NATURAL RESOURCES MANAGEMENT PROJECT

BAPPENAS – Ministry of Forestry
Assisted by
USAID

COMMUNITY WATER SUPPLY FEASIBILITY STUDY FOR BUKIT BAKA–BUKIT RAYA, KALIMANTAN

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PREFACE

This report is one of a number of reports produced under the Government of Indonesia's Natural Resources Management Project (NRM) that is assisted by the United States Agency for International Development (USAID).

The NRM project, working with the Indonesian National Planning Board (Bappenas) and the Department of Forestry (Departemen Kehutanan), provides through a specially established project Policy Secretariat advice to Bappenas on natural resource issues relating to long and short-term national planning. In addition, working with the Department of Forestry the NRM project carries out field activities in two pilot project areas, one in West/Central Kalimantan and one in North Sulawesi including the preparation of management plans for the Bukit Baka - Bukit Raya National Park in Kalimantan and the Bunaken National Park in Sulawesi. Each report addresses an aspect of the planned NRM project activities that are agreed on and laid out in an annual NRM Implementation Plan and each report aims at providing specific recommendations for future work in the area addressed.

This report looks at the feasibility of supplying potable water to local communities living around the Bukit Baka - Bukit Raya National Park in West and Central Kalimantan. It recommends that a pilot project to supply potable water is implemented in seven villages in the surroundings of the Park and given that this proves successful is extended to other local communities. These recommendations will be implemented by the NRM project in the near future.

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Notes

This mission was to do a feasibility study for improving community water supplies and sanitation (WS&S) facilities in the vicinity of the Bukit Baka/Bukit Raya (BB/BR) National Park. The park lies astride the mountainous border of West (Barat) and Central (Tengah) Kalimantan in Indonesia. The mission was part of the USAID-funded Natural Resources Management Project (NRMP) implemented by Associates in Rural Development, Inc. (ARD) of Burlington, Vermont. The purposes of the NRMP include natural resources and forestry policy analysis, multipurpose management of protected areas (the BB/BR National Park and Bunaken National Park in North Sulawesi), applied research, and management of natural production forests (actively being logged by concessionaires such as Sari Bumi Kusuma {SBK} and Kurnia Kapuas Plywood {KKP} in the BB/BR area). This mission was undertaken to assist communities whose water supplies (largely rivers) have been adversely impacted by upstream logging activities.

After meeting with USAID/Jakarta and NRMP staff and identifying an Indonesian counterpart water technician, ARD Senior Engineer Rick McGowan travelled to Pontianak, Kalimantan Barat to meet with the NRMP BB/BR Team Coordinator. With the NRMP hydroelectric consultants, the consultant and the NRMP Team Coordinator flew to Sintang, then proceeded upriver to Nanga Pinoh[1] and SBK's log pond at Popai on the Melawi River. We then travelled up to the SBK camps at Km. 35 and 54 (kilometers up from the river base camp), where the NRMP BB/BR field office is situated. The consultant's counterpart, Alfonso C. B. Rieuwpassa, formerly Project Manager of CARE/Indonesia's water supply and sanitation (WS&S) project in Central Sulawesi, joined the consultant several days later. After three weeks in BB/BR, the consultants returned to Pontianak for four days to gather M&E prices, meet with SBK and MoFr officials, and draft the report. We then returned to Jakarta. for one week to complete the mission.

The authors would like to thank all of those who assisted with this study, especially SBK staff including Pak Mamat (SBK/Pontianak Manager), Pak Adlin (Base Camp 35 Manager), Pak Agus (Personnel Manager), Ir. Edwin Haryana and Ir. Cucu Sunardi (Manager of SBK's *Bina Desa* Program), GOI officials including Pak Darwis (Litbang BB/BR Project Manager) and Pak Suhendar of Kanwil/Pontianak, ARD/NRMP staff including Roy Voss, Fernando Potess, Elmo Drilling, Mering Ngo, Sukarman, Colin MacAndrews, and USAID/Jakarta NRM Project Officer Jerry Bisson.

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[1] The nearest large city to the project area, with about 100,000 people.

ACRONYMS AND INDONESIAN TERMS

adat	Customary law in Kalimantan
alang-alang	Sawgrass, takes hold after land is cleared and burned (Imperata cylindrica)
ARD	Associates in Rural Development, Inc.
Bappenas	National Development Planning Board
BB/BR	Bukit Baka/Bukit Raya (National Park)
Bina Desa	Community development (program)
BPAM	Interim Regional Water Enterprise
CARE	CARE/International in Indonesia
Cipta Karya	Directorate General of Human Settlements, MPW
CSF	Community self-financing
Desa	Village
Dian Desa	Yogjakarta-based Indonesian NGO with experience in WS&S
Dusun	Hamlet
GI	Galvanized iron (pipe)
GOI	Government of Indonesia
Gotong Royong	Community self-help activities
HPH	Indonesian forest concession permit
KAP	Knowledge, attitudes and practices
Kabupaten	District
Kecamatan	Subdistrict
Kepala Adat	Community leader according to traditional law
Kepala Desa	Village leader according to national law
Kepala Dusun	Hamlet leader according to national law
KKP	Kurnia Kapuas Plywood (BB/BR forest concessionaire)

ladang	Agricultural fields (irrigated or otherwise)
LCD	Liters (of water) per capita per day
LKMD	Village Committee for Self-Reliance in Development
Litbang	Agency for Forest Research and Development, MoFr
ls/sec	Liters per second
m^3/day	Cubic meters per day
M&E	Materials and equipment
MC	*Mandi* (bathing) and *cuci* (washing) facility
mm	millimeters (of rainfall)
MoFr	Ministry of Forestry
MOH	Ministry of Health
MPW	Ministry of Public Works
NGO	Non-governmental organization, same as PVO
NRMP	Natural Resources Management Project
O&M	Operation and maintenance
PDA	Regional Water Enterprise
Pembinaan Desa	Community Development (Program), also called *Bina Desa*
PKK	Family Welfare Organization
Posyandu	*Desa*-level health unit
PVC	Polyvinyl chloride pipe
Puskesmas	*Kecamatan*-level health post
QARQ	Quantity, quality, reliability and accessibility
RC	Rainwater catchment
SBK	*Sari Bumi Kusuma* (BB/BR forest concessionaire)
SSF	Slow sand filter
TA	Technical assistance
USAID	U.S. Agency for International Development

WS&S	Water supply and sanitation

EXECUTIVE SUMMARY

Background and Mission Activities

The purpose of this consultancy was to do a feasibility study for improving community water supplies in villages in the vicinity of Bukit Baka/Bukit Raya National Park, particularly those impacted by on-going logging activities in the area. The consultants were provided by the U.S. Agency for International Development (USAID), under the auspices of USAID/Jakarta's Natural Resources Management Project (NRMP). The NRMP contractor is Associates in Rural Development, Inc. (ARD). The consultants visited eight prospective sites in Kalimantan Barat (commonly called Kal-bar) and Kalimantan Tengah (Kal-teng) to assess the opportunities and estimate costs for improved water systems. At each site, we met with village leaders and community members to discuss the purpose of our visit, and to determine their interest in and level of support for improving their water supplies. None of the eight communities[2] had improved water systems. All used nearby rivers or small streams for both water supply and defecation. The results of this practice were evident in its impact upon their general health, particularly that of children. Due in part to the high sediment levels in rivers and streams (due to logging, agricultural development, and natural erosion) especially evident after heavy rains, all communities visited expressed a strong interest in improving their water systems.

The arrangement proposed to each village involved a partnership development approach consisting of support from the main forest concessionaire in the area, *Sari Bumi Kusuma* (SBK), USAID/Indonesia through NRMP, and from the beneficiary communities themselves. As part of its *bina desa* (community development) program, SBK has expressed interest in possibly providing materials and equipment (M&E) for improving community water supplies in or near its logging concession. Because of its interest in assuring long term sustainability of these systems (and to avoid having to go back in 2-3 years and rebuilt them, possibly due to potential community neglect and consequent lack of required maintenance), SBK was in principle willing to provide the M&E for building these systems if the beneficiary communities agreed to actively participate in their construction, operation and maintenance. With technical assistance provided by USAID/Jakarta under NRMP, the systems would be designed on a preliminary basis for cost estimation, after which SBK would make a final determination of its intention to cover the cost of needed M&E (pipe, cement, valves, fittings, and the like).

At each of the communities visited, the consultants, with the assistance of 4-8 villagers often including the village chief (*Kepala Desa*) or other village leaders, located one or more potential spring

2 In Central Kalimantan, Tumbang Kaburai, Tanjung Paku, Riam Batang, and Tumbang Taberau were included. In West Kalimantan, Belaban Ella, Nanga Apat, Nanga Siyai, and Sungkup were included.

sources, tested the yield of each source, and surveyed the proposed pipeline route from the chosen source to the village. With that information, preliminary system designs were developed, M&E costs estimated, and installation schedules developed. In all cases, the beneficiary communities agreed to provide all needed local materials (such as sand, gravel and rock) and all necessary labor (for hauling both purchased and local materials to the site, and for construction) without pay. While mentioned to villagers during these initial discussions, water user fees for system maintenance and repair will have to be discussed at greater length as part of the community organization and training activities in Phase Two.

In all cases, groundwater springs were used as sources to help insure acceptable water quality, and avoid the sedimentation problems associated with most surface water in the area. Suitable springs were located in all but one community visited (Nanga Apat). Each system consists of one or more spring catchments, the main pipeline, a water storage tank, and multiple taps located throughout the village (public taps, not house connections), at least one of which also has bathing and washing facilities. The system designs are relatively simple because each of the villages was fairly tightly clustered along the river bank (thereby simplifying distribution) and in all cases but one (the joint system for the desas of Riam Batang/Tumbang Taberau), only one water source (or group of closely contiguous springs) was used with each system. The simplicity of the system designs helped keep down the cost, but the relatively small village populations (170-350 people) made the per capita system costs somewhat higher than they would be for the larger rural communities commonly encountered in other provinces of Indonesia.

After the field visits, the consultants also met with SBK staff in Bukit Baka, Pontianak, and Jakarta to brief SBK on the results of our mission, and to determine the extent of their on-going interest in funding the M&E portion of system development costs. In all cases, support for the overall proposal was positive. Initial agreement was made in principle for SBK to cover at minimum all M&E transportation costs to the prospective sites, as well as at least a portion of actual procurement costs. Visits to various departments of the Ministry of Forestry (MoFr) in Pontianak responsible for forest research and management also generated positive responses. Assuming that USAID approves of the proposed follow-on activities, negotiations must now take place between SBK and USAID to determine the level of funding for the necessary procurement.

Recommended Follow-On Activities and Associated Costs

Depending upon the amount of financial resources available from USAID (for technical assistance) and SBK (for M&E and logistic support), several options are possible for follow-on activities:

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1) **Option One:** construct all six systems already surveyed and designed;

2) **Option Two:** construct a lesser number of systems, such as one or two communities each in Kal-bar and Kal-teng; or

3) **Option Three:** do nothing further.

Given the relatively modest total M&E cost of about Rp. 30 million to construct six gravity flow, piped water systems to meet the needs of seven communities, Option One is recommended, that ***all of the systems designed during this feasibility study be constructed during Phase Two of this project.*** This would provide reliable water supplies of more than sufficient quantity, high quality, and accessibility, which would in all likelihood have a significant positive impact upon the overall health of the targeted communities. Option One would provide improved water systems in seven of the eight communities visited, excluding Nanga Apat at this time because of its apparent lack of an appropriate nearby spring. Village leadership and community members specifically agreed to contribute all necessary labor and available local materials to build their systems. Their willingness and good faith to participate in the construction of these systems was further evident from their active voluntary participation in the system design activities (spring identification and testing, and clearing and surveying pipeline routes under sometimes difficult conditions). We therefore recommend that SBK fund the necessary M&E and USAID fund the necessary TA to proceed with constructing these systems and providing the necessary training for the communities to maintain their own systems over the long term.

We further recommend that as project resources permit, trained and experienced local health education workers be brought in to provide hygiene education training for all targeted villages in order to further amplify the health benefits of this activity. Most of these communities have never been visited by a doctor. Providing some modicum of health and hygiene education in the process of constructing their water systems will help these communities improve their general level of health by making them more aware of the critical linkages between sanitation and hygiene.

Construction of sanitation facilities in conjunction with improved water supplies is not recommended at this time. People here do not use any but the most primitive sanitation facilities at this time, and

changing hygiene habits is generally a difficult and often very time consuming process. The approach recommended here is a necessary compromise between the ideal approach to maximize system

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sustainability[3] and health benefits, and recognizing that NRMP is **not** a water supply and sanitation (WS&S) project per se. Rather, NRMP is providing support for these WS&S systems as part of a broader community development effort to help build local support for the establishment of the national park. A full-fledged WS&S intervention would require considerable additional time and training of community members in improved health and sanitation practices. In theory, this should be the responsibility of the Ministry of Health (MoH) through its *desa*-level health posts (*posyandu*), which did not exist in any of the communities we visited.

Option Two is to only provide M&E and TA for a limited number (2-4) of communities. Construction in these communities would then be viewed as pilot or demonstration projects for later replication in the remaining communities in the area, as additional financial and technical support becomes available at a later time. If Option Two is chosen, it is recommended that USAID and SBK support the construction of at least four systems, two each in Kal-bar and Kal-teng. The recommended communities in Kal-teng are Tumbang Kaburai and Riam Batang/Tumbang Taberau, and in Kal-bar, Belaban Ella and Sungkup[4].

Option Three is to do nothing further. However, even though it was made quite clear to all communities visited during this mission that no final decisions had been made by any of the principals for further support of this activity, expectations have unavoidably been raised that each community will receive such support. Not doing so may well have an adverse impact on further project activities in the area, if Option Two or Three is chosen.

The overall approach recommended here (under Option One or Two) to develop improved water systems will help insure their sustainability in several ways:

- First, fully involving the beneficiary communities in the design and construction of the systems will assure their feeling of having made an investment in properly operating and maintaining the systems in the future.
- Second, experience gained in construction will provide them with the practical skills required to repair their systems over the long term, making them less dependent upon SBK's continuing largesse than might otherwise be the case.

3Such as the community self-financing (CSF) approach to both water supply *and sanitation* system development as best demonstrated and implemented in Indonesia by CARE/International.

4The reasons for choosing these sites are discussed in Chapter Six of this report. Tumbang Kaberau and Riam Batang are actually side by side, and while formally separate desas, are in fact one community which could be amply served by a single system.

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- o Third, complementing hands-on design and construction experience with appropriate organizational and financial management training will allow the communities to take the necessary steps to properly undertake and pay for maintenance and repair needs as they arise, possibly through instituting a system of regular but modest water user fees. This will help minimize reliance on external sources to support their systems.

- o Fourth, incorporating sanitation and hygiene training in the process will improve their awareness of the critical linkages between water supply, sanitation and hygiene, and the health of the community and especially its children, giving community members that much more incentive to properly care for their systems.

Given the number of logging concessions throughout the country which may be experiencing similar problems with deteriorating water quality in nearby communities, use of the NRMP/SBK-sponsored systems should be monitored to determine whether they might serve as a model for replication for other concessionaires throughout Indonesia.

Manpower Requirements and Scheduling

While SBK has in principle agreed to cover at least a portion of M&E and logistical support costs, formal agreement must be obtained from SBK for financing most if not all of the procurement of project M&E given in Appendix Four of this report. After that, tenders must be made (if necessary) to obtain firm prices and delivery dates, unless SBK will buy them through existing procurement channels. While initial logistics questions have been addressed during this mission, M&E procurement and delivery plans must be firmed up soon after formal approval is obtained. Several of these sites are relatively remote, and availability of community members to work on the systems is constrained by agricultural labor commitments. Certain materials (e.g., cement) can likely be best obtained through SBK/s existing logistics system. However, to insure that pipe for the main pipelines is both of appropriate quality[5] and reasonably priced, it should be purchased directly through manufacturers in Jakarta. In the absence of the consultants, the responsibility for overseeing this procurement will best be undertaken by the NRMP Coordinator in Pontianak, in conjunction with SBK staff.

Once shipping and delivery schedules are determined, technical assistance can begin. Given previous performance and product quality

5This is very important. Many rural water systems in Indonesia have been constructed using the cheapest (and so lowest quality) pipe available, and the results are painfully obvious throughout the countryside. If these systems are to be truly sustainable, it is crucial to build them with high quality components, especially the pipes.

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problems when local contractors were used to construct community water supplies in other rural areas of Indonesia[6], it is strongly recommended that **contractors should not be used to build these systems on a turnkey basis.** Appropriately supervised by experienced local consultants, community members can be suitably and fairly inexpensively trained to undertake all necessary construction activities themselves. The local technical consultant used for this feasibility study should be assigned the role of Chief Construction Supervisor. He will initiate on-site community organization and local materials delivery to the construction sites. After the delivery on site of all necessary materials, each water system will take about 1-1.5 months to complete. Assuming that 2-3 systems will be under construction at any given time, to expedite construction scheduling, one additional local technical consultant should be recruited to help supervise construction in other villages[7]. Thus, local consultant time will total approximately seven months (about 3.5 months for each of the technical advisors). One international consultant will be required for two short periods, first to initiate and oversee initial construction activities (3 weeks), and second to monitor and quality inspect the systems as they are completed (another three weeks) approximately 2 months later, for a total of eight weeks.

Based on conversations with potential beneficiary communities, the best schedule for construction would be during the slow agricultural period from mid-February/early March (i.e., after the rice harvest) through about mid-June[8]. Since this is the (relatively) dry season, this scheduling also facilitates construction. Several communities said that they would be available for project startup in mid-February. However, any bottlenecks encountered will most likely be due to delays in M&E delivery rather than availability of construction labor, and so procurement should be initiated as soon as possible after all appropriate agreements are concluded.

6See *Rural Water Supply and Sanitation in Indonesia*: An Evaluation of CARE/Indonesia's Community Self-Financing Water Supply and Sanitation Project, R. McGowan et al, ARD and CARE/Indonesia, June, 1991, and *Final Evaluation of the Water and Sanitation for Healthier Environmental Settings (WASHES) Project*, R. McGowan et al, ARD and CARE/Indonesia, November, 1991.

7This concurrent construction schedule is necessary because villagers are only available to fully participate in construction activities for certain periods, mainly during slowdowns in agricultural activities. To take maximum advantage of this availability, as much construction as possible should be completed during this period.

8Although some villagers may be busy clearing *ladang* fields of forest cover in the May-June period. Precise scheduling should be checked with each targeted village in order to coordinate M&E delivery and construction. These dates will be re-confirmed by the NRMP Social Forester to be certain of villagers' availability.

1.0 INTRODUCTION AND PROJECT BACKGROUND

The USAID-funded Natural Resources Management Project (NRMP) in Kal-bar and Kal-teng is working with the Ministry of Forestry (MoFr) and the logging concessionaire Sari Bumi Kusuma (SBK) to undertake a variety of activities to encourage and support sustainable forestry in the area around the Bukit Baka/Bukit Raya National Park (BB/BR). SBK has been logging in BB/BR since 1980, and commenced their community development *(bina desa)* program in 1982. Since 1987, logging concessionaires have been required by law by the Government of Indonesia (GOI) to participate in these programs to assist local communities affected by their logging operations. SBK's *bina desa* program was in part responsible for encouraging the GOI to formalize the requirement for *bina desa* programs for all concessionaires. In Kal-bar and Kal-teng, SBK's *bina desa* activities thus far have included[1]:

- providing agricultural extension support for villagers to further develop their capability for producing rice for consumption and sale;
- providing employment opportunities to local communities in direct support of logging operations.
- road building (logging roads which also act as farm to market roads for local communities);
- providing markets for community products such as non-timber forest products and food crops;

Local communities in BB/BR have also expressed interest in SBK providing technical assistance and funding for improvement of their water supply systems, some of which have been adversely impacted by logging and other development activities such as farming. Logging unavoidably results in increased soil erosion and subsequent sediment loading of the local streams and rivers which are the communities' primary water sources. As a result of this community interest, USAID/Jakarta instructed the NRMP contractor Associates in Rural Development, Inc. (ARD) to do a feasibility study for improving community water supplies in the project area. The feasibility study was done by a two person team consisting of ARD's Senior Engineer and an Indonesian water specialist who spent one month in the project area assessing the physical situation, meeting with all interested parties, and developing this feasibility report.

1 *Balancing Forest and Marine Conservation with Local Livelihoods in Kalimantan and North Sulawesi*, J. Belski, ARD/NRM Project, USAID/Jakarta, May 1992.

1.1 Activities Undertaken During this Mission

The consultant spent six weeks in Indonesia during this mission. One week was spent in Jakarta meeting with USAID/Jakarta and NRMP staff, and identifying a suitable local water specialist to participate in the field assessments and system design. At the end of a one month visit to the project site in Kalimantan, the consultant then spent one week in Jakarta finalizing this report, and briefing USAID/Jakarta, ARD/NRM project staff, and staff from SBK, the Ministry of Forestry, and Bappenas on the findings and recommendations of the mission.

During the visit to Kalimantan, the consultant team accomplished the following tasks:

- o Traveled to BB/BR to identify appropriate communities located near the NRM project area which are in need of improved water supply systems;
- o Visited potential beneficiary communities to:
  - review existing water supply and sanitation systems and practices;
  - assess the quantity, accessibility, reliability, and quality (QARQ) of currently used water sources;
  - determine current water demand, and estimate future demand;
  - identify alternative sources for improved water supply (nearby springs), and measure their debit (yield) and determine seasonal variations;
  - survey probable main pipeline routes from sources to communities;
  - develop preliminary designs for spring catchments, distribution and storage facilities[2] ;
  - estimate system cost, based on community contributions of labor and local materials, financial and other support provided by SBK (e.g., M&E), and technical assistance through NRMP; and:
  - review current hygiene and sanitation knowledge, attitudes, and practices (KAP) and assess opportunities for improving them with consequent improvements in the general level of health in the communities.
- o Assessed potential beneficiary communities' willingness and ability to participate in village water committee organization, resource mobilization (local labor, materials, and other resources), system design, construction, operation

2Including items such as spring catchment design, main pipeline size and length, break-pressure tank requirements, storage tank size and location, location and size of secondary pipelines, number and location of taps and bathing/washing facilities, etc.

and maintenance, and financial management of water user fees.

- o Determined technical and managerial training requirements, and outlined an appropriate community training program;
- o Developed site by site M&E costs for 6 systems covering 7 communities based on prices from suppliers in Nanga Pinoh, Pontianak, and Jakarta;
- o Reviewed logistics requirements (e.g., procurement, transportation of personnel and M&E, skilled and unskilled labor requirements, and implementation scheduling) for construction and training activities, and proposed a schedule for these activities; and
- o Drafted this feasibility study containing recommendations for joint USAID/SBK/community cooperation in *bina desa* activities to improve water supply and sanitation in the targeted communities.

1.2 Site Selection

The prospective community sites for this activity over the near term can be conveniently grouped according to provincial location:

- o **Kalimantan Barat** - Nanga Apat, Nanga Siyai, Sungkup, and Belaban Ella; and
- o **Kalimantan Tengah** - Tumbang Kaburai, Tanjung Paku, Riam Batang, and Tumbang Taberau.

These sites were chosen based on recommendations by NRMP staff, their proximity to the National Park which is the focus of project activities, and the impact of logging activities by the concessionaire SBK on the communities' water supplies. Surprisingly, there were very few other communities in the area[3] which might have been chosen. Several were eliminated for consideration in this initial round of site selection because they were much more affected by KKP (- second logging concessionaire in the BB/BR area) rather than SBK activities. These other communities might be considered for assistance in later phases of the current activity.

There are several possible approaches to improving community water supply and sanitation facilities in the BB/BR area, including:

- o design and construct systems in all targeted communities, and provide associated technical, system management, and

3Such as Nanga Landau Mumbung and Belaban Dalam, neither of which were visited during this mission.

health and hygiene training designed to maximize system sustainability;

- o take a pilot or demonstration project approach, with construction and training activities limited to 1-2 communities in each province (Kal-bar and Kal-teng);

- o determine that it is inappropriate to proceed further.

It was initially thought that the best approach was not to try and develop improved water supplies in all of these villages immediately, but rather to take a pilot project approach wherein 2-4 pilot communities (depending upon availability of funding and scheduling of technical assistance) would be identified where systems would be developed over the near term. Since these systems are intended to be self-sustaining, communities will receive appropriate training in system planning, design, construction, operation and maintenance, and financing prior to, during, and after actual construction. These initial pilot villages would be those sufficiently motivated to mobilize their own or other external resources to support their systems. Villagers from surrounding communities would then be encouraged to participate in both the training and construction in the demonstration villages. This would empower them to replicate the approach in their own communities, perhaps with additional assistance from SBK and NRMP at a later date.
However, having completed the feasibility study, it is clear that of the eight communities visited, seven are well-positioned to take immediate advantage of the proposed TA. This means that suitable water sources have been identified, measured, and surveyed, that communities have agreed in principle to participate fully by providing all available local materials and labor free of charge, and that SBK is in principle willing to fund the procurement and logistical support for at least a portion of the M&E costs. This suggests that it may be best to consider construction of systems in all of the qualifying communities at this time.

2.0 WATER SUPPLY AND SANITATION SITUATION IN TARGET COMMUNITIES

The information in this chapter is based on a month long visit to Kalimantan in November-December, 1992. Information was obtained during discussions with community members and their formal and informal leadership, the forest concessionaire SBK, GOI staff from various agencies dealing with forestry research and management, and the ARD/NRMP staff based in Kalimantan and Jakarta.

2.1 Current WS&S Situation

The primary source for drinking water in all of the communities visited during this consultancy was nearby rivers or streams. Community water "systems" consisted of using a bucket to haul water from the river, and storing it in their houses in that or other containers until used. Bathing and clothes washing was done in the river. While groundwater springs abound (especially in the higher elevations), they were seldom used directly. Some people also used rudimentary rainwater catchment systems to supplement their water supply, especially during times when sediment loading in river sources was high. No water pumps, boreholes, hand dug wells, or other types of water systems were observed during our field trip. Situated as they are on river banks, and given generally high annual rainfall levels, all communities visited have year around ready access to large quantities of water. However, a major concern increasingly voiced by these communities is deteriorating drinking water quality.

All of the major rivers we observed in BB/BR were moderately to heavily laden with sedimentation. Sedimentation was especially evident shortly after locally heavy rains[4]. Much of this sediment is from natural soil erosion in the mountains, but some is also due to logging activities[5] (tree cutting and building logging access roads). A large part of this erosion, especially in lower elevations where logging activities (except road maintenance) have long since ceased, is due to the swidden agriculture which often follows upon the footsteps of loggers, particularly in the burnt over area below the BB/BR in Kal-bar. Since clear cutting is forbidden and in fact no longer occurs, logging which typically removes an average of only six tree per acre does not usually result in the denuded hills and rapidly eroding steep mountain slopes one might initially envision. Unsustainable swidden agricultural practices which entail cutting and/or burning all of the trees in a previously logged area

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4After heavy rains, villagers typically take a bucket full of water and simply set it aside for several hours until the majority of the sediment settles out.

5for an order of magnitude estimate of erosion, the draft EIA recently prepared under the auspices of NRMP suggests that logging activities which disturb the type of soil most common in the project area result in about 90 metric tons per hectare per year (mt/ha/yr) of soil erosion, compared to about 4 mt/ha/yr for undisturbed soil with natural forest cover. The great majority of this simply ends up as sediment in the rivers draining the logging areas.

contribute greatly to soil erosion. This unfortunate situation is further compounded by using the cleared areas for only 2-3 crops, after which it often reverts to the *alang-alang* (Imperata cylindrica, or sawgrass), ubiquitous in the low lying areas in Kal-bar, which is barely even suitable even for grazing cattle[6].

While not actually tested with water quality testing instruments, the sediment itself is unlikely to be much of a serious contaminant other than visually. However, some villagers also complain of contamination by petroleum fuels leaked from logging trucks, diesel electric generators, and associated storage tanks[7]. This is further exacerbated by increasing runoff of petrochemical fertilizers and pesticides from the steady development of rice paddies in some of the areas near the park. Even so, while sedimentation may be the most obvious water quality problem to villagers, the most important problem we observed involves communities polluting their own water supplies through very poor sanitation practices.

In many developing countries, rural people often have a modest awareness of the linkage between water quality and health. The communities we visited were no exception. Rivers and streams used as water sources for drinking, bathing, and washing were also the primary site for human waste disposal. This was also observed during the river trip up from Sintang to Nanga Pinoh and then on to the log pond at Popai. Homes in villages located along the Melawi River had outhouses built upon floating log docks on the river, which also served as a pickup point for domestic water. In each community, all but the most upriver dock (and water collection point) had a direct discharge outhouse about 5-10 meters upstream. Since little or no aeration (but of course some dilution) occurred in that short distance in the slow flowing river, all of the water used for domestic consumption likely had significant bacterial contamination (fecal coliform). Even in communities situated upstream of other human habitation, using small, apparently unpolluted mountain streams does not insure good water quality, since there are many animals in the area (e.g., wild pigs and monkeys) who are likely a source of contamination for any surface water.
Observations made by this consultant during previous water supply and sanitation missions in East Java, West Java, and Nusa Tengara Barat strongly suggested that while villagers in many communities in Indonesia are highly motivated to use their own resources (labor, local materials, and cash reserves) to improve their access to larger quantities of reliable water supply, they are generally unwilling to pay for significant increases in water quality because of their general lack of awareness of the intimate relationship between clean

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6a single cow requires nearly ten hectares of this largely undigestible grass to provide sufficient forage, and then only if it has been recently burned off and re-sprouted.

