily available, they will start building rudimentary facilities inside and the tank will move in at that time.

The riser pipe and the discharge pipe of the submersible pump appeared to be only 1¼" in size. At about 150 ft. setting, this will create over 50 ft. of head loss due to friction alone. This will increase power bills far too high. The pump discharge piping should be sized to have a maximum velocity of 3 ft. per second.

LAMAC, CEBU

Conditions found upon arrival, June 30, 1981, were as follows:

- Distribution system is 100% installed.
- More than 50% of the service taps have been made.
- The transmission line from the spring is completed.
- A filter box is under construction at the spring site. It is 75% complete.

The distribution system appears to be well installed. The fittings I observed were of the proper type and properly applied.

The service taps were a different matter. The saddle clamps are tapped with a straight thread and the fittings intended to be used in them are 3/8 X 5/16 tubing couplings. It is intended to thread the straight 3/8 end into the clamp. These straight threads cannot be tightened. The contractor was planning on supplementing the threads with Rugby rubber cement in an attempt to seal them. At the outlet end of the connector, the contractor is placing a 6" long tail of flared copper tubing that fits inside the 3/8" plastic service line. He says he will clamp this, but the ones I had him dig up had no clamps and he had no clamps to show me. One tap was wrapped with a rag in an attempt to stop it from leaking during a test at the time of their fiesta. The copper tube flaring is being badly done with a very inadequate tool. I advised the PEO people to stop all tapping until pipe threaded components are used.

Almost identical wooden stands to that used in Liburan, Car-Car, have been assembled but not yet distributed. The household storage tanks are going to present a problem. The contractor has put holes in the sides of the tanks suitable for the float valves supplied by Liberty and Gascom. However, he has procured the float valves from Moldex of a very inadequate design. These valves are intended to be mounted in the cover. The PEO was advised that these valves do not perform well.

The restrictors are of two types; brass and plastic. One is reputed to be for the higher pressure areas, and the other for lower pressure areas. Answers were inconsistent as to which were which. It is possible that nobody knows. Each service should be tested when the system is put into service.

At the spring source, a two-chamber filter box has been constructed. The spring water is reported to become turbid during periods of heavy rain. This probably means that surface water has direct access to the spring. Accordingly, the water should

be considered potentially dangerous at all times and should be continuously chlorinated. No provision for chlorination was included in the filtration design. The pipeline retention should be adequate for a bacterial kill.

It would appear that the old problem of incompatible components has arisen here again. The contractor has probably shopped around for the cheapest of each and assumed he could somehow make them work. We attempted to prevent this by requiring entire packages be procured from the manufacturers. Cebu does not seem to be following this practice.

The following recommendations were left with the PEO.

- Use pipe threaded saddle clamps and connectors. Replace those already installed with straight threads.
- Test the float valves, and if they do not shut off reliably, reject them.
- Provide for continuous chlorination.

LOCTUGAN, ROXAS CITY

Conditions found on arrival, July 1, 1981, were as follows:

- Distribution complete except for 320 meters of 1" pipe.
- All household connections made except 47.
- Storage tank is erected and painted, but no float switch. Level indicator is unguided.
- No household tanks distributed yet.
- Deepwell submersible pump is installed and has allegedly been tested. No electrical switch is yet installed.

The source is located approximately 500 meters from the storage tank. The pump contractor is attempting to avoid the installation of a float switch at the tank and two control wires to the pump. Instead, he has installed a small household pressure tank and a pressure switch. This arrangement cannot allow the system to operate as designed. This is basically because a pressure switch can only sense system pressure existing at its point of installation, which in this case, is at the well. However, the residual pressure at that location at the time the storage tank nears

overflow will be higher at night than during peak daytime periods. If the pump control is set to stop the pump at nighttime, the daytime operation will overflow. If the control is adjusted to stop the pump before daytime overflow, then it will stop at nighttime while the tank is empty. There are also other reasons for not using a pressure switch. The accuracy (ability to repeat) is only 5 percent at best. For a 40 PSI setting (92 ft. of head) this is 4.6 ft. This is almost half the entire tank capacity, just for accuracy. A float switch will be accurate within one inch. The differential (difference between on and off pressures) is usually fixed and cannot be altered. The proposed switch has a differential of 20 PSI. This is 46 ft. There is only 10 ft. provided between the upper and lower operational levels of the storage.

Accordingly, the CDS was advised to proceed as orignally planned with a float switch and control wires.

A mix-up has occurred in the making of the service connections. Two types were provided by Moldex. For all connections where the line is less than 2" in size, a plastic fabricated tee was provided. The tee is to be fusion welded into the line and has a 3/8" flared tube outlet. A tube-to-tube connector is used with a restrictor built in. Where the line is 2" in size, a saddle clamp is provided with a female pipe thread. The connector is a male pipe to flare tube fitting with a restrictor built in. Both systems were perfectly good, but the workers were unaccustomed to the pipe threads and thought there was something wrong if they could not be threaded very much by hand. The supplier's technician did not stay the required five days to provide guidance.

