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ENVIRONMENTAL ASSESSMENT

VECTOR CONTROL AND WATER

AND SANITATION ACTIVITIES

OF THE

HEALTH SECTOR II PROJECT, HONDURAS

June 1988

AR-093

Managed by Medical Service Corporation International
under contract to the U.S. Agency for International Development

Prepared by

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SECTION 1

EXECUTIVE SUMMARY

This environmental assessment focuses on Disease Vector Control Activities under the Child Survival Component and on the Rural Water and Sanitation Component of Health Sector II, Honduras. The observations and evaluations upon which this report is based were made May 16 - June 4, 1988 by a team of specialists assembled by the Vector Biology & Control (VBC) Project, Medical Service Corporation International (MSCI) of Arlington, Virginia. The Environmental Assessment (EA) was conducted at the request of USAID/Washington and USAID/Honduras, and was in accordance with A.I.D. Regulation 22 CFR 216. The assessment team consisted of Dr. Samuel Breeland, (Vector Control, Physical Larval Control, and Team Leader); Robert Hogrefe, Civil Engineer (Rural Water and Sanitation); Dr. Clay Montague (Physical Larval Control and Aquatic Habitats); and Dr. Mauricio Sauerbrey (Physical Larval Control and Malariology).

Vector control activities proposed under Health Sector II emphasize an integrated program to be conducted by the Division of Vector Control (DCV) of the Ministry of Health with A.I.D. Mission support. Emphasis will be on a judicious mix of physical larval control (PLC) through habitat management, the selective use of Bacillus thuringienis israelensis (B.t.i.) as an anopheline larvicide and intradomiciliary house spraying with the organophosphorus insecticide fenitrothion (Sumithion). Fenitrothion was used by DCV throughout Health Sector I with substantial success in reducing malaria; some physical larval control was accomplished; and the use B.t.i. in Health Sector II represents a new intervention. All vector control activities will be expanded during the 1988-1994 period of Health Sector II.

The approach used by the team included a scoping process involving A.I.D./Washington and A.I.D./Honduras which included specific areas of responsibility for the team as a whole and each team member. Objectives included consideration of all aspects of the proposed use of pesticides and PLC measures in terms of environmental consequences, human safety, and appropriateness of the various interventions, per requirements of Reg. 22 CFR 216. The evaluation background, evaluation criteria and process were attained through indoctrination at all levels, a review of pertinent literature, interviews of appropriate officials, and field site visits of existing or projected activities.

Significant findings of this assessment pertaining to vector control interventions are as follows:

1. Intra-domiciliary spraying of houses with fenitrothion as currently practiced is programmatically sound and poses no environmental threat.

2. The projected use of B.t.i. or other larvicides if approved by Chief Environmental Officer, in strict accordance with EPA label requirements would be efficacious, safe, and environmentally appropriate. Larvicides not approved in this EA would require preparation of amended EA prior to their use.

3. The proposed use of PLC as a principal method of vector control in conjunction with other methodology is especially warranted. However, PLC represents the highest environmental threat of the various interventions proposed, thus requiring cautious planning and implementation along with well devised monitoring, maintenance and sustainability features. Criteria for diminishing environmental consequences of PLC activities are a major concern and target of this assessment. If the EA guidelines are followed, negligible environmental harm would be expected.

Significant recommendations, Section 6, include:

1. The retention of an A.I.D. Advisor to the Project, or the provision by A.I.D. for continuing TA through Health Sector II.

2. The commitment of A.I.D. to assure the continued flow of fenitrothion to DCV, whether or not the Government of Japan continues its support.

3. The completion of warehouses for insecticide storage for each region, budgeted under Health Sector I.

4. The modification of warehouses and storage practices to include palleting, elimination of blockage of ventilated areas, and installation of louvered windows to protect insecticides from rain or sunlight.

Significant findings of the environmental assessment relating to the rural water and sanitation program are as follows:

1. The typical physical activities involved with the water systems and sanitation projects are usually confined to limited areas not representing major intrusions on the environment.

2. A good potential exists to increase the program's sensitivity towards environmental concerns relating to the affected watersheds of the community water system projects.

3. Many planned program improvements will enhance environmental protection and monitoring efforts in the projects in general.

Significant recommendations resulting from the Rural Water and Sanitation Component of this study are as follows:

1. The provision of an A.I.D. supported Advisor to the Rural Water and Sanitation Component of the Project.

2. Incorporate a watershed study as the heart of an environmental review survey for each community water system. A possible guide has been included in the appendix.

3. Provide local design flexibility in cases where reasonable extra costs can achieve a water source from a spring(s) in lieu of an impounded stream, thereby eliminating surface waters wherever feasible.

4. Include watershed management strategies in the work of the field promoters and engineers. Program guide examples have been included in the appendix.

5. Include small drainage improvement measures within communities during water system construction work. Costs should be kept within usual project contingency budgets.

6. Establish a monitoring plan with the Honduran agency responsible for contaminant studies and controls, especially for agricultural pesticides/hydrocarbons monitoring in selected watersheds with intensive agricultural impacts. This is to establish important baseline data and to monitor impacts in sensitive watershed zones.

7. A limited annual assessment of the environmental concerns being addressed in the project can help identify any mitigation measures needed and to review monitoring information obtained as the program advances.

A positive determination was made for the project, as recommended by the Mission (Section IEE #87-10, dated March 27, 1988 in LAC IDR/EST files). Because of this positive determination, this EA was conducted.

SECTION 2

PURPOSE, SCOPING PROCESS, SCOPE OF WORK, PROJECT DESCRIPTION, NEED, AND THRESHOLD DECISION DETERMINATION

2.1 Purpose

The purpose of this activity is to conduct an EA for the Health Sector II Project in Honduras with specific reference to Health Sector II activities in the areas of Vector Control and Rural Water and Sanitation. This report presents the findings of an environmental assessment conducted between May 16 and June 4, 1988.

2.2 Objectives

The objectives of this work are (1) the preparation of an EA document addressing projected activities of the Health Sector II Project in Honduras in the area of Vector Control and Rural Water and Sanitation in accordance with A.I.D. Regulation 22 CFR Part 216; and (2) the development of a matrix, i.e., a transferable system to aid the Mission in future environmental rating and evaluation processes of activities implemented under this project.

2.3 Scoping Process and Scope of Work

According to A.I.D. Environmental Procedures (22 CFR Part 2 216.3(4)), after a positive determination has been made, written statement of the scope of an EA which identifies potentially significant issues is prepared and must be approved by the Bureau Environmental Officer. The approved written scope of work (SOW) for this Project is contained in Department of State telex USAID/Tegucigalpa 03718.

The overall scope has two components: Vector (malaria) Control and Rural Water and Sanitation. The malaria control component includes (1) reviewing the existing EA for fenitrothion used in wall spraying, (2) developing an EA for the use of B.t.i., (3) visiting prospective sites for Physical Larval Control (PLC) operations, (4) developing criteria for evaluating environmental harm from PLC activities, (5) suggesting improvements in PLC operations, and (6) preparation of a draft EA document.

The Rural Water and Sanitation component includes (1) reviewing criteria for location of water supply intakes, wells and latrines; (2) recommending construction practices which will reduce erosion of runoff water from storage tanks, and household

connections, and eliminating pools of water associated with poor drainage; and (3) visiting sites for making watershed protection recommendations, evaluating environmental impact and developing environmental evaluation criteria for use by local project personnel.

Two scoping sessions were held with the EA Team for this Project -- one at VBC in Arlington on May 13, 1988 and a second with A.I.D./Tegucigalpa officials on May 16, 1988. The Arlington session provided background information and individual and team work scopes. The Tegucigalpa session provided Mission and GOH inputs.

Site visits were made during the period May 17-25 and included observations of physical larval control locales in the Jamastran Valley, Catacamas, Comayagua, Bajo Aguan, and water and sanitation sites in proximity to Bajo Aguan.

The collective scope of work for the EA team was as follows:

Vector Control

- Review and assess possible adverse environmental effects of insecticides when properly used.
- Review human safety factors in planned use of insecticides, including warehousing, transport, labeling and handling.
- Outline for MOH the type of training required for the safe use of insecticides.
- Provide guidance to the Mission on the monitoring of safety practices in the handling and use of insecticides.
- Review vector susceptibility monitoring and training activities of DCV.
- Assess physical control measures under the Project.
- Provide guidance to the Mission as to maintenance and monitoring of proposed environmental modifications.
- Assess major activities of the Project (residual insecticides, B.t.i., and physical larval control) in terms of appropriateness, effects on non-target organisms, and general environmental implications.

- Catalogue the types of aquatic habitats affected by mosquito control operations (insecticidal and physical control).

- Determine if the type of habitat modifications are likely to produce ecological changes of the biota of the areas involved.

- Determine possible adverse effects of habitat changes on endangered species.

Rural Water and Sanitation

- Consider proposed physical modifications during the Health Sector II period and how these will be programmed, evaluated, maintained, and monitored.

- Review the current criteria used by the GOH in locating water intake structures, latrines, and wells and submit recommendations for improvements.

- Prepare recommendations for construction practices which will reduce erosion of runoff water from storage tanks, wells and household connections, and eliminate pools of water associated with poor drainage.

- Visit sites for observation of existing and proposed activities.

- Consider a maintenance and evaluation schedule of Water and Sanitation Projects.

- Where possible, address the interfacing of Rural Water and Sanitation and Vector Control interests and activities.

- Prepare a report of the EA.

2.4 Project Description

The purpose of this Project is to support, strengthen and continue the process of extension of coverage of efficient, sustainable and effective primary health care and rural water and sanitation services, with an emphasis on child survival interventions. The focus will be on the sustainable implementation of decentralized management systems in support of primary health care at the operational levels -- regional, area and health center. The Project is divided into two components: The Child Survival Program, and the Rural Water and Sanitation Program. The Project will build on the achievements made during the Health

Sector I (522-0153) and Rural Water and Sanitation (522-0166) Projects. Virtually all of the policy decisions in support of primary health care have been taken. Most of the support systems for the central level are either developed or are under design.

Vector (malaria) Control is included under the Child Survival Health Technologies Section Under Health Sector II where the strategy is to use a continual integrated approach of physical, chemical and biological control measures against the anopheline vectors as well as therapeutic means to attack the parasite, thus breaking the cycle of transmission. The malaria control intervention under child survival supported by this Project is important in that malaria continues to be a problem in Honduras, contributing to both infant and adult mortality and morbidity. Over 90% of the country is potentially malarious and some 80% of the population lives in that area. Of the 29,130 cases of malaria reported in 1986, 18% affected children under the age of five years. From 1976 to 1987, malaria case levels have fluctuated, although the trend has been downward, from a high of 57,000 per year to a low of 18,000 in 1987. The objective of the support to the malaria program under this Project will be to reduce the incidence of malaria by the EOP from 18,000 reported cases in 1987 to no more than 8,500 cases, 47% of the 1987 levels. These objectives are based upon an expected 10% annual decline. A.I.D. purchases under the Project include sprayers, vehicles and earth moving equipment for larval control ($1.7 million), larvicide (principally B.t.i. $1.2 million), and miscellaneous supplies for field sprayers ($198,700).

Chagas' disease control will also be supported with a concentration on case finding and treatment, chemical control through wall spraying, and the conducting of surveys ($125,000) to better define the geographic distribution of the vector and incidence of infection. By the EOP, house infestation rates will be targeted for a 50% reduction, the number of new infections by 25% and 90% of infected patients being treated.

The Vector Control Division (DCV) of the MOH has shown flexibility in adopting previously unapplied technology to the Honduran program and the Mission is committed to taking the appropriate steps to assure that DCV's approach will be technically and environmentally sound.

The provision of basic water and sanitation services in the rural areas and water quality testing form a major component of Health Sector II. The development of water and sanitation activities, and the health impact of such services will work in concert with and complement child survival activities, and the health impact of such services will be clearly monitored.

Potential water and sanitation activities, e.g., wells, drainage, latrines, etc., that might contribute to vector control problems will be considered by MOH under its responsibility for water quality standards.

2.5 Threshold Decision Determination and IEE Findings

The IEE for the Health Sector II Project Paper recommended a positive determination for the threshold decision and was approved on March 27, 1988. Consequently, this EA was carried out to identify and evaluate potential environmental impacts, and devise strategies to minimize or eliminate them.

2.6 Need for the EA

The Health Sector II PID (522-0216) for this Project addresses environmental concerns under Section VIII, viz., "As a part of this Project, vector control activities will play an important role in the overall health strategy. An environmental examination will be needed in order to assess the effects of chemicals which may be used in malaria control programs. While insecticides will continue to be used under Health Sector II, they will be employed less extensively and less frequently. The Health Sector I malaria control program has been highly successful in lowering the incidence of this disease -- accordingly, the characteristics of malaria control efforts under Health Sector II will be modified. Emphasis will be on physical control of the malaria vector. Direct interventions will include drainage of low water catchment areas near rural settlements and the placement of concrete piping to facilitate this drainage. To be sure, water and sanitation system construction and the placement of pipe to assist malaria vector control can adversely affect the environment. Analysis will be undertaken during the intensive review to determine the extent of such impact and devise strategies to minimize or eliminate it".

Also, the need for EA is clearly mandated by several specific sections of A.I.D. Environmental Procedures 22 CFR Part 216.2(d)(ii), with particular reference to drainage projects (216.2(d)(iv)) and pesticides (216.2 (e)) as well as potable water and sewage (216.2(d)(xi)).

The EA for this Project is also mandated under Pesticide Procedures covered by Section 216.3(10)(b)(1) of 22 CFR 216 and Section 216.5 addressing A.I.D. policy covering endangered species.

SECTIONS 3, 4, AND 5

VECTOR CONTROL ACTIVITIES

SECTION 3

(VECTOR CONTROL)

ALTERNATIVES - INCLUDING THE PROPOSED ACTION

3.1 Proposed Action

The proposed action is to extend support of DCV activities of Health Sector I, but to continue moving more away from heavy dependence on house spraying toward a more integrated approach emphasizing physical larval control, supplemented by larviciding with B.t.i. and house spraying with fenitrothion as operational vector control measures. In addition to vector control, DCV would continue to use chemoprophylaxis and chemotherapy as operational components of the program.

A no action alternative, providing a benchmark to judge proposed project interventions, is not clearly presented in this section.

3.2 Alternative: The Elimination of One or More of the Proposed Actions

Historically, DCV and its predecessors, have relied heavily upon house spraying with a number of residual compounds including DDT, Dieldrin, malathion, propoxur and currently fenitrothion (Sumithion). One by one, the former four compounds, including the chlorinated hydrocarbons (DDT and Dieldrin), the organophosphorus (OP) compound (malathion) and the carbamate (propoxur) became ineffective, due mainly to resistance. However, the current OP compound, fenitrothion, remains effective. Despite problems with resistance, the use of the house spraying measure with available materials has been quite effective in controlling malaria. The use of fenitrothion remains a viable part of the program and should be continued. If this method were withdrawn, DCV would lose perhaps its single most effective weapon against malaria and almost certainly have to place emphasis on chemotherapy and chemoprophylaxis which works well in conjunction with house spraying to interrupt the malaria cycle by attacking the parasite. The only remaining methods, i.e., larviciding and physical larval control would be aimed only at reducing anopheline numbers as opposed to the selective reduction of the vector component of the population. Elimination of the measure of prevention and treatment by drugs is untenable.

The elimination of either physical larval control or larviciding, or both, (the no action alternative), from the proposed activity goes against a major objective of the project

to move toward an integrated approach at the locality level, a course mandated and supported by international and regional health agencies. The elimination of physical larval control would put undue reliance on chemical and non-chemical larviciding. Without these habitat-related activities aimed at vector reduction at the source, it is likely that DCV would revert to an "eradication" strategy. Because the emphasis is on physical larval control under Health Sector II, the alternative of its elimination is fully discussed under its own heading, this section.

3.3 Alternative: The Use of Alternative Insecticides

Aside from its effectiveness as a residual insecticide, fenitrothion (Sumithion) has been furnished by the Government of Japan during Health Sector I and has served the DCV well. Its use should be continued. Every effort should be made to seek continuation of the Japanese assistance. In the event Japan withdraws this support, the Mission should support the continued procurement and use of fenitrothion throughout Health Sector II. Possible alternative insecticides for intra-domiciliary spraying include: bendiocarb (Ficam), not previously used for that purpose in Honduras; or possibly, propoxur (Baygon). Even though propoxur has been used in the program, there is evidence that it has rebounded in effectiveness after removal of selective resistance pressure by periods of disuse (Georghiou et al. 1973).

For larviciding, B.t.i. seems quite appropriate to a number of situations country-wide. It is probably the safest and most publicly acceptable material for the proposed purpose. However, the country has no previous experience with this or other larvicides on an operational basis. Although it is classified as a "biocide" derived from a naturally occurring Bacillus, B.t.i. is formulated as a chemical (crystals produced by the B.t.i. organism), applied as a chemical and evaluated as a chemical. Also, it may be more difficult to apply and monitor than more conventional larvicides, or even some of the newer materials. Alternatives to B.t.i. might include temephos (Abate) for selective habitats in the same operational area; the "monomolecular film", Arosurf, either as a surface spreader (carrier) for B.t.i., or possibly alone as a surface film designed to kill larvae by suffocation. This mode of action is particularly effective against anophelines because of their orientation at the air-water interface.

3.4 Alternative: The Elimination of Operational Control Approaches in Favor of a Response-only Approach

In some situations, this alternative is already in practice, i.e., in areas where malaria is sporadic and unpredictable, reliance may be placed on a radical control response to malariametric data, involving all appropriate tools. This is a viable option at the locality level, but would not be tenable as a country-wide policy.

Alternatives - Including the Proposed Action Pertaining Specifically to Physical Larval Control

3.5 Proposed Action

The proposed action redirects the malaria control effort toward a more integrated program with emphasis on physical larval control (PLC) of the malaria vector, principally *An. albimanus*. Projected measures include water management interventions involving small impoundments -- mainly by draining, deepening, ditching, filling, channeling and clearing activities. The objective is to minimize extraneous lentic water deposits.

Physical larval control activities under HSI included: the filling of small areas (<0.1 ha for filling), the removal of emergent vegetation and the drainage of water from known mosquito breeding areas within 3 km of populations with malaria cases. Sites were prioritized according to malaria incidence and vector density. Drainage ditches were dug and maintained by pick and shovel. Vegetation was removed by machete and rake. Effectiveness was monitored by the effect on malaria incidence and PLC operations were monitored periodically for clogging, regrowth of vegetation, and recurrence of breeding of anophelines.

Under HSII, PLC will emphasize more permanent (less reversible, lower maintenance) measures by the installation of concrete lining to existing and new ditches. PLC operations will be expanded by the use of backhoes and dumptrucks to supplement hand labor in constructing drainage ditches, filling areas, removing vegetation, and steepening the edges of farm ponds where appropriate. By the end of HSII perhaps, two-to three-times the area now affected would be treated and maintained using PLC techniques. However, most target area are quite small.

PLC measures vary depending on the use of water by the owner, the expense of available options, and the effect on downstream flooding. In some cases a short drainage ditch 0.5 m wide and 10 m long would suffice. Under the project culverts may be placed under roadways to eliminate ponding, oxbows and other ponded waters filled, water levels lowered by installing simple

water-control structures, existing streams deepened to drain wet pasture land or more natural wetlands, or other actions necessary to reduce malaria through PLC. Plans are to avoid draining of large areas of marshlands in HSII. Selective larviciding of the areas may be necessary during periods of malaria epidemicity.