7mentioned in the draft EIA for the project. However, water quality degradation due to petroleum products dumping was not observed to any significant degree during this consultancy, in observations of SBK (but not KKP)'s fueling procedures and storage facilities. This is not to say that it doesn't happen sometimes.

water and health. There is apparently not the case here, perhaps because of the visually obvious decrease in water quality due to high sedimentation after heavy rains. Fecal contamination, while of much greater concern for health, is not so obvious.

According to informants, drinking water is routinely boiled by many people in the communities visited, as it is in the logging and reforestation camps where the consultants stayed. However, there is a minority (variously estimated to be between 10-30%) of people in all communities here who do not boil their water, and presumably suffer the consequences. Both children and adults were observed in every village with obvious skin diseases, much of which may be due to poor sanitation and low water quality for bathing. Diarrheal diseases are common. Few if any of these communities have ever been visited by a doctor. While the MoH has a mandate and no doubt fully intends to set up *desa*-level health posts (called *posyandu*) in the area, none have so far been established. Part of the *posyandu* program involves training villagers in primary health care and basic sanitation and hygiene practices. Such training is sorely needed in these communities.

2.2 Community Needs and the Potential for Improved WS&S Systems

Even if they are motivated by health or other concerns, without technical assistance and a source of funding, improved water supplies are often quite difficult for poor rural communities to develop by themselves. There are several possible water sources which could be used in the communities targeted for technical assistance, such as:

- rainwater catchment schemes.
- hand dug wells or drilled boreholes with pumps;
- rivers and streams which could be run through slow sand filters; and
- using groundwater springs with gravity flow water systems.

Depending upon rainfall patterns in the area, rainwater catchment (RC) can be a low cost solution to water quality problems. Given the relatively high and fairly uniform level of rainfall over the year in the project area (see Table One below), RC initially appeared to be a good possibility for meeting at least part of community water demand. Given that many of the local houses have wooden or GI sheet roofs, RC would be relatively easy to build and certainly more hygienic water source than the surrounding streams and rivers currently used here now. Rainwater catchment is quite common in more developed areas in the lowlands, such as around Pontianak.

Table One: Mean Monthly Rainfall for Sites Near the Project Area[8]
(in millimeters)

Site Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Nanga Mangap	378	210	284	242	266	198	129	157	237	332	364	270	3,068
Kotabaru	279	259	297	312	214	227	165	185	251	285	352	318	3,143
Nanga Pinoh[9]	402	245	382	319	263	156	166	182	179	318	347	347	3,338

Some households (Nanga Siyai, Belaban Ella) were observed to use rudimentary rainwater catchment schemes (buckets, or discarded oil drums which were then cleaned and painted before using them for water storage, and bamboo rain gutters along roof edges). Unfortunately however, when this possibility was raised in discussion, many villagers voiced beliefs which may preclude any significant use of rainwater in this area. For example, people in various villages have said that:

- rainwater must be consumed soon after collection, or it quickly becomes unpalatable and causes various stomach ailments[10];
- drinking rainwater makes a person choke, that some small animal breeds in rainwater left sitting for more than a day or two so that it must be consumed quickly, or they simply don't like the taste of boiled water (Belaban Ella);
- it is unhealthy because it does not contain the right minerals; and
- it must be boiled before consumption to prevent sickness (although some other villagers said that this was probably just due to chicken manure on the roof, but that they wouldn't drink it anyway just because it wasn't proper).

In spite of the existence of significant RC resources which could be easily exploited, trying to change peoples' beliefs about the appropriateness of water use is usually not worth while. For these reasons, it is not recommended that rainwater catchment schemes be attempted here.

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8 *Regional Physical Planning Programme for Transmigration (RePPProT), Review of Phase One Results, West Kalimantan*, Volume Two, Annexes 1-5, Land Resources Department (ODA/London) and Direcktorat Bina Program, Government of Indonesia, Jakarta. The three sets of rainfall data in this table are from different years (see following footnote).

9 Rainfall data for Nanga Pinoh were from the report *Proposed Bukit Baka Mini-Hydroelectric System: Draft Report of Feasibility Findings*, M. Johnson, Hydro-Tech Engineering, ARD/NRMP, March, 1992. Data are from the Departmen Meterologica from the years 1985-1991.

10 J. Belsky, ARD/NRMP, 5/92.

Dug or drilled wells with pumps are not considered a practical alternative, given the financial position of the communities. Pumps are expensive to buy, operate, and maintain. Trained operators are needed to operate them, and expensive and often difficult to obtain spare parts are needed to keep them running. Fuel is also required, which would be both expensive are difficult to obtain given the remoteness of several of these villages. Pumped systems are therefore not recommended. Open dug wells with bucket dipping is a possibility, but given the highly variable hydrology of the mountain areas, likely problems of well contamination by improper use, possibly limited quantities of water available, and the difficulty of digging and properly maintaining open wells, coupled with the fact that villagers have ready access to river sources, open wells are not recommended here.

Improving the water quality of existing sources is another possibility. However, water quality improvements can be difficult and costly. Slow sand filters (SSF) are used in other parts of Indonesia (e.g., East Java) to clean otherwise unacceptable surface water sources (rivers, streams, and irrigation ditches). However, given the very high sediment loading common in river water in the project area, SSFs would be quickly clogged, requiring tediously frequent cleaning, which the villagers would unlikely perform as often as necessary. What would probably happen (as it does elsewhere in Indonesia) is that after villagers became tired of cleaning their SSFs, they would simply short circuit them and end up drinking water essentially straight from the river, as they do now. Hence, nothing would be gained. There are some instances in which relatively clean surface water springs could be used in conjunction with slow sand filters without need for unduly frequent cleaning, but this should be regarded as a backup option only.

Where topography and groundwater hydrology permit. gravity flow piped water systems are usually the cheapest way to reliably obtain large quantities of easily accessible, high quality water. Fortunately, in nearly all of the communities visited during this consultancy (except Nanga Apat), groundwater springs were readily available in the nearby hills, usually two kilometers or less away from the villages. This allows for the development of improved water supplies using gravity flow piped systems for a relatively modest price, averaging about Rp. 5 million per site or less, depending mainly upon the length of the main pipeline required.

3.0 INSTITUTIONAL AND SOCIAL CONSIDERATIONS

An unfortunately large number of cases exist in developing countries (including Indonesia) where community water systems were designed, financed and installed by government, donor, NGOs, or other agencies external to the community. Typically, after little or no training was given to the recipient community, the systems were left to be managed by the communities themselves, often to fail well before their design lifetime. Unless sufficient external support is available to fully finance and manage community water supply and sanitation systems, communities themselves will have to take on this responsibility, whether or not they have the necessary financial, logistic, and human resources to successfully undertake the job. Since the focus of the NRM project is sustainable development, this principle should also be applied to this WS&S activity associated with NRMP's community development support activities.

3.1 Responsibility for Development Tasks

There are a wide variety of tasks necessary to properly develop a community-based WS&S system. To help insure sustainability, it is necessary to determine responsibility for each of those specific tasks, and make sure that each responsible group not only willingly accepts their responsibility, but understands what commitments of time, effort, or other resources are implied in that responsibility. For the NRMP effort in Bukit Baka/Bukit Raya, community groups or external organizations[11] must be identified who will successfully take responsibility for the following tasks:

- **Community Organization** - establishing village water system management committees, planning and initiating resource mobilization (contributions of labor, local materials, and cash), determining and negotiating community needs and desires, and organizing construction support crews from the communities.

  Initial responsibility for this activity should be given to the NRMP Social Forester, with support from the other NRMP field staff. When construction begins, this responsibility will be taken over by the Construction Supervisor.

- **System Design** - which takes into account physical and financial constraints and community preferences to design a reasonably-priced, long lasting and reliable water system which villagers will be able to operate and maintain with a minimum of outside intervention.

11Such as USAID (through the NRMP), SBK, KKP, various GOI agencies, and the beneficiary communities themselves.

System surveying and design has largely already been completed during this mission. Final details will be supplied by the Construction Supervisor.

- **Material and Equipment Procurement** - This includes pipe, cement, rebar, taps, valves, sand, rock, etc. It is assumed that the cost of all but locally available materials (sand, gravel and rock) will be covered by the concessionaire, with the beneficiary communities themselves providing all available local materials[12].

  Detailed lists of all M&E and quoted prices are give in this report. Depending upon the procurement method (directly through SBK or externally through M&E suppliers), the NRMP Project Coordinator in Pontianak should supervise this activity.

- **System Construction** - including construction of the spring catchment, main pipeline, and storage and distribution facilities.

  Responsibility is that of the communities themselves, working under the close supervision of the Construction Supervisor. *It is strongly recommended that local contractors not be used to construct the systems.*[13] If villagers are properly trained through participation in the construction of their own systems, it will of course take somewhat more time to complete the job, but it will positively affect sustainability because people will know how to repair their own systems if something goes wrong (as it inevitably will at some point in the future).

- **Training in Operation, Maintenance, and Repair** - This training will be an integral part of the process of construction itself. As villagers build the system, they will automatically learn what is required to repair or replace various components as they wear out or are damaged.

  Responsibility for training will not require an expatriate consultant. Instead, it can be best provided by the Construction Supervisor on the job, who will work directly with community construction crews and water management committees to train them in every skill necessary to keep their water systems running over the long term. Without this training, the systems will *never* be sustainable unless

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12In nearly all cases, sand, gravel and rock (for catchment area and storage tank construction) are easily available near the prospective construction sites.

13 While it might initially appear easier to use a local private contractor (a private firm) to do the entire job quickly and easily, we strongly advise against this. Based on experience with community water systems contracted out in other parts of Indonesia, design specifications are not often met, nor are accepted construction practices followed. The result is too often poor quality systems which do not stand the test of time.

an external funding source (such as the concessionaire) is willing to provide *all* required support over the long term.

- **Training in System Financial Management** - This involves determination and collection of user fees, establishing a bank account (or some other suitable repository of user fees) to put them in, and proper management and dispersal of funds for O&M.

  This will also be done by the Construction Supervisor, who has considerable experience in helping communities, collect, manage, and disburse funds collected from communities to support operation, maintenance, repair, and expansion if desired.

- **Health and Sanitation Training** - To maximize health benefits of improved water supplies, sanitation, health and hygiene education should be conducted concurrently with water system development. While this may appear unnecessary, no international development agency undertakes water supply improvement without accompanying health and hygiene training anymore. In fact, the rationale for improved water supplies in entirely based upon expected improvements in health indicators for beneficiary communities[14].

  This training can best be provided by local sanitation specialists (perhaps who have experience working with NGOs such as CARE or *Dian Desa*[15]), and should wherever possible be coordinated with the community *posyandu* development through Dinkes (although no active *posyandu* was found in any of the communities visited).

3.2 Community Participation in WS&S System Development

Existing studies[16] in other provinces of Indonesia on factors affecting the success or failure of community-managed WS&S systems found that one very important factor was the strength of community

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14Note that *this would not require a significant additional financial investment* on the part of USAID or the concessionaire, but it would require additional time and local staff to provide the necessary training. Yogjakarta-based Dian Desa or international PVOs such as CARE/Indonesia already have considerable experience doing this in many provinces in Indonesia (but not in Kalimantan).

15There is only one Pontianak-based NGO which we were able to identify which has any experience in water supply and sanitation (and that is only very limited), Pa Sumarsono of Agromitra. He was out of town during our visits but it is recommended that the NRMP Sociologist follow up to determine the suitability and capability of Agromitra to participate in this activity.

16*Rural Water Supply and Sanitation in Indonesia*: An Evaluation of CARE/Indonesia's Water Supply and Sanitation for a Healthier Environmental Setting (WASHES) Project, R. McGowan, J. Aubel, and Rahardjo Soewandi, ARD, November, 1991.

leadership. In particular, the community leadership's direct interest in and active support of the community water project had a significant impact on the degree of organizational difficulty in initial construction, whether water user fees were regularly collected and effectively managed, and whether O&M procedures were properly undertaken to keep the system operating successfully.

In some communities in the vicinity of the BB/BR National Park, community management of self-help projects has run into problems due to a lack of clear leadership as the community makes the transition from the traditional *adat* system to the *kepala desa* system[17]. It is important to determine what organizations and individuals in the project's beneficiary communities are both willing and able to take on responsibilities for various support activities for the improved water systems. We encouraged the participation of both traditional and official leaders in our work with the targeted communities. Agreement has been reached in principle with them regarding responsibilities for various project tasks, but these should be reconfirmed prior to beginning any construction.

It would be very helpful if the NRMP Social Forester, after his return to BB/BR, were to follow up on contacts made with the targeted communities to discuss the proposed organizational, training, construction, and system management (both for O&M and financial support) arrangements to make certain that the communities fully understand the level of their commitment, and are in full agreement with the implementation approach given in this report. It would also be helpful if the NRMP Sociologist could discuss the need to form a Village Water Committee (VWC) which would serve as the vehicle for organizing community members and insuring their attendance during construction and training when the time comes.

In discussions with villagers in the target communities, few significant cooperative activities were identified which would indicate that they have experience in undertaking joint construction activities. One exception to this were that in some communities (e.g. Tumbang Kaburai) houses were built with community help. When specifically asked about *gotong royong* (self-help) activities, villagers would mention such things as village clean up campaigns, or helping each other build houses, which of course do not require the level of organization needed for building a water system.

Therefore, since it appears that communities do not yet have the capability for successfully undertaking all of the tasks for which they will be responsible, training programs must be undertaken to enable villagers to successfully manage their systems over the long term. Training programs for community WS&S systems have already been developed, implemented and refined by CARE/Indonesia over the last

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17For example, in Nanga Siyai to *kepala adat* holds power, whereas in Tanjung Paku and Tumbang Kaberau, the *kepala desas* hold power. In Riam Batang (the community adjacent to Tumbang Kaberau), there is no active *kepala adat* and the *kepala desa* has limited community support. Ref: *Balancing Forest and Marine Conservation with Local Livelihoods in Kalimantan and North Sulawesi* (J. Belsky, ARD).

twelve years of their active involvement in this sector, and it is recommended that these or similar programs (discussed in Chapter Four below) be used in NRM community support activities as well.

Legal access to or competing uses of water sources can be a major problem in some countries, or even in different regions of the same country. None of the springs measured and surveyed during this mission have competitive uses (e.g., *ladang* irrigation or other uses) for their water. All simply drain into nearby streams and rivers. Land tenure or water rights do not appear to be an issue, since the communities themselves have complete access to any water in their area. In other areas of Indonesia, water source ownership can be quite problematic in developing community water systems, for example in Java or Bali. However, after discussions with community leaders and the NRMP Sociologist, ownership of water sources or the land on which they occur does not seem to be a problem here, but this should be verified with GOI officials in each case prior to initiating any construction activities.

3.3 Forest Concessionaire's Community Development Program

The HPH (Indonesian forest concession permit) *bina desa* program encourages concessionaires to provide support for community development to villages in or around logging concession areas. It is essentially an effort to redistribute some of the profits from logging operations back to the communities who are impacted by those operations in the form of community development support. The recently (1990) established program does not set firm guidelines for what these community development activities can or must consist of. Concessionaires can apparently establish their own programs after carrying out an initial diagnostic study to determine what the needs of these targeted communities are. In BB/BR, the SBK *bina desa* program has focused on providing local communities with rice production systems (both irrigated and rain-fed sedentary rice farming) to supplement their traditional *ladang*. In addition, SBK has also funded the placement of teachers in village schools, in part to promote improved agricultural and forest conservation practices.

A third activity proposed for inclusion in SBK's *bina desa* activities is the development of improved water supplies for local communities. This is especially important because of the adverse impact that logging and related activities such as road building have had upon the local rivers which are used by these communities as their primary water sources. Having communities actively participate in construction of these systems will also address SBK's concerns about avoiding increasing dependence by local communities upon SBK's continuing good graces. After designing and costing out the community water systems discussed in this report, senior SBK managers in Camp 35, Pontianak, and Jakarta were briefed to determine their level of interest in funding the procurement of materials for these systems. In all cases, they responded quite positively, initially agreeing to provide at least all transportation costs for materials and equipment, and, if USAID was unwilling to pay the entire cost of M&E procurement, to consider further assistance in that area as well.

On the government side, we also briefed Ministry of Forestry officials in Pontianak (Kanwil and Litbang) on the mission findings. Kanwil is the Provincial-level Ministry of Forestry office, responsible for overseeing all of the MoFr offices in that province. Litbang is the Forest Research and Development Department, and the NRMP counterpart organization in Pontianak. MoFr/Jakarta staff were invited to the final debriefing, but did not attend. All senior staff we met expressed positive interest in the proposed WS&S development activities, and in some cases considerable surprise that communities had agreed to work without compensation in building their own water systems.

It is conceivable that there is a role for NGOs to play in this training effort. For example, CARE/International has developed a wide variety of training materials in community water supply, sanitation, and health and hygiene education as part of its more than ten year involvement in community water supply and sanitation development in Indonesia. NRMP would be well advised to take advantage of this experience if accessible, perhaps by bringing on several short term local advisors from CARE (if available) to conduct training in sanitation and health and hygiene education for the communities in BB/BR where community water systems will be built.

4.0 DESIGN AND CONSTRUCTION

During this feasibility study, preliminary system designs were developed to estimate system costs. When the consultants visited each candidate site, we met with village leaders and other community members to discuss the purpose of this study, then assessed one or more springs in the area for their suitability. Spring output was measured by building small earthen dams, and using the bucket and stopwatch technique to determine liter per second output. We then surveyed the probable course of the main pipeline from the spring back to the village, including the probable distribution layout within the village. Data from these surveys, pipeline profiles, system layouts, and M&E costs for each site are given in Appendix Four.

Ideally, spring output should be measured during the height of the dry season, since springs typically have a significantly higher yield during the rainy season. However, this consultancy occurred during the rainy season. Nonetheless, over-estimates of spring yield were to some extent compensated for because of unavoidable leakage under the temporary measurement dams. When the actual spring catchment is built, a higher percentage of the spring yield is typically captured. In addition, 60 liters per person per day (LCD) was used as a design criterion for drinking, bathing and washing, which is considerably more generous than the WHO recommended minimum design value of 30 LCD.

Spring yield tests and survey checks will be conducted again during the (relatively) dry season in February-March when Phase Two is implemented to insure that all water sources are adequate. In addition, we will attempt in some cases (e.g., Nanga Siyai) to select either better spring sources or more direct pipeline routes to minimize system costs.

4.1 Water Sources and System Design

To obtain the best available water quality, we sought groundwater sources for all candidate sites. Where available, properly developed and suitably protected groundwater sources are the most reliable and highest quality water sources for community water systems. To minimize cost and maximize sustainability through ease of O&M, we only considered gravity flow piped water systems. The use of rainwater catchment was eliminated for the reasons given in Chapter Two. The gravity flow piped systems designed for these communities consist of the following major components:

- **spring catchment** - a concrete and rock structure designed to obtain the maximum available water yield from the spring source(s), while at the same time protecting the source from external contamination to maintain appropriate water quality.

- **main pipeline** - because of the nature of the topography and surface geology near the villages covered by this study, it will be necessary to use galvanized iron (GI) pipe for most of the length of all the main pipelines. Plastic PVC pipe, while cheaper per unit length and easier to transport and assemble, must be properly buried to protect it from subsequent damage. Steep, rocky slopes and dense forest cover with tenacious roots make it impractical to consider proper burial of main pipelines in all but a few areas (in the villages proper and through nearby *ladang*) in the communities surveyed.

- **distribution system** - including branch pipelines, water storage tanks with a built-on *mandi/cuci* (or MC, for bathing, washing clothes and dishes) and multiple taps, one or more stand-alone MCs, and in some cases public taps located throughout the village. No direct house connections are provided (or encouraged, due to concern for excessive use and subsequent water wastage).

The system designs are relatively simple because each of the villages was fairly tightly clustered along the river bank (thereby simplifying distribution) and in all cases but one (the joint system for the *desas* of Riam Batang/Tumbang Taberau[18]), only one water source (or group of closely contiguous springs) was used with each system. The simplicity of the system designs helped keep down the cost, but the relatively small village populations (100-300 people) made the per capita system costs somewhat higher than they would be for the larger rural communities commonly encountered in other provinces of Indonesia. Note that the total population served by constructing these six systems is 1,480, or 70% of the people estimated to live in the immediate area North and West of BB/BR National Park.

Because of the relative abundance of suitable nearby springs in most communities visited, pipeline lengths are relatively short in most cases. Because of the relatively small size of all communities in the area, springs were easily located with acceptable yields in all cases but Nanga Apat. In Nanga Apat, developing an alternative system using creek water and a slow sand filter (SSF) was ruled out due to the probability that villagers would probably not perform proper maintenance on the SSF when needed. They would likely go back to using the river or the nearby creek for their water source, so there was little point in developing an improved water system there[19] at this time.

18Only one of the two springs will be developed for now, providing more than adequate water for the medium term. The second spring can developed at a later point if so desired.

19This can perhaps be followed up further in a subsequent phase of this activity, since other informants we met later felt that there may be suitable springs within a reasonable development radius of Nanga Apat. One or more properly protected, hand-dug, open wells may be a suitable alternative.

A summary of relevant technical parameters for each of the sites visited is given in Table Two on the following page. While all of these yields were measured during the rainy season, villagers assured us that the springs we measured (unlike other candidate springs in the area) did not dry up during the dry season. In several cases, additional nearby springs exist which could be developed, in the event that community needs grew beyond design expectations.

Systems were sized using a design demand which assumed a fifteen year planning horizon with a 2.5% population growth rate in the targeted communities, which is about average for this part of Indonesia. In most cases, the measured spring yield will be adequate to supply extra water for some small gardens as well. Random samplings were made of daily water demand by asking villagers at several sites how many buckets of water they used per day for drinking and washing dishes (but not bathing or washing clothes, which was done in all cases directly in the river). Typical consumption was only about 12-15 LCD.

Table Two -- System Design Information for Each Site

Site Location and Name	Spring Yield (ls/sec)	Current Population	Pipeline Length (m)	Tank Vol. (m^3)	No. of Taps/MC
1. Kalimantan Tengah					
Tumbang Kaburai	0.23	171	766	12	1/2
Tanjung Paku (#1)	0.35	278	600	12	0/2
Tanjung Paku (#2)[20]	0.17	"	2,037	"	"
R.Bant/T.Tab.(#1)	0.39	260[21]	1,347	12	1/3
R.Bant/T.Tab.(#2)[22]	0.26	"	1,237	"	"
2. Kalimantan Barat					
Belaban Ella	0.22	329[23]	615	12	1/3
Sungkup	0.36	190	1,096	12	0/2
Nanga Siyai	0.71(0.30)	252	1,320	12	0/2
Nanga Apat	none	149	n.a.	n.a.	n.a.

Because of typical sanitation practices[24] encountered in every community we visited, and because this is not a water and sanitation project per se, we decided against the construction of sanitation facilities such as ventilated pit latrines in the village water system designs. It is unlikely they would be properly maintained, and may not even be used if provided. However, developing improved water supplies will break the link between human waste discharge points and drinking water sources. Because of the low population density and widespread village locations in this area, and because of the great difficulty typically encountered in trying to change

20While the head of the first spring we measured at Tanjung Paku was more than adequate, the surveyed head was too low to allow for a proper distribution system throughout the village. However, the second spring we measured had more than adequate head, but was sufficiently far away to greatly increase the cost of the system. We therefore recommend the more modest system using the first spring as a source. The second spring can be added at a later time if needed.

21Riam Batang has 193 people and Tumbang Taberau (which moved from its previous location about 5 years ago) has only 67 people.

22The first spring measured at RB/TK was at the top of the ladang, and behind a small hill from the main drainage surveyed. The second spring with a lower (but sufficient) yield was in the main drainage, so that no excavation was necessary for the main pipeline.

23These population data are not precise, since different informants gave us different information. The official total for Belaban Ella is 531 people, but this includes Sungkup and Belaban Dalam. Based on a reported 38 families and a total of 132 people in Sungkup, and an estimated (by our informants) 70 people in Belaban Dalam, that leaves 329 people in Belaban Ella proper. In any event, the springs measured for both Sungkup and Belaban Ella are more than adequate to supply both communities' needs.

24People almost always defecate in the nearby rivers and streams, and urinate either in the same places or in the nearby bush. The only sanitation structures we observed anywhere during our community visited were floating outhouses which discharged directly into the rivers. In most cases where these were used, they were arranged serially along the river bank so that one family's discharge point was the next family downstream's water source.

strongly culturally ingrained habits such as defecation[25], we feel that this approach is appropriate for this area.

Suitable wastewater handling facilities have been designed into each water point (storage tank, MC, or public tap, see typical component diagrams given in Appendix Five). Wastewater runoff from washing, bathing, open valves, and tank overflow can be redirected and used for gardening or otherwise recycled. Wastewater should not be allowed to stand undrained, since it will become a source of contamination. Finally, where appropriate, fences (either of barbed wire, which is expensive, or natural fences of thorny or other thick bushes which can be very effective) should be used around spring catchments to minimize animal contamination, especially in any catchments where cows or pigs might be possibly interested in intruding.

4.2 Construction and Related Training

In other rural areas of Indonesia, and in Kal-bar and Kal-teng as well, responsibility for developing rural water supplies formally lies with the Directorate of Human Settlements (Cipta Karya) under the Ministry of Public Works. After Cipta Karya engineers design a system, it is typically constructed by a private contractor under the supervision of Cipta Karya field staff. Local laborers are sometimes hired to participate in construction, but only for unskilled menial tasks. However, once a gravity flow water system is designed by engineers or experienced technicians, the skills required to actually build it are not that difficult to learn. These skills are best learned on the job under the direction of an experienced construction supervisor. When beneficiary community members actively participate, they will automatically learn skills required to maintain their systems, and deal with most of the common repair problems they are likely to encounter over the life of their water system. This is what we propose to do here.

If funding is approved, these systems will be constructed in the following order:

- o After procurement is initiated, the Construction Supervisor will travel to Pontianak to make arrangements with SBK to provide the necessary support once he arrives in BB/BR, helping to insure a smooth start for construction activities. This may include authorization to use existing SBK stock (e.g., cement and rebar) which can later be restocked with the project M&E when it arrives.

- o The Construction Supervisor and one assistant (a qualified water technician or engineer) will visit the communities to begin community organization and inform them of proposed

25See the report *Final Evaluation of the Water and Sanitation for Healthier Environmental Settings (WASHES) Project*, R. McGowan et al, ARD and CARE/Indonesia, November, 1991 for more information about sanitation practices in other parts of Indonesia.

scheduling and necessary support tasks. This will entail developing close working relationships with the *Kepala Desa* and/or *Kepala Adat* and other influential persons in the community.

- o The communities will gather all required local construction materials (sand, gravel, and rock) and transport them to the appropriate sites (spring catchment, storage tank, and MC sites). Men, women, and even children can participate in this effort. Every time they go to the river, they can bring back a bucket of sand.

- o If M&E has not yet arrived, construction can nonetheless proceed by using the M&E fund (recommended in Appendix Six) to procure any needed items, allowing construction to continue until the necessary items arrive with the major M&E shipment.

- o After the first major shipment procured materials (cement, certain pipe fittings, rebar, etc.) has arrived at Popai, it will be transported to the individual communities by SBK, then to the construction sites by villagers. All remaining structures (except the main pipeline) can then be completed (except the pipe pillars used to keep the pipe secured along steep slopes or across other obstacles like streams).

- o After the remainder of the procurement (mainly pipes) arrives, the main pipeline and distribution lines will be assembled and the systems completed.

- o As construction proceeds, so will the on-the-job training for system O&M, and concurrently, the health, hygiene and sanitation training.

In general, few villagers in the targeted communities now have the required masonry skills needed to construct spring catchment or water storage tanks, and will have to be trained to do so[26]. From each community, 4-8 people worked with the consultants in surveying the initial pipeline layouts, and these skills will be further developed during construction as other springs and alternative pipeline routes are explored prior to actual construction.

The community management training accompanying system installation will also focus on the need for establishing an O&M fund (see Section 5.1 below) with regular contributions of water user fees. Communities will be provided with standard fee collection books, and be trained in the collection, management, and disbursement of funds for O&M.

26Some communities such as Sungkup did have resident artisans who are experienced in the use of mortar for stucco walls.

4.3 Sanitation and Hygiene Education

Sanitation and hygiene education is needed to maximize community benefits from improved water supplies. For example, it does little good to supply high quality water at the tap if it is then collected and stored in a dirty container. Overall awareness of the causal relationship between clean water, proper sanitation practices, and health is relatively low in the project area. Since the MoH has not yet established *posyandus* in these communities which could provide basic health training, it is recommended that this be done in conjunction with water system development.

Given that there are only seven targeted communities (six if Riam Batang and Tumbang Taberau are considered as one community, which for all practical purposes they are), two Indonesian health educators experienced in rural village-level sanitation and hygiene education should be funded under the project to provide training in the following environmental health areas:

- water transport and hygienic storage in the home;
- the importance of regular cleaning of tanks and MCs;
- the importance of regular maintenance of the drainage facilities to prevent standing wastewater;
- alternative uses of greywater (e.g., for gardens or fruit trees);
- community clean-up campaigns;
- defecation and urination practices and their potential health impacts.

As soon as this activity is approved, the project should identify suitable trainers. Given the dearth of Kal-bar NGOs experienced in water supply, sanitation and health, people from CARE/Indonesia or *Dian Desa* (both of whom have experience in health education) could possibly be used for this training. Where possible, this effort should be strengthened by encouraging MoH to develop and staff *posyandus* in these communities. Particular efforts should be made to involve women (who bear much of the day-to-day responsibility for providing their families with water) are involved in all phases of this training. It may be difficult culturally to directly involve them directly in the construction, but even this should be encouraged wherever it is culturally acceptable.