To effect a remedy, the CDS had the saddle clamps tapped with a straight thread. The fittings now go completely in by hand and cannot fail to leak. I took them to a hardware store and showed them a 3/4"X1/2" pipe bushing reducer that sells for ₱3.00. They can once again tap the saddles with a 3/4" pipe thread and use the bushings. This they agreed to do. Fortunately, there are only ten of this type of connection.

SOLIDO, AKLAN

This system is 100% complete and operational. To better understand this system, its history should be reviewed.

When the system was first completed in the latter half of 1980, it was put into service and found to be an operational failure with much unhappiness in the community. Upon inspection, it was complained that only a few houses obtained water, while the remainder received nothing. This was because no restrictors were used. The reason for doing this was because the people of the community did not want a slow flow. They complained that this would require that they wait too long for everything, even a drink. After various reasons were given for the supposedly monumental obstacles in acquiring restrictors, I furnished them with a full supply and together we installed same. They saw that the performance was as designed and agreed to equip the entire system with restrictors. Immediately upon their installation, all households received service.

A second unfortunate aspect of the system was that instead of furnishing a simple plastic container for household storage, a very expensive steel pressure vessel was furnished. The connection was made at the bottom with no provision for venting. The entrapped air prevented more than a small amount of water from entering. They were advised to provide an overflow outlet near the top. which would act as a vent and place the inlet at the top. The existing faucet at the bottom was sufficient as it was. This they agreed to accomplish. They were also advised that a float valve for automatic shut-off was required. It would be studied to see how this could best be accomplished at a reasonable cost.

Additionally, almost all household storage tanks were located outside, some simply placed in front of the house.

At the time of this visit, the following observations were made.

1. Community acceptance appears to be complete. The local association officials say everybody is happy with the service. To verify this, I personally talked with at least 10 percent of the housewives at scattered locations. They were unanimous in that there is far more water available to them than they can use. They no longer go to the nearby river to do their laundry. They and their families take as many baths as they like. They actually point with pride at the small flow inlet and at what it can do.

2. One hundred percent of the household storage containers have been placed in a location that the householder feels is convenient to him. Probably 60 percent are outside, but at the rear, convenient for bathing and laundry. Forty percent are inside with sinks beginning to appear in the homes. Nobody nas attempted a shower installation yet. It doesn't seem to appeal to them although they are aware that it can be easily done.

3. All containers have an inlet shut-off valve and some sort of overflow pipe to an additional container. Most shut-offs were found to be closed at the time I checked them, which was about 1600 hours. The overflow is being used in two distinctly different ways by two distinctly different types of customers. Those consumers with large families direct the overflow into a substantial additional storage vessel in order to obtain more water. The majority, however, have only a small vessel to catch the overflow. This serves the simple purpose of alerting the residents that the storage tank is full and should be shut off. Nobody seemed to feel that it was necessary to leave the inlet open overnight.

4. About 30 to 35 of the restrictors have been relocated closer to the storage tank. These restrictors became plugged up and the operator did not want to dig down to them again, hence the relocation. At this time, no restrictors are becoming plugged. The original problems were because of the foreign material in the new system. It is the contention of the system operator that there are no users who have attempted to circumvent the restrictor. He does not think anybody is motivated in that direction since there is ample water as things are.

5. The system pressure is probably higher than was designed. This is evidenced by the one three-story building in the community. The owner has closed off his pressure vessel and has piped the outlet up to the third floor for storage. It should only reach to the second floor level if the design residual pressure were prevalent. This points out the need for developing accurate consumption and flow data.

6. The system appears to be a financial success. The flat rate charge is ₱15.00 per month per household. All customers are paying, and the Association after six months of operation, has accumulated a reserve fund of ₱6,000.00. The power bill is averaging ₱400.00 per month. The pressure gage at the pump discharge is not functioning, so it was not possible to conduct a pump test. This should be done to assure that the pump is reasonably efficient. The system must be responding well to the needs of the community. In the month of June, which is their fiesta time, the usage increased substantially and the power bill for that month was ₱666.00.

The Provincial Engineers Office is responding to the suggestions received by the BWP. He has investigated the cost of using larger, covered containers equipped with float valves, as is standard practice for Level III-A. The quotation I saw for the containers alone without any accessories was ₱265.00 each from a firm called Molded Industries. This is unusually high, so I recommended that he not make the purchase. As I recall, Plastimer Inc. was quoting less than ₱100.00.

In view of the very high degree of community satisfaction and acceptance that I found, I would recommend that no further changes be made with the system at this time. To attempt to change the storage containers now that installations are all relatively permanent would be a dislocation for the users. At the present, there is no felt need for the float valves. If this should develop in the future, it will be simple for the Association to make the addition. I suspect the users will never feel the need, however. In the meantime, it will be very useful and instructive to have a community without float valves. It is possible that we may learn that float valves are not necessary after all. It is also useful to observe the ramification of placing the restrictors near the storage tanks. This has always been an option, but was avoided due to the fear of tampering. If it becomes clear that this fear is unfounded, it will simplify conditions by placing the restrictor at the storage tank. I feel it is too early to draw conclusions at this time, but the existence of a laboratory for observation is valuable.