3.6 Alternative Action: Exclude Physical Larval Control

This option would result in the broader use of larvicides, and increased dependence on chemotherapy and wall-spraying. If other options were limited in the absence of PLC, e.g., because of environmental hazards, the overall impact of area malaria control could be diminished.

3.7 Alternative Action: To also Drain Larger Areas of Marshlands and Pristine Swamps

The PP addresses swamp drainage as unnecessary for malaria control and states that large areas of marshlands will not be drained. Nevertheless, the reality is that some small areas of semi-natural wetlands have been drained under HSI and more could be drained under HSII largely because of a lack of a clear definition of marshland. A relatively large tract (> 2 ha) of semi-natural wetland, (wetland that is neither pristine nor heavily grazed, such as that which might occur in a floodplain pasture) or a small to large tract of pristine swamp could conceivably become a target site. If so, the proposed action would preclude treat-ment by PLC, and larviciding could become the only viable option other than not treating, or treating despite the policy. An alternative would be to allow PLC at such a site on a limited basis after a site evaluation to determine the loss of habitat and water filtering and storage functions of such areas and weighing the environmental consequences against the use of larvicide with reference to the severity of the malaria incidence of the area. It is anticipated that very few, if any, sites would involve pristine swamp or large tracts of semi-natural marshlands (> 2 ha) since few occur within 3 km of population centers. This option is included primarily to sharpen the issue of swamp drainage.

3.8 Programming Evaluation, Monitoring and Maintenance Activities Under the Proposed Action ... Physical Larval Control

It is anticipated that under Health Sector II, physical larval control (PLC) will be slightly greater than these activities under Health Sector I, and that sites already modified will be maintained and made more permanent by the selective use of concrete linings for drainage ditches and deepened sections of creeks. By the end of Health Sector II, perhaps from 2 to 2.5

times the area now modified will have been modified in order to achieve the proposed reductions in malaria incidence.

Programming. The types of PLC measures currently employed and proposed and a basic outline of the programming procedures are given in the approved Scope of Work. Malariagenic communities are prioritized according to malaria incidence, population density and distribution, and economic considerations. For the highest priority communities, potential breeding sites are located within a 3 km radius of the community and mapped. Sites are prioritized based on the presence of anopheline larvae as determined by continuing sampling. Priorities are determined by the area chief with the help of the regional supervisor, national inspectors, and the entomological staff of DCV. Engineering details are developed for high priority sites and, after obtaining necessary agreement from land owners, control measures are employed. Control measures vary depending on the use of the water supply and cost effectiveness of the methodology options. Occasionally a short drainage ditch, no larger than 0.5 m wide and 10 m long will suffice. Culverts may be put under roadways or streets, pond edges sloped, low areas filled, or water levels lowered by the use of flash boards. Occasionally larger projects including stream-straightening and marsh drainage have been done. Plans are to avoid draining large areas of marshlands in Health Sector II. These sites may be larvicided, but if they are high priority breeding sites for anophelines, they are unlikely to be left alone. Under Health Sector II, lining ditches with concrete is proposed in order to reduce maintenance of the ditches by diminishing plant growth. This action will reduce the reversibility of the modifications.

Evaluation. Malaria control consists of essentially four combined strategies: medication, house spraying, physical larval control, and larviciding. Together, these make the strategy of integrated pest management (IPM). Evaluations are based on malaria incidence. The extent to which malaria declines measures the success of the integrated program. Economic constraints require that malaria be reduced as cost-effectively as possible. It is unlikely that any areas would be unnecessarily treated. The success of PLC measures is based on the reduction of lentic water at top priority sites with a corresponding reduction of anopheline targeted larvae.

Monitoring. Monitoring of the sites is the responsibility of the area chief under DCV guidelines for inspecting sites for plant growth, blockage, presence of larvivorous fish, larval density, etc., on a continuing basis.

Maintenance. Vegetation is removed from ditches and pond edges by machete and rake. Concrete lined drainage ditches must be adequately monitored. Larvivorous fish are sometimes planted for larval control and grass carp are reportedly sometimes planted for plant control. If larvae are present, additional physical control measures or larviciding may be indicated.

The process of programming involves almost the entire structure of the Field Operations Section of the DCV of the MOH, but is heavily oriented toward the area level with assistance from the regional and national levels. The area chief is directly involved in this process. Area chiefs reside in the affected communities. They locate and prioritize mosquito breeding sites, supervise brigades of house spraymen, and work with volunteers to evaluate sites. The area chief is involved in obtaining landowner permission and presumably will direct larviciding (B.t.i.) at the area level. The evaluation of total activities is based on the impact on malaria.

The plan is not to replace the current A.I.D. Advisor to DCV. To insure that environmental guidelines are followed, an advisor dedicated to minimizing impact and controlling malaria should be employed for the LOP or until such time that environmental awareness is raised to an acceptable level. The MOH should work toward an assurance that the concept of wetlands protection is an integral and sustainable feature of the program. In the absence of an advisor, certainly provisions should be made for interim consultation and advice, perhaps from regional sources, such as PAHO, ROCAP, or private consulting firms.

SECTION 4

(VECTOR CONTROL)

AFFECTED ENVIRONMENT

Since affected environments under house spraying with the residual insecticide Sumithion; or larviciding with B.t.i. are not expected to exert significant environmental impact, the emphasis in this section is on aquatic habitats targeted for physical larval control activities. Also, the insecticidal components are extensively addressed under both Sections 3 and 5 of this EA.

4.0 Affected Environment (Types of Aquatic Habitats Affected)--Physical Larval Control

4.1 Proposed Action

Under the proposed action of HSII, those activities performed under HSI will occur on a larger scale and some projects will involve the use of backhoes and dumptrucks, and the lining of ditches with concrete. Even so, the proposed action involves relatively small areas and small scale earth moving activities.

Activities under HSI affected small manmade farm ponds (< 0.5 ha) generally surrounded by pasture, many small manmade ditches along streets generally surrounded by pasture or urban areas, and many very small (4 to 25 m2) areas of ponded water. In addition, a few small streams (1 to 10 m wide) were deepened for a distance of 50 to 500 m and oxbows with still or slowly moving water were filled. Some of these stream beds contained dense vegetation which was removed to speed water flow. Another purpose of the stream deepening project was to drain wet pasture-land or usually small (< 2 ha) areas of slightly more natural wetland (not heavily grazed, but surrounded by grazing land or urban areas and receiving urban and grazing land runoff).

An example of a larger project:

The total area affected by a single project in HSI apparently rarely exceeded 2 ha. The largest project seen was in Sabá where a 2 ha semi-natural wetland in the floodplain of the Rio Aguan was drained by a network of hand-dug ditches. According to the Regional Supervisor this is the largest project in Region 6. Reportedly, 17 caymans were captured from this site and released into the Rio Aguan (500 m away) during the project. The marsh reportedly formed following the torrential

floods created by Hurricane Fifi in 1974. The marsh presently contains emergent grassy vegetation and was observed being used by Muscovy ducks. It is surrounded by pasture and is just below the town of Sabá (which is atop the east bank of Rio Aguan). The marsh undoubtedly receives urban and pasture runoff. The ditches that were dug now contain considerable emergent vegetation and numerous mosquitofish (Gambusia sp.) which were reportedly collected elsewhere and planted for larval control. The Regional Supervisor was concerned about how to remove the vegetation from the ditch without harming the mosquitofish. He was also concerned about the flow of water into the marsh from the drains rather than out. No leveling equipment was used in the construction of the drains.

Under HSII, plans are being made to line ditches and small stream beds with concrete which eliminates regrowth of vegetation thereby reducing maintenance and making ditches and deepened stream projects more permanent (and less reversible). Plans are also being made to deepen larger streams (10 to 50 m wide), lengthen stream-deepening to perhaps 1 or 2 km, and fill larger depressions and oxbows (25-1000 m2). Larger stream-deepening projects will consequently affect larger tracts of wet pastureland and semi-natural wetland (perhaps 1 to 5 ha in a single project) that are active mosquito breeding sites. It is unlikely that even small pristine swamps or wetlands will be affected because these are very rare, especially within 3 km of population centers (the targeted area).

4.2 Alternative: Eliminate Physical Larval Control

Under this alternative the habitats mentioned in the previous section would be subject only to larviciding with B.t.i. -- given the use of water by humans, fish, and wildlife. It is likely that some vector breeding areas could not be larvicided, thus eliminating the larval control option.

4.3 Alternative: Drain Larger Areas of Marshland and Pristine Swamps

Under this alternative even a single stream deepening or ditching project would affect pristine swamps and areas of semi-natural wetlands exceeding 5 ha, and should not be condoned. Other methods (larviciding, use of drugs, increased wall spraying) with less environmental impact are available.

SECTION 5

(VECTOR CONTROL)

ENVIRONMENTAL CONSEQUENCES: ISSUES ANALYSIS AND MITIGATION MEASURES

Evaluation of Pesticide Procedures A.I.D. Regulation 216.3(b) (1)

This section addresses the list of questions pertaining to the use of insecticides under A.I.D. Regulation 216.3 (b)(1) specifically adapted to the proposed uses under Health Sector II. by the DCV under the MOH. The primary focus is on the use of fenitrothion (Sumithion) as a residual house spray aimed at interrupting transmission of malaria by the selective killing of infective Anopheles vectors of malaria, principally An. albimanus; and the use of Bacillus thuringiensis var israelensis (B.t.i.) as a larvicide in selected aquatic habitats of anophelines, again, principally An. albimanus, the principal vector of malaria in Honduras.

Fenitrothion (Sumithion)

5.1 The USEPA Registration Status of the Requested Pesticide

Sumithion is registered with the EPA with various registration numbers, depending upon the formulation (below). The active ingredient is O,O-Dimethyl O - (4-nitro-m-tolyl) phosphorothiate and belongs to the general class of insecticides referred to as organophosphorus compounds. A copy the Sumithion 40 WP label is included in Appendix C of this report. Spanish versions of the label should be procured. This wettable powder formulation represents the largest use in the Honduras malaria control program. Sumithion is manufactured by Sumitomo Chemical Company, Ltd., of Japan. A technical manual fully describing the use of Sumithion, its formulations, toxicity, environmental fate, safety precautions, etc., is on hand at VBC.

The material is currently used by the DCV in a technical formulation for fogging in the control of adult Aedes aegypti mosquitoes, the vector of dengue (EPA Reg. No. 39398-4); in a 40% wettable powder formulation especially designed and packaged for residual wall spraying (EPA Reg. No. 39398-9); and a 50% EC (Emulsifiable Concentrate) used by VBC for residual wall spraying of painted walls only (EPA Reg. No. 39398-2).

5.2 The Basis for Selection of the Requested Insecticide

Under Health Sector I Sumithion has been provided by the Government of Japan and has been used in selected areas

countrywide since 1982. Prior to that time, the Honduran malaria program had used DDT, Dieldrin, malathion and propoxur in its residual wall spraying program, principally under the principles and practices of the worldwide malaria eradication program. The material was selected on the basis of WHO test results after regional testing in various parts of the world, including Central America. The Twentieth WHO Expert Committee has recommended the use of fenitrothion 40% WP for mosquito control by residual spraying of human dwellings at specific rates of application.

The recommended rate of 2 gr./sq. m. is used in the Honduran program. An environmental assessment (EA) was prepared by the A.I.D. Technical Advisor to DCV in 1985 (Stivers, 1985), further contributing to the continued and projected use of the material during the period of Health Sector II.

5.3 The Extent to which the Proposed Insecticide Use is Part of an Integrated Pest Management Program

Only since the basic strategy of international health agencies, e.g., WHO, PAHO, has tended to move away from a major reliance on one method of vector control against malaria (residual wall spraying of dwellings) toward the encouragement of a locally designed control strategy, has there been much effort toward integrated approaches by specific countries, including Honduras. However, in recent years DCV has begun to incorporate physical larval control as a principal methodology and under Health Sector II would increasingly add selective larviciding to its vector control program. In many situations, the use of house spraying would continue to be an integral and important component of an integrated system. For example, in some rural situations of scattered housing or low agricultural chemical pressure (affecting susceptibility levels of vector species in the area), it is conceivable that residual house spraying could be a most effective measure, especially when supplemented by selective larviciding and chemical prophylaxis and treatment, perhaps only during periods of malaria epidemicity.

5.4 The Proposed Method or Methods of Application Including Availability of Appropriate Application and Safety Equipment

The method of application differs little from that of intra-domiciliary spraying going back to the 1950s and 1960s when other insecticidal compounds were employed. Essentially, a premeasured packet of material is made into a sludge and mixed in a 2-gallon hand sprayer with water and sprayed on the interior walls or outside eaves of dwellings following strict protocols developed by WHO. The spray teams are well equipped with sprayers, mixing buckets, paddles, gloves, masks and provided with specific

training by DCV at the brigade level (5-7 men) when newly employed and at least once annually during employment. Safety measures and spraying efficiency are monitored by three inspectors out of the central office and by regional and area chiefs.

5.5 Any Acute and Long-term Toxicological Hazards either Human or Environmental, Associated with the Proposed Use and Measures Available to Minimize such Hazards

The proposed use of fenitrothion would not be expected to present long-term or acute hazards since the material is used only for house spraying and in a manner consistent with long term practices. Spray teams and occupants of the sprayed houses, on the other hand, may represent a potential risk, but this eventuality is considerably reduced by proper use and proper precautions in terms of following the insecticide label requirements to the letter. According to DCV, cholinesterase levels of spraymen are checked at least at six month intervals, more often than not at four months, and in some cases, e.g., Catacamas, at monthly intervals. The frequency of testing is based on frequency and duration of exposure. DCV has a toxicology unit responsible for this activity. The recommended treatment for poisonings with Sumithion include atropine and PAM both of which are available at the regional level or wherever a MOH physician is based. Manuals on pesticide poisoning and other reference materials are available at DCV and the program seems cognizant of the potential hazards, precautions, and necessary actions for monitoring and emergency treatment contingencies.

5.6 The Effectiveness of the Requested Insecticide for the Proposed Use

Fenitrothion (Sumithion) seems to have served the malaria control program well. The reduction in malaria cases since the inception of its use and continuing reductions during the most recent year (29,130 reported cases in 1986 against 18,000 cases in 1987), is some testimony to its effectiveness during a time when it continues to be a principal method. The familiarity of the program with the material, the experience with its use, and the extensive 1985 EA are all attributes favoring the extended use of fenitrothion as a residual wall spray. While resistance to the insecticide will probably eventually develop, the process could be slowed considerably by using it carefully and selectively in an integrated approach as planned under Health Sector II. DCV has an extensive susceptibility testing program in place for Sumithion under the Entomology Section and it is anticipated that even incipient tolerance to the insecticide by An. albimanus would be rapidly detected. For the foreseeable future it is unlikely that the insecticide will become

operationally ineffective as used. While one other organophosphorus compound (malathion) and a carbamate (propoxur) have previously become ineffective in the Honduran program, fenitrothion remains effective and should continue to be used especially during a period of declining malaria cases coupled with increasing control activities employing other methodology. The decreasing use of fenitrothion could lengthen the life of its usefulness.

5.7 Compatibility of the Proposed Pesticide with Target and Non-target Ecosystems

Fenitrothion is currently effective against the principal target *An. albimanus* and also against *Ae. aegypti*, the vector of dengue, and surely against other household pests. Since the insecticide is used only on inside surfaces of dwellings it should not impact other ecosystems.

5.8 The Conditions Under Which the Insecticide is Used, Including Climate, Flora, Fauna, Geography, Hydrology and Soils

The insecticide is used only in intra-domiciliary applications for malaria control, thus not involving other aspects of this section.

5.9 The Availability and Effectiveness of Other Insecticides or Non-Chemical Control Methods

For the foreseeable future, it is unlikely that another insecticide of equal efficacy will become available for the specific use of intra-domiciliary spraying in Honduras. However, should resistance develop to the point of rendering this insecticide ineffective, the DCV is prepared to conduct pilot studies with bendiocarb (Ficam) or perhaps even take a fresh look at Baygon (propoxur) in that some population studies have shown a rebound in its effectiveness after removal of selection pressure (Georghiou et al. 1973). Alternative measures being used by DCV (physical control and larviciding) as well as the inclusion of fenitrothion in integrated approaches are expected to gradually reduce the heavy dependency on this material.

5.10 The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use and Disposal of the Requested Pesticide

The DCV in Honduras is well organized at the central level, at the regional level, the area level, the sector level and even down to the brigade level. The Central Office has Field Operations, Epidemiology, Education and Administrative Sections.

Additionally, the central office has three full time national inspectors in malaria. the Field Operations section has Engineering, Ae. aegypti, and Malaria components. Each region has in place or budgeted under Health Sector I a well constructed, masonry, ventilated warehouse for the storage of insecticides (see Appendix B, Figures 8 and 9). Also there is a similar central warehouse. All of these structures are behind fences, relatively isolated and guarded 24-hours per day. Facilities for washing and cleanup are included (Figure 8). The packaging of Sumithion is in individual, labeled, water-resistant pouches, enclosed in plastic bags and packed in sealed durable cardboard boxes, also fully labeled. The emulsifiable compound (EC) and technical materials are in standard drums. Provision is made for supervision and caution from unloading to transport to warehouse, to field delivery, to use, to disposal of containers by burning and burying in landfills.

Any deficiency would seem to be in minor problems in storage, easily correctable and in maintaining a continuing monitoring system. Deficiencies in storage noted by the team included a lack of palleting in the Catacamas warehouse at Santa Maria Real and in the central warehouse (Sausique) in Tegucigalpa. Also, there was some blockage of ventilation and possible exposure to sunlight or rain among those containers stacked to the ceiling at the Sausique site. However, these things were relatively minor and could be corrected simply by installing louvered windows as already exist in the Santa Maria Real facility. The installation of louvered structures and use of pallets are recommended for all existing and projected insecticide storage facilities. Completion of all warehouses, already budgeted should be expedited.

5.11 The Provisions Made for Training Users and Applicators

The DCV through its Education, Field Operations, Central Inspectors, and Administrative Sections is sensitive to training needs. All new spraymen are given pre-assignment training and all personnel are trained once annually. Outside training and technical assistance are available through PAHO and other extramural organizations.

5.12 The Provisions Made for Monitoring the Use and Effectiveness of the Insecticide

DCV through its Field Operations Section, its national inspectors and staff entomologist conduct extensive insecticide susceptibility monitoring as well as bioassays to determine residual effectiveness of fenitrothion. An effort is made to test mosquito populations from a number of localities in each

region on an annual basis. If incipient tolerance is found, retesting is done and the area receives increased monitoring.

5.13 Bacillus thuringiensis var. israelensis (B.t.i.)

This section addresses a check list of questions regarding the use of Bacillus thuringiensis var. israelensis (serotype 14), or B.t.i., proposed as a principal method of malaria vector control under the Health Sector II Project. The check list follows A.I.D. Environmental Procedures 22 CFR Part 216.3(b)(1). Since B.t.i. has not been previously used except in limited experi-mental situations in Honduras, responses to the check list questions are largely speculative, but are based on field site visits in Honduras, observations on DCV organization and its track record in dealing with insecticides in general, reference to pertinent literature and transferable experience of the EA team specialists. Detailed documents treating B.t.i. as a mosquito larvicide include: WHO. 1982. Data sheet on the biological control agent Bacillus thuringiensis serotype H-14 (Barjac 1978); Lacey, L.A. & M.S. Mulla, 1988. Safety of Bacillus sphaericus and Bacillus thuringiensis var. israelensis to non-target organisms in the aquatic environment (in ms.); and (3) various company brochures and labels.