The one concern about system sustainability is that the beneficiary communities will not contribute significant amounts of their own financial resources to build these systems, since SBK appears willing to cover most or all M&E costs, and USAID intends to cover the cost of required technical assistance. Communities will only contribute labor and modest local materials. When cash inputs for O&M are required (which they eventually will be), communities may not be willing to provide the cash (for example, to replace a damaged pipe or water tank), and may instead revert to using their existing unimproved water sources rather than repairing the new systems installed under the project. However, increasing their awareness of the critical linkage between water quality and health will help to insure their active and willing support of their systems.

Where appropriate, sanitation and hygiene education should also be coordinated with teachers in the village schools (some of whom include some health education in their standard curriculum), in order to maintain some degree of continuity after WS&S project staff have departed.

5.0 COSTS AND LOGISTICS

Besides system surveys, engineering design, and institutional and social assessments of the targeted communities, an important task for this mission was to develop site by site system cost estimates, determine who would be willing and able to pay those costs, and review the logistical support requirements for constructing the systems and providing necessary training.

5.1 Financing WS&S System Development and Training

For any water supply development project, there are three general cost categories:

- **materials and equipment** (M&E) - for gravity flow piped systems, the major purchased M&E components include pipes, cement, rebar, fittings, and valves. In addition, local materials such as sand, gravel and rock are often obtained near the construction sites.

- **labor** (skilled and unskilled) - for system design (engineers and water technicians), construction (construction supervisor, masons, carpenters, and laborers), and O&M (financial manager, skilled technicians).

- **logistical support** - for procurement, transportation of M&E and personnel, communications, and food and lodging for workers (if required).

As mentioned in previous chapters of this report, the assumption was that these costs would be apportioned among the three major parties as follows:

- SBK - M&E;

- USAID - skilled labor including engineers, technicians, and health trainers, and;

- Beneficiary communities - unskilled labor and all locally available materials.

Making no promises, the consultants discussed this proposed arrangement with all of the communities visited, making clear that no final decisions had been made to proceed any further than the current feasibility study. In all cases, village formal and informal leaders

C. Water Storage Tank (12 cubic meters) w/one attached MC			TT/RIAM BATANG
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Forms	1,000	40,000
20	Wooden Lumber for Forms	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow and washout pipes	4,000	12,000
4	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for outlet to public tap	2,500	10,000
5	Pcs. GI Knee, 1" for overflow/in/outlet pipes	750	3,750
2	Pcs. GI Cap/Dop, 1" for washout pipe	500	1,000
0	Pcs. GI Knee, 1/2" for public tap outlet	400	0
3	Pcs. GI Elbow/Bocht, 1/2" for taps	750	2,250
3	Ball Valves, Kitz brand, 1/2"	14,000	42,000
1	Gate Valve, 1", Kitz brand	16,500	16,500
2	Set achors and lockbar for manhole/valvebo	5,000	10,000
2	Padlock, Globe brand	1,500	3,000
0.25	Kg. Pipe Paint, black	2,000	500

Subtotal = Rp. 911,500

D. Mandi/Cuci (MC, 2 units with M/F sides, 3rd attached to storage tank)			
42	Bags of Cement	6,850	287,700
6	Stems Rebar, 12 m x 8 mm	4,000	24,000
2	Kg. Rebar Wire	2,500	5,000
4	Kg. Nails 5-7 cm.	1,750	7,000
40	Pcs. Wooden Planks for Formwork	1,000	40,000
10	Pcs. Wooden Lumber for Formwork	1,000	10,000
2	Stems PVC Pipe, 1" Pralon VP Class	8,800	17,600
2	Stems PVC Pipe, 1/2" Pralon VP Class	5,000	10,000
2	Pcs. PVC Elbow, 1" for inlet pipe	1,150	2,300
2	Pcs. PVC Elbow, 1/2"	2,500	5,000
2	Pcs. PVC Tee, 1" for mandi taps	3,250	6,500
4	Pcs. PVC Red. Sockets 1"x1/2" for mandi	700	2,800
6	Pcs. PVC Valve Socket, 1/2" for mandi taps	650	3,900
6	Pcs. GI Knee, 1/2" for MC taps	400	2,400
6	Pcs. GI Double Nipple, 1/2"	400	2,400
6	Ball Valves, Kitz brand, 1/2"	14,000	84,000
6	Pcs. GI Elbow/Bocht, 1/2"	750	4,500

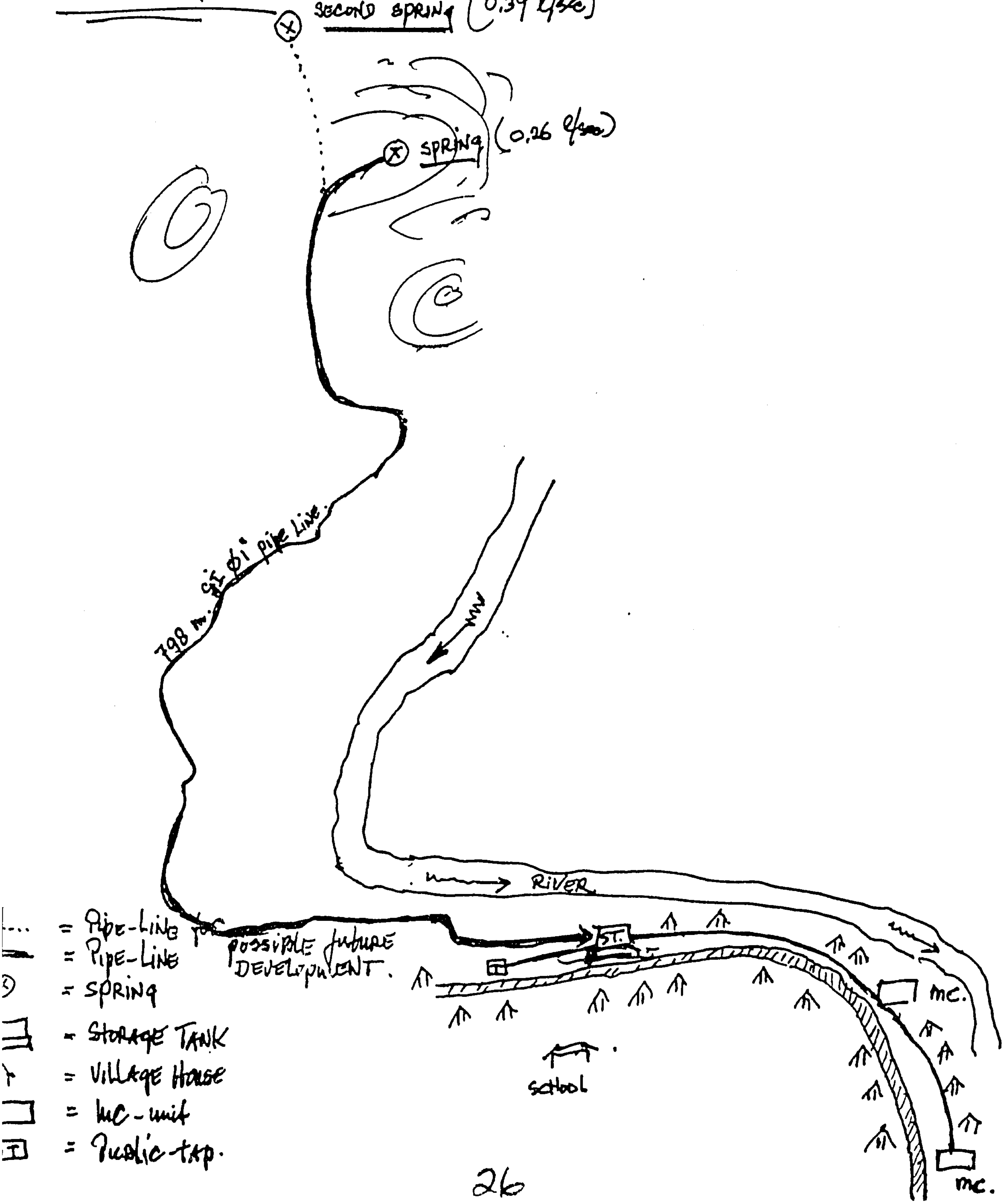
Subtotal = Rp. 515,100

E. Public Tap (1 unit)			
4	Bags of Cement	6,850	27,400
1	Stems Rebar, 12 m x 8 mm	4,000	4,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails, 5-7 cm	1,750	1,750
2	Pcs. Wooden Planks for Formwork	1,000	2,000
1	PVC Pipes, 4 m x 1/2", Pralon VP Class	5,000	5,000
1	Pcs. PVC Elbows, 1/2"	550	550
1	Pcs. PVC Valve Sockets, 1/2"	650	650
1	Pcs. GI Elbow/Bocht, 1/2"	400	400
1	Pcs. GI Knee, 1/2"	400	400
1	Pcs. GI Double Nipple, 1/2"	14,000	14,000
1	Ball Valves, Kitz brand, 1/2"	750	750

Subtotal = Rp. 59,400

Total Cost = Rp. 5,714,750

LAY-OUT of PROPOSED
WATER-SUPPLY SYSTEM
TUMBANG TABERAU
&
RIAM BATANG.



D. BELABAN ELLA

Belaban Ella - Pipeline Survey

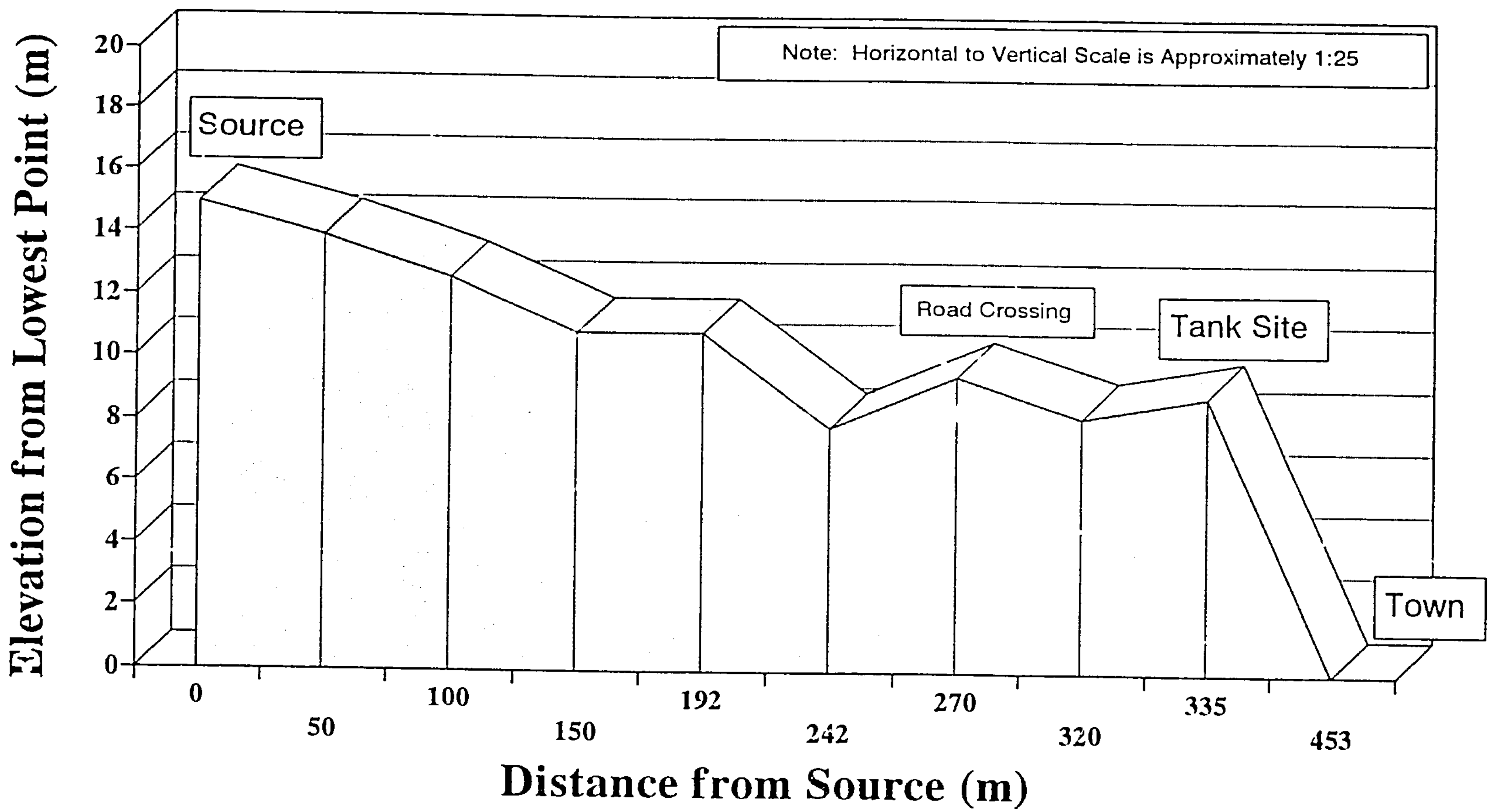
18-Dec-92

Station Number	Angle (degree	Distanc (meters	Elevation Diff. (m)	Accum. Elevation	Accum. Distanc	Top Down	Remarks
1	0.0	0	0.0	0.0	0	15.0	Spring catchment site
2	3.5	50	1.1	1.1	50	13.9	
3	1.5	50	1.3	2.4	100	12.6	
4	2.0	50	1.7	4.1	150	10.8	
5	0.0	42	0.0	4.1	192	10.8	
6	3.5	50	3.1	7.2	242	7.8	
7	-3.5	28	-1.7	5.4	270	9.5	ends on main road
8	1.5	50	1.3	6.8	320	8.2	across main road
9	-2.5	15	-0.7	6.1	335	8.8	to tank on hill by store
10	4.3	118	8.8	15.0	453	0.0	down hill to village
Through town:		230			683		in town distribution

From Station 1-14, use GI pipe due to difficulty in burying pipe (rocks & roots).
From Station 15 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.

Total Length GI Pipe	335	meters, so	56	lengths of 6 meter pipe
Total Length PVC Pi	348	meters, so	87	lengths of 4 meter pipe

Belaban Ela Community Water System
Main Pipeline Profile



System No. 4	Belaban Ella	Present Population:	329
Kecamatan:	Menukung	Design Population	464
Kabupaten:	Sintang	Spring Yield (ls/sec)	0.22
Province:	Kalimantan Barat	10-Dec-92	

System Summary: Single spring catchment with main pipeline of 335 meters to storage tank/MC near the main road, with two MCs on the main village lane, and one additional tap on lane near the river.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank			
17	Bags of Cement	6,850	116,450
6	Stems of Rebar, 12 m x 8 mm	4,000	24,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails 5-7 cm.	1,750	1,750
6	Pcs. Wooden Planks for Forms	1,000	6,000
7	Meters Plastic Sheet	1,500	10,500
3	Pcs. GI Pipe, 1" x 40 cm. neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for Outlet, 1", Kitz brand	16,500	16,500
1	GI Knee for Overflow, 1"	750	750
1	GI Cap/Dop for Washout, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe Brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 204,450
B. Main Pipeline (335 meters in length)			
60	GI Pipe, 1" x 6 m, Medium Class	21,000	1,260,000
6	Pcs. GI Unions, 1"	1,750	10,500
3	Pcs. GI Elbow/Bocht, 1" for sharp bends	1,500	4,500
1	Pcs. GI Tee, 1", for washout	900	900
1	Pc. GI Plug, 1", for washout	500	500
0	Pc. GI Reducing Tee, 1" to 1/2" for AV	1,000	0
0	Air Release Valve, 1/2"	20000	0
0	Pcs. GI Double Nipple, 1/2"	400	0
0	Pcs. GI Reducing Socket, 3/4'x1/2" (AV)	700	0
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set Anchors & lockbar for valve box	5,000	5,000
70	Stems PVC Pipe, 1" x 4m, Pralon VP Class	8,800	616,000
17	Stems PVC Pipe, 1/2"x4 m, Pralon VP Class	5,000	85,000
2	Pcs. PVC Tee, 1" Pralon	3,250	6,500
1	Pcs. PVC Reducing Sockets, 1" to 1/2" for PT	700	700
2	Pcs. PVC Valve Sockets, 1" outlet ST to MC	1,600	3,200
1	Kg. Solvent Cement, Pralon, No.73	32,500	32,500
10	Bags of Cement for Concrete Pillars - mainline	6,850	68,500
0	Stems Rebar, 12 m x 8 mm for pipe pillars	4,000	0
0	Sets Galvanized Iron Cable/chain for suspending pipe runs over creeks	10,000	0
1	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	2,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 2,127,300

C. Water Storage Tank (12 cubic meters) w/one attached MC			BELEBAN ELLA
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Formwork	1,000	40,000
20	Wooden Lumber for Formwork	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow and washout pipes	4,000	12,000
3	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for three MC taps	2,500	7,500
5	Pcs. GI Knee, 1" for outlet/inlet/overflow	750	3,750
2	Pc. GI Cap/Dop, 1" for washout/unused	500	1,000
0	Pcs. GI Knee, 1" for Public Tap Outlet	400	0
3	Pcs. GI Elbow/Bocht, 1/2" for taps	750	2,250
3	Ball Valves, Kitz brand, 1/2" for taps	14,000	42,000
1	Gate Valve, 1", Kitz brand, for outlet pipe	16,500	16,500
2	Set achors and lockbar for manhole/valvebo	5,000	10,000
2	Padlock, Globe brand	1,500	3,000
0.25	Kg. Pipe Paint, black	5,000	1,250

Subtotal = Rp. 909,750

D. Mandi/Cuci (2 MCs, with male and female sides)			
42	Bags of Cement	6,850	287,700
6	Stems Rebar, 12 m x 8 mm	4,000	24,000
2	Kg. Rebar Wire	2,500	5,000
4	Kg. Nails, 5-7 cm	1,750	7,000
40	Pcs. Wooden Planks for Formwork	1,000	40,000
10	Pcs. Wooden Lumber for Formwork	1,000	10,000
2	Stems PVC Pipe, 1"x 4m Pralon VP Class	8,800	17,600
2	Stems PVC Pipe, 1/2" Pralon VP Class	5,000	10,000
2	Pcs. PVC Elbow, 1" for inlet pipe	1,150	2,300
2	Pc. PVC Elbow/Bocht, 1/2"	2,500	5,000
2	Pc. PVC Tee, 1/2" for two mandi taps	3,250	6,500
4	Pcs. PVC Red. Sockets 1"x1/2" fo rmandi	700	2,800
6	Pcs. PVC Valve Socket, 1/2"	650	3,900
6	Pcs. GI Knee, 1/2" for MC taps	400	2,400
6	Pcs. GI Double Nipple, 1/2" for MC taps	400	2,400
6	Ball Valves, Kitz brand, 1/2"	14,000	84,000
6	Pcs. GI Elbow/Bocht, 1/2"	750	4,500

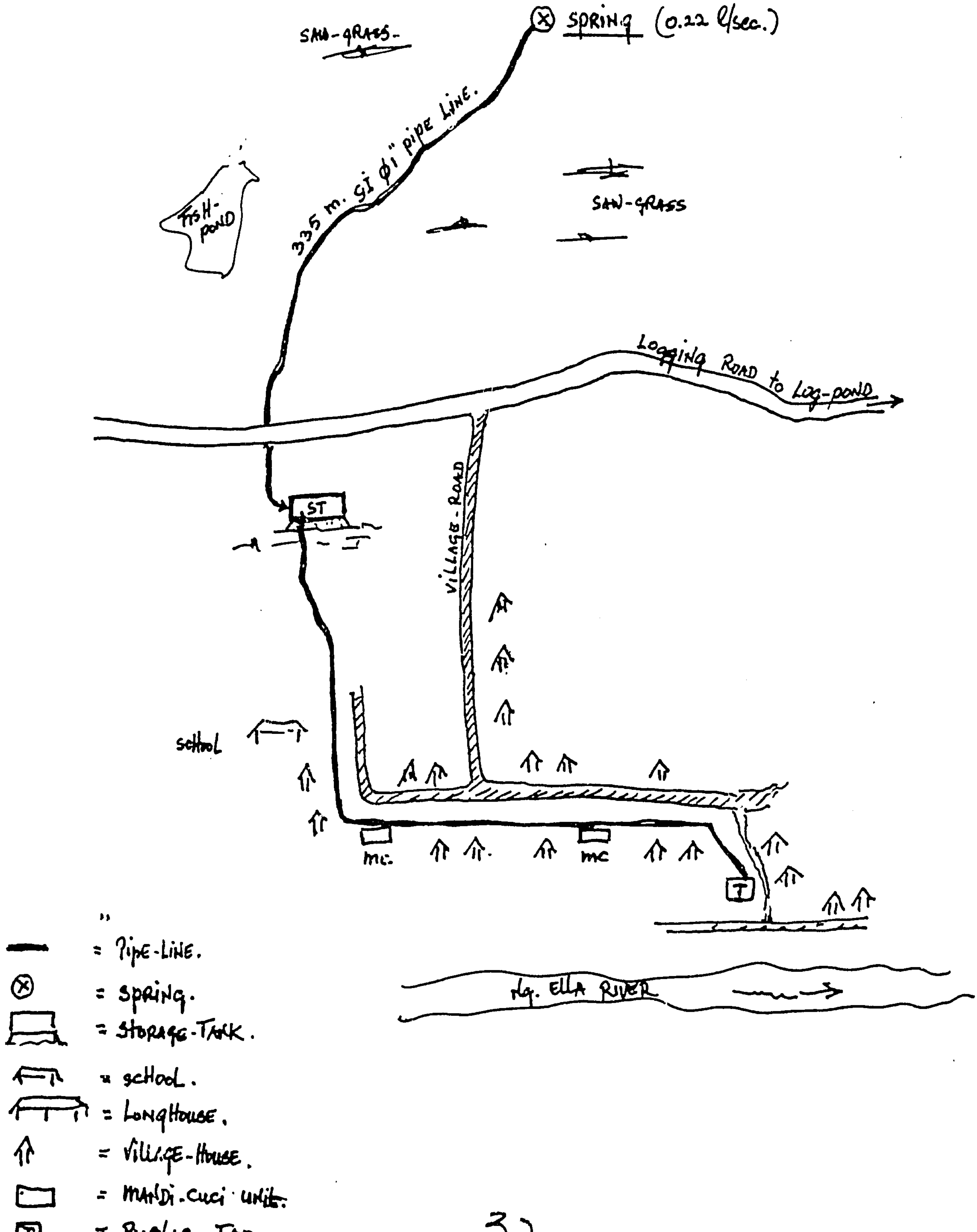
Subtotal = Rp. 510,600

E. Public Tap (1 unit)			
4	Bags of Cement (@ 40 kg/bag)	6,850	27,400
1	Stem Rebar, 12 m x 8 mm	4,000	4,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails, 5-7 cm	1,750	1,750
2	Pcs. Wooden Planks for Formwork	1,000	2,000
1	PVC Pipes, 4 m x 1/2", Pralon VP Class	5,000	5,000
1	Pc. PVC Elbow, 1/2"	550	550
1	Pc. PVC Valve Socket, 1/2"	650	650
1	Pcs. GI Knee, 1/2"	400	400
1	Pcs. GI Double Nipple, 1/2"	400	400
1	Ball Valve, Kitz brand, 1/2"	14,000	14,000
1	Pcs. GI Elbow/Bochtt, 1/2"	750	750

Subtotal = Rp. 58,650

Grand Total = Rp. 3.810,750

LAY-OUT of PROPOSED WATER-SUPPLY SYSTEM. BALABAN ELLA.



E. SUNGKUP

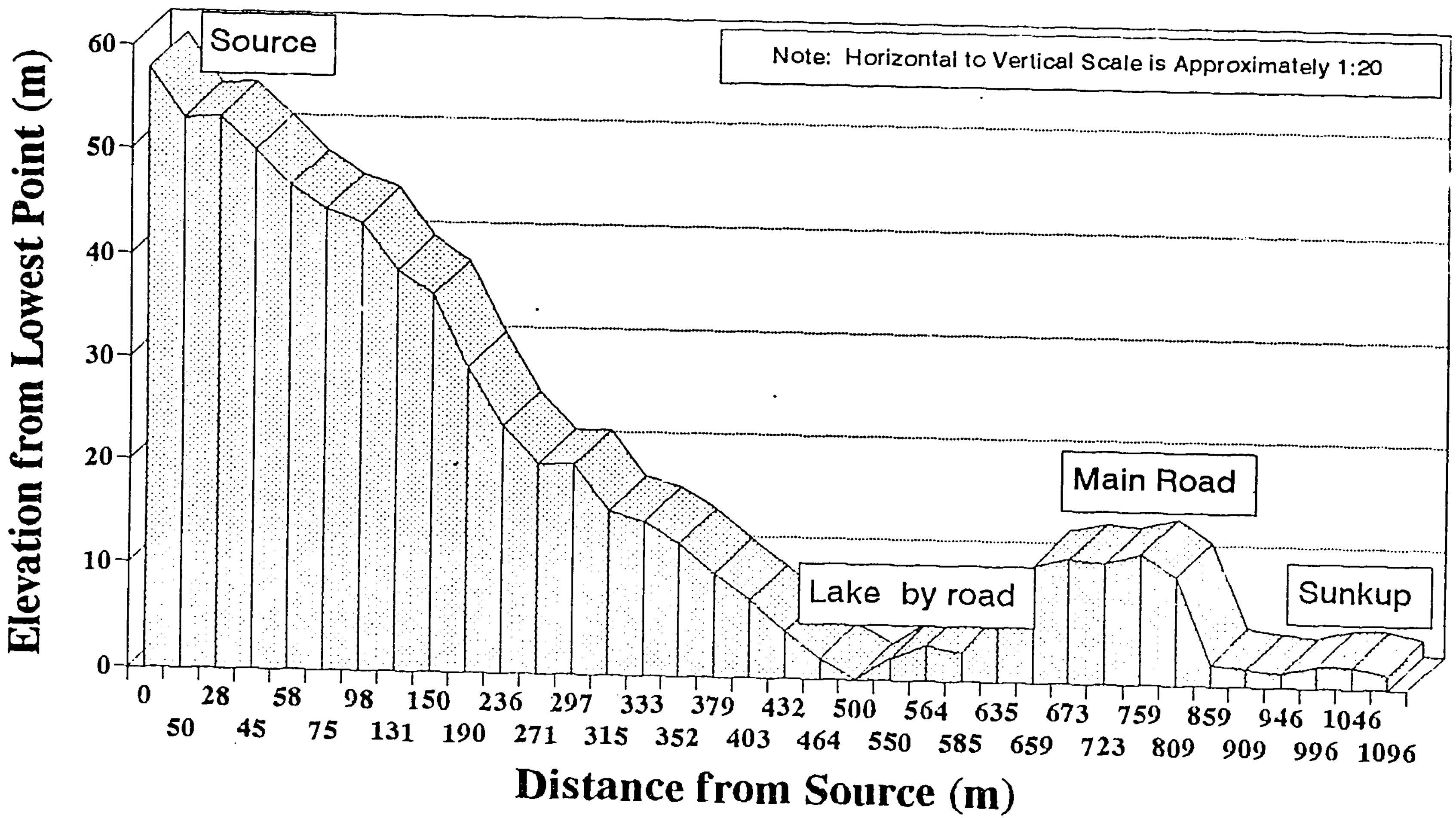
Sunkup - Pipeline Survey (11/29)

Station Number	Angle (degrees	Distance (meters)	Elevation Diff. (m)	Accum. Elevation	Accum. Distance	Top Down	Remarks
0	0.0	0	0.0	0.0	0	57.7	3 springs at source
1	5.5	50	4.8	4.8	50	52.9	total of 0.36 ls/sec
2	-0.5	28	-0.2	4.5	28	53.1	
3	11.0	17	3.2	7.8	45	49.9	
4	14.0	13	3.1	10.9	58	46.7	
5	7.5	17	2.2	13.2	75	44.5	
6	3.0	23	1.2	14.4	98	43.3	
7	8.0	33	4.6	19.0	131	38.7	
8	7.0	19	2.3	21.3	150	36.4	
9	10.0	40	6.9	28.2	190	29.5	
10	7.0	46	5.6	33.8	236	23.9	
11	6.0	35	3.7	37.5	271	20.2	
12	0.0	26	0.0	37.5	297	20.2	
13	14.5	18	4.5	42.0	315	15.7	
14	3.0	18	0.9	42.9	333	14.7	
15	6.0	19	2.0	44.9	352	12.8	
16	6.0	27	2.8	47.7	379	9.9	
17	6.0	24	2.5	50.2	403	7.4	
18	6.0	29	3.0	53.3	432	4.4	
19	4.5	32	2.5	55.8	464	1.9	
20	3.0	36	1.9	57.7	500	0.0	
21	-2.5	50	-2.2	55.5	550	2.2	small lake on right side
22	-5.0	14	-1.2	54.3	564	3.4	
23	2	21	0.7	55.0	585	2.7	
24	-4.5	50	-3.9	51.1	635	6.6	
25	-11.5	24	-4.8	46.3	659	11.4	
26	-2.5	14	-0.6	45.7	673	12.0	ends on main road
27	0.5	50	0.4	46.1	723	11.6	cross m.road, st. tank
28	-1.5	36	-0.9	45.2	759	12.5	entering village road
29	2.5	50	2.2	47.4	809	10.3	
30	9.5	50	8.3	55.6	859	2.1	
31	0.5	50	0.4	56.0	909	1.6	football field
32	0.5	37	0.3	56.4	946	1.3	corner of church/school
33	-1	50	-0.9	55.5	996	2.2	through village
34	0	50	0.0	55.5	1046	2.2	
35	1	50	0.9	56.4	1096	1.3	end of village

From Station 1 to Station 28, use GI pipe due to difficulty in burying pipe (rocks & roots).
From station 29 through 35 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.