SUMMARY AND CONCLUSIONS

In general, the results to date appear to be satisfactory. All significant problems are of a manageable magnitude and are to be expected at the present stage of project implementation.

The greatest single problem area is physical. There are too many cases of inappropriate accessories and misapplied appurtenances to the physical water system. It must be concluded that the manufacturing and supply segment of the Philippine Waterworks Industry has not yet evolved to a point where their products can be installed by local labor with confidence. Leaks and unreliable performance are too prevalent.

Insufficient attention is being paid to the subject of pump performance. No case has been found yet where the installation is in accordance with the design guide. As a result, none can be tested and evaluated. It is not inconceivable that up to double the necessary power bills are being paid due to improper pump selection, performance or application. The attitude remains in the field that a pump is a pump is a pump, and if it moves water, it must be all-right.

There is every indication that the cultural aspect of III-A service need not be a serious consideration. Very properly, we have been very concerned that the folk of the Barangay would be able to accept such an alien concept. Initially, this appeared to be a very valid concern as evidenced by the many complaints from unbelievers prior to the implementation of a system. Solido was no exception and the complaints had been numerous. After proper activation of the system, the Barangay folk immediately grasped the concept and have unanimously accepted it. In fact, they demonstrate a degree of pride that they can do so much with so little.

The absence of float valves at Solido in no way reduces the effectiveness of the system. This does not mean that float valves would not be useful -- they would. But it does establish the fact that they are not a necessity. It even raises the possibility that they could constitute a liability. This is because of the fact that a certain amount of maintenance will undoubtedly be required for them. Also, they could develop a degree of dependence on them. In the event that maintenance was not adequate, this dependence could result in excessive wastage of water.

There appears to be no appreciable incentive for users to tamper with the restrictor. The fact that the system can fully meet their needs in its present configuration seems to preclude this idea. Also, in Solido, the operators found it convenient to relocate the restrictors closer to the household storage unit when they were found to be clogged up. This relocation has not increased the tendency for tampering, but it has improved the serviceability of the restrictors.

The problems being encountered with fittings is not crucial but should be eliminated in the interest of smooth program performance. A higher degree of standardization is one way of insuring increased performance and uniformity. This could be accomplished by utilizing a central procurement system for fittings only. If this were to be attempted, great care would be required in the preparation of procurement specifications. Obviously, the procurement of a large number of any item offers an opportunity for error on a larger scale.

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M E M O R A N D U M

TO: Mr. C. Brady, Philippine Project Officer

FROM: E. F. Lowry, Consultant

DATE: October 6, 1981

SUBJECT: 2ND PROGRESS REPORT - WASH ORDER OF TECHNICAL DIRECTION NO. 43

1. 24 AUGUST '81

Upon arrival, I proceeded to Angeles City where I met the City Waterworks Engineer, Romy Calara. We proceeded to Sapangbato. No work is underway due to lack of proper materials. A change order was prepared but not executed that would acquire saddles with pipe threads and brass pipe to tube adapters with built-in restrictors. The change order also provided for exchanging the poor performing float valves with an improved version. The change order provided for additional payment to the supplier for these changes. I advised Romy that additional payment for the brass adapters in lieu of plastic was reasonable but that the cost of improving the float valves should not be borne by anybody but the supplier.

While at Sapangbato I tested a sample combination saddle clamp and tapping valve that I had brought from the U.S. It incorporates a needle for piercing plastic pipe and a needle valve that shuts off. A pressurized line of 1" diameter was used as a test main. With no substantial effort and no tools, the line was pierced and the valve clamped into place. There were no leaks and the flow could be readily controlled from .05 to .3 gallons per minute and shut off completely, if desired.

2. 25 AUGUST '81

A meeting was held at the BWP office with Romy and the supplier's representative, Mr. Mercado. Romy had with him the change order request. BWP is unable to process the change order due to the absence of the Deputy Minister Socrates in the States. Moldex was prepared to make deliveries on the saddles and adapters pending an order. No decision was made on the float valve until financial and physical matters are resolved. The sample improved float valve was still a deficient design and Moldex was to consider making the change at no cost. One option I proposed to Romy was that if a significant charge were to be made, a standard, very inexpensive, float valve could be imported from the States cheaper and with greater reliability.

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3. 27 AUGUST '81

A second visit was made to Sapangbato to gather data on the proposed resettlement of some 168 households near the system with a view towards evaluating integration options. A precise site was not known but the general area to be served was identified. It is on the North bank of the river and immediately East of the existing settlement adjacent to the Satelite Communications facility. The 168 houses as resettled will be more difficult to serve from the existing water system than their present location. The new area is further East by about 300 meters. The existing settlement was originally excluded on the instruction of Angeles City because of the temporary nature of their occupancy. Accordingly, the capacity to serve homes in that sector of the water system was not provided. It now turns out that the proposed resettlement is simply moved East. There could not be a more costly place to attempt to add 168 homes to the existing system. The new area is at an elevation higher than the existing system and is beyond the extreme end of the North segment which, in turn, is supplied from the South segment. The elevation aspect alone is manageable, and the straight line distance from the source is not excessive. The problem is the river between the two. Only one crossing exists at the West end of the system. The river is wide and subject to flooding. This makes a very costly proposition to attempt an additional pipe crossing upstream near the resettlement area. Because of the scouring action of a flooding riverbed, an overhead pipeline would be required.