5.14 The USEPA Registration Status of the Requested Pesticide

B.t.i. is produced and marketed by several companies in North America, England and Western Europe. Available materials include Vectobac produced by Abbott Laboratories of North Chicago, Illinois, available in both liquid and granular formulations. The liquid is Vectobac-AS (EPA Reg. No. 275.52) and the granular Vectobac-G (EPA Reg. No. 275-50). Teknar is a product of Zoecon Corp. (Professional Pest Management) of Dallas, Texas. Formulations are registered under EPA Registration Nos. 2724-316-5089 and 11273-53. Bactimos is marketed by Biochem Products of Belgium and is available as a wettable powder (WP) and as a flowable concentrate. The WP formulation can be mixed with sand and applied as a granular material for penetrating vegetative cover. Skeetal FC (flowable concentrate) is manufactured by Microbial Research, Inc. of England and is marketed in the United States by Microbial Research, Inc. of Wilmington, Delaware (EPA Reg. No. 49054-5). Available labels for B.t.i. appear in Appendix C. Appropriate labels and technical manuals covering all available B.t.i. products should be procured by DCV prior to selection of specific formulations for specific uses. Spanish versions should be procured.

5.15 The Basis for Selection of the Requested Insecticide

B.t.i. represents probably the safest mosquito larvicide for country-wide use in Honduras in that it is rather specific for mosquitoes and closely related nematocerous diptera; it is derived from a naturally occurring soil Bacillus and is regarded as a non-chemical biocide; its mode of action requires ingestion by the larvae; it is available in appropriate formulations; and has wide public acceptance. Honduras has no "experience bank" with operational larviciding -- thus, an environmentally safe and culturally acceptable larvicide is important to the program. It is recognized that considerable field testing under a variety of conditions will be required. Some field testing has already been accomplished. The material would seem to be particularly useful in areas where conventional larvicides, e.g., organophosphorus compounds might already have developed resistance due to pressure from insecticides used in agriculture. While the material has not been previously used in Honduras malaria control, neither have conventional larvicides and some 5,000 tons of B.t.i. have been used worldwide, affording considerable transferable background.

5.16 The Extent to which the Proposed Insecticide Use is Part of an Integrated Pest Management Program

Under the Health Sector II, it is proposed that B.t.i. will be used mainly to complement the use of residual wall spraying and physical larviciding approaches. Site visits indicate that the majority of habitats targeted for B.t.i. use would be in relatively small bodies of water easily accessible. In some locales, the use of B.t.i. might be a principal approach (e.g., agricultural areas with pre-existing resistance to organophosphorus compounds which would render house spraying with fenitrothion less effective). In some other situations, it would be used in various combinations with other available methodology, but always determined for the local site.

5.17 The Proposed Method or Methods of Application Including Availability of Appropriate Application and Safety Equipment

It is probable that the most frequent method of application would be by hand pump sprayer of the same type long used by malaria control brigades for house spraying. Use of wettable powder, water based sprays and flowable concentrate sprays are envisioned. An important consideration in anopheline larval control is that only the surface of the water is targeted. Thus, it is conceivable that B.t.i. could be combined with a surface surfactant (spreader) to better target the material.

5.18 Any Acute and Long-term Toxicological Hazards either Human or Environmental, Associated with the Proposed Use, and Measures Available to Minimize Such Hazards

The proposed use at dosages sufficient to affect anopheline larvae only on the surface of the water and the inherent safety of the material are such that neither acute nor long-term toxicological hazards are expected.

5.19 The Effectiveness of the Requested Insecticide for the Proposed Use

The efficacy of B.t.i. has been demonstrated against vector species of mosquitos worldwide and results are detailed in both the WHO document (1982) and the Lacey and Mulla document (1988) listed above and referenced in Section 8. Although B.t.i. has often been less effective against Anopheles than some other genera of mosquitos, it is likely that formulations combined with available carriers will allow the material to target the water surface -- with potential for even double action, i.e., larval ingestion of B.t.i. and larval suffocation from the spreader. A "monomolecular" film such as Arosurf would seem particularly promising for this purpose.

5.20 Compatibility of the Proposed Pesticide with Target and Non-target Ecosystems

The selective nature of B.t.i. against only mosquito larvae and near relatives, activity restricted to the water surface, and its known lack of effect on humans, other mammals or aquatic fauna other than nematocerous diptera, combine to make B.t.i. extremely compatible with target and non-target ecosystems. The concern most often registered about the material's effect on non-target organisms is associated with lotic habitats (moving water). An. albimanus tolerates essentially no moving water, essentially nullifying these concerns.

5.21 The Conditions under which the Insecticide is Used, including Climate, Flora, Fauna, Geography, Hydrology and Soils

As stated above, B.t.i. would be used against species that occur only in lentic habitats (still water) and targeted for the surface where An. albimanus concentrates. The material would be used mostly in relatively small, isolated bodies of water with surface vegetation and floatage, water not frequented by domestic animals or humans. The material would likely be used only where other methods, e.g., physical control and house spraying, are not indicated.

5.22 The Availability and Effectiveness of other Insecticides or Non-Chemical Control Methods

There are available effective and relatively safe chemical larvicides for Anopheles control. Probably the most efficacious chemical larvicide would be temephos (Abate). Temephos can be applied at extremely low doses for anopheline control, e.g., The Tennessee Valley Authority used this material for control of Anopheles quadrimaculatus operationally over a 17 year period on its reservoirs at rates of .001 to .004 pounds per acre, depending on foliage penetration requirements. Temephos could possibly be used in Honduras, but only in areas where organophosphorus cross-resistance from agricultural practices is not a factor. It could even be preferable to B.t.i. in such habitats as drainage ditches along streets and roadsides not used for bathing or washing by humans or for drinking by domestic animals. Even some of these situations would probably pose no real threat if the chemical were properly used -- but, given the choice, the program should employ the safest larvicide possible. Other possible larvicidal materials would include the newer insect growth regulator (IGR) compounds which kill mosquito larvae by interference with normal growth and development (e.g., Altosid), and the "monomolecular films", i.e., highly refined oils which kill mosquito larvae by suffocation at the surface of the water (e.g., Arosurf). Although Arosurf could be used alone, it is likely that the best use of the material would be as a spreader for temephos or B.t.i. to keep these materials at the air/water interface. Should other insecticides, such as Abate, be considered for use under this project? An amended EA must be prepared and approved by the LAC Chief Environmental Officer prior to their use.

5.23 The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use and Disposal of the Requested Pesticide

The DCV in Honduras is well organized at the central level, at the regional level, the area level, the sector level-- even down to the brigade level. The Central Office has Field operations, Epidemiology, Education and Administrative Sections. Additionally, the DCV has three full time national inspectors in malaria. The Field Operations section has Engineering, Ae. aegypti and Malaria components. Each region has in place, or budgeted under Health Sector I, a well constructed, masonry, ventilated warehouse for the storage of insecticides. Also there is a similar central warehouse. All of these structures are behind fences, relatively isolated and guarded 24-hours per day. Facilities for washing and cleanup are included (see Appendix B, Figures 8 and 9). The same systems already in place for

Sumithion would serve well the purpose of B.t.i., or other insecticides.

5.24 The Provisions Made for Training Users and Applicators

The DCV through its Education, Field Operations, Central Inspectors and Administrative Sections is sensitive to training needs. All new spraymen are given pre-assignment training and all personnel are trained once annually. Outside training and technical assistance are available through PAHO and other extramural organizations with which DCV is thoroughly acquainted. With no experience in operational larviciding, however, DCV personnel would require extensive training in all aspects of dealing with a technology new to the program. However, the use of essentially the same handling, mixing and spray tank preparations required for fenitrothion spraying would apply to any larviciding program. Important to the success of a mosquito larvicidal program is the frequent field monitoring of widely fluctuating mosquito populations and their response to the larvicide. Training and retraining programs should be developed using outside technical assistance, principally PAHO, as mosquito larvicidal programs are implemented. A protocol manual similar to the one already available for fenitrothion (Honduras MOH, 1986) should be developed by DCV to cover all aspects of B.t.i. use.

5.25 The Provisions Made for Monitoring the Use and Effectiveness of the Insecticide

Because B.t.i. larviciding has not yet been implemented in Honduras, a monitoring program has not been established. However, the existing organizational framework of DCV certainly has the capacity to receive and deliver appropriate training of field larviciding crews in all phases of pre-treatment evaluations, treatment with the material, post-treatment evaluations, and periodic field bioassays needed for a long-term monitoring program of the effectiveness of larviciding. The addition of a medical entomologist, already projected, to the staff of DCV and the presence of a foreign advisor would help assure the development and implementation of an adequate monitoring system for B.t.i. in the malaria control operation.

5.26 Physical Larval Control

Proposed Action

According to the SOW telex (# 03718) "the primary habitat of Anopheles albimanus, the main vector of malaria in Honduras, is in still or slowly moving fresh water with emergent vegetation.". The definition could serve very well as a definition of wetlands,

for which known and suspected functions are highly valued in the United States. Perhaps the most scientifically well-supported and relevant functions of wetlands are:

1. Habitats for specialized animals and plants.

2. Storage and slowing of water, which reduces downstream flooding, and

3. Filtration of water (removal of some fine particles, nutrients, and pathogens) from runoff passing through a wetland.

4. Concern about significant loss of these wetland functions undoubtedly contributed to the need for this EA. Not every wetland performs these functions well or at all, depending in part on their size, and the quantity and quality of runoff entering the wetland. Large tracts of pristine wetland are the best wetland habitat, but such wetlands may not function as filters because entering waters may already be very clean. In such cases, wetland outfall could conceivably contain more organic matter and plant nutrients, such as nitrogen and phosphorus, than did entering water.

Although physical larval control operations will directly and unavoidably eliminate wetland, several factors make a significant environmental effect unlikely or negligible in most projects. First and foremost is the small size of most projects. The frequency distribution of project size would undoubtedly show a mode of less than 0.5 ha, with few projects, if any, exceeding 5.0 ha. Secondly, and nearly as important, is that most projects involve manmade water bodies such as farm ponds, roadways, and existing ditches, or heavily grazed, wet pastureland. Thirdly, engineering criteria currently used considers both human water-use (generally irrigation, livestock watering, washing and bathing) and downstream flooding. Fourthly, in many cases potential breeding sites will not actually be treated by any means, either because they contain no larvae, they do not occur near populations with a priority malaria incidence, or they are inaccessible. Fifthly, the small size of all projects relative to the steep watersheds, high rainfall during the wet season, and surrounding urban and grazing land-use help to overcome the filtration and water retention functions of project sites.

The projects with the greatest potential impact are those that affect semi-natural wetlands that are the target of stream-deepening or ditching projects. Lining of ditches with concrete makes these modifications far less reversible. Some loss of habitat, filtration, and water retention capacity is possible in

these cases. According to the engineering criteria, projects that would have a significant impact on downstream flooding are not projected. The filtering characteristic of a wetland relates to some degree to its water retention characteristics, so the downstream flooding criteria may act serendipitously as a water quality criteria also. Actual direct determination of the water filtration effect of wetlands is prohibitively expensive in the context of Honduran vector control.

Habitat losses will be more significant if alternative, similar habitats are unavailable in the vicinity or if endangered species occur in the affected areas.

As projects become larger, more numerous, and more permanent in HSII, the risk of the loss of these uncertain wetland values increases, though it is very unlikely that the total area affected by PLC within 3km of a priority population would exceed 28 ha (1% of the total land area within 3km), or that a significant fraction of the wetlands of Honduras can be eliminated, given the small amount of funds allocated to the project. The main means for mitigating all these effects is to keep the size of projects small. Nevertheless, if endangered species happen to occur in a site, PLC measures should not be used.

5.27 Endangered Species

A.I.D. environmental policy includes identification of global impacts of A.I.D. projects that affect all mankind (Environmental Procedures 22 CFR Part 216.1 (b)(1). Protection of endangered species is of global concern. Although during this brief assessment it is impossible to determine with certainty that endangered species will not be affected by physical and insecticidal vector control operations, the small size of the projects would tend to reduce the probability. Furthermore, alternative similar habitats exist that are not targeted for control measures either because they do not contain vectors or because few people occur within the 3km radius identified as a public health criterion. Therefore, no significant effect on any endangered plant or invertebrate animal is anticipated. Improved knowledge of the endangered plants and invertebrates of Honduras would allow an increase in certainty, but, no lists were available for these biota. Twenty seven species of vertebrates, however, are listed as threatened or endangered in Honduras. Of these, only two could be potentially affected by vector control activities. These are the American crocodile (*Crocodylus acutus*), which occurs in coastal (generally brackish to saline) lagoons and swamps, and the banded tiger heron (*Tigrisoma fasciatum*), which occurs in lowland tropical wetlands. The other 25 species are found in habitats not affected by HSI, or HSII

vector control activities. (i.e., rain forests, marine waters, terrestrial).

Because drainage of coastal swamps was apparently not done in HSI and is not proposed in HSII, no affect on American crocodiles is anticipated.

Because larval control sites are always located near population centers (3km radius) and usually involve little or no large areas of natural lowland wetland, any effect on the banded tiger heron is unlikely. Again, the major means for mitigating these effects is to keep the size of projects small and avoid areas used by these species.

5.28 Alternative: Do No Physical Larval Control

Under this alternative, environmental consequences of PLC would be totally eliminated, but would be replaced by environmental consequences of larviciding, and wall-spraying (see appropriate Section) as well as a likely increase of malaria epidemics.

5.29 Alternative: Also Drain Larger Areas of Marshlands and Pristine Swamps

Although unlikely ever to be necessary, drainage of pristine swamps in contiguous areas of semi-natural wetland greater than 5 ha would carry greatly enhanced risk of significant effects on (1) habitats for specialized animals and plants; (2) downstream water quality; and (3) downstream flooding.

Large contiguous tracts of habitat are much more valuable to large vagile animals than the same total area of smaller tracts separated by human activities. Large tracts are also more likely to contain endangered species. In addition, large tracts contain more slow moving water so are more effective at water filtration and prevention of downstream flooding.

SECTIONS 3, 4, AND 5

RURAL WATER AND SANITATION COMPONENT

SECTION 3

(RURAL WATER AND SANITATION)

ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 Proposed Action

The proposed action is to continue and expand the work of the Rural Water and Sanitation Project (No. 522-0166) in Health Regions 3,5 and 6 covering a total of 9 Departments (map provided in Appendix H) in the north and northwest parts of Honduras. The Health Regions identified have the highest population concentrations per square kilometer along with correspondingly high rates of infant mortality due to water-borne diseases as well as malnutrition. The project design proposes to build more than 500 gravity fed community water supply systems, some 1600 wells equipped with handpumps, some 52,000 water-seal latrines, 20,000 pit (dry) latrines and 73 septic systems. Other components include enhancing maintenance abilities for the physical systems constructed, increased promotional and educational capabilities and emphasis on water quality testing.

The construction of the various projects of the rural water and sanitation component represents usually confined activities occurring at preselected locations according to certain standards or criteria of design. The degree of environmental intervention is largely dependent on the given location and the applied design criteria for a given component. The design criteria to be utilized in the project have been reviewed both in written form and in the field. For clarity, different physical components will be addressed separately including alternatives that may apply. This format will be carried through the report for ease of reference.

3.2 Alternative: Criteria for Water Supply Sources for Community Water Supply Systems

Water sources for community water systems are proposed to be selected according to certain essential physical requirements to assure the proper functioning of the system to deliver water. Economic constraints exist that usually rule out water sources too distant from a community. The safest quality of a water source is usually considered along with some analytical tests to confirm the assumption. A somewhat small consideration of the status and protection potential for the surrounding watershed is proposed in the project.

Given the priority importance of selecting the best quality of water source, certain alternatives can apply. The first alternative is through flexibility of economic criteria to allow a greater project expanse to reach a water source of better quality or better protection. This design flexibility can be established within what would be reasonable limits of affordability taking into account the variables of size of community to be served, amount of water, status of watershed protection and other judgmental factors. This concept must also be communicated to those in the field, the promoters and field engineers, that such flexibility is possible.

Due to the confined nature of a water source intake structure, the actual physical impact of locating a water source intake at a longer distance from a community is believed to be minimal. The benefits of selecting as pure a water source as possible are essential for the intended benefits of the project. The possibility of avoiding the necessity of water treatment of the water source is another potential benefit.

An example of the first alternative is the choice between water sources selected within small streams thus capturing essentially surface water versus selecting wherever possible a water source at its origin from the ground, thus avoiding surface water altogether. Again, economic affordability must be considered but wherever a reasonable greater expense can result in a spring water intake instead of a river intake, the choice should be the spring. This assumes sufficient quantity as well.

A second alternative in water source selection criteria is to consider the status of the watershed at present and its potential for either deterioration or protection. At present, little or no consideration is made of the physical status of the watershed where a water source is proposed. The item of present focus regarding the land at a water source is its present ownership and permission to utilize its water.

The impacts due to watershed destruction are evident throughout the country and many times communities are confronted with conflicting watershed uses that result in diminished water supply from their source. Contamination due to uses above and surrounding a water source also occur. A study of the physical status, existing uses and ownership of the surrounding watershed for a water source could be part of the initial promotion work undertaken by the project with assistance from each community.

Potential protection measures to mitigate watershed deterioration could also be defined early with the necessary arrangements, legal work and physical measures undertaken to insure the quality and longevity of a water source. The project

design has provided greater manpower and time available per community than the earlier phase and therefore no additional manpower is believed to be needed. It is understood that the Mission has complementary programs (e.g., reforestation) through PVOs and through use of local currency funds that are to be coordinated with this Health Sector II Project.

3.3 Alternative: Criteria for Water Wells

The project design has allowed for multi-family wells in locations where appropriate, e.g., where no community water source is available or affordable. Water wells are located according to criteria to allow adequate physical distance between potential pollution sources, e.g., latrines. Community promotion work attempts to establish a group responsible for the continued protection and operation of each hand pumped well.

Surface runoff of excess pumped water or nearby rainfall drainage is normally accomplished with a concrete sealed top over the well. A commonly discussed item is a drainage pit to allow excess pumpage/drainage to enter an underground filter/absorption pit. The latter, however, is not commonly seen in spite of its importance to eliminate standing pools of water. Standing pools of water are potential breeding sites for some vectors (mosquitoes, flies) as well as eventually becoming septic from surface contamination.

A suggested alternative in establishing a multi-family well is to require the construction beforehand of the standard drainage pit before actual delivery of the hand pump complete unit. Too many times the drainage pit is left as an after thought or simple trenches are installed to replace the drainage pit, in either case resulting in poor or no drainage of the used water. This practice should also be included in community promotion work to establish drainage pits where the family water discarding occurs; e.g., at each families outside small tank or "pila" where everyday washing occurs.

3.4 Alternative: Criteria for Latrines

The project design for family latrines has placed proper emphasis on the water-seal type (a.k.a. "pour/flush" or "taza campesina") to apply in communities served with water systems. The water-seal latrine is popular and is utilized in other projects as well, e.g., housing projects in rural areas. Criteria for locating is generally left up to the family's preference to have inside or outside their home. However, requirements for a 100' separation for latrines and groundwater sources should be established.

In the case of an existing high groundwater table, design modifications are made to make a latrine shallower than normal but longer, thus allowing separation between the bottom of latrine and the groundwater. This type of shallow latrine (a.k.a. "tipo-tumba") is recognized as necessary in areas of high groundwater. Since no wells are intended to be placed in communities with pour/flush latrines, the possibilities of cross contamination are minimized.