Total length of GI Pipe=	759	meters, so	127	lengths of 6 meter pipe
Total Length of PVC Pip	337	meters, so	84	lengths of 4 meter pipe

Sunkup Community Water System
Main Pipeline Profile



System No. 5	Sungkup	Present Population:	150
Kecamatan:	Menukung	Design Population:	212
Kabupaten:	Sintang	Spring Yield (ls/sec)	0.30
Province:	Kalimantan Barat	10-Dec-92	

System Summary: Single spring catchment, 723 meters of 1" GI main pipeline, plus 300 meters of PVC distribution line, one storage tank plus MC, a second MC, and no other public taps.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank (one unit)			
50	Bags of Cement	6,850	342,500
20	Stems of Rebar, 12 m x 8 mm	4,000	80,000
2	Kg. Rebar Wire	2,500	5,000
1	Kg. Nails 5-7 cm.	1,750	1,750
6	Pcs. Wooden Planks for Forms	1,000	6,000
15	Meters Plastic Sheet	1,500	22,500
3	Pcs. GI Pipe, 1" x 40 cm. neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for outlet, 1", Kitz brand	16,500	16,500
1	GI Knee for overflow pipe, 1"	750	750
1	GI Cap/Dop for washout pipe, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 501,000
B. Main Pipeline (723 meters in length)			
125	GI Pipe, 1"x 6 m, Medium Class	21,000	2,625,000
13	Pcs. GI Unions, 1"	1,750	22,750
5	Pcs. GI Elbow/Bocht, 1" for sharp bends	750	3,750
1	Pc. GI Tee, 1", for low point washout (1)	900	900
1	Pc. GI Plug, 1", for washout (1)	500	500
1	Pcs. GI Reducing Tee, 1" x 1/2" for AV	1,000	1,000
1	Air Release Valve, 1/2"	10,000	10,000
1	Pcs. GI Double Nipple, 1/2" for air valve	400	400
1	Pc. GI Reducing Socket, 3/4" x 1/2" (AV)	750	750
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set Anchors & lockbar for valve box	5,000	5,000
75	Stems PVC Pipe, 1"x 4 m, Pralon VP Class	8,800	660,000
0	Stems PVC Pipe, 1/2"x4m, Pralon VP Class	5,000	0
2	Pcs. PVC Valve Sockets, 1" from ST to PVC pipe	1600	3,200
1	Pcs. PVC Tee, 1" Pralon to #1 MC	3,250	3,250
0	Pcs. PVC Reducing Sockets, 1" to 1/2"	700	0
1	Kg. Solvent Cement, Pralon, No.73	32,500	32,500
30	Bags of Cement for Concrete Pillars - mainline	6,850	205,500
8	Stems Rebar, 12 m x 8 mm for pipe pillars	4,000	32,000
1	Sets Galvanized Iron Cable/chain for suspending pipe runs over creeks	10,000	10,000
5	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	10,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 3,658,000

C. Water Storage Tank (12 cubic meters) w/one attached MC			SUNGKUP
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Forms	1,000	40,000
20	Wooden Lumber for Forms	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow and washout pipes	4,000	12,000
3	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for MC taps	2,500	7,500
5	Pcs. GI Knee, 1" for overflow/in/outlet pipes	750	3,750
2	Pc. GI Cap/Dop, 1" for washout pipe/unused	500	1,000
0	Pcs. GI Knee, 1" for Public Tap Outlet	700	0
3	Pcs. GI Elbow/Bocht, 1/2" for taps	750	2,250
3	Ball Valves, Kitz brand, 1"	14,000	42,000
1	Gate Valve, 1", Kitz brand	16,500	16,500
2	Set achors and lockbar for manhole/valvebox	5,000	10,000
2	Padlock, Globe brand	1,500	3,000
0.25	Kg. Pipe Paint, black	2,000	500

Subtotal =	Rp. 909,000

D. Mandi/Cuci (MC, 2 units with male and female sides)			
42	Bags of Cement	6,850	287,700
6	Stems Rebar, 12 m x 8 mm	4,000	24,000
2	Kg. Rebar Wire	2,500	5,000
4	Kg. Nails 5-7 cm.	1,750	7,000
40	Pcs. Wooden Planks for Formwork	1,000	40,000
10	Pcs. Wooden Lumber for Formwork	1,000	10,000
2	Stems PVC Pipe, 1: Pralon VP Class	8,800	17,600
2	Stems PVC Pipe, 1/2" Pralon VP Class	5,000	10,000
2	Pcs. PVC Elbow, 1" for inlet pipe	1,150	2,300
2	Pcs. PVC Reducing Tee, 1" x 1/2" for cuci	2,500	5,000
2	Pcs. PVC Tee, 1" for two mandi taps	3,250	6,500
4	Pcs. PVC Red.Sockets 1"x1/2" for mandi taps	700	2,800
6	Pcs. PVC Valve Socket, 1/2" for MC taps	650	3,900
6	Pcs. GI Knee, 1/2" for MC taps	400	2,400
6	Pcs. GI Double Nipple, 1/2" for MC taps	400	2,400
6	Ball Valves, Kitz brand, 1/2" for MC taps	14,000	84,000
6	Pcs. GI Elbow/Bocht, 1/2" for MC taps	750	4,500

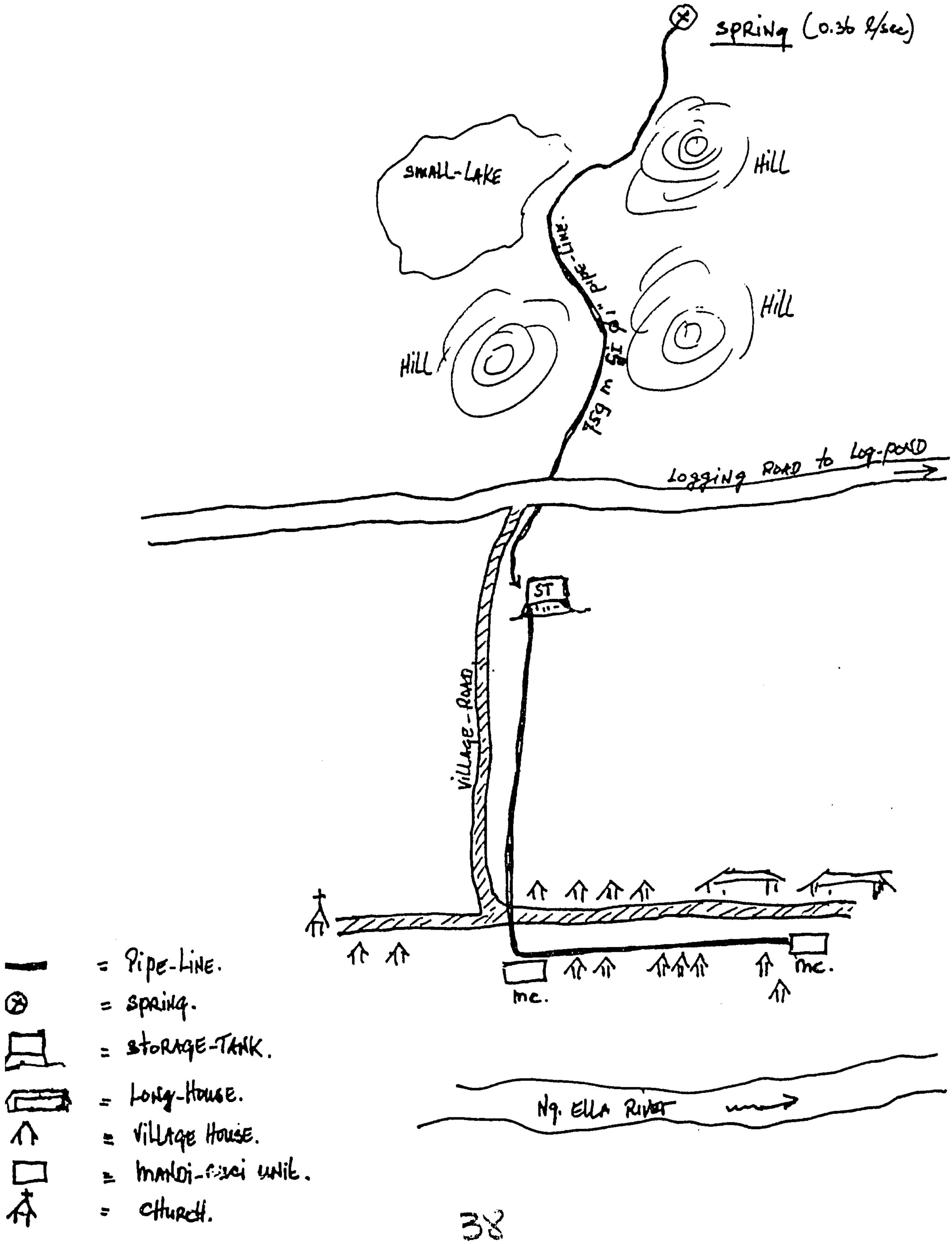
Subtotal =	Rp. 515,100

E. Public Tap (none)		
0	Bags of Cement	0
0	Stems Rebar, 12 m x 8 mm	0
0	Kg. Rebar Wire	0
0	Kg. Nails, 5-7 cm	0
0	Pcs. Wooden Planks for Formwork	0
0	PVC Pipes, 4 m x 1/2", Pralon VP Class	0
0	Pcs. PVC Elbows, 1/2"	0
0	Pcs. PVC Valve Sockets, 1/2"	0
0	Pcs. GI Elbow/Bochtt, 1/2"	0
0	Pcs. GI Knee, 1/2" * Needed here?	0
0	Pcs. GI Double Nipple, 1/2"	0
0	Ball Valves, Kitz brand, 1/2"	0

Subtotal =	Rp. 0

Total Cost =	Rp. 5,583,100

LAY-OUT OF PROPOSED
WATER-SUPPLY SYSTEM.
SUNGKUP.



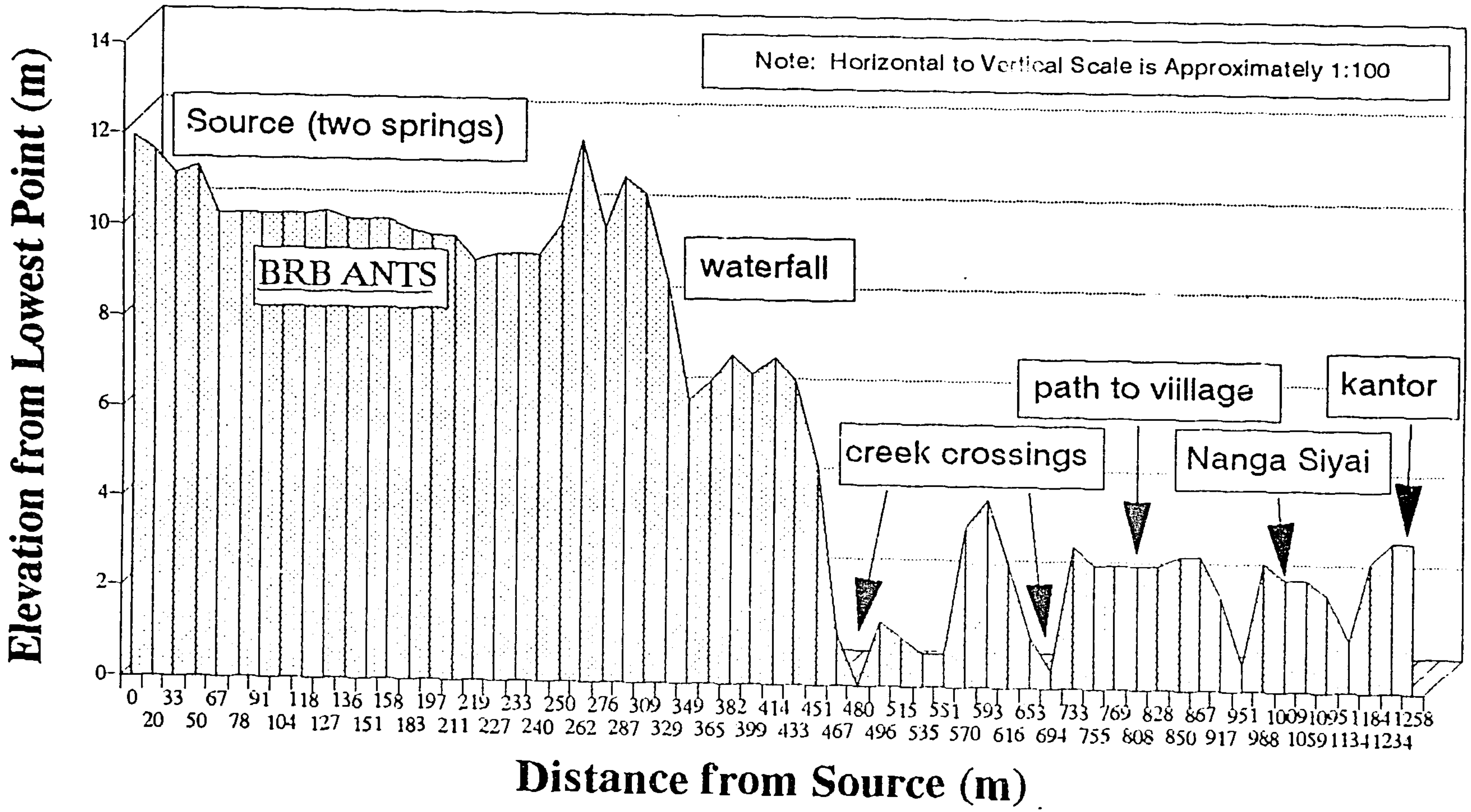
F. NANGA SIYAI

Nanga Siyai (Second Spring) - Pipeline Survey							17-Dec-92
Station Number	Angle in degrees	Distanc (meters	Elevation Diff. (m)	Accum. Elevation	Accum. Distanc	Top Down	Remarks
0	0.0	0	0.00	0.0	0	12.0	
1	1.0	20	0.35	0.3	20	11.6	
2	2.0	13	0.45	0.8	33	11.1	
3	-0.5	17	-0.15	0.7	50	11.3	
4	3.5	17	1.04	1.7	67	10.3	
5	0.0	11	0.00	1.7	78	10.3	
6	0.0	13	0.00	1.7	91	10.3	
7	0.0	13	0.00	1.7	104	10.3	
8	0.0	14	0.00	1.7	118	10.3	
9	-0.5	9	-0.08	1.6	127	10.3	
10	1.0	9	0.16	1.8	136	10.2	BIG RED BITING ANTS
11	0.0	15	0.00	1.8	151	10.2	•
12	0.0	7	0.00	1.8	158	10.2	•
13	0.5	25	0.22	2.0	183	10.0	•
14	0.5	14	0.12	2.1	197	9.8	•
15	0.0	14	0.00	2.1	211	9.8	•
16	4.0	8	0.56	2.7	219	9.3	•
17	-1.0	8	-0.14	2.5	227	9.4	•
18	0.0	6	0.00	2.5	233	9.4	•
19	0.0	7	0.00	2.5	240	9.4	•
20	-4.0	10	-0.70	1.8	250	10.1	•
21	-9.0	12	-1.88	-0.0	262	12.0	•
22	8.0	14	1.95	1.9	276	10.0	•
23	-6.0	11	-1.15	0.8	287	11.2	•
24	1.0	22	0.38	1.1	309	10.8	•
25	5.5	20	1.92	3.1	329	8.9	waterfall (W/BRB ANTS)
26	7.5	20	2.61	5.7	349	6.3	waterfall (W/BRB ANTS)
27	-1.5	16	-0.42	5.2	365	6.7	BIG RED BITING ANTS
28	-2.0	17	-0.59	4.7	382	7.3	•
29	1.5	17	0.45	5.1	399	6.9	•
30	-1.5	15	-0.39	4.7	414	7.2	
31	1.5	19	0.50	5.2	433	6.7	
32	6.0	18	1.88	7.1	451	4.9	
33	13.5	16	3.74	10.8	467	1.1	
34	5.0	13	1.13	12.0	480	0.0	small creek crossing
35	-5.0	16	-1.39	10.6	496	1.4	
36	1.0	19	0.33	10.9	515	1.1	
37	1.0	20	0.35	11.2	535	0.7	
38	0.0	16	0.00	11.2	551	0.7	
39	-8.5	19	-2.81	8.4	570	3.5	reach village path
40	-1.5	23	-0.60	7.8	593	4.1	
41	3.5	23	1.40	9.2	616	2.7	
42	2.5	37	1.61	10.8	653	1.1	
43	1.0	41	0.72	11.6	694	0.4	
44	-4.0	39	-2.72	8.8	733	3.1	
45	1.0	22	0.38	9.2	755	2.7	
46	0.0	14	0.00	9.2	769	2.7	
47	0.0	39	0.00	9.2	808	2.7	
48	0.0	20	0.00	9.2	828	2.7	
49	-0.5	22	-0.19	9.0	850	2.9	
50	0.0	17	0.00	9.0	867	2.9	
51	1.0	50	0.87	9.9	917	2.0	
52	2.5	34	1.48	11.4	951	0.6	village bridge
53	-3.5	37	-2.26	9.1	988	2.8	storage tank site
54	1.0	21	0.37	9.5	1009	2.5	
55	0.0	50	0.00	9.5	1059	2.5	Kepala Adat's Longhous
56	0.5	36	0.31	9.8	1095	2.1	bend towards KD kantor
57	1.5	39	1.02	10.8	1134	1.1	bridge to kantor
58	-2.0	50	-1.74	9.1	1184	2.9	
59	-0.5	50	-0.44	8.6	1234	3.3	
60	0.0	24	0.00	8.6	1258	3.3	KD kantor
			Mainline w/o kantor =		1059		

From Station 1-15, use GI pipe due to difficulty in burying pipe (rocks & roots).
From Station 16 through 20 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.

Total Length GI Pipe	951	meters, so	159	lengths of 6 meter pipe is required
Total Length PVC Pipe=	307	meters, so	77	lengths of 4 meter pipe is required

Nanga Siyai System - Two Springs
Main Pipeline Profile



System No. 6	Nanga Siyai	Present Population:	190
Kecamatan:	Menukung	Design Population:	268
Kabupaten:	Sintang	Spring Yield (ls/sec)	0.36
Province:	Kalimantan Barat	10-Dec-92	

System Summary: Single spring catchment, a 1020 meters of 1" GI main pipeline, 300 meters of PVC distribution pipe, one storage tank plus MC, a second MC, and no other public taps.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank (one unit)			
29	Bags of Cement	6,850	198,650
15	Stems of Rebar, 12 m x 8 mm	4,000	60,000
2	Kg. Rebar Wire	2,500	5,000
1	Kg. Nails 5-7 cm.	1,750	1,750
6	Pcs. Wooden Planks for Forms	1,000	6,000
12	Meters Plastic Sheet	1,500	18,000
3	Pcs. GI Pipe, 1" x 40 cm. neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for outlet, 1", Kitz brand	16,500	16,500
1	GI Knee for overflow pipe, 1"	750	750
1	GI Cap/Dop for washout pipe, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 332,650

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
B. Main Pipeline (988 meters in length)			
170	GI Pipe, 1"x 6 m, Medium Class	21,000	3,570,000
17	Pcs. GI Unions, 1"	1,750	29,750
5	Pcs. GI Elbow/Bocht, 1" Price right? (750?)	1,500	7,500
3	Pc. GI Tee, 1", for washouts (3)	900	2,700
3	Pc. GI Plug, 1", for washouts (3)	500	1,500
1	Pcs. GI Reducing Tee, 1" x 1/2" for AV	1,000	1,000
3	Air Release Valve, 1/2"	10,000	30,000
3	Pcs. GI Double Nipple, 1/2" for AV	400	1,200
3	Pc. GI Reducing Socket, 3/4" x 1/2" (AV)	750	2,250
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set anchors and lockbar for valvebox	5,000	5,000
25	Stems PVC Pipe, 1", Pralon Class VP	750	18,750
0	Stems PVC Pipe, 1"x 4 m, Pralon VP Class	8,800	0
2	Pcs. PVC Valve Sockets, 1" for ST to MC PVC	1600	3,200
1	Pcs. PVC Tee, 1" Pralon	3,250	3,250
0	Pcs. PVC Reducing Sockets, 1" to 1/2"	700	0
1	Kg. Solvent Cement, Pralon, No.73	32,500	32,500
20	Bags of Cement for Concrete Pillars - mainline	6,850	137,000
8	Stems Rebar, 12 m x 8 mm for pipe pillars	4,000	32,000
4	Sets Galvanized Iron Cable/chain for suspending pipe runs over creeks	10,000	40,000
6	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	12,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 3,961,100

C. Water Storage Tank (12 cubic meters) w/one attached MC		NANGA SIYAI	
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Forms	1,000	40,000
20	Wooden Lumber for Forms	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow and washout pipes	4,000	12,000
3	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for MC taps	2,500	7,500
5	Pcs. GI Knee, 1" for overflow/in/outlet pipes	750	3,750
2	Pc. GI Cap/Dop, 1" for washout pipe	500	1,000
0	Pc. GI Knee, 1/2" for public tap outlet	700	0
3	Pcs. GI Elbow/Bocht, 1/2" for MC taps	750	2,250
3	Ball Valves, Kitz brand, 1/2"	14,000	42,000
1	Gate Valve, 1", Kitz brand	16,500	16,500
2	Set achors and lockbar for tank manhole	5,000	10,000
2	Padlocks, Globe brand	1,500	3,000
0.25	Kg. Pipe Paint, black	2,000	500

Subtotal =	Rp. 909,000

D. Mandi/Cuci (MC, 1 unit with male and female sides)			
21	Bags of Cement	6,850	143,850
3	Stems Rebar, 12 m x 8 mm	4,000	12,000
1	Kg. Rebar Wire	2,500	2,500
2	Kg. Nails 5-7 cm.	1,750	3,500
20	Pcs. Wooden Planks for Formwork	1,000	20,000
5	Pcs. Wooden Lumber for Formwork	1,000	5,000
1	Stems PVC Pipe, 1" Pralon VP Class for	8,800	8,800
1	Stems PVC Pipe, 1/2" Pralon VP Class	5,000	5,000
1	Pcs. PVC Elbow, 1" for inlet pipe	1,150	1,150
1	Pc. PVC Reducing Tee 1" x 1/2" for cuci	2,500	2,500
1	Pcs. PVC Tee, 1" for two mandi taps	3,250	3,250
2	Pcs. PVC Red.Sockets 1"x1/2" for mandi	700	1,400
3	Pcs. PVC Valve Socket, 1/2" for mandi taps	650	1,950
3	Pcs. GI Knee, 1/2" for MC taps	400	1,200
3	Pcs. GI Double Nipple, 1/2" for MC taps	400	1,200
3	Ball Valves, Kitz brand, 1/2"	14,000	42,000
3	Pcs. GI Elbow/Bocht, 1/2"	750	2,250

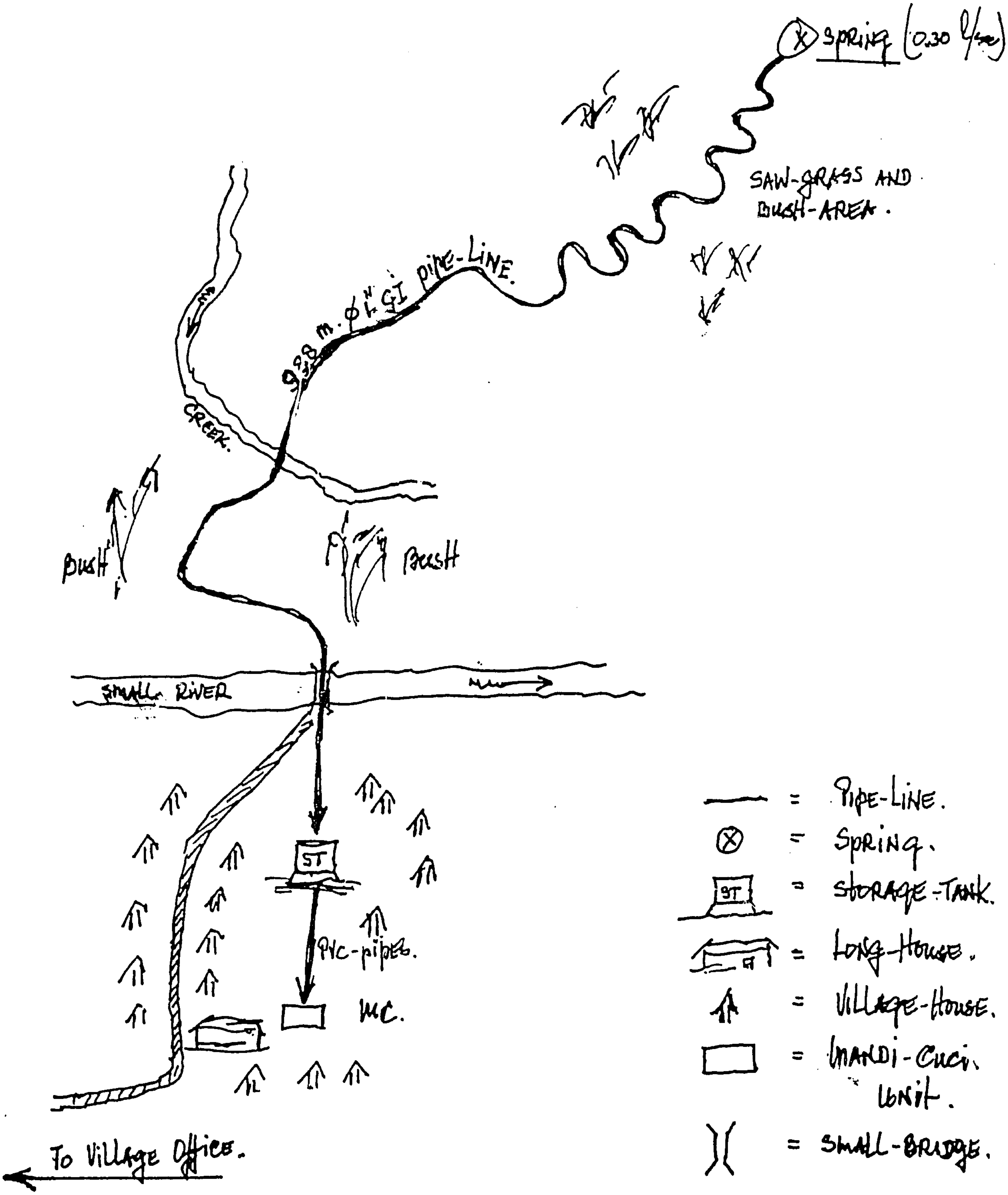
Subtotal =	Rp. 257,550

E. Public Tap (none)		
0	Bags of Cement	0
0	Stems Rebar, 12 m x 8 mm	0
0	Kg. Rebar Wire	0
0	Kg. Nails	0
0	Pcs. Wooden Planks for Formwork	0
0	PVC Pipes, 4 m x 1/2", Pralon VP Class	0
0	Pcs. PVC Elbows, 1/2"	0
0	Pcs. PVC Valve Sockets, 1/2"	0
0	Pcs. GI Elbow/Bochtt, 1/2"	0
0	Pcs. GI Knee, 1/2" * Needed here?	0
0	Pcs. GI Double Nipple, 1/2"	0
0	Ball Valves, Kitz brand, 1/2"	0

Subtotal =	Rp. 0

Total Cost =	Rp. 5,460,300

LAY-Out of PROPOSED WATER Supply system NANGA SIYAI . site



G. TOTALS FOR ALL SYSTEMS BY COMPONENT TYPE

Summary M&E List for All Six Sites — 18-Dec-92

	Concrete Materials		
976	Bags of Cement	6,850	6,685,600
348	Stems of Rebar, 12 m x 8 mm	4,000	1,392,000
44	Kg. Rebar Wire	2,500	110,000
57	Kg. Nails 5-7 cm.	1,750	99,750
458	Pcs. Wooden Planks for Forms	1,000	458,000
165	Pcs. Wooden Lumber for Forms	1,000	165,000
56	Meters Plastic Sheet	1,500	84,000

	GI Pipe and Fittings		
668	GI Pipe, 1" x 6 m, Medium Class	21,000	14,028,000
66	Pcs. GI Union, 1"	1,750	115,500
28	Pcs. GI Elbow/Bocht, 1" for sharp bends	1,500	42,000
11	Pcs. GI Tee, 1" for washouts (2)	900	9,900
11	Pcs. GI Plug, 1" for washouts (2)	500	5,500
5	Pc. GI Reducing Tee, 1" to 1/2" for air valve	1,000	5,000
7	Air Release Valve, 1/2"	20,000	140,000
37	Pcs. GI Double Nipple, 1/2"	400	14,800
7	Pcs. GI Reducing Socket, 3/4"x1/2" (AV)	700	4,900
18	Gate Valve (Kitz), 1"	16,500	297,000
36	Pcs. GI Pipe, 1" x 40 cm, neckwelded for SCT and WST outlet, overflow, and washout pipes	4000	144,000
20	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for MC taps	2,500	50,000
36	GI Knee for SCT and WST, 1"	750	27,000
18	GI Cap/Dop for SCT and WST Washout, 1"	500	9,000
32	Pcs. GI Knee, 1/2" for public tap outlet	400	12,800
48	Ball Valves, Kitz brand, 1/2" for MC taps	14,000	672,000
48	Pcs. GI Elbow/Bocht, 1/2" for MC taps	750	36,000