Without going into a formal investigation of alternatives, I am of the opinion that a new source within, or close by, the resettlement area could be developed and no attempt made to integrate the two systems physically.

4. 28 AUGUST '81

The offices and factory of Moldex were visited. Discussions with the President of the company emphasized their responsibilities, particularly as regards the float valves. They appeared to agree that sound design was their responsibility and of a high priority.

A visit was made to the factory in Valenzuela to verify that the new cast iron clamps were really there for shipment as claimed. They were found to be ready for immediate shipment.

Moldex was preparing to ship them to Angles City the following work day (Monday, 31 August). I had an opportunity to inspect the latest version of their float valve. They finally had decided to follow

the initial advice of keeping the entry opening very small in order to reduce the forces required to seal against pressure. The new valve was sturdy and tested to seal completely and effortlessly. It was observed that the geometry of the flat lever was such that the water level at shut-off was very high. We lowered the level by slightly bending the float arm.

As regards the new brass service fittings, they are very well made. The inlet is now a proper tapered pipe thread. A restrictor of the configuration, shown in the BWP manual, is permanently pressed into place. It was not equipped with a micrometer to determine if the machining was as specified so must rely upon the manufacturer. Only 203 fittings were prepared at that time, but that was enough to warrant starting the replacement program. No marking was placed on the fitting to indicate L, M or H, so Moldex promised to mark them before shipping.

5. The saddles and restrictors were delivered to Angeles City on 31 August, as promised, but the system operator in charge of the work (Tony Cabrera), was in Manila so work was to commence the next day (Tuesday, 1 September).

I traveled to Sapangbato 1 September, to assist the work but found Mr. Cabrera still in Manila. He was scheduled to return that afternoon. Inspection of the saddles revealed that they were still straight threads. This was disappointing, but not disastrous. A tapered male pipe thread can achieve a seal in a straight female thread. In any case, it is possible to easily taper the straight female thread with a few turns of tapered tap. Moldex was advised of the situation. They responded that they thought all female pipe threads are straight and were not aware of tapered female as available, let alone standard. They agreed to furnish me with two taps that I could take to Sapangbato to rehab the clamps.

That evening, two taps were delivered to my hotel but they turned out to be 1/2"-13 NC, which is a standard 1/2 bolt thread and useless for our purpose.

6. 2 SEPTEMBER '81

Returned to Sapangbato to see what could be accomplished with existing materials. Tony Cabrera and his crew were ready to commence. In order to test for water tight joints and proper operation of restrictors, it is imperative that the distribution system be pressurized while taps are installed. Accordingly, we started the deepwell pump. With water in the Southern section

by gravity through the booster pump to the Northern section, we attempted to boost water to the North storage tank. The booster pump will not run. The installing electrician is to be called to troubleshoot the problem. Without the pump there was still substantial pressure at the lower lines of the North section where the new connections were desired.

The crews were prepared to install the new saddles using the 3/4" tapping drill that was previously used. A large tap hole is very undesirable for two reasons. It can seriously weaken a pipe if the tap hole is almost as large as the pipe itself. Also, for service maintenance, a large tap hole under pressure will pass an unmanageable quantity of water. I went to a hardware store and acquired three hand augers 3/16" size.

A tapping sequence was developed as follows:

1. Clamp placed on pipe fairly tight.
2. 3/8" service line cut to proper length and flared ready to connect.
3. Adapter with restrictor coated with sealer ready to install.
4. 3/16" hole augered into main line at center of clamp outlet.
5. Adapter threaded into place snug, but not tight.
6. 3/8" service line connected to adapter.
7. Adapter tightened till no leak.
8. 3/8 service tightened till no leak.
9. Clamp tightened, if leaking, till no leak.

The purpose of the above sequence is to minimize the amount of the loose water that must be contended with and to avoid overtightening of these relatively small parts. It also lends itself to an assembly line-type of operationa. One man digs and exposes the pipes. A second applied clamps and flares service lines. A third drills the hole and assembles the adapter and service line to the clamp and tightens the assembly. The six men should be able to do about 40 connections per working day.

Problems were encountered with the pipe thread connection at the clamp. The threads are not consistent. Some adapters only go in two turns by hand, while others go all the way in. By selective assembly, combinations were found that sealed. An inspection of the manufacturers process will be required to find the reason for the inconsistent machining. Standard threading tools and gages are available but may not be used.

7. 7 SEPTEMBER '81

Accompanied by the Moldex representative, I inspected all of the facilities engaged in manufacturing their components.

At the Luzon Foundry the brass replacement pieces with restrictors were examined. They have excellent quality control complete with master and submaster thread gages. I found, however, that their ability to machine the restrictor pins accurately is limited due to the small quantity. They are doing them without tooling. This causes inconsistencies which can invalidate our efforts to achieve three different pressure ratings. We discussed simple tooling which they propose to institute for future work.