In the case of very high groundwater preventing the use of a standard latrine, various surface-enclosed composting types have been built. Again, it is recognized that a standard design is not appropriate and that a "higher technology" type is needed. A commonly applied design of composting latrine (a.k.a. "tipo Viet-Nam" or "tipo abonera") has met with mixed results. Other standard designs are reportedly being utilized in Guatemala.

The alternative presents itself therefore to obtain other designs to prove which works best under what circumstances. An experimental program is recommended to prove different designs as best for either high groundwater or rocky areas.

3.5 Alternative: Criteria for Runoff Protection

Runoff water can cause erosion damage or problems with standing water. Overflowing water from water source intake structures usually is allowed to follow its natural course without modification. Overflow from storage tanks is usually directed away from the structure so as to minimize potential foundation damage. A small canal may sometimes be needed to direct water in a desired direction to avoid erosion and/or standing water. Simple piping of such overflow waters in an effective technique.

A greater problem exists with community household water discarding resulting in standing waters along ditches, in pools or depressions, and generally creating a nuisance or at worst a breeding site for disease carrying vectors. A potential to eliminate this problem of drainage waters exists during water systems construction.

When work crews are digging ditches and making connections, a possibility exists at that time to install simple cross ditches and/or pipes which would connect the major drainage depressions along road ways, in yards or wherever. A commitment would need to be made during community promotion work to accomplish this along with the provision of materials as needed through the project.

It is believed that the financial impact of increased materials (e.g., large diameter PVC pipe, 6" average diameter) from these efforts would easily be absorbed within the contingency allowance for each project. The field engineer and promoter could include in their visits the direction to accomplish the desired drainage of the small areas and to recommended alternative measures as needed.

3.6 Alternative: Criteria for Analyzing Watershed Impact

The project design calls for enhanced water quality testing at the three new MSP regional offices to be built by the project. Capability to test water from existing systems for physical, chemical, and biological parameters is intended at these offices. Also, SANAA field teams are to be equipped with portable bacteriological test kits to test proposed water sources. No other baseline water quality tests are proposed for evaluating proposed water sources. Water quality criteria are stated to be based on (1) turbidity, (2) color, and (3) bacteriological parameters to determine the acceptability of a water source.

In addition to water quality testing for water source selection, the project should also provide monitoring of the impacts of construction or operations on downstream watershed conditions. During construction, there is a potential impact on water turbidity and color from soil erosion (especially where instream intakes are built). During operations, there is a potential adverse impact on river or stream water quality if latrines are constructed where high groundwater levels exist. In both cases, periodic monitoring of representative watersheds is needed to ensure that proper construction practices are followed and that latrines are correctly designed and sited.

For each representative watershed, a baseline analysis should be carried out and periodic monitoring during construction and once a year after construction should be programmed. Indicators for potential environmental impacts from the project should include turbidity, color, fecal coliforms, and nitrates. If unacceptable levels of nitrate occur, then the water upstream of possible latrine contamination should be sampled to determine if the problem is caused by agricultural practices. Likewise, bacteriological contamination should be checked to verify that it is not coming from upstream of project facilities.

Given the vulnerability of water sources in general to the effects of watershed deterioration, the assurance of water quality over the long term is in part dependent on some degree of monitoring from the inception of a project and carried into the future.

The services of the program "Centro de Estudios y Control de Contaminantes" CESCCO (Center for studios and Control of Contaminants) are available to assist in providing the types of analyses needed to establish baseline water quality data (e.g., all normal water chemistry and hydrocarbons analysis for pesticides) at the inception of the project.

3.7 Alternative: Criteria for Maintenance of Water Systems

The project design includes improved measures for long term maintenance of the community water systems. As recommended in WASH Report No. 169-S, June 1986 (Summary of the Evaluation of the Rural Water and Sanitation Project in Honduras) a high priority is needed to establish an effective operations and maintenance program as has been established for the PRASAR Phase I Project. Increased funding and personnel are needed to ensure adequate and periodic maintenance.

The project design recognizes this need and calls for additional TEOMARS (field maintenance technicians) to work in the three new regional offices to be funded by the Interamerican Development Bank (IDB). No organization design for the TEOMAR based maintenance concept has been defined yet, but is intended to be included later. Fees collected by the communities served are intended to finance the maintenance organization of SANAA/OMUR.

The Project Paper, in Appendix F. 4 and 5, describes maintenance choices and financing through community collections. The statement is made to establish the standard family fee at L. 2.50 ($1.25) per month while recognizing that charges will have to be increased over time to cover rises in costs. Reference is also made to the poor results of establishing the basic family fee at L. 4.00 ($2.00) per month as previously recommended in the WASH Field Report No. 129, Sept. 1987 (Operation and Maintenance of Rural Drinking water and Latrine Programs in Honduras).

The latter report recognized the importance of resources to perform maintenance work in a program along with trained and willing operators. The plan presented in F.R. No. 129 called for the establishment of regional maintenance centers funded separately and directly from community collections. To date, no separate regional fund specific to SANAA/OMUR regional maintenance offices has been established. However, a proposed separate fund for SANAA/OMUR for the PRASAR projects is said to be forthcoming in 1988.

No identification of the success of community collections to date is made in the Project Paper although reports exist of locations where a highly motivated SANAA/OMUR engineer (whose salary is paid by SANAA/PRASAR funds) has succeeded in establishing community collections sufficient to organize and plan maintenance activities in his area. More information is needed to identify the factors contributing to the success of the collections and maintenance work in the above mentioned area.

At present, efforts should be seriously considered to set up the to be defined maintenance structure as proposed in the 3 regional offices. Given that a significant number (430 water systems; 1,800 wells) of water systems have already been built in the PRASAR Phase I program, a great need exists at present to establish a functioning maintenance system to protect initial human and financial investments. If a maintenance system is not planned to be set-up until community collections are self-supporting of the system, such a system may never result. A serious commitment towards strengthening and expanding the PRASAR Phase I maintenance program as soon as possible after project initiation is imperative.

3.8 Alternative: Criteria for Environmental Evaluation

The project design calls for two overall project reviews. The first is planned after 20 months, the second during the final project year. No specific environmental monitoring/evaluation work is described.

An alternative would be to perform an annual assessment of environmental impacts of the water and sanitation project. The intent would be to focus on the most significant areas of environmental concern to assure that the project is addressing these early on and as a guiding principle in the progress of the project.

The alternative of no environmental assessments during the course of the project may have the result of some aspects being overlooked and never incorporated into the projects. Analysis of some monitoring parameters (e.g., water quality records, runoff/ drainage problems) could also shed light on mitigation measures to undertake. Watershed direct and indirect impacts of projects should also be of concern especially relating to multiple use watershed areas.

SECTION 4

(RURAL WATER AND SANITATION)

AFFECTED ENVIRONMENT

4.1 Proposed Action

The affected environment is primarily the rural areas in the three health regions in the north and north west departments of Honduras (see map in Appendix H). The coverage area ranges from elevation extremes of coastal banana plantations to mountainous coffee growing areas.

4.2 Alternative: Criteria for Water Supply Sources for Community Water Supply Systems

Water sources of greater quality or protection within a watershed but located at distances outside of standard norms would result in longer water transmission pipelines traversing more land to reach a given source. The pipeline construction would be confined to the transmission route. The water source intake would be confined to the best location possible to capture pure and protected water, ideally at the spring origin. The affected environment would be no different than water sources built under normal criteria. The avoidance of stream damming may instead be the resulting non-affected environmental benefit.

The study of the watershed status and potential for either deterioration or protection would apply to the individual water source environment where it is found. The affected environment would depend on its present status of multiple use (e.g., cultivation, cattle, dwellings) or natural state of a watershed.

4.3 Alternative: Criteria for Water Wells

Multi-family water wells are located within groups of dwellings in a community, typically for 5 to 10 homes. Suggested construction of drainage pits as prerequisite to final hand pump provision by the project would only affect the immediate land at the well site. Suggested drainage pits at points of family water discard are again at the locations of direct usage within family home areas.

4.4 Alternative: Criteria for Latrines

Specially designed latrines for difficult high groundwater on rocky ground would be placed near dwellings. The experimental program suggested would only place a few differently designed

latrines at such locations in order to determine their appropriateness in the project.

4.5 Alternative: Criteria for Runoff Protection

Water accumulations recommended to be drained via ditching and/or piping would affect only those ditches, pools or small water accumulations typically found in a community. The affected environment would be in the immediate vicinity of dwellings and the downstream natural drainage courses to be diverted to.

4.6 Alternative: Criteria for Water Quality Testing

Enhanced water quality baseline measurements are intended only in those multiple-use watershed areas determined to be vulnerable to water source contamination.

4.7 Alternative: Criteria for Maintenance of Water System

The recommendation for establishment of a functional maintenance system would affect all water system components but be confined to already built system elements. The greatest affected environment is the actual community benefiting from the proper functioning of their water system.

4.8 Alternative: Criteria for Evaluation

Annual environmental evaluations would provide information and direction to guide the project's advance through time. All physical components would be considered along with monitoring of the affected environments of the watershed and the communities.

SECTION 5

(RURAL WATER AND SANITATION)

ENVIRONMENTAL CONSEQUENCES

In order to provide an analytical basis for comparisons of the alternatives mentioned under Section 3, the following presents brief discussions of the positive and negative aspects of each proposed action and alternatives suggested. This breakdown into positive and negative aspects is intended to take into account the variety of factors mentioned in 22 CFR Part 216 to allow consideration of the environmental impacts of the alternatives and proposed actions. No duplication is intended from Section 3 where the reader may find more information describing each alternative. The possible direct and indirect effects have been considered along with possible conflicts, conservation potential and mitigation measures.

5.1 Alternative: Criteria for Water Supply Sources for Community Water Systems

As Proposed: Standardized Designs & Criteria within Economic Constraints

Positive Aspects:

1. Cost control resulting from standards applied in Selection of feasible projects.

2. Distances between communities and their water sources maintained within average ranges.

3. Acceptable water quality obtainable in most locations but dependent on future watershed uses.

Negative Aspects:

1. Could rule out a higher quality or protected water source without flexibility to consider design to reach a better source.
2. Locating water source intakes in streams has more adverse environmental impact than use of springs and leaves sources open to surface water runoff direct contamination.
3. Lack of regular water quality monitoring disallows assurance that

downstream water users are unaffected by the project.
4. Could rule out an alternate project, e.g., irrigation system if instream water intake is located where irrigation source is needed.

<u>Alternative</u>: Flexible Criteria to emphasize priority for water sources at spring origins.

Positive Aspects:
1. Downstream construction impact minimized and assurance of long-term high water quality with little susceptibility to surface runoff contamination.
2. Less monitoring needed to assure acceptable water quality.
3. Less conflicts with surrounding land uses given conservation of watershed is compatible with multiple uses.
4. Alternate projects (e.g. irrigation systems) are possible through use of instream sources downstream.

Negative Aspects:
1. Higher cost of installation.
2. Longer transmission pipeline to maintain.
3. Possible greater difficulty to establish right of passages through more land.
4. Less water may be available at an individual spring compared to the downstream quantity. May imply additional spring source needed to justify a project.

<u>Alternative</u>: Watershed study as part of Selection Criteria for a Water System

Positive Aspects:
1. Would identify conditions and uses in watersheds to allow assessment of downstream source risk of contamination and future deterioration of both quantity and quality of water.
2. Would allow opportunity for arrangements for watershed protection, preservation or conservation when motivation to do so is at its highest. Possibility to resolve conflicting land uses, e.g., relocate cattle to other

areas and to apply laws to establish protection or preservation practices before water system is built.
3. Identification of best possible water quality source is facilitated by greater extent of study of watershed as opposed to only the immediate vicinity of a community.
4. Project design allows for sufficient personnel to address watershed aspects (i.e., one promoter to work in 3 communities).

Negative Aspects: 1. Could conceivably rule out selection of a water source for a community if there are irresolvable conflicting multiple uses.
2. May add to initial difficulty in establishing project feasibility if land ownership disagreements result from attempts to protect a watershed.
3. Watershed determination may result in higher construction costs if best water source determined to be at distance outside standard criteria from community.

5.2 Alternative: Criteria for Water Wells

As Proposed: Multi-family wells with hand pumps

Positive Aspects: 1. Standardized designs exist for proper installation and maintenance of wells, including drainage pits.
2. Affordability of upkeep and repair generally has a good record.

Negative Aspects: 1. Drainage pits are often not constructed after pump installation.
2. Lack of attention to standing water presents possibilities for recontamination of waterand disease carrying vector breeding.

Alternative: Require installation of drainage pit prior to complete pump provision.

Positive Aspects: 1. Would assure the proper drainage of used water to a seepage pit thus avoiding standing water.

2. Promotion work would also address the placement of seepage pits at home water discard locations with educational aspects emphasized.

Negative Aspects: None

5.3 Alternative: Criteria for Latrines

As Proposed: Family latrines, either water-seal on dry pit types.

Positive Aspects:
1. High popularity with water-seal type fosters acceptability of good designs.
2. Dry pit types usually applied only in multi-family well areas thus minimizing chances for groundwater contamination.

Negative Aspects:
1. Some areas of high groundwater or rock require design of composting type dry latrine that is difficult to maintain in an inoffensive condition.

Alternative: Experimental Program to test different compost-type dry latrines.

Positive Aspects:
1. Hopefully would establish most compatible design for a compost type dry latrine.
2. Design could be copied elsewhere in country to afford a viable alternative to difficult latrine sites.
3. A 100' separation between latrines and streams should be maintained.

Negative Aspect:
1. Experimental program would require financial commitment to study and build several recommended types in order to assess their successful compatibility.

5.4 Alternative: Criteria for Runoff Protection

As Proposed: Small drainage pits at household water location

Positive Aspects:
1. When provided, small seepage pits do dispose of discarded water effectively thereby avoiding standing water problems.

2. Standard community promotion does include education material addressing need to build drainage pits.

Negative Aspects: 1. After a water system has been provided for a community, motivation drops to perform some of the ancillary tasks like drainage pit construction. In addition, promotion work typically moves on to the next community. In practice, few drainage pits are installed in some communities.
2. Lack of many drainage pits at dwellings can result in cumulative waters collecting at natural depressions, ditches along roads etc. resulting in even greater problems due to contamination, vectors and nuisances.

<u>Alternative</u>: Small measures undertaken during water system construction

Positive Aspects: 1. Timing of work when motivation is high can result in minimizing subsequent drainage pools after a water system is installed. Individual home drainage pits can also be included in water system work, even to the point of being a prerequisite to receiving the family tap or well.
2. Some provision of drainage materials, e.g., 6" diameter PCV pipe could be affordable within the contingency allowance for each project.
3. Engineering and promoter expertise is available during design and construction which can also address simple drainage measures to minimize ponding areas within a community. Simple cross ditching with tubing can in many instances be sufficient to provide positive drainage.

Negative Aspects: 1. Some communities may need a relatively large amount of materials and/or work to effect positive drainage. This may simply not be affordable within budgets.
2. Downstream impacts from improved drainage are possible, but are believed

to be minimal due to their quantity and natural tendency to reach downstream locations regularly during rainy seasons anyway.

5.5 Alternative: Criteria for Water Quality Testing

As Proposed: Baseline bacteriological tests only. Operating system tests for chemical and physical parameters. Water quality criteria based on turbidity, color and bacteriological characteristics. Regional laboratories (3) to be built.

Positive Aspects:
1. Less time delays due to field expertise in lieu of sending to central lab.
2. Less cost for water baseline analyses.
3. Portable kits useful for in-field testing and responding.
4. Increased capability of water quality long term testing located at regional MSP offices.

Negative Aspects:
1. No knowledge of water source impacts from multiple use practices within watersheds.
2. Lack of complete baseline data obtained to monitor subsequent impacts from watershed activities.
3. No test to determine advisability to chlorinate water or not in areas of multiple use watersheds.
4. No plan to cooperate with country agency charged with overall contaminant control.

Alternative: Selective baseline water quality analyses of water sources within multiple use water sheds. Cooperation with CESCCO to obtain pesticide/hydrocarbon analyses in selected water source areas. Do not add chlorine to water sources determined to be contaminated with pesticides/hydrocarbons until problem is resolved.

Positive Aspects:
1. Would provide for initial and long term assessments of impacts on water quality due to multiple uses in a water shed.

2. Would be a factor in the decision process to select a water source under study.
3. Cooperation with country agency charged with contaminant control (CESCCO) would be established for monitoring pesticide/hydrocarbon contamination.
4. Advisability of chlorinating a water supply would be known.
5. Baseline water quality of previously built systems would be established as soon as possible, especially in sensitive watershed areas.

Negative Aspects:

1. Delays may result to get test results for pesticide/hydrocarbons of selective watersheds.
2. Water quality may determine inadvisability to provide the intended water source, thus forcing an alternative water source choice of probable greater expense.
3. Water system without chlorination will be more susceptible to bacterial contamination.
4. Some additional projects costs due to increased testing.

5.6 Alternative: Criteria for Maintenance of Water Systems

As Proposed: Additional field maintenance technicians operating at three new maintenance field offices. Financial support based on portion of community fee collection for water systems. Separate maintenance account planned for SANAA/OMUR for the PRASAR Project.

Positive Aspects:

1. Enhancement of field maintenance capabilities and storage of supplies.
2. Separate financial account will enable greater fiscal control and quicker processing to address needs.
3. Training to be provided to increase skills for field water system operations and maintenance, and will help in community training.

Negative Aspects:

1. No organization structure at present, although one is planned.
2. No records to support the assumption of financial self-sustainability through a portion of community collections.
3. Difficulty of initial set-up for the maintenance program.
4. No income from multi-family well areas to return to a maintenance fund of the MPS.
5. Lack of maintenance program for PRASAR Phase I is creating a backlog of water systems needing attention.

Alternative: Provide emphasis for set-up and operation of a viable maintenance organization.

Positive Aspects:

1. Would provide the essential initial feasibility to set-up an organization for maintenance of the past and proposed PRASAR Projects.
2. Attention could be given to the backlog of completed projects needing immediate maintenance work.
3. Operation of the maintenance program should allow for community collections build-up of funds until some level of self-sustaining operation is achieved.
4. Increased community confidence that their water system maintenance needs will be attended to by SANAA/OMUR will help to reverse the present poor image of the organization and encourage community collections.

Negative Aspects:

1. Financing the initial set-up and operation of a viable maintenance program may be difficult to achieve.
2. It is uncertain what level of self-sustaining operation can be achieved.
3. Lack of a prepared organizational plan for the maintenance program hinders an immediate analysis of set-up and operational costs.

5.7 Alternative: Criteria for Environmental Evaluation

As Proposed: Two overall project reviews are planned after 20 months and in final project year.

Positive Aspects:
1. Will be comprehensive in nature.
2. Budget cost kept low for evaluation work.

Negative Aspects:
1. Environmental monitoring during life of project is undefined.
2. Mitigation measures will be difficult to define without some level of regular environmental monitoring.
3. Some danger of never incorporating some environmental protection/mitigation measures as originally intended.

<u>Alternative</u>: Annual limited environmental assessments of project impacts for rural water and sanitation projects.

Positive Aspects:
1. Would allow early detection of lack of attention to significant environmental concerns.
2. Mitigation/prevention measures would be potentially feasible during the life of the project.
3. Could take advantage of information available such as water quality records, drainage problems reports, latrine problems and watershed reviews to detect possible areas needing attention.
4. Would establish basis for long-term monitoring.