	PVC Pipe and Fittings		
351	Stems PVC Pipe, 1", Pralon VP Class	8,800	3,088,800
78	Stems PVC Pipe, 1/2", Pralon VP Class	5,000	390,000
15	Pcs. PVC Valve Sockets, 1" for GI/PVC switch	3,250	48,750
6	Kg. Solvent Cement, Pralon, No.73	32,500	195,000
9	Pcs. PVC Elbow, 1" for inlet pipe	1,150	10,350
9	Pcs. PVC Reducing Tee, 1" x 1/2" for cuci tap	2,500	22,500
14	Pcs. PVC Tee, 1" for 2 mandi taps or MC connect	3,250	45,500
19	Pcs. PVC Red.Sockets 1" x 1/2" for mandi taps	700	13,300
30	Pcs. PVC Valve Socket, 1/2" for MC taps	650	19,500
3	Pcs. PVC Elbow/Bocht, 1/2" for taps	550	1,650

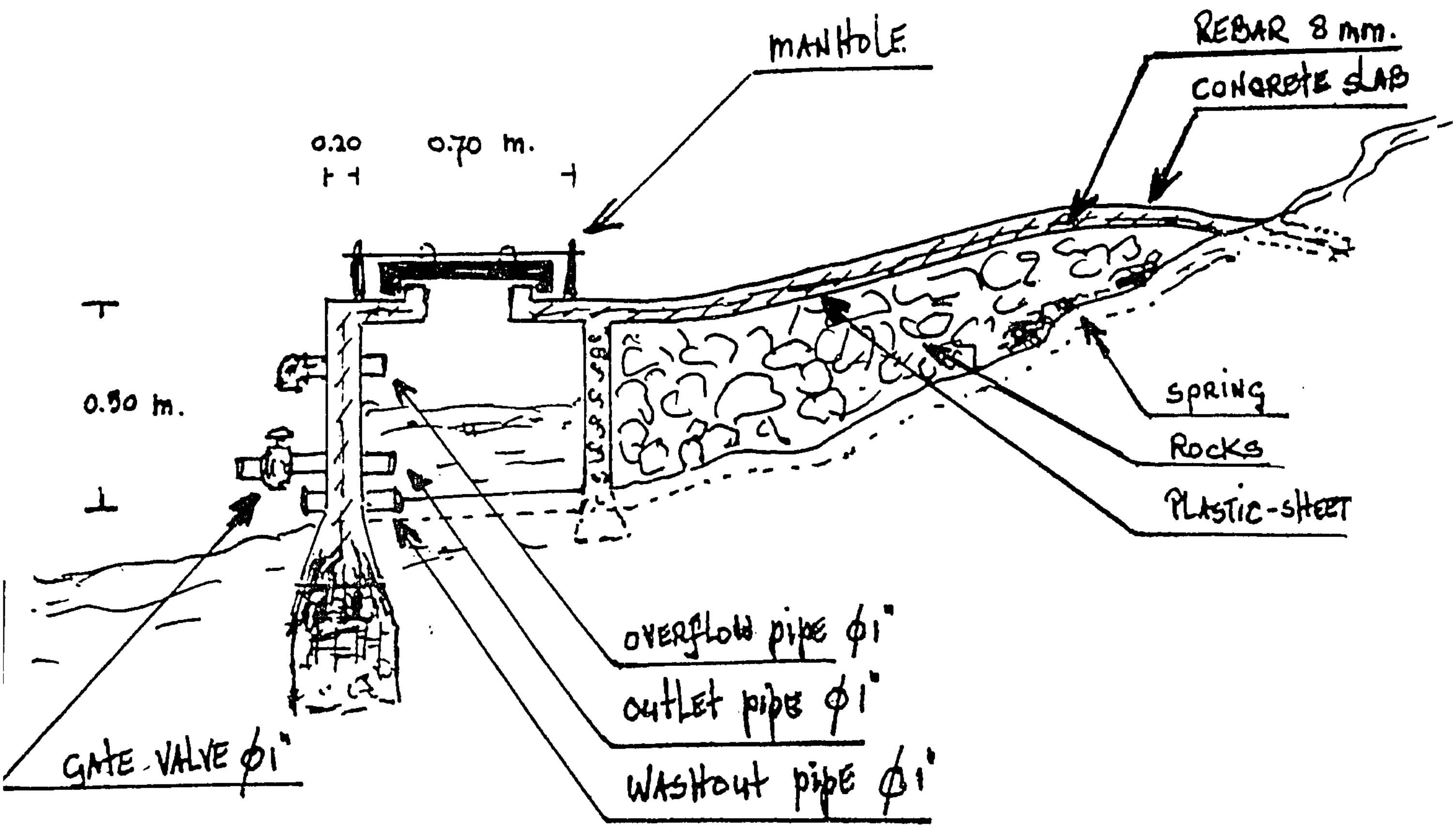
	Other Assorted M&E		
28	Sets of Anchors and Lockbar for Valve Boxes and Storage Tank Manhole Covers	5,000	140,000
24	Padlocks, Globe Brand	1,500	36,000
1.5	Liter Lamtoro-Gung Seeds for SCT protection	2,000	3,000
1.5	Kg. Pipe Paint, black	5,000	7,500
12	Pcs. Pipe Wrench, 24/18" Length	7,500	90,000
9	Sets Galvanized Iron Cable for suspending pipe	10,000	90,000
23	Kg. Steel Paint (Meni Besi) for GI pipe ends	2,000	46,000

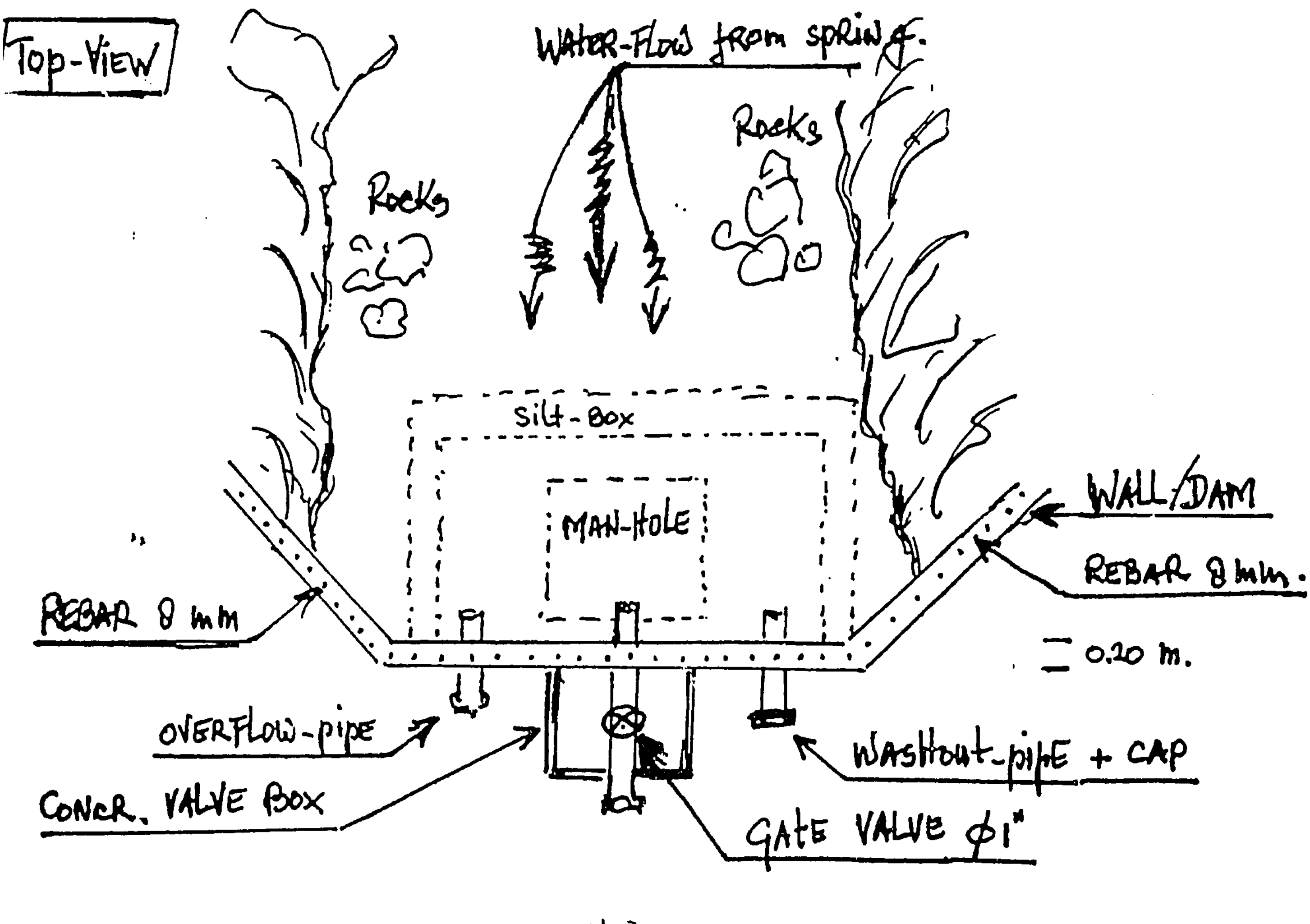
Total M&E Cost = Rp. 28,855,600

From Single System Totals, Total M&E Cost = Rp. 28,619,550

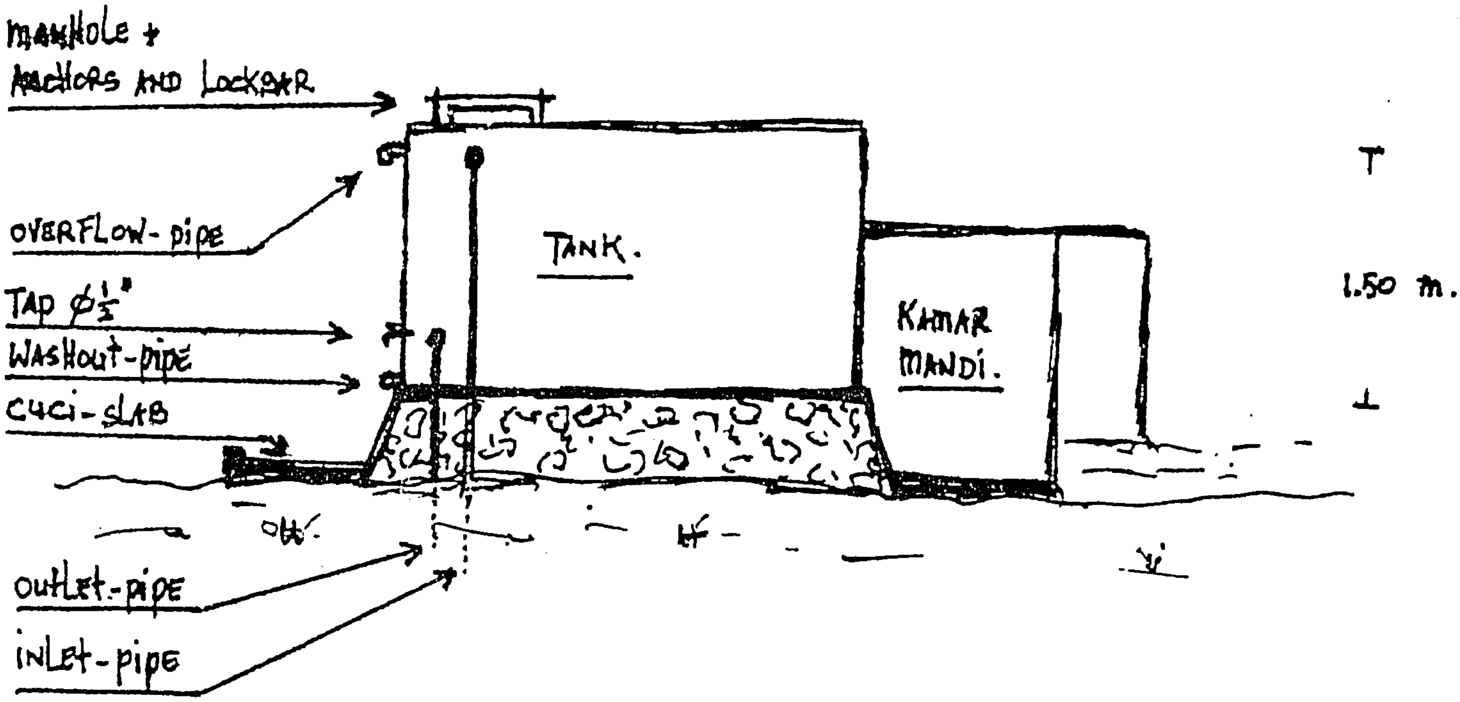
APPENDIX FIVE: WORKING DRAWINGS OF MAJOR SYSTEM COMPONENTS

"SPRING-CATCHMENT.

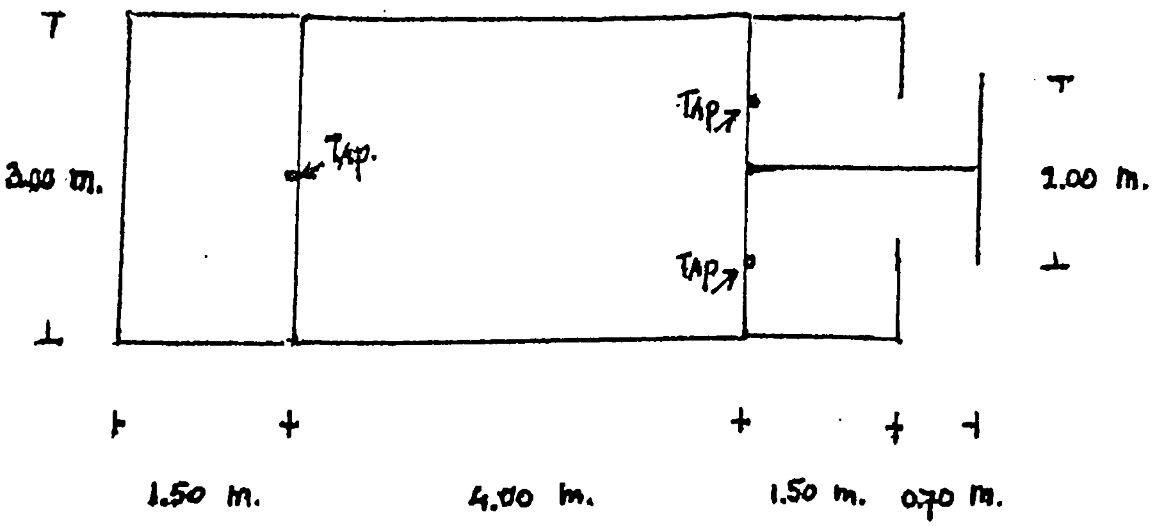




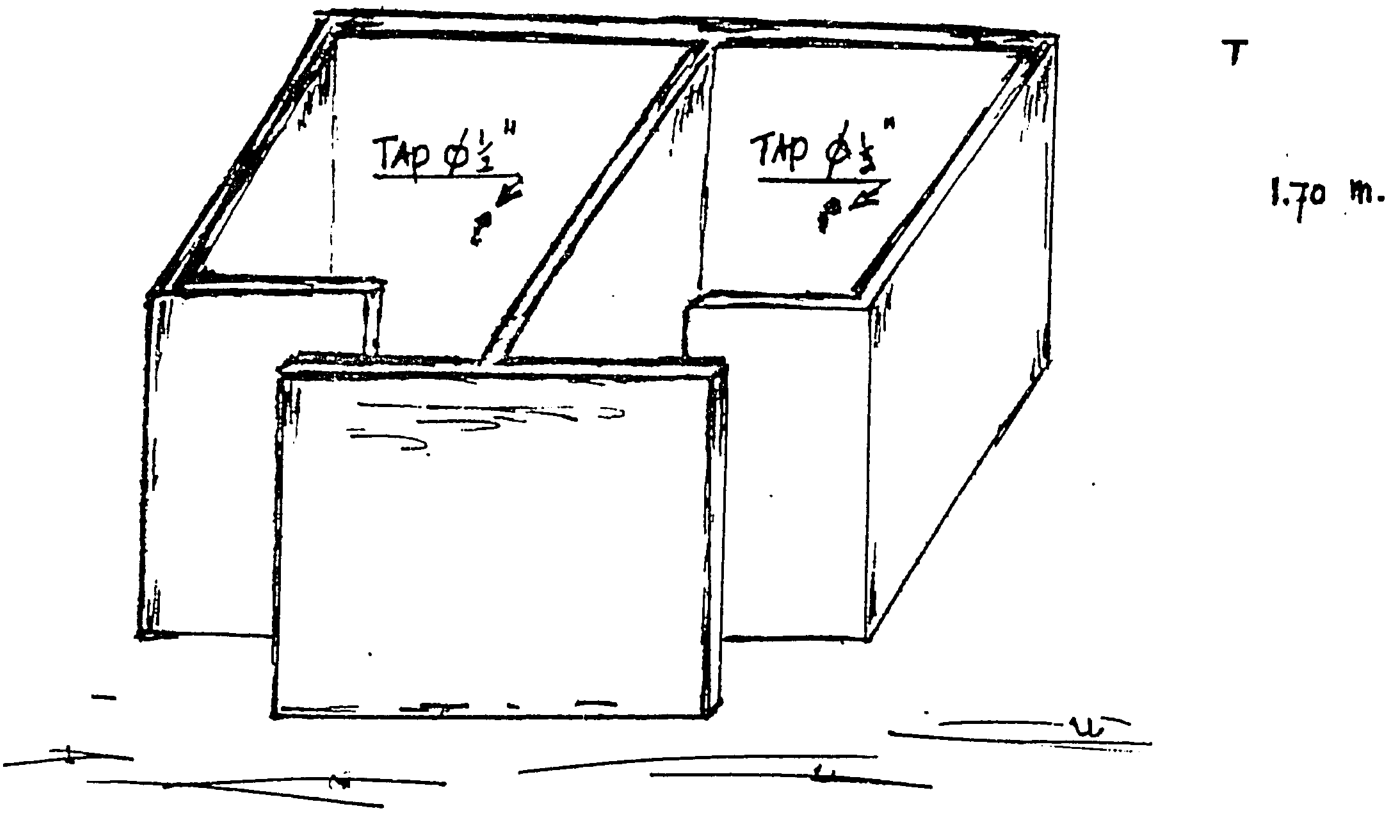
Storage Tank + MC

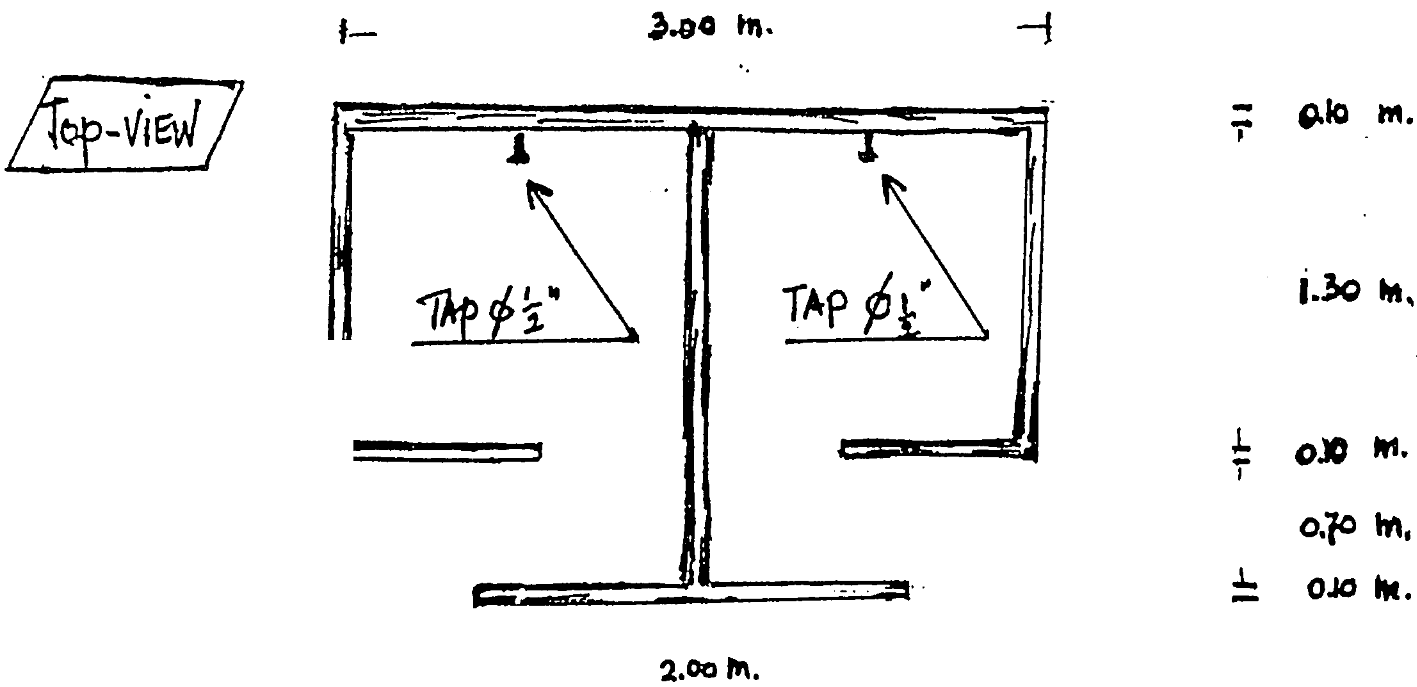


Top-View

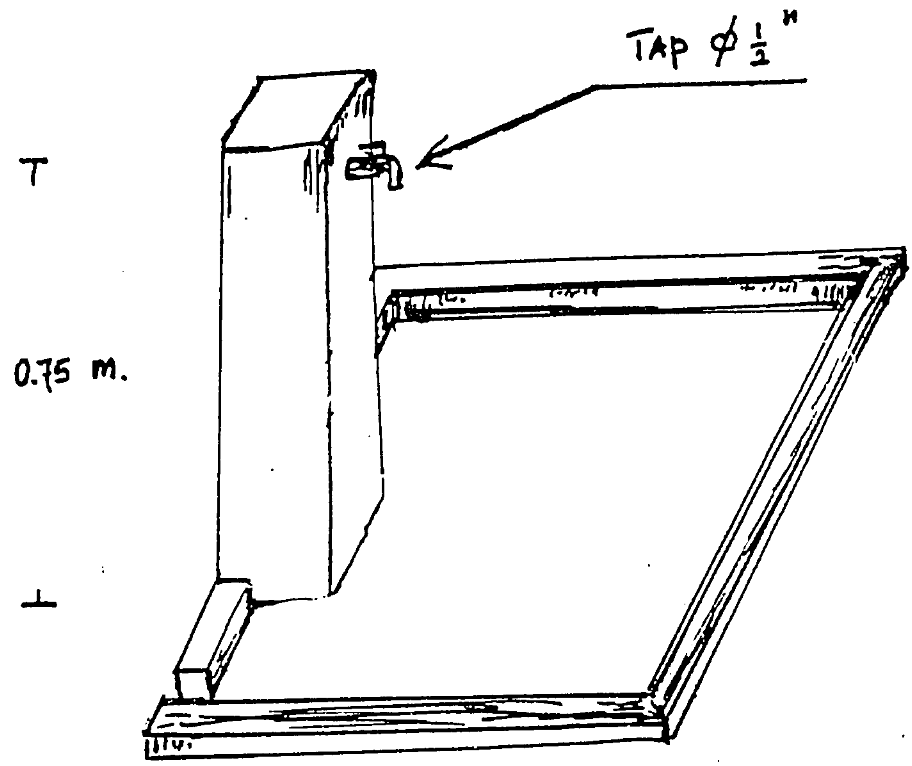


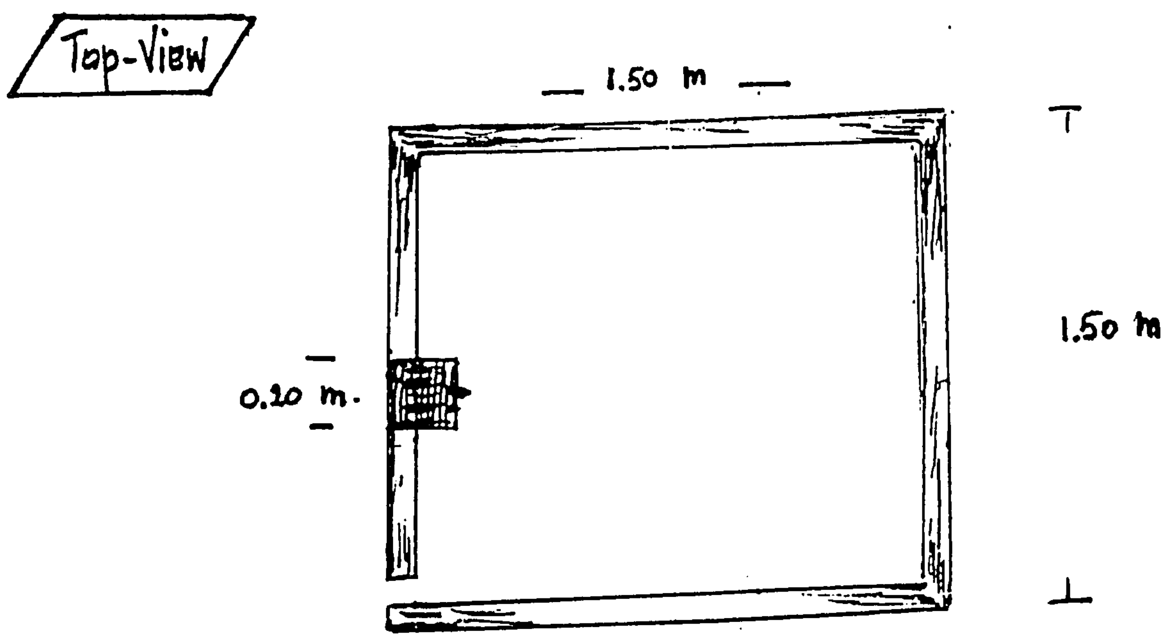
MANDI-CUCI unit

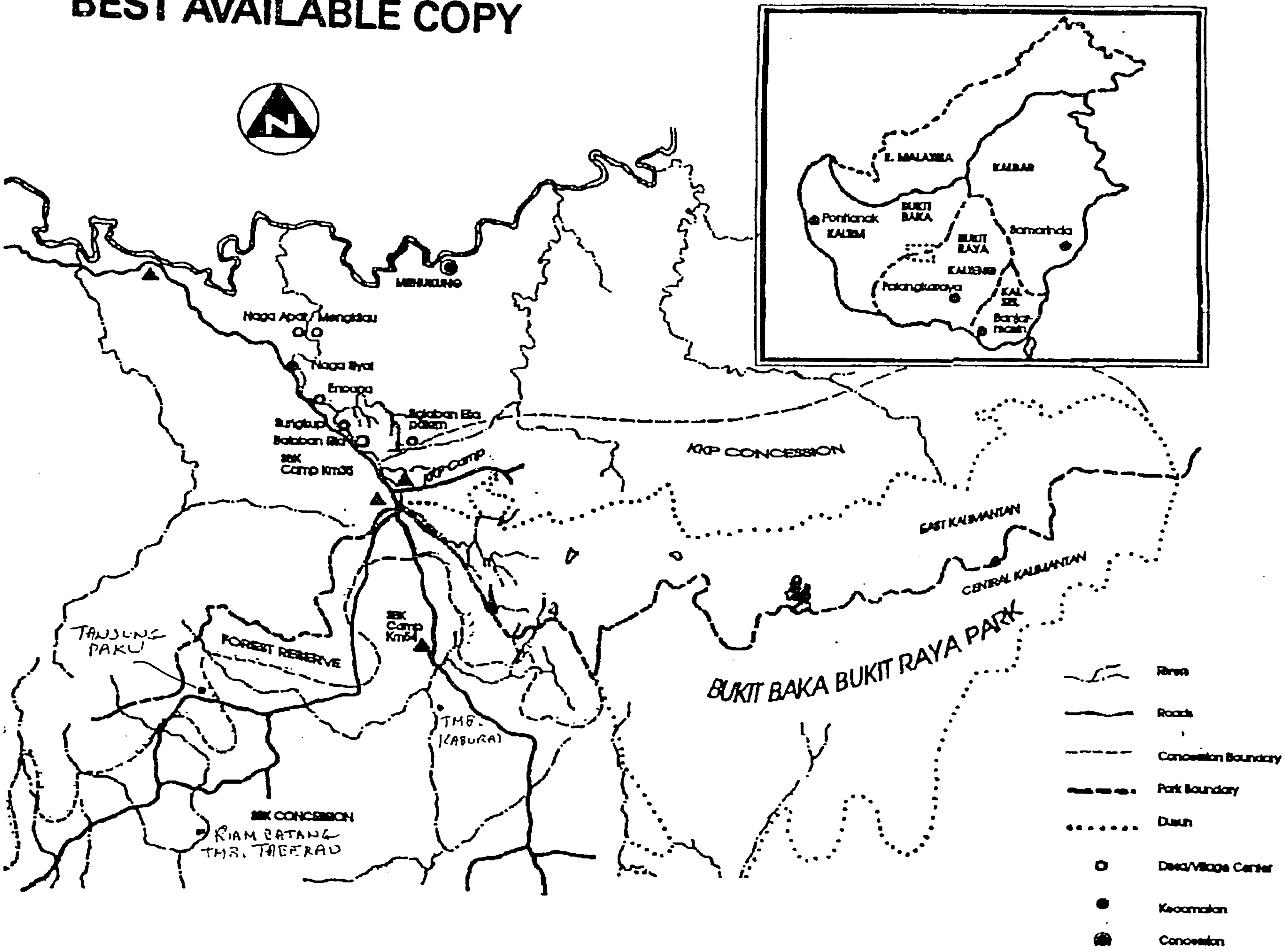




PUBLIC-TAP + SLAB






N
MENUKUNG
Naga Apat
Mengkilau
Naga Siyai
Encopa
Sungkup
Balaban Eba
Balaban Eba pakan
SBK Camp Km35
KKP CONCESSION
EAST KALIMANTAN
CENTRAL KALIMANTAN
TANJUNG PAKU
FOREST RESERVE
SBK Camp Km54
TMB. KABURAI
SBK CONCESSION
RIAM BATANG
THB. TAEERAU
BUKIT BAKA BUKIT RAYA PARK
E. MALAYSIA
KALBAR
BUKIT BAKA
Pontianak
KALBAR
BUKIT RAYA
Samarinda
KALTENG
Palangkaraya
KAL SEL
Banjarmasin
Rivers
Roads
Concession Boundary
Park Boundary
Dusun
Desa/Village Center
Kecamatan
Concession

APPENDIX SIX: EQUIPMENT REQUIRED FOR FOLLOW-ON TRAINING

Assuming that the systems recommended in this feasibility study are funded, the following equipment will need to be procured with USAID funding in order to carry out the remaining training of villagers in the design, construction and maintenance of the community water systems:

For final system surveying, design and layout training:

2 Abney hand levels w/leather cases
2 Measuring Tapes, fiberglass, 50 meters
2 Clipboards for recording data
2 Altimeters w/leather cases
2 Mears Water Flow Calculators
2 Stopwatches
2 Hand Compasses
2 Electronic Calculators (with trigonometric functions)
1 Hatch water quality testing kit

For system construction, operation and maintenance training:

1 GI Pipe Threader Set (incl. 1/2", 3/4", 1", 1-1/4", 1-1/2" taps/dies)
1 Pipe Vise with Stand
2 Hacksaws with sets of spare blades
4 Pipe wrenches (two 24" and two 18")

Finally, in order that construction (especially at the beginning) not be inadvertently held up due to a lack of M&E or tools, a small M&E fund should be made available to the Construction Supervisor so that some materials could be initially purchased directly out of pocket, properly documented by receipts of course. For example, this might include the neck-welded 40 cm 1 inch GI pipes needed for overflow, outlet and washout pipes needed to build the spring catchment tanks, storage tanks, and MCs. This fund need not be any more than Rp. 1 million. It would also cover any small items which may have been inadvertently left off the site by site M&E lists.