The cast iron service clamps are made at Eastern Foundry. This is a very disorganized facility. We examined their representative products and tools. No drawings or specifications existed. Some clamps have straight pipe threads, while others have tapered pipe threads. They know of both types but treat them interchangeably.

8. 9 SEPTEMBER '81

Sapangbato was revisited to make test installations of the new float valves. Work was still progressing in the installation of connections, but with the system empty. The electric company had disconnected their service to the pumps for non-payment. The Association had signed the original electric service contract, but had no funds other than its trust fund to pay for power consumed during early system testing. I advised them that since their members are receiving water while the connecting process is underway, they should be able to collect from them and generate funds to pay for the power. Since the system is not yet turned over, Romy stated that the City would authorize the Association to make interim collections. We visited the power company and they agreed to a short additional grace period and immediately reconnected the well pump.

Also, somebody had pilfered some 600 meters of the control wires between the storage tanks and the pumps. The City advised the Association that these may be replaced by the Association and that it was the communities responsibility to control such actions.

With the wire missing, the pump could not be started, even in "manual" position. I found that the controls had been connected very irregularly. I temporarily jumpered the remote wires to operate the pump.

I anticipate there will be leaks at the connections which were made while the system was dry. I observed one workman connecting a 3/8" service line that was 1/4" short of reaching the fitting it was to be attached to. He connected it anyway knowing that it was too short.

9. I examined the proposal to add approximately 45 households to the system of its extreme Northeastern sector. I found that this could be tolerated by the system only if the water is not taken from the system beyond the point identified as 21a. This addition will stress the system in that sector to its limit.

10. The following recommendations are made for the conclusion of the Sapangbato water system construction:

    a. Replace all saddle clamps where the threads are oversized.

    b. Make all connections under pressure.

    c. Revise pump controls so that pumps will operate manually, regardless of level sensing wires.

    d. Obtain a proper pressure gage and conduct pump tests.

    e. Test new float valves before making mass installation.

    f. Promote community campaign for proper placement of household storage tanks and 3/8" service lines.

ms

INTERIM REPORT #3
W.A.S.H. OTD #43
November 20, 1981

1. Discussions with Mr. Brady revealed that Moldex had delivered the new style float valves to Sopangbato but were also found to be defective upon attempts at usage. They leaked both at the closure orifice and at the inlet fitting. Additionally, the floats were breaking from the lever arm. Accordingly, all valves were returned to Moldex for credit. A new style of float valve was found on the commercial market that is all plastic and normally used for toilet bowls. The cost is on the order of 35 Pesos each. This is an acceptable figure if they work effectively. It is still possible for a small valve to be manufactured locally for about 15 Pesos.

2. A field visit to Sopangbato in the company of Mr. Brady on 19 November '81, revealed that little real progress had been made since the last visit. In fact, there was probably a retrogression.

   All during the pipe laying period, the supervisor was continuously warned that the ends of the pipes must be sealed closed with heat at the end of each day to prevent children from pouring sand, stones, dirt and debris in the open ends. This had not been adequately done and on many occasions open ends were seen with debris in the pipes. When water was first introduced into the system, it was attempted to flush out the system at the booster pump by exercising the system gate valves in turn. Much debris was flushed out and eventually the discharge was continuously clear. It was hoped that this flushing was adequate. This may not have been the case.

   Initial usage of the system delivered very clear water and no residue could be seen in the household storage tanks. New connections were made near the Water Association office building at the time of my last visit. Even without the booster pump running the pressure was adequate and the quality of water served was good. At the time of this visit, these same houses had no service at all and indicated this had been the case for some time. We then checked on the service at the lower elevations and found in every case the water was flowing unrestricted at about 3 GPM. This had not been the case before except in a few instances. One man admitted that he had removed the restrictor. The water standing in the household storage units now showed a dark residue.

3. Two serious defects now exist which must be resolved. First, the origin of this residue must be discovered. It may be dirt in the pipelines slowly being extracted, or it may be a product of the production well such as precipitating iron. Physical/Chemical tests are being run by Clark Air Base to resolve this question. Secondly, all restrictors must be replaced.

   It is possible that one problem has revealed the other. The free flowing connections are creating unusually high velocity flows in localized sections. This could scour the bottom and put otherwise stable particles of matter into suspension and carried out through the connections.

   It will be essential to assure a clean pipeline network before any success can be had with properly functioning restrictors.

4. The following procedures are recommended to complete the system:

   a. Systematically dismantle each intersection and flush out each reach of pipe until the system is known to be clean.

   b. Determine by tests that the production of the source well is not introducing foreign material to the system. If it is found to be doing this, then treatment is required or the well modified or replaced.

   c. On an individual record card for each connected house, list an identifying number, the approximate location of the tap at the main and the name of the responsible head of the household.

   d. Conduct a community-wide information campaign to emphasize the need for total cooperation as regards restrictors if all are to be served. Specifically advise that each lower elevation household that tampers with his restrictor will deprive 10 to 30 houses in the higher elevations from service.

   e. Systematically, by the numbers, examine each existing connection for a properly functioning restrictor. At each connection found with excess flow, insert a proper restrictor.

   f. As each connection is seen to be properly functioning, give each such household a notice from the Association that each connection will be followed up with periodic flow tests. Any evidence of tampering will be cause for disconnection for at least six months or serve notice of other undesirable punitive action. Obtain signature for receipt of notice.

g. After all existing connections are operating properly, systematically make new connections following the procedure outlined in Report #2 until all are served.

h. When all households are properly connected, conduct a campaign to protect the 3/8" plastic service line and the storage units.