Negative Aspects:
1. Possible adverse impact on budget for evaluations in project.
2. Mitigation measures recommended may not be feasible within project funded budgets.
3. Long term monitoring may not be possible after termination of project.

SECTION 6

(VECTOR CONTROL)

RECOMMENDATIONS

6.1 USAID Management

- It is strongly recommended that the Mission reconsider its position and retain a technical advisor to DCV in the early phase of Health Sector II followed by continuing TA through the life of the project. There are many new environmental and chemical interventions programmed in this project as well as implementation of additional methodology, a serious need for training, retraining, modified and new monitoring schemes that will benefit from such assistance.

- It is recommended that the Mission assure the continued availability of fenitrothion to the DCV for the duration of Health Sector II by whatever means, including direct purchase. Although A.I.D.'s commitment to this project is solid, there is not the same level of assurance that the Government of Japan will continue to donate Sumithion throughout the LOP of Health Sector II. There is some confusion at present regarding the A.I.D. position regarding the purchase of fenitrothion, should Japan withdraw its contribution.

- That the warehouses budgeted for each region under Health Sector I be completed.

- That should other larvicides become more appropriate or needed to complement B.t.i., an amended EA approving their use be prepared and approved by the Chief Environmental Officer, and their use adopted.

6.2 MOH/DCV

- That DCV develop a working guide for the use of both fenitrothion and B.t.i. as well as Physical Larval Control activities.

- That DCV call upon PAHO or other sources to conduct workshops for indoctrination of employees on the use of new interventions, principally the use of larvicide and PLC in the operational programs. The manuals recommended above could serve as the basic for these workshops.

- That DCV use pallets on the floor of each warehouse; refrain from blocking ventilation by storing containers to the ceiling, or at least leave sufficient space to space to allow for good ventilation; and install louvered structures in ventilation openings to protect materials from rain and sunlight.

- Recommendation: That labels and manuals for all insecticides employed be made available in Spanish.

6.3 Project Activities

- Consideration should be given to testing the efficacy of highly refined oil as a carrier for B.t.i. or other larvicides (if their use is subsequently approved) to improve spreadability and surface action of these materials since Anopheles larvae are surface oriented.

- Because the majority of anopheline habitats are relatively small and uncomplicated, it is recommended that PLC activities be kept to a manageable minimum and that emphasis be placed on the use of hand tools and small implements as opposed to large, earth-moving equipment. This effort will (1) minimize environmental impact, and (2) involve more people, thus enhancing education and awareness about malaria at the community level.

- Where possible, PLC activities with long-term benefits should be favored over those requiring constant maintenance. However, it must be remembered that long term projects are not easily reversed. In all cases, those responsible for PLC should consider the check list of factors in Appendix in establishing the need and nature of new projects. It is recommended that PLC activities involve both entomological and engineering input and that new projects be based epidemiologic need as opposed to topographic on opportunity. Concrete lining of ditches should be used in such sites as roadside ditches as opposed to stream beds or wetland drainage.

- It is recommended that community involvement be sought for PLC operations and that a public relations effort be made to assure acceptance and cooperation at the community level. Under no circumstance should environmental interventions be made without approval of ownership, preferably written. The public relations aspects can be probably best handled thorough the Education Section of DCV.

- The design of every type of PLC construction should include a plan for maintenance and monitoring at the area level. It is recommended that DCV require periodic written reports of maintenance and monitoring of PLC activities. This procedure could probably be handled best through the Engineering Section of DCV.

- Consideration has not generally been given to habitats for flora and fauna other than mosquito larvae in previous PLC efforts. Nor, has consideration been given to the water purification potential of wetland. Primarily as a matter of raising the awareness of the people for these wetland functions, as well as to help minimize the impact of PLC operations, consideration should be given to these functions. This can be accomplished appropriately if not completely by using the following means:

  a. Ground-level photographs of each project to supplement the mapping process. Photos should show all ecosystems to be effected by a project and should be taken before the project begins to establish a baseline (preferably after the wet season begins). Photos should be taken annually, always from the same spot. An object should be included for judging distance (scale).

  b. Use the accompanying environmental review document, or some appropriate modification which includes an assessment of ecological considerations at each site.

  c. Retain a technical advisor dedicated to reducing environmental impact as well as to controlling malaria.

  d. Develop a central (national level) information management system that contains the size and type (by original ecosystem type) for each project. Copies of all photos should be kept at the central depository as well and should be indexed by site and date. This information system will make evaluation of ecological impact more objective.

SECTION 6

(RURAL WATER AND SANITATION)

RECOMMENDATIONS

The following presents recommendations in the spirit of enhancing the project's sensitivity towards environmental concerns associated with the rural water and sanitation projects. The presentation is by subjects consistent with the preceding sections of this report.

6.1 Water Supply Sources

- Provide the flexibility to select the best quality/ protected water source with preference given to spring origins. Judgement factors must be weighed in the decision to consider the status and multiple uses in a watershed, size of community and amount of water. The key point is to allow flexible judgement to outweigh fixed criteria when appropriate and to communicate this to the field engineers/promoters actually involved in the source locating work.

- Include watershed management efforts in the job descriptions of all PRASAR engineers and promoters to work in the field. Define specific objectives to identify watershed characteristics, land ownership, multiple uses, potential protection measures and community work possible to preserve the watersheds. Ongoing activities with PVOs and appropriate GOH agencies in these fields should be brought into association with Health Sector II activities. This work should be initiated from the onset of community promotion and continued beyond the completion of a water system. See Appendix F for additional recommendations on this subject.

6.2 Water Wells

- Require construction of drainage pits per standard designs in the project as a pre-requisite to receiving a complete hand pump installation. This should also apply at the dwellings of the users at the points of water discard.

6.3 Family Latrines

- Obtain alternate designs for a dry composting type latrine, notably any of Guatemala, and set up an experimental trial program to determine the most compatible design. This type of latrine would apply only in very high groundwater or rocky areas preventing other types from working.

- In all cases, a 100' separation between latrines and wells should be maintained.

6.4 Runoff Protection

- Include in the job descriptions of field engineers and promotion the requirement to design and supervise construction of small drainage measures within community boundaries. Provide the necessary materials to effect positive drainage of standing water areas into natural drainage courses where possible at low cost. See Appendix G for additional recommendations on this subject.

6.5 Water Quality Testing

- Establish a long term work plan with CESCCO to provide baseline analyses of pesticides/hydrocarbons of water sources located in vulnerable watersheds, especially any instream intakes in agricultural zones. Previous water system sources meeting the same description should be tested similarly. Monitoring should be set up to test during the rainy season and dry season to compare seasonal variations in the selected sensitive watersheds.

- Temporarily discontinue the standard practice of chlorine addition to water systems identified as contaminated from agricultural multiple use activities. Place heavy emphasis on changing practices resulting in contamination. Only after pesticide/hydrocarbons analyses can prove no detrimental contamination of the water should chlorination be resumed.

6.6 Environmental Evaluation of Monitoring

- An annual assessment by Mission and in-country staff of the project's environmental impacts is recommended in order to allow continued guidance in addressing environmental concerns. Different mitigation measures can be recommended as appropriate during the progress

of the projects, as well taking advantage of monitoring information made available. Funding for the evaluations may be able to be provided from WASH funds as opposed to project funds.

To assure that implementation, monitoring and maintenance concerns of A.I.D.-supported projects are met, it is recommended that the Mission provide Technical Assistance to the Rural Water and Sanitation Component of Health Sector II.

6.7 Other Concerns

Other design and management concerns that will enhance the development of Health Sector II activities, but do not fall in the category of environmental impacts foreseen for the project, are worth mentioning. These include:

- An alternative exists to significantly enhance water quality work in the project. Without baseline analyses of water quality, no future comparisons are possible to analyze any deterioration in water quality over time. Given the vulnerability of water sources in general to the effects of watershed deterioration, the assurance of water quality over the long term is in part dependent on some degree of monitoring from the inception of a project and carried into the future.

- The services of the program "Centro de Estudios y Control de Contaminantes" CESCO (Center for Studies and Control of Contaminants) are available to assist in providing the types of analyses needed to establish baseline water quality data (e.g., all normal water chemistry and hydrocarbons analysis for agricultural pesticides) at the inception of the project.

- It is recommended to test at least twice a year for indicators of watershed impacts on water sources only in locations where multiple uses of the surrounding lands is occurring (e.g., significant cultivation, cattle grazing, or dwellings). The two tests would be during the rainy and dry seasons to compare seasonal variations. This recommendation is intended to apply to projects built in PRASAR Phase I, as well as the new projects in PRASAR Phase II of Health Sector II.

- A Water System Maintenance is currently developed and functioning under the PRASAR Phase I Rural Water and Sanitation Project (522-0166). This plan should continue to be refined as project implementation of

Health Sector II developed and provide the required assistance to the Health Sector II Project.

SECTION 7

QUALIFICATIONS OF PREPARERS

Samuel G. Breeland (Team Leader) - Born 1926; US citizen; BS University of Georgia (Zoology 1950); MS North Carolina St. (Entomology 1953); Ph.D University of Tennessee (Zoology and Entomology 1957); Positions held include 1980-84 Supervisor, Mosquito Control Section, Office of Entomology, FL Dept of Health and Rehabilitative Services; 1979-80 Director, Florida Medical Entomology Laboratory; 1973-78 Chief, Medical Entomology Branch, Bureau of Tropical Diseases, CDC; 1967-72 Research Entomologist/ Deputy Chief, Central America Research Station, CDC, El Salvador; 1960-67 Research Biologist, Reservoir Ecology Branch, Tennessee Valley Authority; 1958-60 Medical Entomologist, Canal Zone Health Bureau, Panama; Chairman, Section D (Medical Entomology), Entomological Soc. of America; Worldwide Committee, Amer. Mosquito Contr. Assoc., Author of 70 publications, 3 monographs mostly dealing with the biology and control of disease vectors in the Americas with emphasis on operational and basic research. Frequent consultant to international national and state health agencies, universities, and industry.

Clay L. Montague - Born 1951; BS University of North Carolina (Biology 1973); MS Georgia Tech (Industrial and Systems Engineering 1977); Ph.D University of Georgia (Zoology 1980); Positions held include 1980-present Asst. Prof., University of Florida (Systems Ecologist, Dept. Environ. Engineering Sciences); tenured 1987; Assoc. Prof. effective 12 Aug. 1988; author of book chapter, 9 publications in refereed journals, 4 non-refereed publications, 4 reviewed technical reports, and 8 additional reports and abstracts; developed management models for mosquito control impoundments in Florida, and coastal wetland impoundments throughout the southeastern US; projects include assessment of impoundments on: ecological production and diversity; published extensive literature reviews on ecological effect of impoundments; natural history of fiddler crabs; and salt marsh animals, a book chapter on salt marshes of Florida is in press; collected extensive field data on the effect of freshwater flow on bottom-dwelling plants and animals in NE Florida Bay; developed computer simulation models on plankton dynamics and rat population dynamics; Teaches course in computer simulation, esturine ecology, environmental science, systems ecology and marine biology at University of Florida; major research interest is in esturine systems ecology and socially responsible use of ecological information; has rudimentary knowledge of spoken and written Spanish and written French; proficient in use of

microcomputers for BASIC programming; word processing; data management and other applications.

Mauricio Sauerbrey - Salvadoran, born 1940; MS and Ph.D (Tropical Medicine, Tulane University 1972); Prof. Parasitology, University of El Salvador (1973-76); Medical Parasitologist (1973-79) and Director (1979-81), Central Amer. Research Station, US CDC, San Salvador; Public Health Consultant, USAID/San Salvador (1981-82); malaria consultant 1983-present. USAID/San Salvador; currently staff member VBC Project/USAID and Adjunct Professor University of South Carolina; has served as consultant to PAHO, WHO (Geneva) and various universities in US and Central America; currently involved in physical larval control, general malaria policy, training and planning of A.I.D. supported malaria control programs in El Salvador.

Robert H. Hogrefe, P.E. U.S. Citizen; BA (University of New Mexico, Arts and Sciences-Sociology 1972); BS (University of New Mexico, Civil Engineering) MS Environmental Health Engineerings (University of Texas - Austin) - USEPA Traineeship Scholarship, 1973; Positions held include 1986 - present, City of Albuquerque, New Mexico, Public Works Dept., Engineering Division, Public Works Projects Design Development, Chairman of Design Review Committee for all of the city's public works related projects; 1985-86 State of New Mexico, Environmental Improvement Div., Santa Fe; Regional Environmental Engineer for northern half of state; consulting services to nine field offices and communities relating to water, waste water and environmental regulation of state, federal and local projects; 1983-85 Peace Corps Volunteer - Honduras, worked with local office of Save The Children, Inc., initiated first phase of water/sanitation program, coordinated with A.I.D./GOH Water and Sanitation Rural Program; acted as Project Engineer in charge of two field offices, two field engineers (Hondurans) and eight construction foremen in eight communities; prepared work plan and strategy for later phases; 1981-83 Senior Engineer in private consulting firm, Bovay Eng. Inc.; 1980-81 self employed, President of R.H. Hogrefe Eng. Inc.; also was consultant to A.I.D./Washington, Jan. 1987, Case Study of the Dominican Republic Hand Pump Manufacture Program for larger study of Privatization of Operation and Maintenance; licensed Civil Engineer, New Mexico; fluent in Spanish.

SECTION 8

(VECTOR CONTROL)

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(RURAL WATER AND SANITATION)

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APPENDIX A

LIST OF CONTACTS

1. USAID/WASHINGTON

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Jorge Flores	- Regional Engineer/MSP/PRASAR	San Pedro Sula
Roberto Garcia	- Health Promoter/MSP	Quimistan
Eddy Orlando Moya	- Promoter/MSP/PRASAR	El Progreso
Herman Bueso	- Promoter/MSP/PRASAR	San Pedro Sula

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Miriam Colindres	- Office Admin./CARE	Tegucigalpa

APPENDIX B

SITE VISITS TO OBSERVE TYPES OF VECTOR CONTROL PROBLEMS INTERVENTIONS AND ENVIRONMENTAL CONSEQUENCES HONDURAS, MAY 1988

Jamastran Valley, May 17 (Breeland, Montague, and Sauerbrey with Stivers). This is a rural area with scattered housing. Mosquito breeding habitats are small, relatively isolated and in an area of little agriculture. HS-1 activities included house spraying with fenitrothion, and PLC was begun with small-scale cleaning, ditching, and stream-flow improvement with hand tools. During HS-2, priority will be given to PLC, supplemented by the use of B.t.i. and perhaps house spraying. Recommendations: Because of rather widely separated housing, the lack of agriculture and the small nature of water sources, PLC should indeed be the principal approach -- however, house spraying should be continued since there is not likely to be a cross-resistance problem from agriculture and there are relatively few houses in an expansive area of isolated water deposits. Use of B.t.i. in most situations would be appropriate, but it is likely the temephos would be a good adjunct in many of the small roadside ditches which are not used by humans or animals. The expected environmental impact of the proposed measures is negligible. Figure 1 shows a rather typical drainage ditch and small inundation, and the scattered nature of housing in the Jamastrán area. Figure 2 illustrates some HS-1 ditching by DCV.

Catacamas, May 18-19 (Breeland and Sauerbrey with Stivers). This is a rather extensive urban area with considerable street drainage, much of it in disrepair. There is no sewage system for the population which exceeds 10,000. It is essentially a non-agricultural area. A lengthy vegetated rocky channel runs through the town from north to south with intermittent pooling. Where pooling occurs, the water is used for bathing and washing clothes. HS-1 activities included residual spraying with fenitrothion, supplemented by substantial ditching, clearing and construction of small culverts and an occasional drainage structure. Under HS-2, it is proposed to line the main channel with concrete; and to extensively improve shallow, vegetated roadside ditches by deepening, sloping and some concrete lining. House spraying will continue with fenitrothion. B.t.i. may be used, but probably limited to the malaria transmission season. Recommendations: The planned activities seem both adequate and appropriate to this urban environment. Public support and community participation should be solicited. Design and monitoring provisions should be limited to B.t.i. or other non-chemical approaches, e.g., IGR compounds or monomolecular films.

APPENDIX B cont.

The potential for adverse environmental effects is negligible for the proposed activities. Any downstream flooding from the main channel would seem to be well removed from population concentrations and could be further minimized by the construction of pools for bathing and washing of clothes in essentially the same areas they now exist. Flow could be controlled with flashboards in these pooled areas. Figures 3-6 reflect the nature of problems and some interventions in PLC in the Catacamas area. Figure 10 illustrates a degree of monitoring at the area level.

Comayagua Valley, May 19. (Breeland and Sauerbrey with Stivers). This is a rural valley with urban concentrations and barrios. It is a truck farming region with extensive agricultural use of pesticides -- a factor which would diminish the effectiveness of OP or carbamate compounds by DCV. There is extensive irrigation with small reservoirs and distribution canals. There exists the potential for extensive shallow inundations in some of the area during the wettest part of the year, a situation conducive to the propagation of *An. albimanus*. HS-1 activities included house spraying with fenitrothion and some experimental work with *B.t.i.*, reportedly quite successful. During HS-2, priority will be given to rather extensive use of *B.t.i.*, supplemented by PLC and the selective use of house spraying where efficacious. Recommendations: The agricultural activities preclude the likelihood of success with any single approach -- especially with conventional pesticides. The DCV integrated approach seems feasible. The area lends itself to extensive testing of new interventions and may well serve as a model area for developing and extending newer methodology. Experience in this setting would seem transferable. (Note: A DCV spray brigade was observed during the visit and safety precautions (mixing procedure, use of gloves and masks) appeared to be adequate (Figure 7). In this area, certainly any insecticide activity by DCV would seem to impact very little on the environment, most especially the use of *B.t.i.*

Insecticide Storage Warehouse (Sta. Maria Rial, Catacamas) May 19 (Breeland and Sauerbrey with Stivers). This warehouse, serving Region 7, is a well constructed, masonry building. It is isolated from the town, completely fenced, guarded 24 hours a day and appears to be an excellent facility. Warehouses of this type were budgeted under HS-1 for each of the eight regions. Recommendations: Insecticide containers should be on pallets and ventilation areas should not be blocked by storage containers. Figure 8 shows the Region 7 warehouse and guardhouse within the fenced area. Figure 9 shows the interior of the warehouse with containers of Sumithion.

APPENDIX B cont.

Insecticide Storage Warehouse (Sausique, Tegucigalpa) (Breeland and Sauerbrey with Stivers). This warehouse serves as the central warehouse and also the Tegucigalpa region. It is of the same type construction as the Santa Maria Real warehouse, but in addition to palleting deficiencies, there were no louvered windows for the ventilated areas and boxes of insecticide were stored to the ceiling and exposed to sunlight and rain. Recommendations: The correction of the above noted deficiencies in the Sausique warehouse and the completion of all regional warehouses as budgeted under Health Sector I.