APPENDIX SEVEN: BIBLIOGRAPHY AND REFERENCES

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2.	Agroforestry in Bukit Baka/ Bukit Raya	W.G. Granert
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10.	Recommendations for Controlled Timber Harvesting in the SBK Forest Concession	John Hendrison
11.	Cruiser Identifications at SBK and Local Uses of Trees by Local People	Jim Jarvie

agreed that they would provide the necessary labor[27] and local materials (delivered at the construction sites) without any monetary compensation. To assess the concessionaire SBK's position, we had discussions with several levels of SBK staff, including Camp 54 *Bina Desa* program staff, Camp 35 concession managers, the SBK Program Manager in Pontianak, and the Alas Kusuma Forestry Division Manager in Jakarta[28]. While specific details of actual funding levels were not discussed, all SBK staff we met supported the recommendation of this mission that six water systems should be constructed to serve the seven communities given previously in Table Two.

After being shown the cost figures for those systems (totalling about Rp. 30 million, based on Pontianak sourcing), the Pontianak SBK manager agreed to provide all M&E transportation costs. He further said that if USAID were not able to cover the M&E procurement costs, SBK would be willing to cover 50% of the M&E. The Alas Kusuma Forestry Division Manager in Jakarta was not so specific, but voiced enthusiastic support for the proposed activity, saying that specific details could be worked out later. Given SBK's evident commitment to its *bina desa* program, and the GOI mandate for providing this support for all affected communities, it appears quite likely that the proposed water systems will be given priority in SBK's *bina desa* program, and required M&E be funded accordingly. The M&E cost amounts to about Rp. 21,000 per person served, a relatively modest investment for the expected improvement in the general health of community members, and their probable increased productivity.

When asked directly, communities in BB/BR generally balked about contributing any substantial amount of cash for initial system construction. At the current daily wage for laborers of Rp. 3,000 per day, this is understandable. However, it is interesting to note that in other communities where gravity fed water systems have been developed (e.g., Jawa Barat, Jawa Timur, and Nusa Tenggara Barat under the auspices of CARE/Indonesia), villagers who were equally poor not only paid regular water fees (Rp. 100-500 per family per month) for system maintenance and repair, but have also paid in part or entirely (with the assistance of bank loans in some cases) for the installed capital cost of their systems.

For order of magnitude estimates of the likely costs of water supply systems based on the total number of beneficiaries, it costs about US$ 15-20 per person for gravity flow water systems in other

27We specified that the construction would require 8-10 persons per day for as long as it took to complete the systems (approximately 1.5-2 months per site). The current minimum wage in the area is Rp. 3,000 per day. However, as evidenced by the construction activities for the NRMP micro-hydroelectric facility, it may not be that easy to get local people to do heavy labor for this rate.

28Who mentioned that this was a quite promising activity which SBK should have developed themselves for their *bina desa* program.

provinces in Indonesia[29], depending largely upon variables such as:

- the distance to the water source (since pipe is a major portion of M&E cost);

- the size of the community (systems for smaller communities typically cost more per capita);

- the distribution of the community, since multiple storage tanks and extensive secondary distribution greatly increase system cost; and

- local topography and soils, which determine whether or not the main pipeline can be buried. If it can be, cheaper plastic PVC pipe can be used rather than more expensive GI pipe, which need not be buried.

Fortunately, gravity flow piped water systems can be used in all but one of the targeted communities. In addition, spring sources are located relatively near (i.e., less than 2 kilometers) each of those communities. The communities, while relatively small (170-350 members), are nonetheless tightly clustered along river banks, thereby significantly reducing distribution costs. Unfortunately, because of the topography, soils, and vegetation (e.g., large tree roots), the majority of all pipeline runs (except within the village boundaries and through nearby *ladang*) will have to be galvanized iron (GI) pipe, since it would be very difficult to bury PVC there.

Pipes (both GI and PVC) should be sourced independently of the other M&E. While this might appear to be a minor detail, ***it is very important to the sustainability of these systems that medium class GI pipe and VP Class PVC be used.*** In many rural water systems throughout Indonesia, the lowest available quality of pipe is typically used, with consequently low reliability and unnecessarily short system lifetimes. It is penny-wise and pound-foolish to compromise on pipe quality, given its relatively small incremental cost compared to the overall cost of this activity. Since the higher quality pipe specified in the accompanying cost sheets is not easily available in Pontianak, and given economies of scale in procuring pipe for all six systems at once, pipes should be sourced from their manufacturers (Bakri Brothers for the GI, Pralon for the PVC) in Jakarta. All other components can be readily obtained in Pontianak for shipment to the project sites on SBK barges.

A list of certain instruments and tools directly associated with construction training is given in Appendix Six (Equipment Required for Follow-On Training). This equipment will be used for reviewing the initial surveys and possibly determining more convenient pipeline

29According to average cost estimates of system developed by CARE/Indonesia over more than ten years of gravity water system design and installation. These estimates are based on data in the CARE-Assisted Water Survey (CAWS) as provided by Glenn Gibney of CARE/Jakarta. Wherever possible, pumped systems should be avoided due to their high cost and relative complexity.

routes, re-measuring spring yields under the drier conditions we will encounter during the February-May construction period (ending with the June 5th harvest festival), and training villagers on how to cut, thread, and assemble the main pipelines. It is proposed that USAID could pay for this directly out of NRMP training funds. This list also includes the recommended Rp. 1 million fund for buying small lots of M&E on short notice as necessary to allow construction of concrete structures if the main shipment has not yet arrived, and all other preparations have otherwise been completed.

5.2 Operation, Maintenance and Repair Costs

The costs discussed thus far deal primarily with initial training and system construction. Another cost component is the long term recurrent costs of system operation, maintenance, and repair. Gravity flow piped water systems have essentially no operation costs. Maintenance costs are largely for unskilled labor, for tasks such as periodic cleaning of catchment and storage tanks, dealing with minor leaks in pipes and tanks, and clearing the mainline of any accumulated sediment through already installed washouts.

Periodically, other costs will be incurred for things such as larger pipe or tank leaks, valve repairs, and drainage system maintenance. Since a small set of equipment spares will be provided for each system as part of initial procurement, large expenditures are not anticipated for the first 3-5 years of system operation. However, there will inevitably be small labor charges incurred from time to time. To cover these and any minor M&E costs, it is standard procedure to regularly collect a modest amount of money from each family in the community to cover O&M. In other rural water supply projects in Indonesia, this water user fee varies between Rp. 100-500 per family per month. The purpose of this fee is to establish an O&M fund so that any necessary maintenance or repairs will be routinely done in a timely way without having to find funding for them on an ad hoc basis. This is not an onerous amount, since the minimum daily wage paid by SBK or NRMP (such as for the micro-hydroelectric installation) is Rp. 3,000 per day. Water user fees should be jointly managed by the village water committee, established early on as the vehicle for coordinating all community inputs for construction, training, and operation of the water system. The user fee fund could also be used (if desired) for system expansion as the village grows, although the systems have already been designed to accommodate anticipated population growth over the foreseeable future.

The amount of the monthly water user fee as much as possible should be tied to actual anticipated O&M costs for each site. Unfortunately, it is not easy to forecast what these costs will be, since little data exist on gravity system O&M costs in Indonesia or elsewhere. Based on project evaluations of CARE/Indonesia-assisted community water systems in other parts of Indonesia, for well-constructed systems serving 500-2,500 people, Rp. 100-500 per month seems adequate to cover commonly occurring recurrent costs. Since the systems for BB/BR have smaller populations, it is recommended that user fees be chosen at the high end of that range, due to dis-economies of scale for the smaller sites here.

It is not unreasonable to expect communities to pay water user fees. CARE/Indonesia has worked with many very poor communities in West Java, East Java, NTB, and Sulawesi which nonetheless pay in some cases as much as 100% of the **installed** costs of their systems. While this will not be done on this project (since it is anticipated that SBK will cover most or all M&E procurement), beneficiary communities should be required to pay some significant portion of system costs. If people don't pay something significant, they will always expect external assistance for all costs over the lifetime of the system. Apart from construction costs, like many communities in Indonesia, people in nearby cities such as Nanga Pinoh pay for their water system O&M (probably to their local regional water enterprise PDAM[30]), and it is reasonable to expect beneficiary communities on this project to pay all **anticipated** O&M costs for their water systems as well.

It is not necessarily intended that the user fees would cover eventual replacement costs for the systems, although this would be desirable if communities are willing and able to pay that much. Based on the 15 year lifetime, establishing a fund to completely replace a Rp. 5 million system would require a monthly community contribution of Rp. 19,000[31]. Based on an average community size of 250 people and an average family of 5 persons, that means each family would have to contribute Rp. 380 per month just to cover eventual system replacement. These systems are relatively simple, well-designed, and will be well-built if villagers are properly supervised during each phase of construction. Under these conditions, they are expected to last 15-20 years. Anticipated O&M costs, especially in the early years, will likely be very low, but would grow over time as components require repair or replacement due to unavoidable wear and tear.

One further potential cost which should be considered is the possibility of early system replacement due to some catastrophic failure. For example, if a landslide destroys a spring catchment, or if the spring fails due to shifting water tables, it may be quite difficult for the affected community to finance the necessary repairs

30After PW/Cipta Karya designs and supervises the construction of rural water systems (usually by a private contractor), responsibility for operation, maintenance and repair then falls to the interim water enterprise (BPAM) for about five years. BPAM collects user fees which are then indirectly applied to system maintenance. After the first five years or so, O&M responsibility is then turned over the regional water enterprise (PDAM), which collects water fees (at a rate determined by the local Bupati) and uses them in theory to maintain the systems. While PW Cipta Karya is in theory responsible for village water supplies, they are not active in the targeted communities, nor is it likely to be in the near future, based both on their remoteness and small size.

31This is just a representative example based on a 5% real discount rate (i.e., 15% interest net of 10% inflation) for monthly payments made over a fifteen year period.

or system modifications, especially if it is early in the life of the system before any substantial amount of money is accumulated in the water user fee fund. In that case, the community may have to appeal to an external funding source (such as SBK) for immediate but short term assistance in developing a new spring. Other than this, there is no reason that communities should have to rely on any but their own internal resources to maintain their new systems over the long term.

SBK has also expressed interest in having one of its own technical staff accompany the Construction Supervisor during construction of these systems. If that were done, this would provide a readily accessible source of technical assistance should communities have any questions about maintenance, repair, or system expansion needs in the future.

In summary, in order that momentum not be lost, after review of this feasibility report, the NRMP COP and the USAID Project Officer should finalize agreements with SBK on who will pay for each cost component of the project, and proceed apace. The longest delay is likely to occur in M&E procurement and delivery. Given the three and a half month window of opportunity (mid-February through May inclusive) for completing construction, procurement should be initiated as soon as possible. A detailed proposed implementation plan is given in the following section.

5.3 Implementation Plan and Logistics

The implementation plan given on the following page is based on the window of availability of community members for participating in training and construction. While some communities said that they would be willing to make people available at any time, most said that the best time for construction would be after the mid-February to early March rice harvest. It is very unlikely that procurement of materials could be completed any sooner than that anyway.

Once the project is approved, the first step is to get procurement underway. Procurement will be in two parts, pipes and other M&E. Pipes will be ordered directly from the manufacturers in Jakarta. All other materials can be procured directly in Pontianak or Nanga Pinoh. The M&E list (minus PVC and GI pipes) should be tendered to two or more suppliers, one in Nanga Pinoh[32], and at least one in Pontianak. Much of the non-pipe M&E can probably most easily be obtained through SBK's existing procurement channels. This is also being done for much of the non-mechanical or electrical M&E for the micro-hydroelectric project being built by the ARD/NRMP for the Agency for Forest Research and Development's Training and Research Station at the Bukit Baka/Bukit Raya. The ease and timeliness with

32Through SBK's supplier there, Pa Adjus, who has an admirably well-stocked equipment store there, which was nearly underwater (along with the rest of Nanga Pinoh) the last time we were there.

which this procurement proceeds will determine whether or not to procure this project's M&E through SBK or directly through the selected vendor.

After procurement is underway, the Construction Supervisor will return to BB/BR to begin organizing the targeted communities to collect and transport the needed local materials (sand, gravel and rock) to the construction sites. The Construction Supervisor will work with all six communities to get local materials processing well underway before any construction is started. The Consulting Water Engineer will arrive about one week later to spend two weeks assisting with construction preparations, survey revisions (see below) and initiation of construction.

Construction of the concrete structures can begin as soon as the local materials, cement, and required fittings are on site. While waiting for them, the Construction Supervisor will work with community members to recheck spring yields, and resurvey pipeline routes both to check critical elevations (such as Tanjung Paku) and to see if better routes can be identified.

Concurrent construction at several sites is the only way to complete the systems within the available window of opportunity. So that every system can be properly supervised throughout construction, a second experienced Indonesian water technician will be used. That way, the Construction Supervisor and his assistant will each be primarily responsible for three systems each, and will support each other's systems as time permits. The sanitation and hygiene education, particularly focused on the women in the community, will begin after construction is well underway. The two health educators will work together or individually, as they deem fit. They will deliver pre-packaged sanitation and hygiene education modules (such as those developed by CARE/Indonesia over the last five years) in each of the beneficiary communities. This training may extend beyond the completion of construction, depending upon villagers' availability and actual implementation. The health workers would provide about 4 weeks of training in each community.

As the concrete structures are completed at each site, if pipes have not yet arrived, the Construction Supervisor and his assistant will move on to the next village and begin construction of concrete structures there. If the pipe has arrived, the first systems will be completed before moving on to the next village. Depending upon the aptitude with which village construction crews develop their skills, it may not be necessary for the supervisors to be on site the entire time. If not, they can proceed to the next site to begin mobilization of local materials and construction as they see fit. In this way, at least two sites will be active at any given time. More likely, all sites will be active, since villagers can be transporting local materials to the sites and doing basic civil works preparation without the constant presence of the construction supervisors. After the first four of the six systems are complete or nearly complete, the Consulting Water Engineer will return for a three week visit to

monitor project progress, inspect completed construction, assist as necessary with completion of the last two systems, and monitor the progress of the sanitation and hygiene education effort.
Since it is always best to start with the easiest sites to gain experience and self-confidence, start with Belaban Ella in Kal-bar first. It is a small system, without any major obstacles, conveniently located on the main logging road, and so can be completed quickly. Community members from neighboring Sungkup should be encouraged to participate in the Belaban Ella construction, so they will be that much more skilled when their own system is constructed. Similarly, villagers from Belaban Ella should be encouraged to use their newly acquired skills to help with the Sungkup system. If possible, the same arrangement should be worked out with the next town down river, Nanga Siyai.

Higher up in Kal-teng, the system at Tanjung Paku will be the easiest to build, so it should be first. Since none of the communities in Kal-teng are very close to each other[33], it would be logistically difficult to get more than one or two experienced villagers from previous sites to help with the next site. After Tanjung Paku, Tumbang Kaburai (ten minutes by vehicle plus one hour's walk from Camp 54) is the next easiest site. The joint system for Riam Batang and Tumbang Taberau should be last.

When M&E is being transported from Popai to each individual site, it is important to take inventory at each step along the way to make certain that all items are accounted for and suitably stored (if the cement inadvertently gets wet, it will become useless). From Popai to (anticipated) temporary storage at Camp 35, the Construction Supervisor should be responsible for this task. At the individual sites, village water committees or one of the village leaders (*kepala desa* or *kepala adat*) must assume responsibility for M&E safekeeping prior to installation.

33Except Riam Batang and Tumbang Taberau, which will share the same system.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Seven of the eight communities visited during this mission have good potential for developing low-cost, improved water systems to increase the quality, accessibility and reliability of the communities' water supply.

Because of the potential health benefits to beneficiary communities, and the potential goodwill accruing to both SBK and the NRMP from this high profile (yet relatively low cost) activity, all six gravity flow piped water systems surveyed, designed and costed during this mission should be constructed. The three major parties involved have agreed in principle to provide the necessary inputs to construct, operate and maintain the systems over the long term. Communities have agreed to provide all required unskilled labor for construction and transportation of materials and equipment from the nearest drop off point to the construction sites, and will also provide all local materials needed for the concrete structures. SBK has agreed in principle in to provide all transportation of procured M&E to the project area, as well as covering the cost of an as yet undecided percentage of all M&E costs. USAID has agreed in principle to cover all skilled labor costs for the engineering consultant, two water technicians to supervise construction and provide training, and two sanitation and hygiene specialists to train the communities.

Negotiations should take place as soon as possible between USAID, ARD/NRMP staff, and SBK to make a final determination of the proportion of M&E costs covered by the parties. Once that has been decided, the M&E lists given in Appendix Four should be put out for tender (if necessary). Everything except for the GI and PVC pipes should be bought in either Pontianak or Nanga Pinoh. The pipes should be sourced directly from manufacturers in Jakarta **to make sure that the specified quality of pipe is procured.**

The Indonesian Rural Water Supply Specialist used on this feasibility mission should be retained as Chief Construction Supervisor for all of these systems. A second local water technician should be retained to assist the Construction Supervisor, so that several systems can be built simultaneously under proper supervision. Two experienced sanitation and hygiene educators should be identified and retained to train villagers about the linkages between water supply, improved sanitation and hygiene practices, and improved health. The expatriate Rural Water Supply Specialist should participate in initiation of construction, and monitoring and inspection of systems as they are completed.

All communities where systems were designed actively participated in spring identification, testing, and pipelines profile surveys. This, coupled with the apparent tradition of people in the area to do what they agree to do, lent credence to their expressed willingness to provide their requisite inputs to the project.

The recommendations of this mission were verbally supported by staff at every level of SBK with whom we met, from the *Bina Desa* Program Manager in Camp 54, through the Concession Manager at Camp 35, through the Project Manager in Pontianak, to the Alas Kusuma Forest Division Manager in Jakarta. They clearly recognized the potential goodwill earned by SBK through support for these systems, and the valuable role this activity would play in their overall *bina desa* program.

All NRMP staff, local and expatriate, also voiced support for this activity both as a way of further assisting the communities they work with, and as a means of demonstrating their long term commitment to those communities. This will likely result in improved community willingness to participate in other NRMP project activities.

While this is not the recommended option, if sufficient funds are not available to fund the construction of all six of the systems serving seven of the eight candidate communities, then the following four communities are recommended as the best sites for demonstration projects:

- From Kal-bar, use Belaban Ella and Sungkup;

- From Kal-teng, use Tumbang Kaburai and Riam Batang/Tumbang Taberau.

However many systems are funded, it is strongly recommended that they be built with the active participation and cooperation of the beneficiary communities. Under no circumstances should local private contractors be used. if that were done, the systems will not be sustainable.

After construction, the operation of the systems should be periodically monitored by the project. During occasional system inspections of the entire system, from spring catchment to the lowest tap, any problems will become readily apparent to one of the NRMP staff. Depending upon the success of this activity, USAID and MoFr should consider whether they might want to follow up further by promoting this *bina desa*-based water supply improvement approach to other forest concessionaires in other areas. Water supply is one area in which a relatively small investment can achieve significant returns in terms of improvements in both health (hence productivity) and goodwill in communities adversely affected by logging and other economic development activities[34].

34Along with experience gained in this activity, useful lessons have also been learned about community-managed water systems by other donor agencies and NGOs in Indonesia (especially CARE/International) which could be usefully applied to future development activities in this sector.

APPENDIX ONE: CONSULTANT TERMS OF REFERENCE

1. Background

Under the USAID-assisted Natural Resources Management (NRM) Project, a team of advisors has been assigned to do work in the Bukit Baka/Bukit Raya National Park carrying out activities under the NRM implementation Plan. This includes a Forestry Management Advisor and a Social Forestry Advisor. As the project moves forward with the implementation of field activities, an urgent need has been identified for technical assistance in the area of community water supply system development in the villages surrounding the Bukit Baka/Bukit Raya National Park.

This assistance would be undertaken in two phases. In Phase One, the consultants will survey the potable water supply for the individual villages, and develop a feasibility study (including preliminary designs and cost estimates) for the required systems, The second phase will focus on detailed system planning, resource mobilization, construction, and operation and maintenance training. The actual implementation of this second phase will depend upon the findings of the first phase.

2. Major Tasks

The major tasks to be completed during Phase One of this technical assistance activity include:

a. Identify communities requiring assistance and assess their currently used water supplies. Determine constraints and opportunities for system rehabilitation, expansion, or replacement, including:

   - estimation of demand levels;

   - assessment of the water resource (for quantity, accessibility, seasonal and long term reliability, and water quality);

   - determination of the type of system required (probably gravity flow, possibly supplemented with handpumps and/or hydraulic rams as appropriate);

   - determination of distribution and storage requirements.

b. For each beneficiary village, determine the approximate cost of the recommended system and the ability of the villages to finance their water supply systems. If adequate financing is not available, identify other possible sources of funding.

c. Work with LKMD and Kepala/Desa/Dusun to assess the community's organizational capability, determine what training requirements exists, and develop a community-focused training program (to be implemented in Phase Two) to cover the areas of:

- community organization for water supply operations and maintenance;
- resource mobilization (cash, materials, labor);
- system design and construction;
- operation, maintenance, and repair; and
- financial management of anticipated systems expenses and, if feasible, of water user fees.

d. On the basis of the above, develop preliminary designs and estimated costs for water supply systems for the targeted villages. Explicitly identify the amount and source of funding (including any available government funds) required for each major component, including:

- equipment, materials, and labor (skilled and unskilled), training, transportation and associated logistical support for detailed design and construction;
- spare parts and materials, and training for operation, maintenance, repair, and financial management.

e. To help insure the sustainability of these systems, after assessing the institutional context of the water supply systems in the targeted villages, identify probable support requirements which may have to be met from outside the immediate community (for example, major pipeline washouts and severe source degradation to the point where another source will have to be developed). Identify organizations (government departments such as Cipta Karya, NGOs, or local national private contractors) which may be available to provide the villages with the necessary technical support, and determine how such services will be paid for.

f. Draft a report on the findings of the Phase One activities, including recommendations on (1) whether to proceed with the Phase Two activities, and (2) if to proceed, how to do this.

3. Outputs

Major outputs will be:

a. A report summarizing the findings of Phase One activities with recommendations on the appropriateness of Phase Two. This will be submitted to the Government of Indonesia and USAID before the consultants complete their assignment.

b. An outline of the Training Program under (2C).

4. **Level of Effort**

A team of consultants, one an international specialist on community-based village water supply systems and a local engineer.

Qualifications

These two consultants should have the following qualifications:

Team Leader/Community Water Supply Specialist

a. A degree in engineering or a related field;

b. Experience in community-based water supply systems, including the engineering financial and institutional aspects of community water supply; and

c. Working experience in Southeast Asia, and preferably Indonesia.

Local Engineer

a. A degree in engineering or a related field;

b. Extensive experience in Indonesia in system design, costing, and construction supervision of village water supply;

c. Experience working with village-level communities in Indonesia;

d. Fluent in Bahasa Indonesia and good oral and written English.

5. **Roles and Responsibilities**

The consultant will report to the NRM/ARD Chief of Party liaising with the Government of Indonesia counterparts in Jakarta, Pontianak, and Bukit Baka. In Bukit Baka, he will work closely with the NRM/ARD Forestry Management Advisor and Nature Conservation Advisor.

6. **Duration**

Six weeks.

APPENDIX TWO: COMMUNITY DESCRIPTIONS

While all of the target communities in Kal-bar were participants in SBK's *bina desa* program for either irrigated or non-irrigated agriculture, only Tanjung Paku in Kal-teng had received any assistance at this time, and that was for non-irrigated rice production. All of the sites have certain characteristics in common. Average education levels are typically low, but nearly all communities have a school[1], and in some cases one or more teachers' salaries are provided by SBK's *Bina Desa* program. Few if any of the communities have ever been visited by a doctor, and only traditional medicines are used by villagers. There are SBK paramedics in camps at Km. 72 and 93, but these are largely for SBK staff. Government presence is subtle, and village health posts (posyandu) exist only on paper, as do LKMD and PKK. Local village government is a mix between traditional (*adat*) law and current civil law, with some villages led by a *kepala adat*, and others more strongly influenced by a *kepala desa* or a *kepala dusun*.

Other than the occasional generator (one in Tumbang Taberau - along with a satellite dish and TV supplied by the government - and another in Nanga Siyai), none of the communities has power. Income is typically generated through the sale of timber and non-timber forest products, wage labor, and the sale of *ladang* crops such as rice and vegetables and other food (large pigs for Rp. 15,000), especially to the nearby logging camps. Rice is the staple food, and animal protein is supplied by hunting (wild pigs and deer), fishing, and raising pigs, chickens, and an occasional goat.

Water and sanitation conditions are generally primitive, with no improved water systems or improved latrines (other than straight pipe outhouses floating on the rivers) in evidence in any of the communities. Water is taken from the main river or a small but usually clearer nearby stream. Water collection points, *cuci/mandi* and defecation sites are mixed (some upstream of water points). People are generally poor, but appear to have plenty to eat. Skin diseases are common (especially among small children), no doubt in part due to the primitive sanitation conditions.

A significant amount of community income in Kal-bar comes from employment with the forest concessionaire SBK. Most of the remainder comes from sales of rice crops and non-timber forest products.

Sites in Kal-bar

Belaban Ella

Like all of the prospective sites in Kal-bar, Belaban Ella is situated well out of the forest on the main logging road at Km. 25. There are two nearby communities, Belaban Dalam and Sungkup. The small village of Belaban Dalam is 3 km up the Belaban River from

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1Although Sungkup's school/church is now only used for a church since the *dusun* has been absorbed in Belaban Ella, where the children from Sungkup now go to school.

Belaban Ella. There are a total of 531 people in the three villages, with about 270 people in Belaban Ella, 190 in Sungkup, and 70 in Belaban Dalam. The people in Belaban Ella get their water almost exclusively from the Ella River, along which the village houses are largely placed. There are also two creeks coming down from the hills west across the main logging road. These creeks combine into Ransa Creek, which flows into the Ella River just above Belaban Ella. According to local informants, the two creeks originate in springs in the hills. One is partially diverted into a small fishpond near the logging road. One of the creeks did indeed have a spring, which we measured and surveyed for use as a drinking water source. Like most of the villages in Kal-bar, most of the houses are down the hill near the river. There are a few buildings (a small store, a military building, and several other small buildings, but no houses) right on the logging road. Since the storage tank and MC will be sited near the road, this may influence people to build houses up in that area in the future. NRMP activities here include dusun-based fire prevention and control, agroforestry and soil conservation, home garden improvement, and community development work. Belaban Ella is also one of the major target communities for national park support activities.

Sungkup

Sungkup is a small community just off the main SBK road at Km. 24, five minutes walk down the hill from the road, and about 500 meters downstream (northwest) of Belaban Ella. It consists of about 20 houses, a long house, and a church, and contains about 190 people. The only water source used by the community is the Ella River. There is an excellent triple spring located some 1.2 km up into the hills to the West of the village which we measured and surveyed for use as the water system source. Like Belaban Ella, the main storage tank will be situated on top of the hill near the logging road to provide pressure for the water system, and this may influence people to start building houses nearby. NRMP activities here include dusun-based fire prevention and control, agroforestry and soil conservation, home garden improvement, community development work, and environmental awareness.