5. The above items will require several months to accomplish. Accordingly, Mr. Brady has requested that I return during the first half of March 1982, for two specific tasks. A final review of this Sopangbato system and a wrap-up evaluation of all other III-A projects. I can schedule this if it is the wishes of USAID/Washington and they fund my round trip transportation. Otherwise, this must be considered my final report relative to OTD #43.

FINAL TRIP REPORT - W.A.S.H.
ORDER OF TECHNICAL DIRECTION
NO. 43

From 15 through 29 March 1982 a final visit was made. During the first week of this period, I was accompanied by Mr. Renato Galang of USAID/Manila and by observers from Sri-Lanka at the request of USAID/COLOMBO. Observers were:

T. B. Madugalle, General Manager;
S. B. Boyangane, Deputer General Manager;
S. Palamuthusingam, Chief Engineer;
S. Nagaratnam, Assistant General Manager;

All of the National Water Supply and Drainage Board of Sri-Lanka; and,

Mr. John McGill, Project Manager of the Jaffna Project.

Each subproject community that was visited is discussed separately below:

SAPANG-BATO: Here matters were found to have regressed. The previous recommendation made to flush the dirt out of the system had not yet been accomplished. The restrictors had reportedly plugged up and all restricting pins had been removed by users. As a result, only a portion of the community has any service and wastage is very evident. The users in the upper elevations are receiving no water. Given the myriad of water receptacle arrangements and the extremely high extraction rates, it is unavoidable that back-siphonage will occur frequently and the system is continuously exposed to contamination.

The restrictor pins are in the process of being replaced by orifice restrictors. This is an appropriate measure if it is to be assumed that the system water will not be sufficiently free of particulate matter. It was observed that the replacement restrictors are flowing at two to four times the desired flow rate of 1/10 gallon per minute. If this is repeated at all connections, the total flow rates will exceed the system design.

BUENLAG-CALASIAO: This system is now fully operational. The flow rates are approximately 50% higher than designs due to the use of oversized replacement orifice restrictors. Even with this increased flow rate, the system is fully pressurized 100% of the time. This validates the assumption that design parameters were conservative.

Many users were interviewed in households with up to 10 persons. In all cases, the householder expressed full satisfaction with the service. No instances were found where there was not sufficient water for all requirements. It should be anticipated that this will change with time as users learn how to use the water.

It should be noted that this community is a very difficult one to serve effectively. It is two kilometers long with almost no depth to it. Houses are strung out in both sides of a long level road.

CALAJOAN-CEBU: This is a small community of 250 households. Only 150 have requested service and are connected. The rest generally get their water from those that are connected. The system is fully operational but only being 60% utilized. All restrictors are in place but have been altered by the installing contractor to yield higher flow rates. These range from 0.3 to 1.0 gallons per minute. Even with these high rates, all users were found to have full-time service. Here it must be pointed out that while the system is apparently able to meet the present needs, it may become inadequate if the number of users increase substantially with the high individual flow rates.

MANTALONGON-CEBU: This is a small mountain community of 170 households. The terrain is very steep and the system consists primarily of a single pipeline from a spring at a higher elevation down the main traffic way. 146 households are connected. The last connection, which is at the lowest elevation, is a restaurant owned by the chairman of the Water Users Association.

Again, these restrictors were altered by the installing contractor to yield flow rates higher than 1/10 GPM. Many were measured. In excess of 5 GPM was observed at the restaurant of the chairman. It is highly probable that the restrictor has been removed. Others were measured at 1 to 2 GPM.

There is a lack of understanding in regards to the hydraulic dynamics of such a proposed system. The engineers were of the opinion that restrictors are not important if the source is a spring. This conclusion ignores the hydraulics limitation of a low-cost, small diameter distribution system.

However, even with this abuse, all users that were interviewed were very satisfied with the service and knew of no instances where a user did not have all the water desired.

SOLIDO-AKLAN: This community had been visited in July 1981 and is reported in detail in the appended progress report of July 1581. Solido was again visited to attempt to find new reactions. Two incidents are noteable. One user was

discovered to have removed his restrictor and was using the continuous flow to irrigate rice. His neighbors reported him and he was issued a warning that he would loose his connection if he repeated the infraction. Normal restricted service was restored. Secondly, the Water User Association employee who collects the bills wants to receive full service (level III) without household storage and is continuously trying to enlist support from the other users for his position. Nobody appears to support him.