Bajo Aguán: May 18-21 (Montague and Hogrefe). This area is characterized by farm ponds, roadside ditches, and small streams bordered by areas of slowly moving water, mainly extensions of pasture. When this area was visited, there had been no rain for a period of 70 days. There was one river floodplain containing wetlands and pastures (Sabá). HS-1 activities included the clearing of ditches in streambeds 1-2 m wide and 10 - 100 m long; draining 2 ha. wetlands by ditching (one wetland contained 17 Caymans that were removed to the Rio Aguán Swamp); planting fish for both weed and mosquito control; adding salt to small areas; and adding culverts under low sites of road beds. Proposed HS-2 activities are to continue the same program by maintaining existing ditches and general expansion. Recommendations: Projects should be kept small to minimize physical control, but based only on entomological and epidemiological need. Wherever possible, enlist community cooperation for ditch maintenance rather than the less reversible option of concrete lined drainage ditches. If the total area affected increases five-fold, an alternate approach is recommended. Document the size and type of affected sites with before and after photographs. The environmental impact would seem to be negligible if the projects are kept small and are carefully selected. The wetland drainage does not seem especially significant given the small size (2 ha.), however the wetlands are likely used by a variety of birds, reptiles and amphibians and may have some small filtration or purification effect on runoff from the adjacent pasture land.

The effect on downstream flooding and sanitation of keeping the water moving in clean ditches rather than allowing the slowing effect of meandering and wetlands storage is insignificant because of the small size of these projects relative to the steepness of the surrounding watershed and the large volume of water that must flow through despite the little meanders and wetlands. If the size of affected areas of marshes and creeks were to increase by ten-fold, more refined decisions would be required. Monitoring: Needed is the development of a scheme to

APPENDIX B cont.

periodically review project size, type and changes with appropriate photos with emphasis on potential problem sites, even as little as 1 ha. of contiguous wetland.

Figure 1. Typical drainage ditch and small inundation in the Jamastran Valley.

Figure 2. Example of ditching by VCB in the Jamastran Valley.

Figure 3. The main drainage channel running through Catacamas -- proposed for concrete lining.

Figure 4. DCV ditching activity, Catacamas.

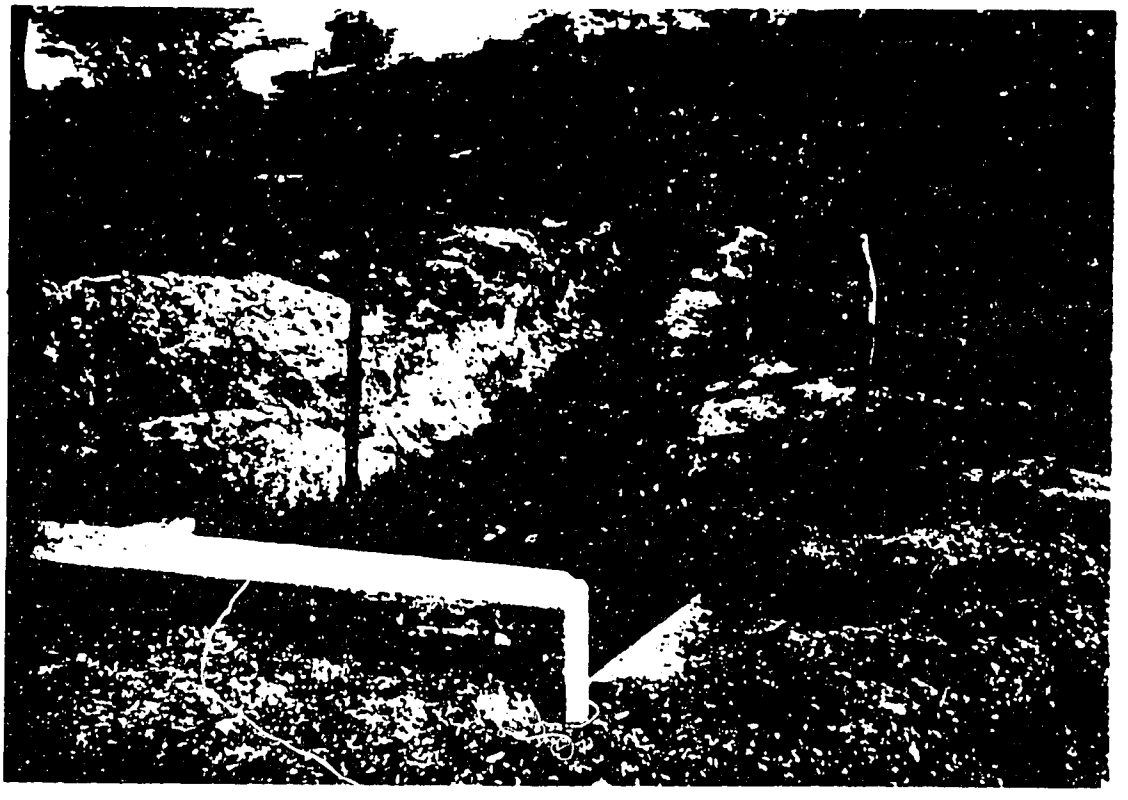

Figure 5. Drainage ditch and culvert constructed by DCV, Catacamas. Concrete lining would eliminate vegetation.

Figure 6. Catch basin constructed by DCV, Catacamas.

Figure 7. Spraying of eaves of house, Camayagua. Note gloves -- mask was worn for inside spraying.

Figure 8. Warehouse for insecticide storage, Region 7, Catacamas. Note fenced area, guard shack and water tower.

Figure 9. Interior of warehouse. Note the louvered ventilation area and the need for pallets.

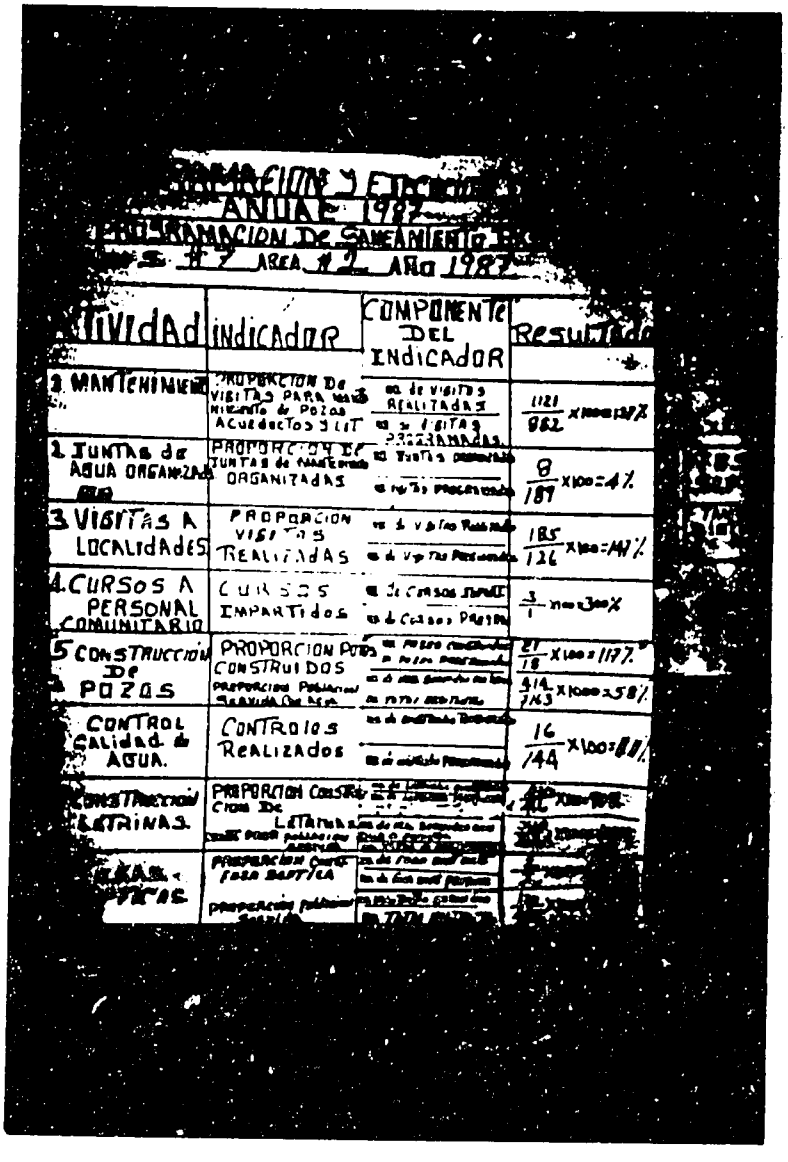

Figure 10. Wall chart of activities and results, DCV, Catacamas.

APPENDIX C

LABELS FOR SUMITHION AND *B.t.i.* PRODUCTS

SPECIMEN

vectobac®-AS

BIOLOGICAL MOSQUITO AND BLACK FLY LARVICIDE

AQUEOUS SUSPENSION

Active Ingredient: *Bacillus thuringiensis*, Serotype, H-14, 600 International Toxic Units (ITU) per milligram (Equivalent to 2.19 billion ITU per gallon; 0.576 billion ITU per liter) 0.6%

Inert Ingredients 99.4%

KEEP OUT OF REACH OF CHILDREN

CAUTION

EPA Reg. No. 275-52
EPA Establishment No. 33762-IA-1
List No. 5059

BEST AVAILABLE DOCUMENT

APPLICATION DIRECTIONS

MOSQUITOES Habitat	Suggested Range Rate*
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	0.5 pt-2 pts/acre
Polluted water (such as sewage lagoons, animal waste lagoons)	2 pts/acre

*Use higher rate in polluted water and when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

BLACK FLIES Habitat	Suggested Range Rate
Streams	1-50 mg/liter stream water** (=ppm)

**Use higher rate when stream contains high concentration of organic material, or dense aquatic vegetation.

Ground and Aerial Application

Vectobac®-AS may be applied in conventional ground or aerial application equipment with quantities of water sufficient to provide uniform coverage of the target area. The amount of water needed per acre will depend on weather, spray equipment, and mosquito habitat characteristics. Do not mix more Vectobac-AS than can be used in a 2-week period.

For most ground spraying, apply in 5-100 gallons per acre using hand-pump, airblast, mist blower, etc., spray equipment.

For aerial application, Vectobac-AS may be applied either undiluted or diluted with water. For undiluted applications, apply 0.5 to 2.0 pt/acre of Vectobac-AS through fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or rotary atomizers.

For diluted application, fill the mix tank or plane hopper with the desired quantity of water. Start the mechanical or hydraulic agitation to provide moderate circulation before adding the Vectobac-AS. Maintain the agitation while loading or spraying. For all aerial applications, a droplet spectrum in the range of 50-100 microns (VMD)

For black fly aerial applications, Vectobac-AS can be applied undiluted via fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or open pipes. Rate of application will be determined by the stream discharge and the required amount of Vectobac-AS necessary to maintain a 1-50 ppm concentration in the stream water. Vectobac-AS can also be applied diluted with similar spray equipment. Do not mix more Vectobac-AS than can be used in a 2-week period.

SMALL QUANTITY DILUTION RATES FOR VECTOBAC-A

Rates in Pints Per Acre	Gallons Spray Solution/Acre: 10 Gal/A	25 Gal/A	50 Gal/
	(Ounces Needed Per Gallon of Spray)		
0.5	.8	.33	.16
1.0	1.6	.66	.32
2.0	3.2	1.30	.64

Vectobac-AS is a highly selective insecticide for use against mosquito and black fly larvae.

PRECAUTIONARY STATEMENTS
HAZARD TO HUMANS

As a precautionary measure in case of contact, flush eyes with plenty of water. In case of irritation, contact a physician.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store in a cool place.

PESTICIDE DISPOSAL: Wastes resulting from use of thi product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Do not reuse container.

NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User

BEST AVAILABLE DOCUMENT

SPECIMEN

Vectobac®-G

GRANULES

Active Ingredient: *Bacillus thuringiensis*, Serotype H-14, 200 International Toxic Units (ITU) per milligram (Equivalent to 0.091 billion ITU's per pound) 0.2%
Inert Ingredients 99.8%

KEEP OUT OF REACH OF CHILDREN

CAUTION

EPA Registration No. [illegible]
EPA Est. No. 2393-[illegible]
Filled by weight not volume
Lot No. 5109-01

NET WEIGHT: 50 LBS.

APPLICATION DIRECTIONS

MOSQUITOES

Habitat	Suggested Rate Range*
Irrigation ditches, roadside ditches, flood water, standing ponds.	2-10 lb/acre
Catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	2-10 lb/acre
Polluted water, sewage lagoons, etc.	10-20 lb/acre

*Use higher rate when late 3rd and 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

Apply uniformly by aerial or ground conventional equipment.

A 7 to 14 day interval between applications should be employed. Where non-target aquatic invertebrate parasites and predators are present longer periods of suppression may result since these beneficials would be conserved to aid in mosquito population management.

NOTICE TO USER

Seller makes no warranty, express or implied of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Vectobac®-G is a highly selective insecticide for use against mosquito larvae. The active ingredient, *Bacillus thuringiensis*, Serotype H-14 is exempt from the requirement of tolerance on agricultural commodities when applied to growing crops.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

STORAGE AND DISPOSAL

Do not contaminate potable water, food or feed by storage or disposal.

STORAGE: Store in a cool, dry place.

PESTICIDE DISPOSAL: Pesticide that cannot be used according to label instructions must be disposed of according to applicable Federal, State, or local procedures.

CONTAINER DISPOSAL: Completely empty bag by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities. Dispose of empty drum in the same manner.

Chemical & Agricultural Products Division
Abbott Laboratories
North Chicago, Illinois 60064

Sumithion® 40 WDP

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FOR USE ONLY BY OR UNDER THE SUPERVISION OF STATE OR FEDERAL OFFICIALS RESPONSIBLE FOR MALARIA CONTROL

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
WARNING

Causes eye irritation. Harmful if swallowed. Do not get in eyes. Avoid contact with skin. Wear protective gloves, clean protective clothing and goggles or face shield when handling the material. Remove and wash contaminated clothing before reuse. Wash hands and arms thoroughly after handling and before eating, drinking or smoking.

STATEMENT OF PRACTICAL TREATMENT

If in eyes, wash thoroughly with water for 15 minutes. Get medical attention.

If contact with skin, wash thoroughly with soap and water. Get medical attention if irritation persists.

Note to Physician: Sumithion is an organophosphorus compound that inhibits cholinesterase. Atropine is antidotal. 2-PAM is also antidotal and may be administered in conjunction with atropine.

Do not permit children or pets near treated surfaces until dry.

Keep out of domestic or animal water supplies.

Do not store or transport with food or animal feed.

Do not contaminate water by cleaning equipment or disposal of containers.

STORAGE AND DISPOSAL

1. PROHIBITIONS: Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.
2. PESTICIDE DISPOSAL: Pesticide, spray mixture, or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or burned in a safe place away from water supplies.
3. CONTAINER DISPOSAL: Dispose of in a incinerator or land fill approved for pesticide containers, or bury in a safe place.
4. GENERAL: Consult Federal, State or local disposal authorities for approved alternative procedures such as limited open burning.

ACTIVE INGREDIENTS:

O,O-Dimethyl O-(4-nitro-m-tolyl) phosphorothioate ..... 40% (w/w)

INERT INGREDIENTS: ..... 60% (w/w)

WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

STATEMENT OF PRACTICAL TREATMENT

If in eyes, wash thoroughly with water for 15 minutes. Get medical attention.

If contact with skin, wash thoroughly with soap and water. Get medical attention if irritation persists.

Note to Physician: Sumithion is an organophosphorus compound that inhibits cholinesterase. Atropine is antidotal. 2-PAM is also antidotal and may be administered in conjunction with atropine.

ACCEPTED

OCT 8 1980

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 39398-9

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

For control of adult Anopheline mosquitoes in private residences only. Not for use in food handling establishments or in food handling areas of private residences.

Apply as a residual spray to wall surfaces at a rate not to exceed 2 grams (active ingredient) (0.07 oz) per square meter of surface. Cover floor area, furniture and other objects prior to spraying. After spraying is complete, remove coverings and dispose of in an incinerator or landfill approved for pesticides or bury in a safe place. Do not allow occupants of residence to return until treated surfaces have dried.

Recommended dosage: Mix one kilo (2.2 lbs) of Sumithion 40 WDP with 8 liters (2.1 gal) of water and apply to 200 sq m (2153 sq ft) of wall surface to obtain 2 g/sq m (.07 oz/10.8 sq ft). Agitate well before using. Do not apply more often than once every three months.

NOTICE - READ CAREFULLY

CONDITIONS OF SALE:

Sumitomo (and seller) offer(s) this product for sale subject to, and buyer and all users are deemed to have accepted, the following conditions of sale and warranty which may only be varied by written agreement of a duly authorized representative of Sumitomo.

WARRANTY LIMITATION:

Sumitomo warrants that this product conforms to the chemical description in the directions for use on the label subject to the inherent risks referred to below. Sumitomo makes no other express warranties: THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY and there are no warranties which extend beyond the description on the label hereof.

INHERENT RISKS:

The directions for use of this product are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks associated with use. Buyer assumes all risks associated with use or application of this product contrary to label instructions or resulting from extraordinary weather conditions.

LIMITATION OF LIABILITY:

In no case shall Sumitomo be liable for special, indirect or consequential damages resulting from the use or handling of this product and no claim of any kind shall be greater in amount than the purchase price of the product in respect of which such damages are claimed.

EPA Registration No. 39398-9
EPA EST. NO 476-FL-1

BEST AVAILABLE DOCUMENT

Made for:

SUMITOMO CHEMICAL AMERICA, Inc.
345 PARK AVENUE
NEW YORK, N.Y. 10154

Net Contents ____ Kilos ____ Lbs.

Lot No. _____

®Registered Trademark of Sumitomo Chemical Company, Ltd.

JUN 14 1979

EPA Reg. No. 39398-4

SUMITHION

TECHNICAL

EPA PR 5.31.78

79

TIVE INGREDIENT:

O,O-Dimethyl O-(4-nitro-m-tolyl) phosphorothioate 95%

ERT INGREDIENTS: 5%

VARNING Keep Out of Reach of Children

lay be fatal if swallowed, inhaled or absorbed through the skin.

o not breathe vapor or mist. Do not get in eyes, on skin or on lothing. Wash hands, arms and face with soap and water after andling and before eating or smoking. In case of skin contact ash with soap and water, for eyes flush with water and get medcal attention. Wash clothing with soap and hot water before euse.

void contamination of food and feed. Do not store near feed or ood products.

OTE TO PHYSICIAN: Atropine is antidotal. 2-PAM is also ntidotal and may be administered in conjunction with atropine.

FOR FORMULATION OF INSECTICIDES ONLY

- Do not use, pour, spill or store near heat or open flame.
- This product is toxic to fish and wildlife.
- Keep out of lakes, streams or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.
- Do not reuse empty drums. Return to drum reconditioner or destroy by perforating or crushing. Bury in landfill away from water supplies.
- Refer to technical bulletin for information on chemical and physical properties.

EPA Reg. No. 39398-4 Net wt. 550 pounds

EPA Est. No. 41155-TN-1 (250 kilos)

BEST AVAILABLE DOCUMENT

SUMITOMO CHEMICAL AMERICA INC.

345 PARK AVENUE NEW YORK N.Y.

Microbial Resources

Skeetal

FLOWABLE CONCENTRATE

FOR MOSQUITO AND BLACKFLY LARVAL CONTROL

ACTIVE INGREDIENT

Bacillus thuringiensis israelensis (H14) to 1400 International AA Units per milligram of formulation	15%
Inert Ingredients	85%
Total	100%

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

Avoid contact with Eyes, Skin, or Clothing. Wash thoroughly with soap and water after handling.