Nanga Siyai

Situated a 20 minute walk off the main SBK logging road at Km. 17, Nanga Siyai is the *desa* which includes the *dusuns* of Belaban Ella, Sungkup (now formally subsumed under Belaban Ella), Belaban Dalam (situated in the KKP instead of the SBK concession and so not considered for this project), and Nanga Landau Mumbung. As such, Nanga Siyai has been the focus of several development efforts, the most significant of which is the irrigated rice farming area developed for the community by SBK.

During an initial visit to Nanga Siyai and meeting with official village leaders, we were somewhat discouraged by the lack of priority they placed upon improved water supplies. Village officials differed considerably in the importance they assigned to various development priorities such as agricultural development (rice production in particular), schools, and farm to market road access. During a subsequent visit with the *Kepala Adat*, we got a much more positive response, leading to identifying a spring source and then surveying the proposed pipeline route. Nanga Siyai has about 20 houses and a large long house, with a total population of 252 people. There is a *desa kantor*, and nominally a PKK and posyandu, but neither was obviously active.

NRMP activities here include fire prevention and control, national park support activities, environmental awareness, and *adat* council support activities..

Nanga Apat

Nanga Apat is reached by boat after a half hour walk through alang-alang grasslands along the main logging road at Km. 12. The boat ride takes about half an hour. The village is clearly less prosperous than most of the other visited, with the possible exception of Tumbang Kaburai. The total population is 149, all of whom live very near the river. The entire town is about 200 meters long, and contains a small church.

Nanga Apat is the only site we visited where we were unable to locate a suitable groundwater source after extensive discussions with villages, and some looking around ourselves. Further discussions should be held with village leadership and efforts made to check out other possible groundwater sources, such as hand dug wells. At this time, no system will be installed here due to the apparent lack of a suitable nearby spring. NRMP activities here include agroforestry and soil conservation, and dusun-based fire prevention and control.

Sites in Kal-teng

Unlike the villages in Kal-bar which are largely located in the rolling hills and alang-alang areas below the park, all of the candidate sites in Kal-teng were in heavily forested and more mountainous areas. They were in general more remote and so harder to get to than the Kal-bar communities, although not greatly so. Several of the communities derive income from crop production (mostly vegetables, but also forest animals such as wild pigs and deer) and sales to the nearby logging camps.

Tumbang Kaburai

Tumbang Kaburai is the nearest village to the NRMP office at Km. 54. It is a ten minute ride and then a 45 walk through the jungle to the village. There is a small school, and three teachers (one funded by SBK's *Bina Desa* efforts), all of whom are men. It appears to be the poorest village we visited, but its income is increasing in part due to sales of food crops to the nearby forestry camp. Total population is 171 people. NRMP activities here include national park support activities, agroforestry, and socioeconomic surveys.

Tanjung Paku

This village, located a five minute ride or 10 minute walk down a dry weather road from Km. 75 of the main logging road has been designated as the headquarters for the SBK *Bina Desa* Program. As such, SBK has built several new office buildings just outside the village, and also supplies four teachers for the local school, grades one through six. After that, village children have to go to the *kecamatan* (some six hours away) to continue their schooling. Unlike most communities we visited, one of the teachers was a woman (funded by SBK) who teaches first and second grade. Given that the thrust of the project is not really a water and sanitation project, it might be good to provide these teachers with suitable hygiene education materials.

The village is easily accessible from the main logging road by a 1.2 km secondary access road. It has a training center for craftsmen (carpenters, rattan furniture makers, agricultural and forestry extension). People get their income from selling ladang crops (rice, corn, and other vegetables). They also harvest and sell cut lumber. NRMP activities here include socioeconomic studies, agroforestry, and non-timber forest product assessment.

We found and measured the output of three candidate springs. The first was near some ladang 200 meters up the hill from the logging road and 1.5 km from the middle of Tanjung Paku. The spring debit was 0.35 ls/sec or 2.5 m^3/day, but the village required 23 m^3/day. The second spring we found was 2 km from the village, and had a debit of 0.17 ls/sec, or 15 m^3/day, which was more than ample for the design water requirement. However, after conducting a survey, we found that there was insufficient head to drive the system. We then found, measured, and surveyed a third spring which was found to be more than sufficient.

Riam Batang and Tumbang Taberau

Riam Batang and Tumbang Taberau are side by side communities which are about 2 hours walk (or a one hour boat ride in, 1-1/2 hours out) from the main logging road at Km. 83. Riam Batang/Tumbang Taberau were unusual compared to the other communities visited in that they did use floating outhouses (like other communities we passed along the Melawi River between Popai, Nanga Pinoh, and Sintang) which served both as defecation sites as well as water collection points.

Suitable springs chosen for development in RB/TB are located in a non-irrigated ladang area about 1.2 km from the north edge of town. If this system is constructed, farmers must be strongly cautioned not to use any pesticides or fertilizers which might contaminate their spring catchment. NRMP activities thus far include socioeconomic studies, and botanical taxonomic surveys, and non-timber forest product assessment. Future activities include agroforestry.

APPENDIX THREE: SCHEDULE OF MISSION ACTIVITIES

November

7/8 (Sat/Sun): Travel to Jakarta.

9 (Mon): Meetings with NRMP staff and USAID. Review NRMP reports.

10 (Tue): Meet with CARE/Indonesia, UNDP/World Bank to identify mission counterparts.

11 (Wed): Meet with consulting firms to identify counterpart. TOR to CARE in Ujungpandang. Visit CARE, meet w/prospective counterparts. Questions memo to USAID.

12 (Thu): Logistics briefing at NRMP. Make travel arrangements for Pontianak. Visit Hunting Technical Services for BB/BR maps.

13 (Fri): Memo to NRMP COP on counterpart options. Meet w/M. Ngo on social issues. Tickets/money/pack for Pontianak departure.

14 (Sat): Depart for Pontianak. Meet NRMP Pontianak Coordinator. Get clearances and make arrangements for travel to BB/BR 11/15.

15 (Sun): Depart for BB/BR Km. 35 via Sintang, Nanga Pinoh, and Popai.

16 (Mon): Travel to Camp Km. 54 and meet with NRMP staff. Visit planned hydroelectric site. Read project progress reports and NRMP annual report.

17 (Tue): Review NRMP consultant technical reports. Begin writing feasibility report.

18 (Wed): Meet with SBK *Bina Desa* Program staff. Visit Belaban Ella site to meet w/community leaders.

19 (Thu): Visit Belaban Ella again, Sungkup site, and Demplot.

20 (Fri): Meet w/NRMP staff to get briefed on prospective WS&S site choices. Visit Tumbang Kaburai. Write up village visits.

21 (Sat): Counterpart water technician arrives at Km. 54. Drive to Tanjung Paku for interviews, source identification and test spring yield.

22 (Sun): Drive to Tanjung Paku, survey proposed pipeline route from spring #1 to village.

23 (Mon): Walk to Tumbang Kaburai and survey proposed pipeline route from main spring. Continue feasibility report write-up.

24 (Tue): Survey proposed pipeline route from spring #2 to river at Tanjung Paku.

25 (Wed): Drive/walk to Riam Batang and Tumbang Kaberau, interview community leaders and identify candidate water sources.

26 (Thu): Test yields and shoot survey for RB/TK springs #1 and #2. Return to Km. 54 from RB/TK in river canoe. Review draft NRMP environmental impact assessment report.

27 (Fri): Visit Nanga Siyai to arrange meeting and spring testing. Survey spring #1 at Belaban Ella site. Move down to Km. 35 for remainder of stay in BB/BR.

28 (Sat): Travel to Nanga Apat and interview community leaders and do site assessment. Return to Sungkup to arrange 11/30 survey.

29 (Sun): Survey main spring at Sungkup. Discuss WS&S project costs and logistics with SBK staff at Km. 35.

30 (Mon): Revisit Nanga Siyai to meet Kepala Desa/Adat and discuss community WS&S project interest. Schedule survey for 12/1.

<u>**December**</u>

1 (Tue): Heavy rains, so rescheduled Nanga Siyai survey for 12/2. Work on feasibility report.

2 (Wed): Nanga Siyai survey and final discussions w/community.

3 (Thu): Review system designs, assemble cost estimates, continue work on feasibility report, debrief w/SBK Camp and BD staff.

4 (Fri): Depart BB/BR for Nanga Pinoh and travel to Pontianak. Set up meetings with SBK/Pontianak and Litbang/Pontianak.

5 (Sat): Pontianak, brief Litbang BB/BR Project Manager and other Litbang counterpart staff on mission results, report writing.

6 (Sun): Pontianak, report writing.

7 (Mon): Pontianak, brief SBK/Pontianak senior managers on mission results, meet with Kanwil forestry manager.

8 (Tue): Pontianak, report writing, check around on existing NGO WS&S capabilities, update community WS&S Quattro cost sheets.

9 (Wed): Depart Pontianak for Jakarta. Report writing.

10 (Thu): Debrief NRMP COP and other project staff on mission findings and recommendations. Meet with SBK/Jakarta. Revise executive summary for distribution at Friday briefing.

11 (Fri): Main debriefing w/NRMP and USAID in Jakarta.

12 (Sat): Work on report, system drawings, and cost revisions.

13 (Sun): Off

14 (Mon): Draft report to NRMP staff for review and comment. Write up expense report.

15 (Tue): Discuss comments w/NRMP staff, make revisions. Finalize travel arrangements. Do expense reports.

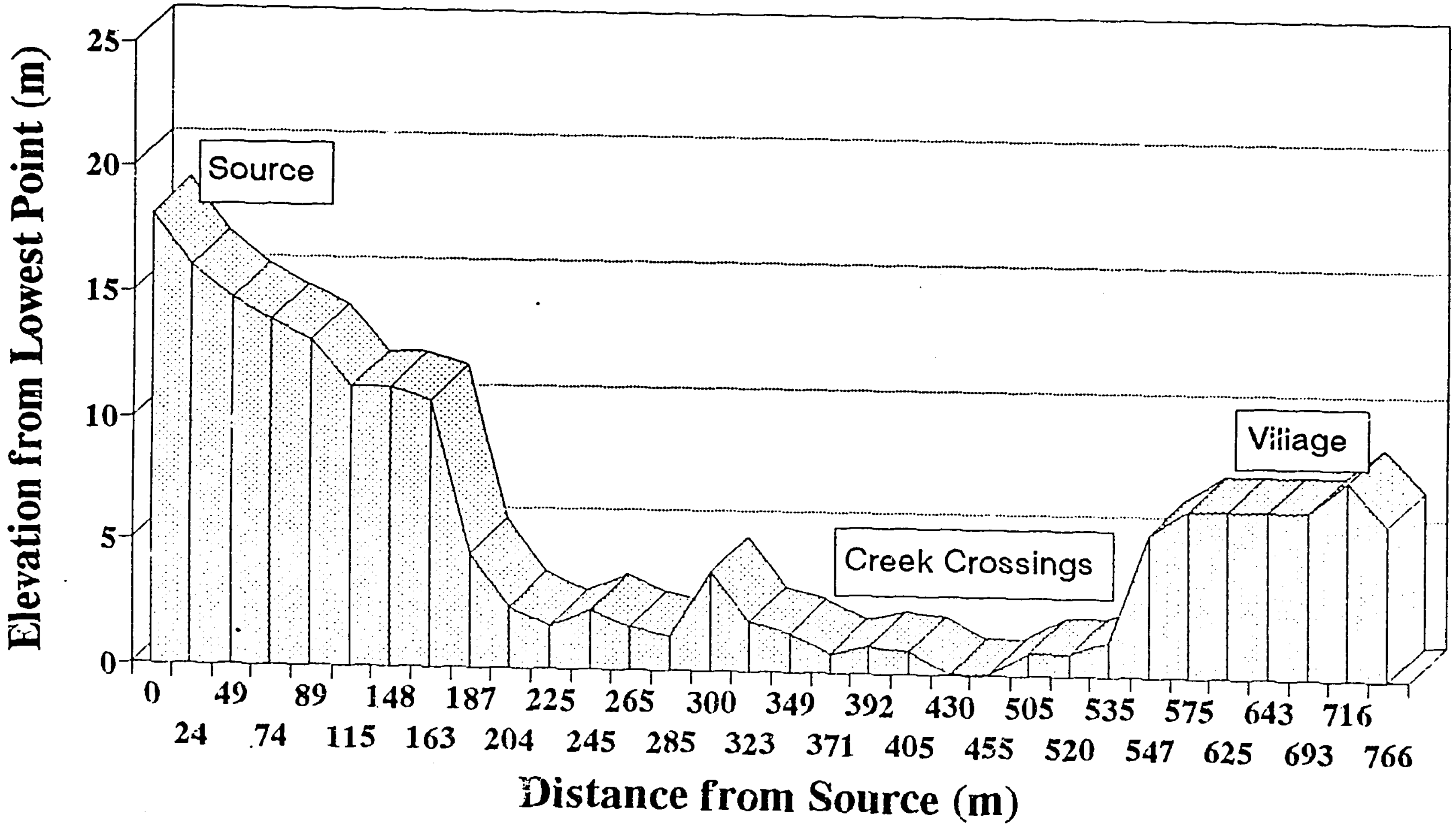
16 (Wed): Complete and submit draft final report to NRMP and USAID/Jakarta.

17 (Thu): Depart Jakarta.

APPENDIX FOUR: SURVEYS, PIPELINE PROFILES, M&E LISTS AND LAYOUTS

A. TUMBANG KABURAI

Tumbang Kaburai Water System
Main Pipeline Profile



Tumbang Kaburai - Pipeline Survey

Station Number	Angle (degrees)	Distance (meters)	Elevation Diff. (m)	Accum. Elevation	Accum. Distance	Top Down	Remarks
0	0	0	0	0	0	18.1	
1	5	24	2.1	2.1	24	16.0	
2	3	25	1.3	3.4	49	14.7	
3	2	25	0.9	4.3	74	13.8	
4	3	15	0.8	5.1	89	13.1	
5	4	26	1.8	6.9	115	11.2	
6	0	33	0.0	6.9	148	11.2	
7	2	15	0.5	7.4	163	10.7	
8	15	24	6.2	13.6	187	4.5	
9	7	17	2.1	15.7	204	2.4	
10	2	21	0.7	16.4	225	1.7	
11	-2	20	-0.7	15.7	245	2.4	
12	2	20	0.7	16.4	265	1.7	
13	1	20	0.3	16.8	285	1.4	
14	-10	15	-2.6	14.2	300	4.0	
15	5	23	2.0	16.2	323	2.0	Need air release valve
16	1	26	0.5	16.6	349	1.5	
17	2	22	0.8	17.4	371	0.7	
18	-1	21	-0.4	17.0	392	1.1	
19	1	13	0.2	17.2	405	0.9	Creek crossing #1
20	2	25	0.9	18.1	430	0.0	
21	0	25	0.0	18.1	455	0.0	Creek crossing #2
22	-1	50	-0.9	17.2	505	0.9	
23	0	15	0.0	17.2	520	0.9	
24	-2	15	-0.5	16.7	535	1.4	Creek crossing #3
25	-21	12	-4.3	12.4	547	5.7	
26	-2	28	-1.0	11.4	575	6.7	
27	0	50	0.0	11.4	625	6.7	Inside village (PVC)
28	0	18	0.0	11.4	643	6.7	
29	0	50	0.0	11.4	693	6.7	
30	-3	23	-1.2	10.2	716	7.9	
31	2	50	1.7	12.0	766	6.1	

From station 0 to station 27, use GI pipe due to difficulty in burying pipe.

From station 27 through 31 (inside village boundary), use buried PVC.

Total length of GI Pipe=	575	meters, so	96	lengths of 6 meter pipe
Total Length of PVC Pipe	191	meters, so	48	lengths of 4 meter pipe

System No. 1	Tumbang Kabural	Present Population:	190
Kecamatan:	Seruyan Hulu	Design Population:	268
Kabupaten:	Kotawaringun Timur	Spring Yield (ls/sec)	0.23
Province:	Kalimantan Tengah	10-Dec-92	

System Summary: Single spring catchment, 766 meter pipeline consisting of 575 meters of GI pipe and 191 meters PVC, one storage tank plus MC, a second MC, and one separate public tap.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank (one unit)			
33	Bags of Cement	6,850	226,050
10	Stems of Rebar, 12 m x 8 mm	4,000	40,000
2	Kg. Rebar Wire	2,500	5,000
1	Kg. Nails 5-7 cm.	1,750	1,750
6	Pcs. Wooden Planks for Forms	1,000	6,000
10	Meters Plastic Sheet	1,500	15,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for Outlet, 1" Kitz brand	16,500	16,500
1	GI Knee for Overflow, 1"	750	750
1	GI Cap/Dop for Washout, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe Brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 337,050
B. Main Pipeline (625 meters in length)			
106	GI Pipe, 1" x 6 m, Medium Class	21,000	2,226,000
10	Pcs. GI Union, 1"	1,750	17,500
5	Pcs. GI Elbow/Bocht, 1" for sharp bends	1,500	7,500
2	Pcs. GI Tee, 1" for washouts (2)	900	1,800
2	Pcs. GI Plug, 1" for washouts (2)	500	1,000
1	Pc. GI Reducing Tee, 1" to 1/2" for air valve	1,000	1,000
1	Air Release Valve, 1/2"	20,000	20,000
1	Pcs. GI Double Nipple, 1/2"	400	400
1	Pcs. GI Reducing Socket, 3/4"x1/2" (AV)	700	700
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set Anchors & lockbar for valve box	5,000	5,000
50	Stems PVC Pipe, 1", Pralon VP Class	8,800	440,000
12	Stems PVC Pipe, 1/2", Pralon VP Class	5,000	60,000
3	Pcs. PVC Valve Sockets, 1" for GI/PVC switch and on storage tank inlet/outlet to MC.	3,250	9,750
1	Kg. Solvent Cement, Pralon, No.73	32,500	32,500
15	Bags of Cement for Concrete Pillars supporting/holding the main pipeline	6,850	102,750
4	Stems rebar, 12 m x 8 mm	4,000	16,000
2	Sets Galvanized Iron Cable for suspending pipe runs over creeks/dips	10,000	20,000
5	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	10,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 3,003,400

C. Water Storage Tank (12 cubic meters) w/one attached MC			TUMBANG KABU
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Forms	1,000	40,000
20	Wooden Lumber for Forms	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for overflow, washout, and outlet to MC pipes	4,000	12,000
4	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for MC taps and outlet to public tap	2,500	10,000
5	Pcs. GI Knee, 1" for in/outlet/overflow pipes	750	3,750
2	Pcs. GI Cap/Dop, 1" for washout/unused out!	500	1,000
2	Pcs. GI Knee, 1/2" for public tap outlet	400	800
3	Pcs. GI Elbow/Bocht, 1/2" for MC taps	750	2,250
3	Ball Valves, Kitz brand, 1/2" for MC taps	14,000	42,000
1	Gate Valve, 1", Kitz brand	16,500	16,500
2	Set achors and lockbar for manhole/valve bo	5,000	10,000
2	Padlock, Globe brand	1,500	3,000
0.25	Kg. Pipe Paint, black	5,000	1,250

Subtotal = Rp. 913,050

D. Mandi/Cuci (1 MCs, with M/F sides, stand-alone)			
21	Bags of Cement	6,850	143,850
3	Stems Rebar, 12 m x 8 mm	4,000	12,000
1	Kg. Rebar Wire	2,500	2,500
2	Kg. Nails, 5-7 cm	1,750	3,500
20	Pcs. Wooden Planks for Formwork	1,000	20,000
5	Pcs. Wooden Lumber for Formwork	1,000	5,000
1	Stems PVC Pipe, 1" Pralon VP Class for inlet	8,800	8,800
1	Stems PVC Pipe, 1/2" Pralon VP Class for inl	5,000	5,000
1	Pc. PVC Elbow, 1" for inlet pipe	1,150	1,150
1	Pc. PVC Reducing Tee, 1" x 1/2" for cuci tap	2,500	2,500
1	Pc. PVC Tee, 1" for two mandi taps	3,250	3,250
2	Pcs. PVC Red.Sockets 1" x 1/2" for mandi ta	700	1,400
3	Pc. PVC Valve Socket, 1/2" for MC taps	650	1,950
3	Pcs. GI Knee, 1/2" for MC taps	400	1,200
3	Pcs. GI Double Nipple, 1/2" for MC taps	400	1,200
3	Ball Valves, Kitz brand, 1/2" for MC taps	14,000	42,000
3	Pcs. GI Elbow/Bocht, 1/2" for MC taps	750	2,250

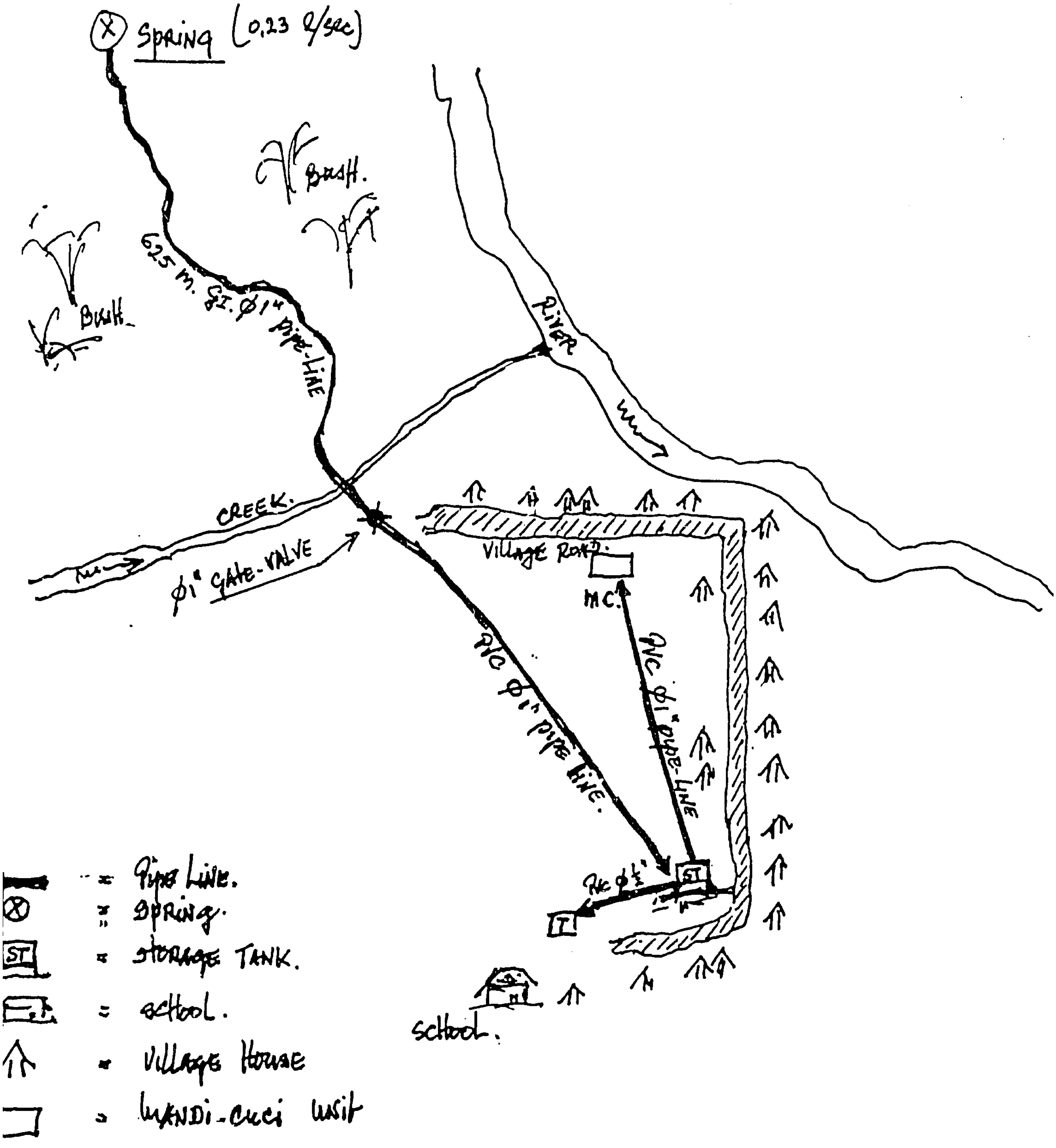
Subtotal = Rp. 257,550

E. Public Tap (1 unit)			
4	Bags of Cement	6,850	27,400
1	Stems Rebar, 12 m x 8 mm	4,000	4,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails, 5-7 cm	1,750	1,750
2	Pcs. Wooden Planks for Formwork	1,000	2,000
1	PVC Pipe, 4 m x 1/2", Pralon VP Class	5,000	5,000
1	Pc. PVC Elbow, 1/2"	550	550
1	Pc. PVC Valve Sockets, 1/2"	650	650
1	Pc. GI Knee, 1/2"	400	400
1	Pc. GI Double Nipple, 1/2"	400	400
1	Ball Valve, Kitz brand, 1/2"	14,000	14,000
1	Pc. GI Elbow/Bocht, 1/2"	750	750

Subtotal = Rp. 59,400

Grand Total = Rp. 4,570,450

Lay-out of Proposed Water-Supply System.
Tumbang Kaburai Site



B. TANJUNG PAKU

Tanjung Paku (First Spring) - Pipeline Survey

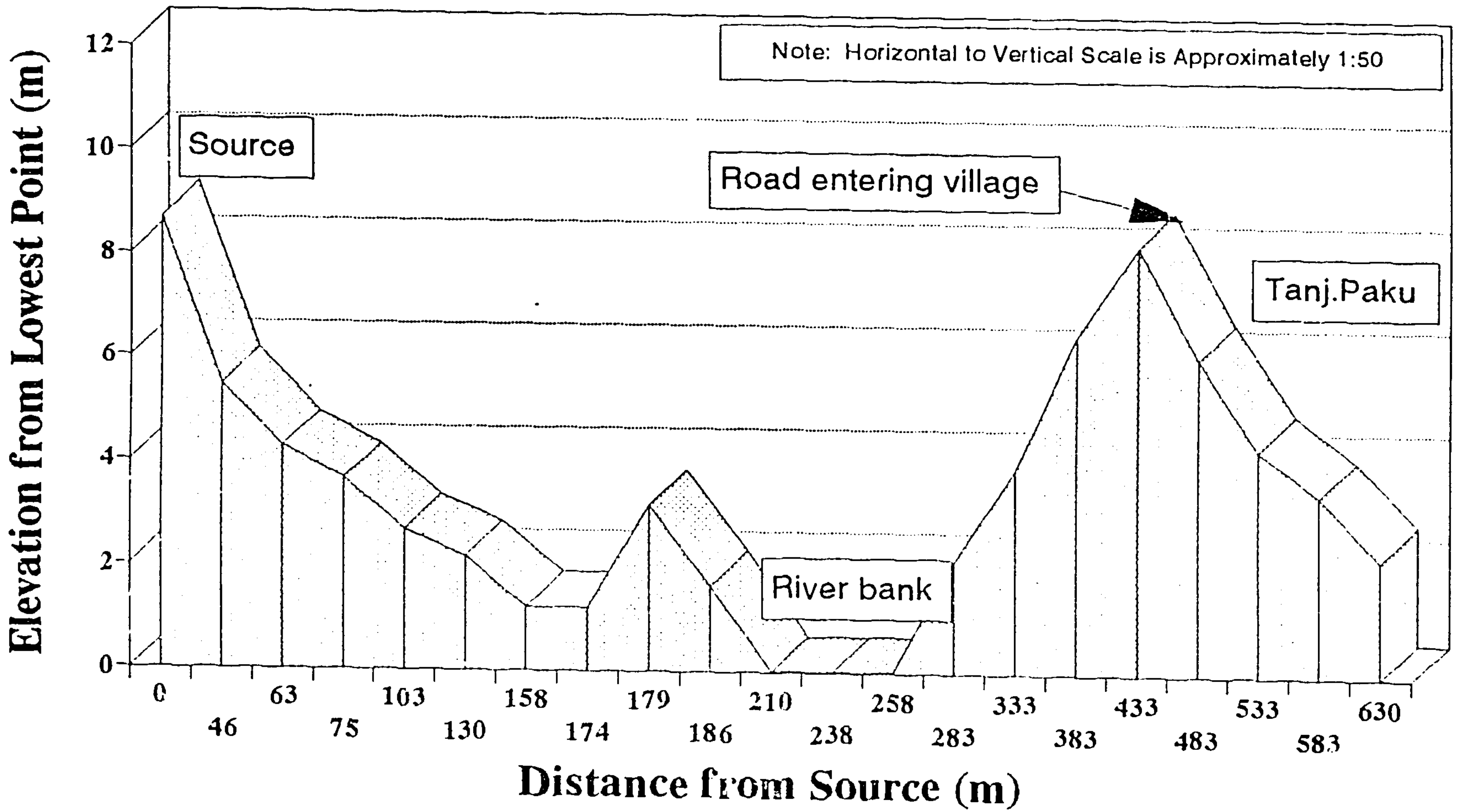
05-Dec-92

Station Number	Angle in degrees	Distance (meters)	Elevation Diff. (m)	Accum. Elevation	Accum. Distance	Top Down	Remarks
0	0.0	0	0.0	0.0	0	8.7	
1	4.0	46	3.2	3.2	46	5.5	
2	4.0	17	1.2	4.4	63	4.3	
3	3.0	12	0.6	5.0	75	3.7	
4	2.0	28	1.0	6.0	103	2.7	
5	1.0	27	0.5	6.5	130	2.2	
6	2.0	28	1.0	7.4	158	1.2	
7	0.0	16	0.0	7.4	174	1.2	
8	-23.0	5	-2.0	5.5	179	3.2	
9	12.5	7	1.5	7.0	186	1.7	
10	4.0	24	1.7	8.7	210	0.0	
11	0.0	28	0.0	8.7	238	0.0	*ends on river bank*
12	0.0	20	0.0	8.7	258	0.0	
13	-5.0	25	-2.2	6.5	283	2.2	
14	-2.0	50	-1.7	4.8	333	3.9	
15	-3.0	50	-2.6	2.1	383	6.5	*ends at edge of village*
16	-2.0	50	-1.7	0.4	433	8.3	crosses entry roadway
17	2.5	50	2.2	2.6	483	6.1	
18	2.0	50	1.7	4.3	533	4.4	
19	1.0	50	0.9	5.2	583	3.5	road forks
20	1.5	47	1.2	6.4	630	2.3	ends at path corner
Start fr.#17							
21	3.5	21	1.3	3.9	554	4.8	From #17 down to river
22	11.5	41	8.2	12.0	595	-3.4	ends at river bank

From Station 1-15, use GI pipe due to difficulty in burying pipe (rocks & roots).
From Station 16 through 20 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.