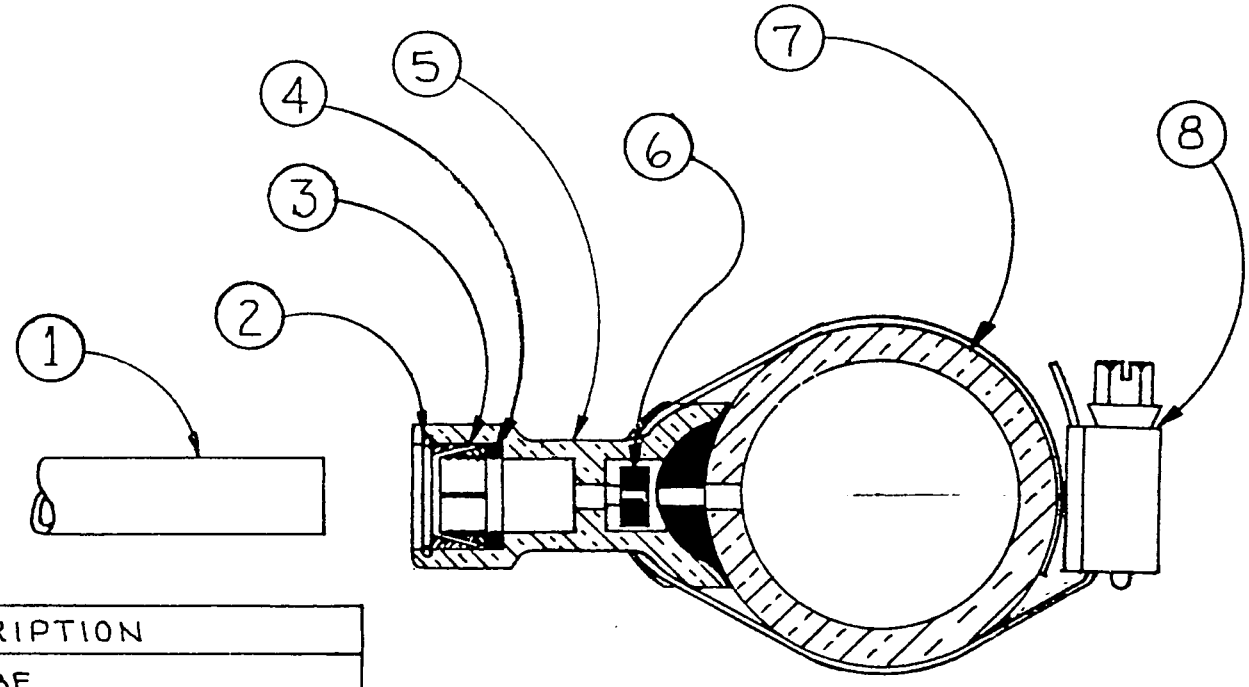
Again, all interviewed users are fully satisfied with service. Flow tests were made and ranged from .08 to .1 GPM. Users with large families and low incomes were searched out. I could find nobody who needed more water or knew of anybody else who needed more water.

LOCTUGAN-ROXAS CITY: This community was not visited because discussions with the engineers revealed that all restrictor pins had been removed. Even under these adverse circumstances, about 75% of the system is served with water. The remainder is at the higher elevations near the edge of the system. Roxas City was attempting to find clogged pipelines instead of examining the hydraulics of the system. Full pressure can be achieved by the use of restrictors. An in-line restrictor developed by the Barangay Water Program could be placed in the service lines for an estimated cost of ₱27 ($3.30). Roxas City is contemplating a simple orifice placed where the pin had been removed for an estimated ₱3.00 ($0.40). Either solution will perform well but flow should be restricted to 0.1 GPM (.006 LPS).

CASANAYAN-CAPIZ: This community system is still under construction. Consideration is being given to attempting a level III system even though the pipes are designed for III-A. Reportedly, the community is waiting to see how the Loctugan system works.

APPENDIX H

Components



ITEM	DESCRIPTION
1	10 mm TUBE
2	RETAINER RING
3	GRIPPING DEVICE
4	'O' RING SEAL
5	SERVICE SADDLE
6	FLOW REGULATOR *
7	PLASTIC PIPE 1" THRU 4"
8	ATTACHMENT CLAMP ASSY.

* SPECIFICATIONS

SERVICE PRESSURE 10 - 150 PSI
REGULATED FLOW RATE : .006 LPS ± 5 %

THE FORD METER BOX CO., INC.
Wabash, Indiana 46992, U.S.A. 219-563-3171

FLOW REGULATING SERVICE CONNECTION

TOLERANCES (EXCEPT AS NOTED)
DECIMAL ± N.A.
FRACTIONAL ± N.A.