PRACTICAL TREATMENT

If on skin Wash with soap and water
If in eyes Flush eyes with water until any irritation has stopped
If inhaled Remove victim to fresh air
If swallowed Drink 1 or 2 glasses of water

Manufactured by
Microbial Resources Limited, Reading, England

EPA Establishment No: 49054-EN-01
EPA Registration No: 49054-5

NET CONTENTS: 1 Liter.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling

SKEETAL FC is a larvicide dependent upon the presence of a selective natural toxin which when eaten by the mosquito or blackfly breaks down in the insect's gut. Paralysis and death follow normally within 4-8 hours, control being complete within 24 hours. The natural toxin has been shown to be an effective pesticide against over 30 species of mosquito larvae and several species of blackfly (*Simulium* spp.). Among the mosquitoes controlled are those belonging to the genera *Aedes*, *Anopheles*, *Culex*, *Culiseta*, *Psorophora*, *Wyeomyia*, *Uranotaenia*. In most cases 1st to 3rd instar larvae are the most susceptible, although 4th instar can be controlled

Partially fill the spray tank, add required quantity of SKEETAL FC, stir and continue filling the tank. For the maximum efficacy the mixture should be used the same day. Application can be made using any standard spray equipment, and in any volume of water suitable for adequate coverage. For aerial application 10-15 litres/ha (formulation plus diluent) should be sufficient.

APPLICATION RATES

Mosquitoes	
Clean water, flood water, ponds, ditches, tidal water, salt marsh, etc	1 pint/acre (1 liter/ha)
Polluted water, eg. with sewage	2 pints/acre (2 liter/ha)
Blackflies	
Application made upstream. SKEETAL mixed with up to 3-5 times its own volume of water	3 milligrams formulation/liter of water flowing down stream per minute (0.0001 oz/gallon of water flow). Apply for 10 minutes (example: a stream flow of 10 gallons per minute will require a treatment with 0.001 oz of formulation (diluted as needed) applied over a ten minute period)

STORAGE AND DISPOSAL

Storage
Store in a cool dry place in original sealed container. Do not freeze.

Disposal
Do not contaminate water, food, or feed by storage or disposal. Triple rinse (or equivalent) container. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY NOTICE

All goods supplied by Microbial Resources Limited are of high grade and we believe them suitable for the purpose recommended but as we can not exercise control over their storage or use, no responsibility will be accepted by Microbial Resources Limited for any damage or injury whatsoever arising from their storage, handling, application, or use.

Distributed by:

Made in England.

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ZOECON

BEST AVAILABLE DOCUMENT

Teknar® LARVICIDE

A LARVICIDE FOR MOSQUITO AND BLACKFLY CONTROL

ACTIVE INGREDIENT: *Bacillus thuringiensis* Berliner variety *israelensis*, potency of 1500 AA Units (*Aedes aegypti* units) per milligram: 0.8%
INERT INGREDIENTS: 99.2%
Equivalent to 1.4 billion AA Units per quart

KEEP OUT OF REACH OF CHILDREN
CAUTION

CONTENTS:

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS: Avoid inhalation or contact with eyes or open wounds.

ENVIRONMENTAL HAZARDS: Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

DIRECTIONS FOR USE: It is a violation of Federal law to use this product in a manner inconsistent with its labeling. For mosquito and blackfly larval control, **TEKNAR Larvicide** may be applied to any water sites except treated, finished drinking water reservoirs or drinking water receptacles. As the active ingredient of **TEKNAR Larvicide** is exempt from the requirement of a tolerance on all raw agricultural commodities, applications to irrigation water are permissible.

General Mixing Instructions: Always shake or stir thoroughly before use. Pour recommended amount of **TEKNAR Larvicide** onto surface of water in a nearly filled spray tank. Maintain agitation. Do not allow diluted sprays to stand in the tank for more than 12 hours.

Specific Instructions for Mosquito Control—Application: Apply **TEKNAR Larvicide** when larvae are in 1st to early 4th instar. Larvicidal action is expected within 24 hours. Reapply as neeeded. **TEKNAR Larvicide** may be applied either by air or by ground application techniques. When using standard spray equipment, use adequate volume of water to insure good coverage and penetration. As low as one gallon per surface acre can be applied when the site is open and vegetative cover is light. **TEKNAR Larvicide** may also be applied undiluted through appropriate ULV equipment.

Recommendations: Use lowest rate when 1st to 3rd instar larvae are predominant and highest rate when late 3rd to early 4th instar larvae are predominant in the mosquito population. For guidance, rate ranges according to the most common mosquito habitats are provided on right panel.

Specific Instructions for Blackfly Control—Application: For blackfly control, apply with conventional equipment or with metered release upstream from infested sites to achieve recommended concentrations. Larvicidal action is expected within 24 hours. Reapply as needed.

HABITAT	RATE REQUIRED FOR CONTROL
Floodwater, rice fields, pastures, standing ponds and ditches	0.5-1.0 pts./
Tidal water and salt marshes, catch basins and storm water retention areas	1.0-2.0 pts./
Water polluted with sewage, water with moderate organic content and water with a high level of suspended solids	2.0 pts./

Recommendations: Maintain a 1.0 to 1.5 ppm concentration the stream for 15 minutes. If a shorter dosage time is desire use an equivalent amount of **TEKNAR Larvicide** by increasi the concentration.

Storage & Disposal: Storage—Store in a cool pla Activity may be impaired by prolonged storage at tempe tures above 90°F. Protect from freezing.

Disposal: Pesticide—Pesticide, spray mixture or rinse wa that cannot be used according to label instructions must disposed of according to applicable Federal, state or local p cedures. **Plastic Containers**—Triple rinse (or equivalent). Th offer for recycling or reconditioning, or dispose of in a sanita landfill, or by incineration if allowed by state and lo authorities.

Seller makes no warranty, express or implied, concerning the use of this proc other than indicated on the label. Buyer assumes all risks of use and handlin this material when such use and handling are contrary to label instructions

EPA Reg. No 2724-315-50809
EPA Est. 36299-CA-1

Made in U
© 1986 Zoe
Printed in U

Sold by
professional pest management
A Division of Zoecon Corporation
12200 Denton Drive—Dallas, Texas 75234

For detailed directions for use, limitations, restrictions, exceptions and precautions, car read label attached to container

TEKNAR is a trademark of Sandoz, Inc

Teknar®

BEST AVAILABLE DOCUMENT

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HIGH POTENCY LARVICIDE FOR MOSQUITO AND BLACKFLY CONTROL

ACTIVE INGREDIENT: *Bacillus thuringiensis* Berliner var. *israelensis*, potency of 3000 AA Units (*Aedes aegypti* units) per milligram*	1.6%
INERT INGREDIENTS:	98.4%
	100.00%

*Equivalent to 2.8 billion AA Units per quart.

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENT

HAZARDS TO HUMANS: Avoid inhalation or contact with eyes or open wounds.

Environmental Hazards: Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

DIRECTIONS FOR USE: It is a violation of Federal law to use this product in a manner inconsistent with its labeling. For Mosquito and Blackfly larval control, **TEKNAR**® may be applied to any water sites except treated, finished drinking water reservoirs or drinking water receptacles. As the active ingredient of **TEKNAR** is exempt from the requirement of a tolerance on all raw agricultural commodities, applications to irrigation water are permissible.

GENERAL MIXING INSTRUCTIONS: Always shake or stir thoroughly before use. Pour recommended amount of **TEKNAR** onto surface of water in a nearly filled spray tank. Maintain agitation. Do not allow diluted sprays to stand in the tank for more than hours.

SPECIFIC INSTRUCTIONS FOR MOSQUITO CONTROL—Application: Apply **TEKNAR** when larvae are in 1st to early 4th instar. Larvicidal action is expected within 24 hours. Reapply as needed. **TEKNAR** may be applied either by air or by ground application techniques. When using standard spray equipment, use adequate volume of water to insure good coverage and penetration. As low as one gallon per surface acre can be applied where the site is open and vegetative cover is light. **TEKNAR** may also be applied undiluted through appropriate ULV equipment.

Recommendations: Use lowest rate when 1st to 3rd instar larvae are predominant, and highest rate when late 3rd to early 4th instar larvae are predominant in the mosquito population. For guidance, rate ranges according to the most common mosquito habitats are provided below:

HABITAT	RATE REQUIRED FOR CONTROL
Floodwater, rice fields, pastures, standing ponds, and ditches	0.25-0.5 pt./A
Tidal water and salt marshes, catch basins, and storm water retention areas	0.5-1.0 pt./A
Water polluted with sewage, water with moderate organic content, and water with a high level of suspended solids	1.0 pt./A

Specific Instructions for Blackfly Control—Application: For Blackfly control, apply with conventional equipment or with metered release upstream from infested sites to achieve recommended concentrations. Larvicidal action is expected within 24 hours. Reapply as needed. **TEKNAR** may be applied undiluted through appropriate ULV equipment.

Recommendations: Maintain a 0.5 to 0.75 ppm concentration in the stream for 15 minutes. If a shorter dosage time is desired, use an equivalent amount of **TEKNAR** by increasing the concentration.

STORAGE & DISPOSAL: Storage—Store in a cool place. Activity may be impaired by prolonged storage at temperature above 90° F. Protect from freezing.

Disposal: Pesticide—Pesticide, spray mixture, or rinse water that cannot be used according to label instructions must be disposed of according to applicable Federal, state or local procedures. **Plastic Containers**—Triple rinse (or equivalent). Then offer for recycling or reconditioning or dispose of in a sanitary landfill, or by incineration if allowed by state and local authorities; if burned, stay out of smoke. Reuse of thoroughly cleaned container by consumer is allowable after container has been triple rinsed and label removed. **Metal Drums** — Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other approved state or local procedures. Reuse of drums by the consumer is also allowable once the drum has been triple rinsed and the labeling has been removed.

Notice: Zoecon Corp. makes no warranty, express or implied, including the warranties of merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on this label.

EPA Est. No. 36299-CA-1 EPA Reg. No. 11273-53

Sold by

PM

professional pest management
A Division of Zoecon Corporation
1-800-527-0512
12200 Denton Drive — Dallas, Texas 75234

TEKNAR is a trademark of Sandoz, Inc.

85-1411

APPENDIX D

ACRONYMS

B.t.i.	Mosquito larvicide, *Bacillus thuringiensis* var. *israelensis*.
CARE	Corporation for America Relief Everywhere, CARE Inc.
CDC	US Centers for Disease Control
CESCCO	Centro de Estudios y Control de Contaminación (Center for Study and Contamination Control)
CLM	Clay Lafitte Montague
COHDEFOR	Corporación Hondureña de Desarrollo Forestal (Honduran Forest Development Corporation)
DCV	División de Control de Vectores (Division of Vector Control)
EA	Environmental Assessment
FEDECOH	Federación de Desarrollo Comunitario de Honduras (Community Development Federation of Honduras)
GOH	Government of Honduras
HS1	Health Sector I
HS2	Health Sector II
INA	Instituto Nacional Agrario (National Agrarian Institute)
MSP	Ministerio de Salud Publica (Ministry of Public Health)
MOH	Ministry of Health
OMUR	Operación y Mantenimiento Urbano y Rural (Office of Operation and Maintenance)
OPS	Oficina Panamericana de la Salud (Panamerican Health Organization)
SOW	Scope of Work

APPENDIX D cont.

OSA	Oficina de Salud Ambiental (Office of Environmental Health/MSP)
PAHO	Pan American Health Organization (same as OPS)
PP	Project Paper
PRASAR	Proyecto de Agua y Sanamiento Rural (Honduras Rural Water System of Environmental Sanitation Project, Funded by A.I.D.)
PLC	Physical Larval Control
PVO	Private Voluntary Organization
USAID	United States Agency for International Development
WASH	Water and Sanitation for Health Project
WHO	World Health Organization

APPENDIX E

SELECTED REFERENCES USEFUL TO DCV, HONDURAS

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USNavy, 1982. Emergency medical treatment for acute pesticide poisoning (Chart). USNavy Disease Vector Ecology and Control Center, Jacksonville, FL.

APPENDIX E cont.

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WHO/FAO, 1977. Data sheets on pesticides, No.52, Bendiocarb. (VBC/DS/82.52)

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WHO, 1982. Manual on Environmental Management for Mosquito Control. WHO Offset Publ. No.66, 283 pp.

WHO/FAO/UNEP. Guidelines for forecasting the vector-borne disease implications in the development of a water resources project (prepared by M.H. Birley), undated.

WHO, 1986. The WHO recommended classification of pesticides by hazard and guidelines to classification 1986-87 (VBC/86.1).

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APPENDIX F

RECOMMENDATIONS FOR WATERSHED PROTECTION MEASURES

Water Systems Already Installed and to be Installed

1. It is understood that the Mission is already working with PVOs working in this element of the project with SANAA and appropriate GOH governmental agencies, including reforestation and protection of watersheds, and the required public communications efforts. These elements should be brought into closer participation with the Health Sector II activities in these areas and supported whenever possible.

2. Efforts should be applied initially to perform an assessment and classification of the watersheds. (See CARE Study, 1982 Reference in Appendix). Interagency assistance with organizations such as COHDEFOR or CARE should be solicited to identify any management efforts planned or possible to implement in the project areas, and to obtain assistance, training and materials used in studying watersheds. A typical watershed analysis program guide is attached.

3. Community promotion work should begin and continue with the community water committees "Juntas de Agua" to encourage watershed protection and preservation oriented efforts. This implies a knowledge at hand of alternate measures to undertake and could imply training requirements for the project promoters before hand. Again interagency coordination may be needed. As a minimum, with simply more promotion time and energy applied in this direction, such measures like bringing a matter to the attention of a local municipal legal office has had the result of effecting changes in land use and preservation in watersheds.

4. Positive examples of complimentary approaches to include watershed protection as an integral component of water system promotion and work in communities should be studied and recommendations made to serve as a possible model. One positive example noted during this study was the work by the Save the Children (STC) organization working in the PRASAR Phase I Program. An integrated approach was undertaken by STC by incorporating reforestation materials donated by COHDEFOR along with promotion work. In addition, the CARE organization has had a long history of complimentary water system and watershed protection work in Honduras.

APPENDIX F cont.

Experiences and recommendations of these organizations and other would be invaluable for the longevity of the water systems built in the PRASAR program.

5. Emphasis is needed on the importance of an integrated approach towards water supply and watershed protection in the development of community water systems. Given the extensive watershed destruction and continual deterioration, deforestation, shifting agriculture and uncontrolled uses of fertilizers and pesticides in rural areas, a basic program component should by design address these issues. Experience tells us that investments can be lost quickly without attention to watershed preservation.

APPENDIX G

RECOMMENDATIONS FOR CONSTRUCTION PRACTICES TO REDUCE EROSION AND ELIMINATE POOLS OF WATER ASSOCIATED WITH POOR DRAINAGE

1. Continue to follow standard norms of directing overflows of water intakes and storage tanks away from structures. Erosion protection measures commonly applied are small rock lined ditches to dissipate energy, small canals to divert runoff from around structures and into natural drainage courses and the use of elevated well pedestals.

2. Engineering analysis can be applied to most ponding water areas within communities to effect the most cost efficient means of positive drainage. Field engineers and promoters should have in their job descriptions the requirement to analyze community drainage problems and possible solutions during water system constructive. Some affordable quantities of materials should be made available during water system construction to apply to drainage measures identified as appropriate and affordable, e.g., 6" PVC pipe, rock, cement.

3. The following represents possible low cost drainage measures that can apply:

   a. Cross ditching to connect ponding areas where elevations permit to allow positive drainage out of low areas and into natural drainage courses. This is similar to control work for physical control of larval mosquitoes.

   b. Installation of piped drains under roadways to drain road ditches without outlets. Pipeline such as 6-inch diameter P.V.C. can be an appropriate drain line for such practice. Any 6" diameter pipe should be able to be so located to have sufficient slope (average 2% grade minimum) and accessibility to be maintained. In some instances, road grades are such that one side of a road only needs to be able to drain through an underground connection to the other side to continue in natural drainage ways.

APPENDIX G cont.

c. In some locations construction of small to medium sized seepage drain pits, with similar specifications as those for dwelling and well drainage pits, can be installed in areas of problematic drainage. This is not a method of first choice due to maintenance requirements for longevity of operation.

d. In communities with relatively flat terrain without much natural drainage the emphasis should be made on the construction of individual drainage pits. In this manner, the dispersed disposal of discarded water can curtail the collections from many families.

e. In extreme cases, absorption wells could be constructed that would function by filling up with water and allowing side wall absorption (similar to septic tank systems with identical absorption wells in lieu of drain tiles). Absorption wells would not have to be deep, in the order of 5 to 10 feet in depth by 4 to 5 feet in diameter in order to function adequately. Any wells so constructed would need a grate installed to allow water passage but exclude other matarial. Longevity of operation would be dependent on the permeability of the subsoils and the degree of annual siltation which will in time require removal.

APPENDIX H

MAP OF THE OFFICES OF THE HONDURAS "CENTER OF STUDIES AND CONTROL OF CONTAMINANTS" ORGANIZATION "CESCCO"

Notes:

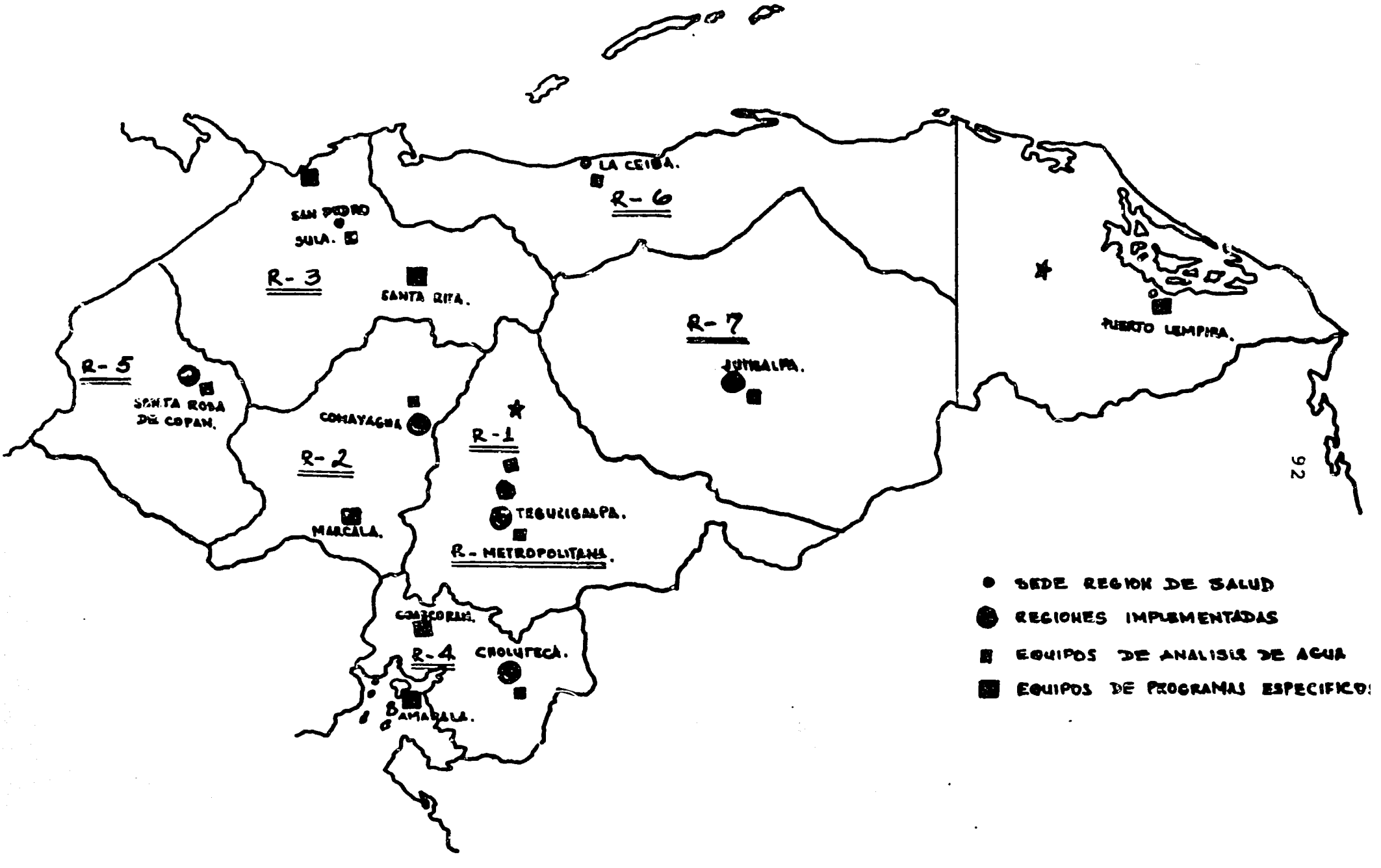
The offices shown represent locations where members work in the Environmental Health Offices of the Ministry of Health in eight regional offices.