Total Length GI Pipe	383	meters, so	64	lengths of 6 meter pipe is required
Total Length PVC Pipe=	247	meters, so	62	lengths of 4 meter pipe is required

Tanjung Paku System - First Spring
Main Pipeline Profile



Tanjung Paku - Survey of High Spring

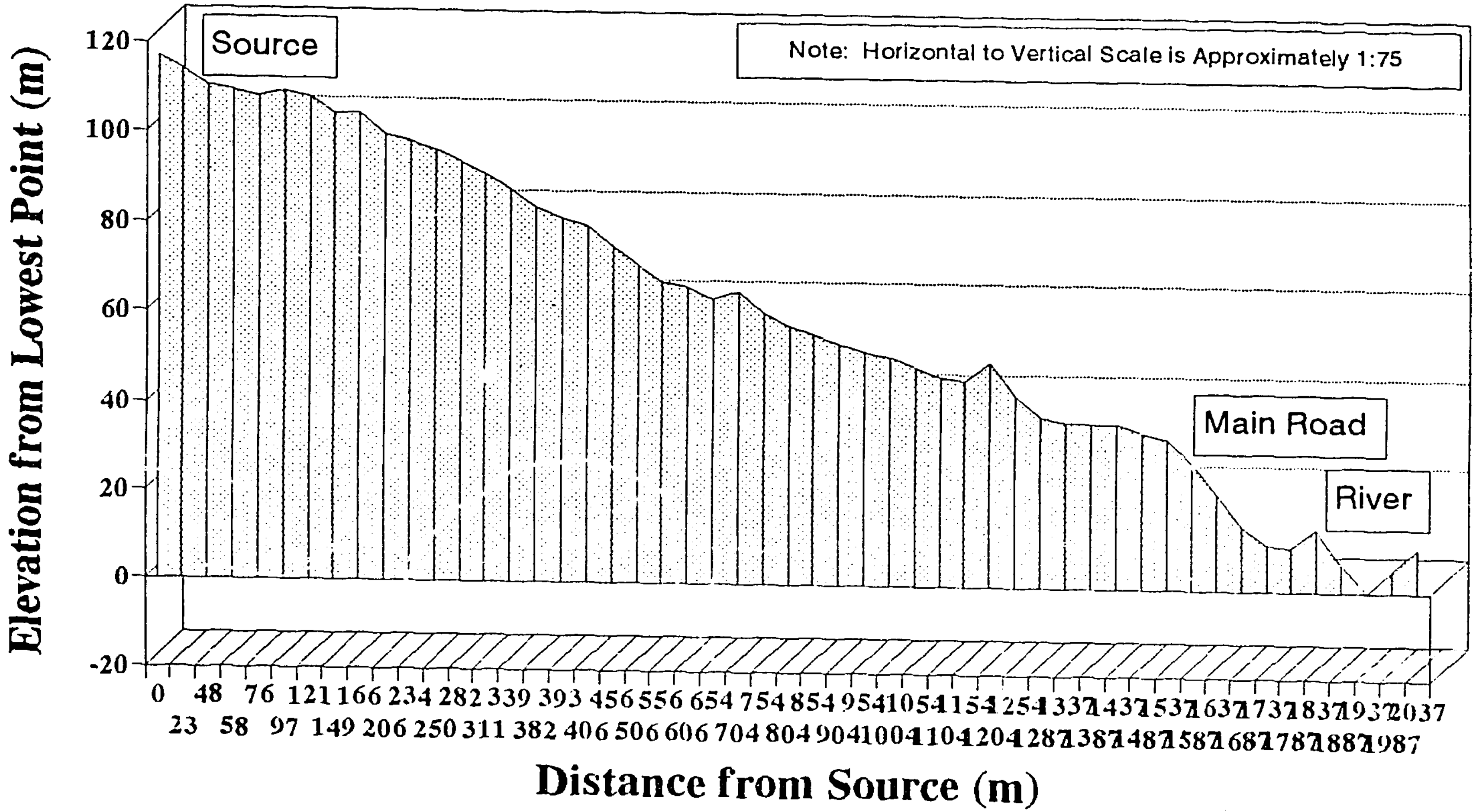
05-Dec-92

Station Number	Angle (degrees)	Distance (meters)	Elevation Diff. (m)	Accum. Elevation	Accum. Distance	Top Down	Remarks these are for RB/TK.
1	0.0	0	0.0	0.0	0	116.8	Alfonso, 2nd spring
2	7.0	23	2.8	2.8	23	114.0	tie-in point w/first spring
3	8.0	25	3.5	6.3	48	110.5	corner drainage by forest
4	7.0	10	1.2	7.5	58	109.3	heading East
5	4.0	18	1.3	8.8	76	108.0	90 degree turn to North
6	-3.0	21	-1.1	7.7	97	109.1	
7	3.0	24	1.3	8.9	121	107.9	right&up out of creek bed
8	6.5	28	3.2	12.1	149	104.7	over swamp (8 m. wide)
9	1.0	17	0.3	12.4	166	104.4	
10	6.5	40	4.5	16.9	206	99.9	need air release valve
11	3.5	28	1.7	18.5	234	98.2	on river bank from here
12	6.5	16	1.8	20.4	250	96.4	
13	4.5	32	2.5	22.9	282	93.9	ends at s.creek/ladang
14	5.0	29	2.5	25.5	311	91.3	across ladang
15	6.5	28	3.2	28.6	339	88.2	"
16	6.0	43	4.5	33.1	382	83.7	"
17	10.0	11	1.9	35.0	393	81.8	
18	8.0	13	1.8	36.9	406	80.0	
19	5.0	50	4.4	41.2	456	75.6	ends almost at big tree
20	5.0	50	4.4	45.6	506	71.2	
21	4.5	50	3.9	49.5	556	67.3	
22	1.0	50	0.9	50.4	606	66.4	out of woods to ladang
23	3.0	48	2.5	52.9	654	63.9	
24	-2.0	50	-1.7	51.1	704	65.7	big tree root, to ladang
25	6.0	50	5.2	56.4	754	60.4	suspend pipe: 20'w.dip
26	3.0	50	2.6	59.0	804	57.8	
27	2.0	50	1.7	60.7	854	56.1	ends at teacher's house
28	2.0	50	1.7	62.5	904	54.3	
29	2.0	50	1.7	64.2	954	52.6	to border of R.Batang
30	1.5	50	1.3	65.5	1004	51.3	corner to SW
31	2.5	50	2.2	67.7	1054	49.1	
32	2.5	50	2.2	69.9	1104	46.9	
33	0.5	50	0.4	70.3	1154	46.5	end of RB past KD.
34	-4.5	50	-3.9	66.4	1204	50.4	
35	8	50	7.0	73.4	1254	43.5	
36	9	33	5.2	78.5	1287	38.3	
37	1	50	0.9	79.4	1337	37.4	
38	0.5	50	0.4	79.8	1387	37.0	
39	0	50	0.0	79.8	1437	37.0	
40	2	50	1.7	81.6	1487	35.2	
41	2	50	1.7	83.3	1537	33.5	
42	5.5	50	4.8	88.1	1587	28.7	
43	8	50	7.0	95.1	1637	21.7	
44	8.5	50	7.4	102.5	1687	14.4	
45	4.5	50	3.9	106.4	1737	10.4	
46	0.5	50	0.4	106.8	1787	10.0	
47	-4.5	50	-3.9	102.9	1837	13.9	
48	9	50	7.8	110.7	1887	6.1	
49	7	50	6.1	116.8	1937	-0.0	
50	-5.5	50	-4.8	112.0	1987	4.8	
51	-6	50	-5.2	106.8	2037	10.0	

From Station 1 to Station 25, use GI pipe due to difficulty in burying pipe (rocks & roots).
From station 26 through 31 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.

Total length of GI Pipe= 2037 meters, so 340 lengths of 6 meter pipe

Tanjung Paku - High Spring
Main Pipeline Profile



System No. 2	**Tanjung Paku**	Present Population:	**270**
Kecamatan:	**Seruyan Hulu**	Design Population:	**391**
Kabupaten:	**Kotswaringin Timur**	Spring Yield (ls/sec)	**0.35**
Province:	**Kalimantan Tengah**	10-Dec-92	

System Summary: Single spring catchment, 600 meter main pipeline consisting of 383 meters of GI pipe and 217 meters of PVC, one storage tank plus MC, a separate MC, and no other public taps.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank (one unit)			
13	Bags of Cement	6,850	89,050
7	Stems of Rebar, 12 m x 8 mm	4,000	28,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails 5-7 cm.	1,750	1,750
4	Pcs. Wooden Planks for Forms	1,000	4,000
6	Meters Plastic Sheet	1,500	9,000
3	Pcs. GI Pipe, 1" x 40 cm. neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for outlet, 1", Kitz brand	16,500	16,500
1	GI Knee for overflow pipe, 1"	750	750
1	GI Cap/Dop for washout pipe, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 177,550
B. Main Pipeline (383 meters in length)			
65	GI Pipe, 1"x 6 m, Medium Class	21,000	1,365,000
6	Pcs. GI Unions, 1"	1,750	10,500
5	Pcs. GI Elbow/Bocht, 1" Price right? (750?)	1,500	7,500
2	Pc. GI Tee, 1", for washouts (2)	900	1,800
2	Pc. GI Plug, 1", for washouts (2)	500	1,000
1	Pcs. GI Reducing Tee, 1" x 1/2" for AV	1,000	1,000
1	Air Release Valve, 1/2"	10,000	10,000
1	Pcs. GI Double Nipple, 1/2" for air valve	400	400
1	Pc. GI Reducing Socket, 3/4" x 1/2" (AV)	750	750
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set Anchors & lockbar for valve box.	5,000	5,000
62	Stems PVC Pipe, 1"x 4 m, Pralon VP Class	8,800	545,600
0	Stems PVC Pipe, 1/2"x4m, Pralon VP Class	8,800	0
2	Pcs. PVC Valve Sockets, 1" for GI/PVC switch and on storage tank outlet to MC	1600	3,200
1	Kg. Solvent Cement, Pralon, No.73	32,500	32,500
15	Bags of Cement for Concrete Pillars supporting/holding the main pipeline	6,850	102,750
4	Stems Rebar, 12 m x 8 mm	4,000	16,000
0	Sets Galvanized Iron Cable/chain for suspending pipe runs over creeks	10,000	0
1	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	2,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 2,136,500

C. Water Storage Tank (12 cubic meters) w/one attached MC			TANJUNG PAKU
85	Bags of Cement	6,850	582,250
38	Stems Rebar, 8 mm x 12 m	4,000	152,000
3	Kg. Rebar Wire	2,500	7,500
5	Kg. Nails 5-7 cm.	1,750	8,750
40	Wooden Planks for Forms	1,000	40,000
20	Wooden Lumber for Forms	1,000	20,000
3	Pcs. GI Pipe, 1" x 40 cm, neckwelded for outlet, overflow and washout pipes	4,000	12,000
3	Pcs. GI Pipe, 1/2" x 40 cm, neckwelded for outlet to public tap	2,500	7,500
5	Pcs. GI Knee, 1" for overflow/in/outlet pipes	750	3,750
2	Pc. GI Cap/Dop, 1" for washout pipe	500	1,000
0	Pc. GI Knee, 1/2" for public tap outlet	700	0
3	Pcs. GI Elbow/Bocht, 1/2" for taps	750	2,250
3	Ball Valves, Kitz brand, 1/2"	14,000	42,000
0	Gate Valve, 1", Kitz brand	16,500	0
2	Set achors and lockbar for manhole/valvebo	5,000	10,000
2	Padlock, Globe brand	1,500	3,000
0.25	Kg. Paint (Glotex, black)	2,000	500

Subtotal = Rp. 892,500

D. Mandi/Cuci (MC, 1 unit with male and female sides)			
21	Bags of Cement	6,850	143,850
3	Stems Rebar, 12 m x 8 mm	4,000	12,000
1	Kg. Rebar Wire	2,500	2,500
2	Kg. Nails, 5-7 cm	1,750	3,500
20	Pcs. Wooden Planks for Formwork	1,000	20,000
5	Pcs. Wooden Lumber for Formwork	1,000	5,000
1	Stems PVC Pipe, 1" Pralon VP Class	8,800	8,800
1	Stems PVC Pipe, 1/2" Pralon VP Class	5,000	5,000
1	Pcs. PVC Elbow, 1" for inlet pipe	1,150	1,150
1	Pcs. PVC Elbow, 1/2"	2,500	2,500
1	Pcs. PVC Tee, 1" for mandi taps	3,250	3,250
2	Pcs. PVC Red. Sockets 1"x1/2" for mandi	700	1,400
3	Pcs. PVC Valve Socket, 1/2" for mandi taps	650	1,950
3	Pcs. GI Knee, 1/2" for MC taps	400	1,200
3	Pcs. GI Double Nipple, 1/2" for MC taps	400	1,200
3	Ball Valves, Kitz brand, 1/2"	14,000	42,000
3	Pcs. GI Elbow/Bocht, 1/2"	750	2,250

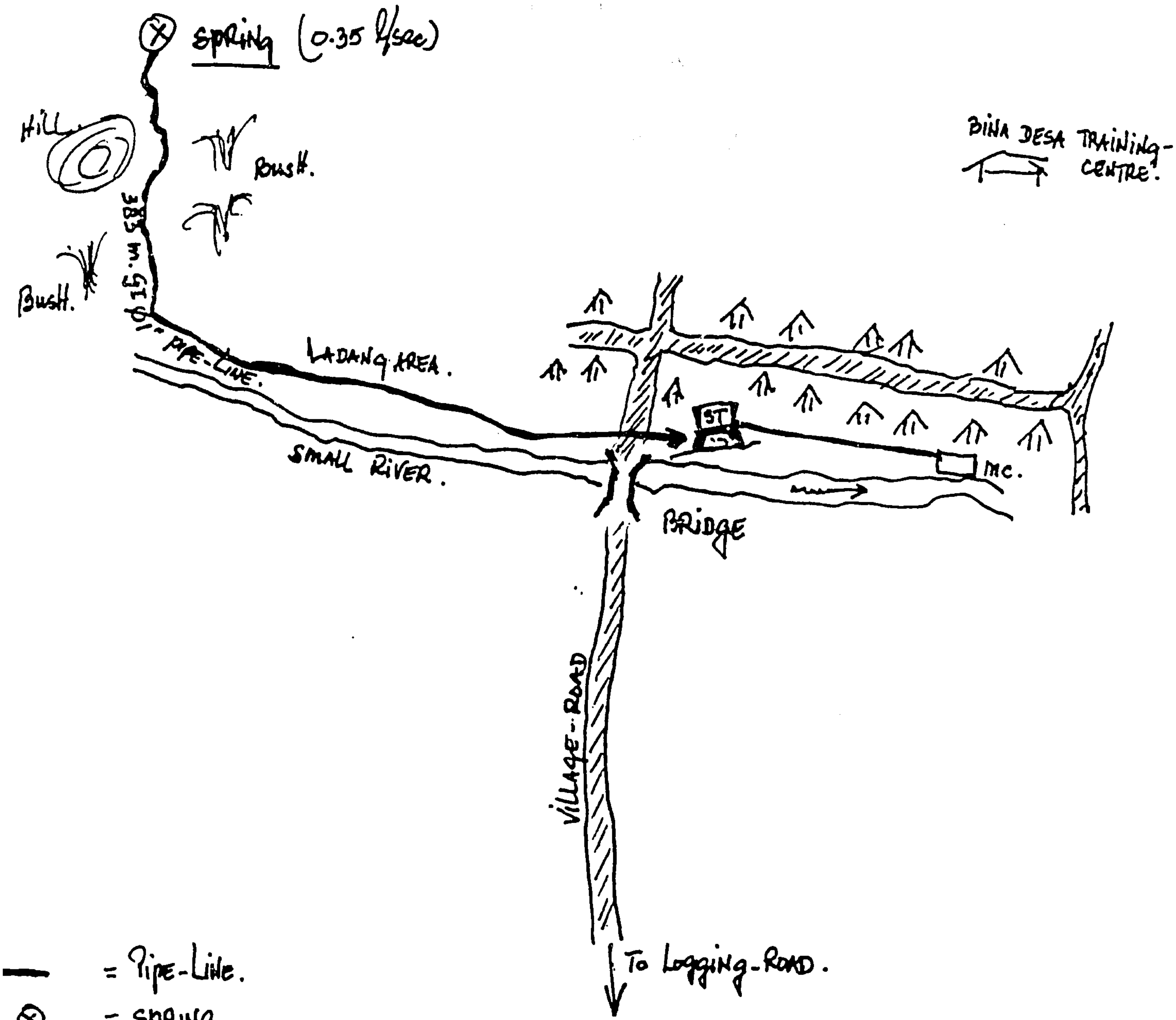
Subtotal = Rp. 257,550

E. Public Tap (none)			
0	Bags of Cement	0	0
0	Stems Rebar, 12 m x 8 mm	0	0
0	Kg. Rebar Wire	0	0
0	Kg. Nails, 5-7 cm	0	0
0	Pcs. Wooden Planks for Formwork	0	0
0	PVC Pipes, 4 m x 1/2", Pralon VP Class	0	0
0	Pcs. PVC Elbows, 1/2"	0	0
0	Pcs. PVC Valve Sockets, 1/2"	0	0
0	Pcs. GI Knee, 1/2"	0	0
0	Pcs. GI Double Nipple, 1/2"	0	0
0	Ball Valves, Kitz brand, 1/2"	0	0
0	Pcs. GI Elbow/Bochtt, 1/2"	0	0

Subtotal = Rp. 0

Total Cost = Rp. 3,464,100

Lay-out of Proposed Water-supply system. Tanjung Paku



— = Pipe-Line.

⊗ = Spring.

= Storage-Tank.

= Village-House

= Mandi-cuci unit.

= Bridge.

C. TUMBANG TABERAU & RIAM BATANG

Tumbang Taberau/Riam Batang - Pipeline Survey

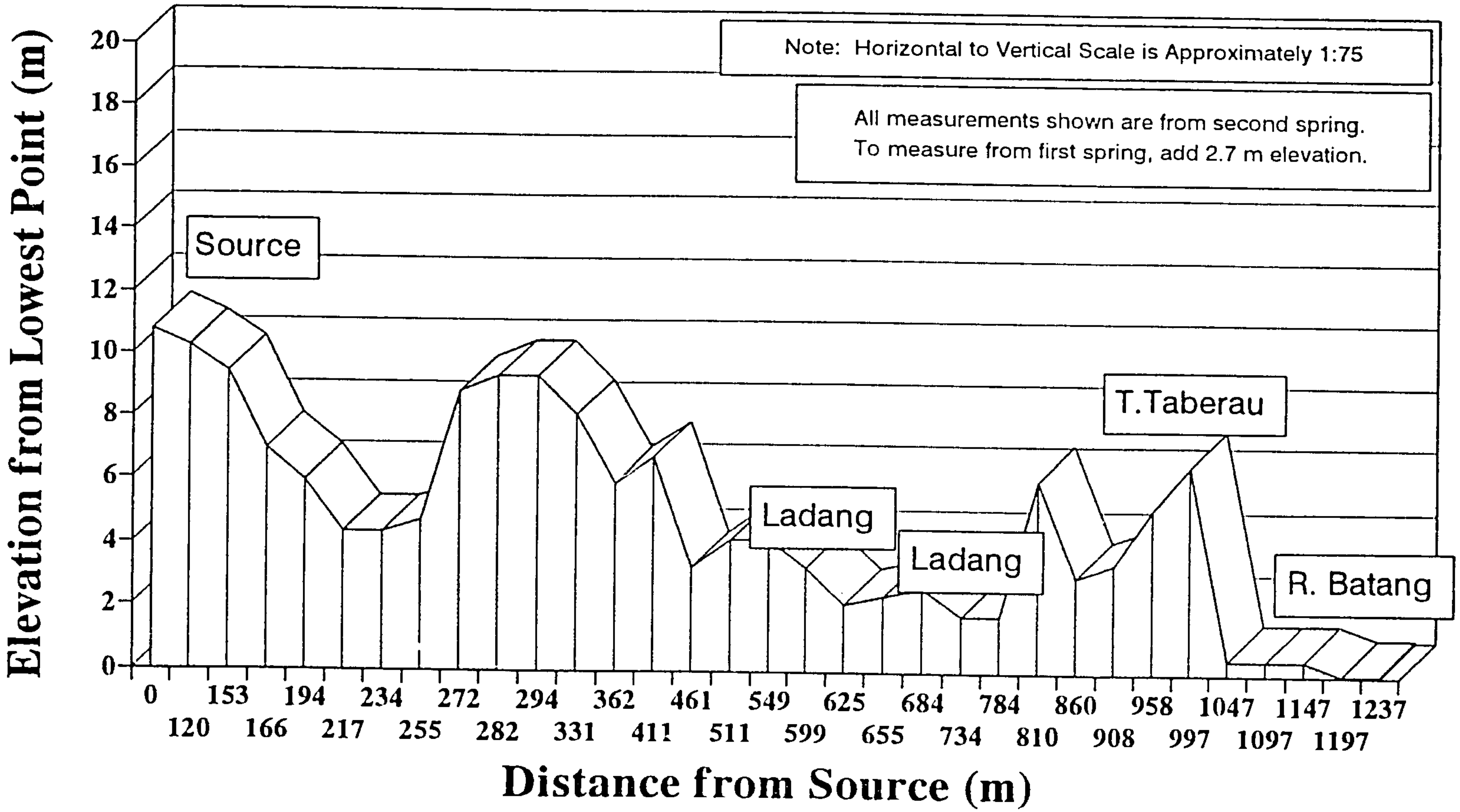
Station Number	Angle (degree	Distance (meters)	Elevation Diff. (m)	Accum. Elevation	Accum. Distance	Top Down	Remarks
a	-2.5	50	-2.2	-2.2	50		Rick reading, 1st spring
b	-6.0	20	-2.1	-4.3	70		", top of hill
c	10.0	40	6.9	2.7	110		tie-in point, sources 1-2
							* Will not use this for now**
1	0.0	0	0.0	0.0	0	10.8	Alfonso, 2nd spring
2	3.0	10	0.5	0.5	120	10.3	tie-in point w/first spring
3	1.5	33	0.9	1.4	153	9.4	corner drainage by forest
4	11.0	13	2.5	3.9	166	6.9	heading East
5	2.0	28	1.0	4.8	194	5.9	90 degree turn to North
6	4.0	23	1.6	6.4	217	4.3	
7	0.0	17	0.0	6.4	234	4.3	right&up out of creek bed
8	-1.0	21	-0.4	6.1	255	4.7	over swamp (8 m. wide)
9	-14.0	17	-4.1	2.0	272	8.8	
10	-3.0	10	-0.5	1.4	282	9.3	need air release valve
11	0.0	12	0.0	1.4	294	9.3	on river bank from here on
12	2.0	37	1.3	2.7	331	8.1	
13	4.0	31	2.2	4.9	362	5.9	ends at sm/creek & ladang
14	-1.0	49	-0.9	4.0	411	6.7	across ladang
15	4.0	50	3.5	7.5	461	3.3	"
16	-1.0	50	-0.9	6.7	511	4.1	"
17	0.0	38	0.0	6.7	549	4.1	
18	1.0	50	0.9	7.5	599	3.3	
19	2.5	26	1.1	8.7	625	2.1	ends almost at big tree
20	-0.5	30	-0.3	8.4	655	2.4	
21	-0.5	29	-0.3	8.2	684	2.6	
22	1.0	50	0.9	9.0	734	1.8	out of woods, more ladang
23	0.0	50	0.0	9.0	784	1.8	
24	-9.5	26	-4.3	4.7	810	6.1	big tree root, into ladang
25	3.5	50	3.1	7.8	860	3.0	suspend pipe: 20'wide dip
26	-0.5	48	-0.4	7.4	908	3.4	End of GI pipeline
27	-2.0	50	-1.7	5.6	958	5.2	ends at teacher's house
28	-2.0	39	-1.4	4.3	997	6.5	good storage tank site
29	7.0	50	6.1	10.4	1047	0.4	to border of Riam Batang
30	0.0	50	0.0	10.4	1097	0.4	bend around corner to SW
31	0.0	50	0.0	10.4	1147	0.4	straight through village
32	0.5	50	0.4	10.8	1197	0.0	straight through village
31	0.0	40	0.0	10.8	1237	0.0	end of RB past KD's house

Note: All totals shown below are starting from second spring

From Station 1 to Station 25, use GI pipe due to difficulty in burying pipe (rocks & roots).
From station 26 through 31 (inside village boundary), use buried PVC.
Additional savings could be had by using PVC through ladang areas as well.
If only the second spring is developed, then pipe requirements are:

Total length of GI Pipe=	798 meters, so	133	lengths of 6 meter pipe
Total Length of PVC Pipe	329 meters, so	82	lengths of 4 meter pipe,
			plus return run of 1/2" from storage to TT/KD.

Tumbang Taberau and Riam Batang System
Main Pipeline Profile



System No. 3	Tumbang Taberau & Riam Batang	Present Population:	260
Kacamatan:	Seruyan Hulu	Design Population:	367
Kabupaten:	Kotswaringin Timur	Spring Yield (ls/sec)	0.26
Province:	Kalimantan Tengah	10-Dec-92	

System Summary: Single spring catchment, 798 meter main pipeline consisting of of 1" GI pipe, plus 217 m of PVC distribution pipe, 1 storage tank plus MC, 2 other MCs, and one public tap.

Quantity	Equipment and Materials	Unit Cost (Rp.)	Extension (Rp.)
A. Spring Catchment Tank (one unit)			
13	Bags of Cement	6,850	89,050
7	Stems of Rebar, 12 m x 8 mm	4,000	28,000
1	Kg. Rebar Wire	2,500	2,500
1	Kg. Nails 5-7 cm.	1,750	1,750
4	Pcs. Wooden Planks for Forms	1,000	4,000
6	Meters Plastic Sheet	1,500	9,000
3	Pcs. GI Pipe, 1" x 40 cm. neckwelded for outlet, overflow, and washout pipes	4,000	12,000
1	Gate Valve for outlet, 1", Kitz brand	16,500	16,500
1	GI Knee for overflow pipe, 1"	750	750
1	GI Cap/Dop for washout pipe, 1"	500	500
2	Sets of Anchors and Lockbar for Valve Box and Tank Manhole	5,000	10,000
2	Padlocks, Globe brand	1,500	3,000
0.25	Liter Lamtore-Gung Seeds for catchment	2,000	500
		Subtotal =	Rp. 177,550
B. Main Pipeline (798 meters in length)			
142	GI Pipe, 1"x 6 m, Medium Class	21,000	2,982,000
14	Pcs. GI Unions, 1"	1,750	24,500
5	Pcs. GI Elbow/Bocht, 1" for sharp bends	1,500	7,500
2	Pcs. GI Tee, 1", for washouts (2)	900	1,800
2	Pcs. GI Plug, 1", for washouts (2)	500	1,000
1	Pc. GI Reducing Tee, 1"x1/2" for air valve	850	850
1	Air Release Valve, 1/2"	10,000	10,000
1	Pcs. GI Double Nipple, 1/2" for air valve	700	700
1	Pcs. GI Reducing Socket, 3/4" x 1/2" (AV)	700	700
1	Gate Valve (Kitz), 1"	16,500	16,500
1	Set Anchors & lockbar for valve box	5,000	5,000
60	Stems PVC Pipe, 1"x 4 m, Pralon VP Class	8,800	528,000
40	Stems PVC Pipe, 1/2"x4m, Pralon VP Class	5,000	200,000
4	Pcs. PVC Valve Sockets, 1" for GI to PVC	1,600	6,400
1	Pcs. PVC Tee, 1", for MC#1 connection	3,250	3,250
2	Kg. Solvent Cement, Pralon, No.73	32,500	65,000
20	Bags of Cement for Concrete Pillars supporting/holding the main pipeline	6,850	137,000
4	Stems rebar, 12 m x 8 mm	4,000	16,000
2	Sets Galvanized Iron Cable/chain for suspending pipe runs over creeks	10,000	20,000
5	Kg. Steel Paint (Meni Besi) for GI pipe ends when hooking on main pipeline	2,000	10,000
2	Pcs. Pipe Wrench, 24/18" Length	7,500	15,000
		Subtotal =	Rp. 4,051,200