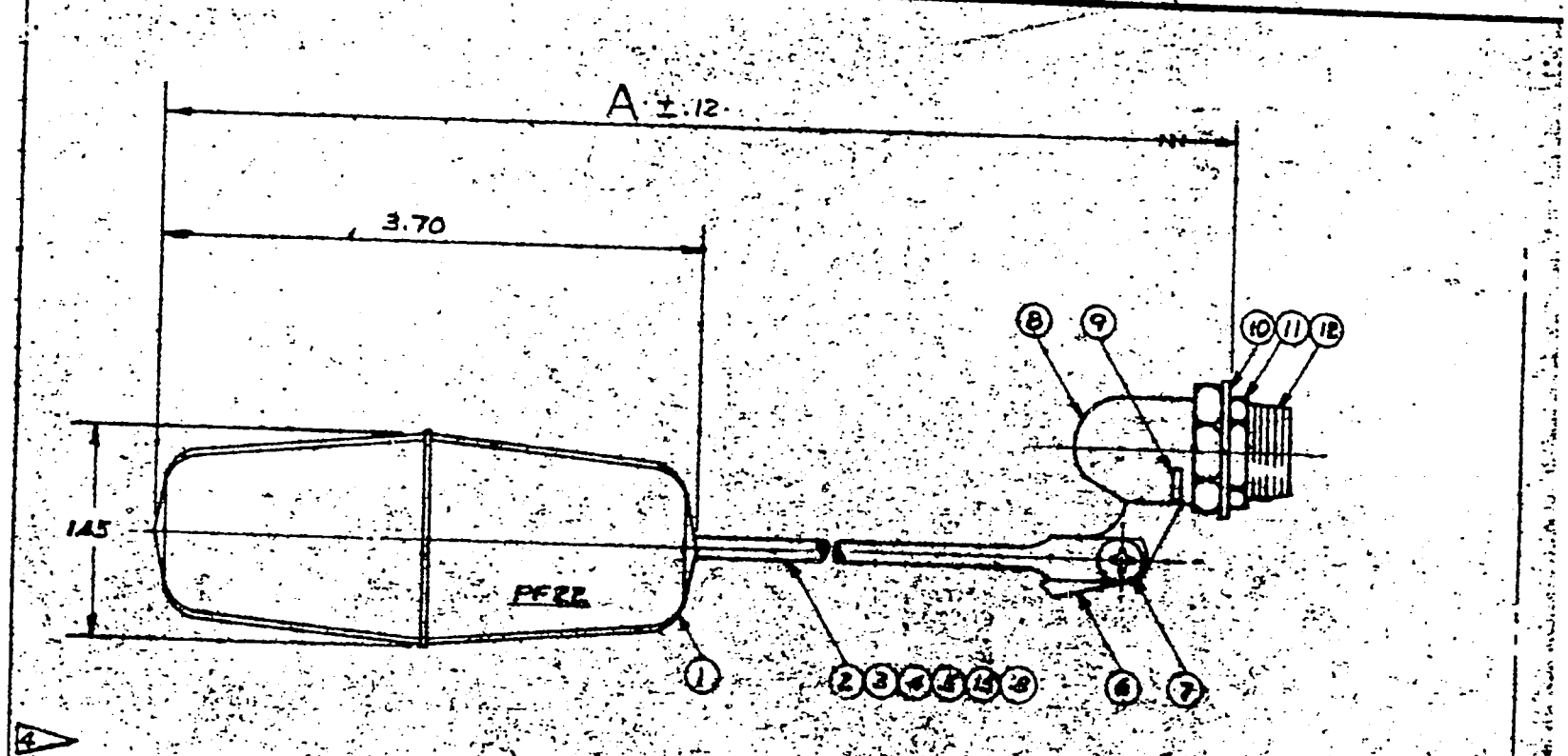
MATERIAL

DRAWN BY RES | DATE | DRAWING NO. 9944
CHK'D BY | SCALE NONE

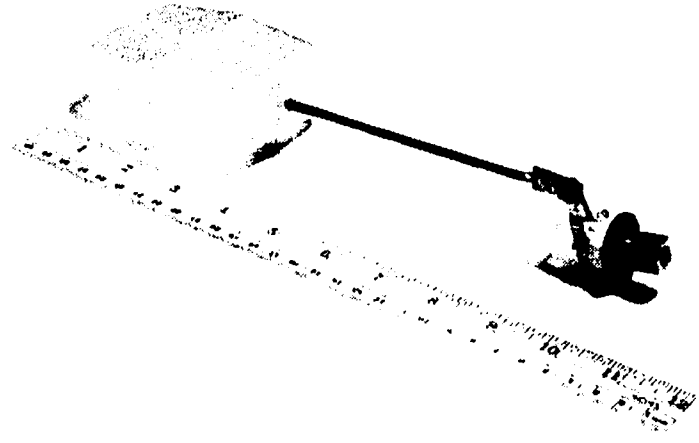
REV.	DATE	DESCRIPTION	BY

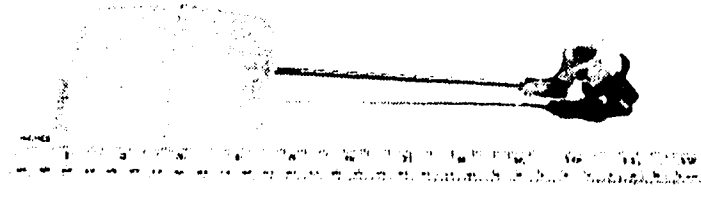
ROBERT MFG. CO.
P. O. DRAWER A
10567 JERSEY BLVD.
CUCAMONGA, CA. 91730

RM71



RM71 ASSY





FLOAT VALVE

Manufactured by:

Robert Manufacturing Company

10667 Jersey Boulevard

Cucamonga, California

Phone (714) 987-4654