The central office in Tegucigalpa is undergoing expansion and will be equipped during 1989 with complete laboratory facilities to include detection in water of heavy metals, pesticides/hydrocarbons (the latter two are present capabilities), complete primary and secondary chemical and physical parameters and biological contamination.

This program has received the mandate to set the standards and controls for all contaminants country wide. Studies now include meat products, milk, soils, ceramics, water, foods, and others.

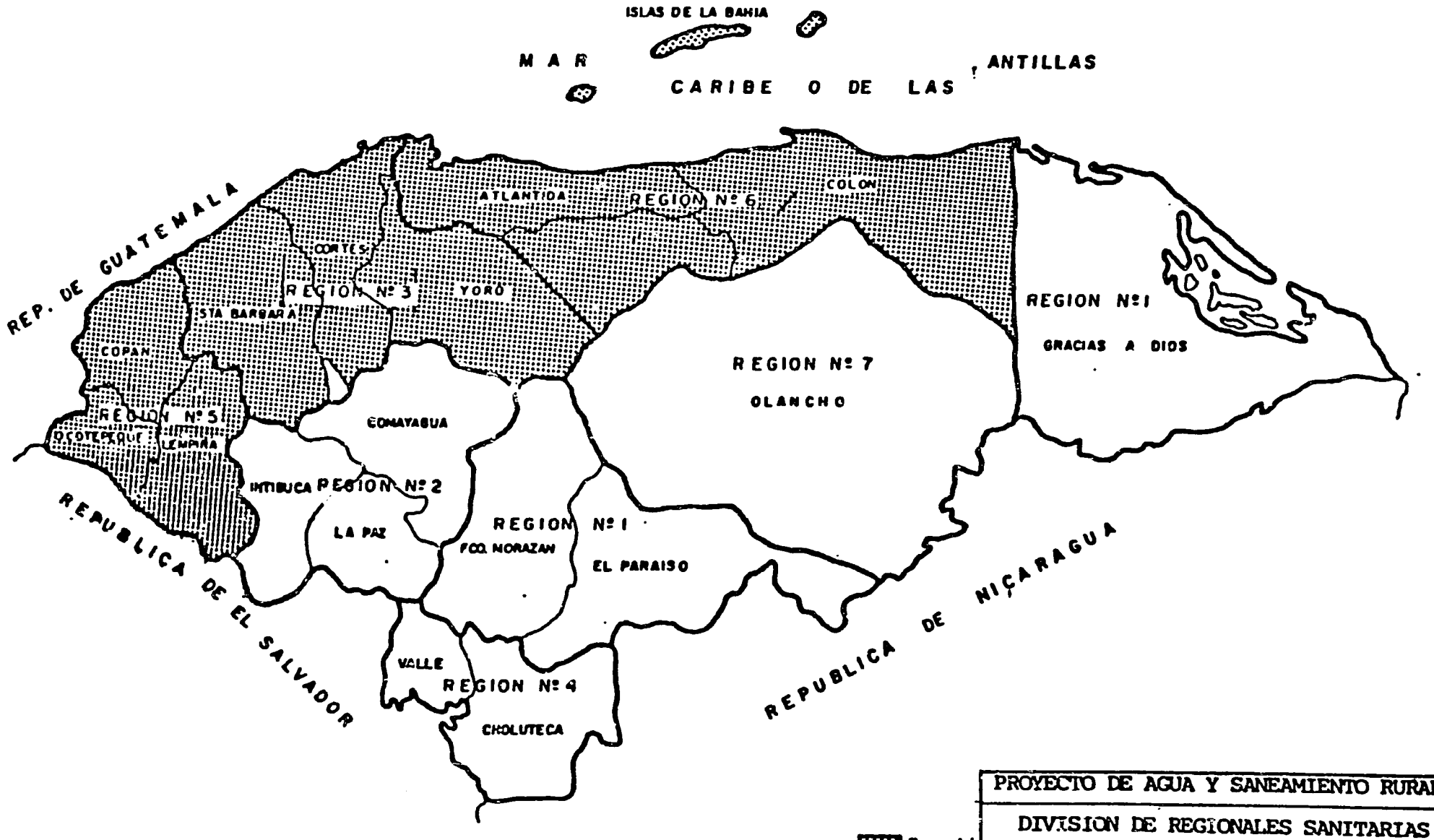
CENTRO DE ESTUDIOS Y CONTROL DE CONTAMINANTES

MEJORAMIENTO DE CALIDAD DE AGUA. CESCCO



APPENDIX I

MAP OF STUDY AREAS, RURAL WATER AND SANITATION



PROYECTO DE AGUA Y SANEAMIENTO RURAL
DIVISION DE REGIONALES SANITARIAS
FECHA: NOV/87

Zona del Proyecto

APPENDIX J

ENVIRONMENTAL ASSESSMENT - HEALTH SECTOR II - RURAL WATER AND SANITATION PROGRAM

RECORD OF FIELD TRIPS - ROBERT HOGREFE

1. Monday, May 16, 1988
   Tegucigalpa

   A.M. Meeting with USAID personnel and members of Vector Control Division and Program in Rural Water and Sanitation. Discussed basic strategy for the EA. Team split up to Different Meetings Planned.

   A.M. and P.M.
   Meetings with SANAA/PRASAR Engineers at Office of SANAA/PRASAR, also included MPS/PRASAR Chief Engineer. Discussed purpose of study and requested a copy of all criteria pertaining to site selection for springs, dams, handpumps, wells, latrines and others system components. Learned that other offices of PAHO and CESCCO are involved in water quality analysis and have criteria available. Discussed general concerns of watershed impact on water systems.

2. Tuesday, May 17, 1988
   Tegucigalpa

   A.M. Meetings at Offices of MPS to obtain criteria utilized in PRASAR/MPS Projects; interviewed MPS/Engineer in charge of Well/Handpump Program and discussed system of parts supply, hand-pump manufacture and maintenance and well locating criteria.

   A.M. Meeting with PAHO Sanitary Engineer to discuss the jointly supported Control for Contamination Progra, (CESSCO). Learned of water quality laboratory capabilities in regional offices and in Tegucigalpa. Will obtain copy of norms/criteria of water quality they use.

   A.M. Meeting with CESCCO Director to discuss their Program and efforts in country-wide water quality monitoring. CESCCO works directly with MPS in Offices of Environmental Health in 8 Regions (offices). CESCCO is the Honduras Agency with mandate to monitor and establish chemical contaminant criteria in all waters, foods, meat and other products (e.g., ceramics). Central lab in Tegucigalpa is set up to do pesticide and heavy metal analysis only;

APPENDIX J cont.

regional labs are capable of bacteriological and chemical/ physical water testing. Central Lab to expand services in new building in 1989.

P.M. Met with A.I.D. Engineer/coordinator at A.I.D. offices to discuss the Project Paper and intent of watershed protection mentioned in the Scope of Work. Also discussed present plan to establish separate operation/maintenance budget within SANAA/OMUR; agreement is pending this year. Watershed activities may be possible with project funds.

3. Wednesday, May 18, 1988
Tegucigalpa - San Pedro Sula - El Progresso - Tela

Flew to San Pedro Sula with Clay Montague, Team member, and met SANAA/PRASAR Engineer and Promoter in El Progreso (SANAA/PRASAR Office). Obtained basic community survey/ profile data forms utilized for establishing feasibility for projects. Discussed site location criteria and watershed protection.

Drove to community of "Ruth Garcia". Walked to water source (small dam) for water system. Reviewed status of land ownership in watershed with local water committee member. Learned of recent conflict with INA organization that allowed slash/burn activities to occur nearby. Competition among government agencies sometimes results in no action to control damages to watershed.

Also noted that a road built for ease of material delivery for water system also allows ingress for wood cutting. Indirect impact of greater accessibility has resulted. Damage from flood in 1987 has been repaired at the source. Watertable in community only 4 or 5 ft. from surface. Shallow type latrine must be utilized in this area.

Water source appears to be well protected with exception of one dwelling located at same elevation as water source several hundred meters away. Agricultural uses occurring in the greater areas of the watershed.

APPENDIX J cont.

4. Thursday, May 19, 1988
Tela - La Ceiba - Montevideo - Sonaguera

Met Regional MPS Engineer at Office in La Ceiba. Also met Regional Director of Vector Control - physical Larval Control Program - and arranged itinerary for today and tomorrow. Reviewed charts and work plan of PLC program for the region.

Drove to communities of Montevideo and Lopez Benito, joint water system project planned for these communities. Inspected proposed water source and discussed selection of the site and watershed. No water quality analyses have been taken, but promoters are expecting to perform these tests in the regional office/labs planned in next phase. Old latrines in use will be replaced with pour/flush variety.

Watershed appears to be well protected on one side where land is owned by member of the armed forces who is allowing the community to use a small dammed stream. Open burning of land was occurring on the other side within several hundred meters of the water source. No explanation was available regarding the fire underway.

President of the water committee commented that stopping cutting/burning is difficult as farmers in the mountains consider their land to be given by God and that they have the inherent right to cut down the forest in order to cultivate land. Community is highly motivated and has collected several thousand Lempiras to spend once the water project is underway.

5. Friday, May 20, 1988
Sonaguera - Saba - La Ceiba

A.M. Reviewed physical larval control program in the field with Regional Director and staff at office in Sonaguera. Inspected past and present work sites and learned of work methodology utilized. SANAA/PRASAR engineer and a promoter also along to learn of the program. Basic techniques of landfill, drainage ditch construction, cleaning, fish relocation and salt applications discussed in the field. Program appears very well organized.

APPENDIX J cont.

P.M. Drove to community of El Naranjo to inspect water systems. Walked to water source (small dam and tank together at the spring). Learned of community's attempts to coordinate with COHDEFOR for stopping of slash/burn/ planting agricultural practices in their watershed. Attempts have been futile and obvious watershed damages are present. Community is very frustrated with inability to stop damage in watershed.

Discussed collection of family water payments to pay for needed maintenance (bottom of small dam damaged from flood in 1987 - water escaping from below dam). So far collections have been irregular and a strong effort is planned to collect funds to fix the damaged source.

6. Monday, May 23, 1988
Tegucigalpa - San Pedro Sula

Drove to San Pedro Sula and Office of PRASAR/MSP to meet with Regional Chief PRASAR/MSP engineer and promoters. Discussed the various water system design, locating and maintenance components involved in their work. Learned of poor experience with compost type latrine as used in some (experimental) high groundwater table areas. Some of the latter types are still in use after 2 - 3 years and have not filled up yet- maintenance will be needed but it is not know what frequency. Designs are also available in Guatemala that would be useful to have. "Viet-Nam" type of latrine also discussed.

Discussions pointed out that groundwater table depths are generally known in their areas and this helps determine the appropriate type of latrine to use. Generally, 15 meters is the minimum distance b/w a hand pump well and latrine and 1.5 meters is the norm for min. separation b/w latrine receptacle and high groundwater depth. No pour/flush types of latrine are used unless a community water system is being built.

Hand pump fabrication and maintenance was discussed. Efforts to establish the Honduras "Catracha" hand pump seem to be succeeding (i.e., to standardize the pump to be supplied thru the program). Quality control program seems to be acceptable to the only pump fabricator (in Tegucigalpa) who guarantees the pumps against defects for life.

APPENDIX J cont.

Recognition of the CESCCO program exists as appropriate to coordinate chemical water quality control and monitoring along with MPS offices.

7. Tuesday, May 24, 1988
San Pedro Sula - Quimistan; La Flecha; Callejones; 6 DE MAYO; 39 DE GUAYMAS

Drove with MPS Engineer and Promoters to Quimistan areas to review previous projects with hand pump wells and latrines (both dry and pomp/flush). Discussed watershed protection achieved through promoter's work at the "Ley de Municipio" (Municipal Law) level that did work to resolve some conflicting uses in a community's watershed. MPS has more time to spend in community promotion work that includes watershed protection. COHDEFOR is recognized as generally ineffective w/o sufficient field people.

At Callejones, many pour/flush latrines are working well both inside and outside. Drainage problems were evident where used wash water has filled holes and ditches without any drainage ability. Will recommended to include some cross ditches and drainage pipes underground in all communities.

On May 6, a new home INVA project is installing pour/flush latrines in good locations and soils (26 homes). Pictures taken.

Learned of water quality problem at Urraco Pueblo, Mun. de Progresso where Black population is beset with teeth mottling - probably due to excess fluoride in water. Well drilling occurring in Progresso are w/hand pumps installed, followed by latrines.

8. Wednesday, May 25, 1988
San Pedro Sula - El Pino - Los Cavaos - Tegucigalpa

Travelled to a MSP built community water system, 1982 (80 + homes) System is now uprooted due to new road construction! Community is building new road and will re-install water system.

APPENDIX J cont.

At Los Cavaos, artesian well supplying water to 200 + homes in MSP built system; 70% coverage of latrine, pour/flush types. Well donated by banana company 12 years ago. SANAA had previously denied feasibility of the project. Large pressure variation in distribution system.

APPENDIX K

EXAMPLES OF PROMOTION PROGRAM AND MATERIALS

(Four-day Course for Watershed Protection Training for Local Community Members)

Source: SANAA/CARE/COMUNIDAD

Recommendation: Incorporate Watershed Protection Promotion into Health Sector II - PRASAR Program; utilize the SANAA/CARE/Comunidad guidelines.

PROGRAMA PARA ENTRENAMIENTO DE LIDERES COMUNALES
CUENCAS
PRIMERA FASE - SETIEMBRE/OCTUBRE DE 1987

DIA	HORA	TEMA	OBJETIVOS	ACTIVIDADES	MATERIALES	RESPONSABLE
PRIMERO	6:30 p.m. 6:30-7:30	Llegada y ubicación de participantes Inauguración	- Presentación - Explicar el programa - Objetivos - Contenidos	Exposición	- Marcadores - Rotafolio - Papel bond	
SEGUNDO	8:00-11:00 a.m.	Liderazgo: Cualidades y motivaciones	- Describir cualidades del líder - Analizar la importancia del líder en la promoción de la comunidad.	Dinámicas de grupo y análisis	- Manta - Arena - Cartulina - Marcadores	
	11:00-12:00	Presentación de datos por comunidad	Que los líderes conozcan datos del diagnóstico de sus comunidades.	- Formación de grupos - Discusión de datos por comunidad.	- Marcadores - Cartulina - Papel bond	
	12:00-01:00	Almuerzo				
	01:00-02:00	Introducción al Componente de Cuencas	Que los participantes identifiquen la importancia de la cuenca dentro del marco general del programa	- Presentación de participantes - Exposición sobre las partes del sistema de agua	- Rotafolio - Marcadores - Tiza - Maskin tape	
	02:00	Gira de campo La cuenca y sus problemas de manejo	Identificar en el campo los problemas que afectan la cuenca	- Explicar propósito de gira - Organizarse en grupos (2) - Establecer ruta - Recorrido - Enfatizar puntos claves	- 2 vehículos - libreta de apuntes - merienda	
	07:00	El problema de contaminación por pesticidas	Realizar la problemática del uso de pesticidas y su impacto en el medio ambiente	- Introducción al problema - Presentación del sonoviso "Gotas de Vida, Gotas de Muerte" - Comentarios, reflexión	- Pantalla - Grabadora - Proyector - Diapositivas	
TERCERO	08:00-10:00	Análisis participativo sobre los problemas que afectan una cuenca	Basados en la experiencia de la gira de campo: - Identificar las causas y problemas encontrados en la cuenca - Definir y simplificar los conceptos mas comunes en el manejo de la cuenca	- Discusión y preparación de presentaciones por grupos (2) - Presentación por grupos (2) - Resumen	- Rotafolio - Marcadores - Tiza - Maskin tape - Reglas (2)	

PROGRAMA PARA ENTRENAMIENTO DE LIDERES COMUNALES
CUENCAS
PRIMERA FASE - SETIEMBRE/OCTUBRE DE 1987

DIA	HORA	TEMA	OBJETIVOS	ACTIVIDADES	MATERIALES	RESPONSABLE
TERCERO	10:15-11:00	Aspectos básicos sobre el manejo de cuencas	- Clarificar conceptos sobre el manejo de la cuenca - Enfatizar prácticas a realizar en el área de protección de sus cuencas	- Describir conceptos claves - Describir las tres actividades prioritarias del programa	- Rotafolio - Marcadores - Tiza - Maskin tape	
	11:00-12:00	Uso de los afiches como medio motivacional	Enseñar el uso de los afiches para motivar y promover la comunidad	Presentación y análisis de contenido de afiches	- Afiches - Puntero - Tiza de color - Maskin tape	
	12:00-01:00	Almuerzo				
	01:00-02:00	El comité de cuencas: Su organización y papel	- Que el líder aplique conceptos básicos sobre organización en la formación del comité - Que el comité identifique sus funciones	- Explicación del ¿por qué del comité? - Integración del comité - Lluvia de ideas sobre funciones - Priorización	- Rotafolio - Marcadores - Tiza	
	02:00	Gira de campo: Alternativas para mejorar la cuenca	Basados en la información recibida: Identificar actividades prácticas en beneficio de la cuenca	- Explicar propósito de la gira - Establecer ruta - Recorrido por grupos (2) - Enfatizar puntos claves	- 2 vehículos - Libreta de apuntes - Merienda	
	07:00 p.m.	Impacto social de los problemas de la cuenca	Realizar el impacto social causado por las causas y problemas en la cuenca y su uso como motivación comunal	- Introducción - Presentación de diapositivas con diálogo participativo - Comentarios y reflexión	- Pantalla - Proyector de diapositivas	
CUARTO	08:00-09:00	Aspectos claves por recordar	Afianzar conceptos impartidos durante el curso y manejarlos adecuadamente para ser transmitidos a sus comunidades	- Lluvia de ideas sobre aspectos de mayor impacto - Participación individual seleccionando los puntos anteriores	- Rotafolio - Marcadores - Tiza - Maskin tape	
	09:00-10:00	Plan de actividades para el manejo de cada cuenca comunal	- Determinar las áreas críticas de la cuenca y priorizar las actividades a llevar a cabo - Tomando en cuenta las tres actividades prioritarias del programa ejecutar un plan de acción	- Formar grupos por sistema - Discutir áreas críticas de la cuenca - Elaborar plan de acción en base a prioridades establecidas	- Formularios - Reglas - Tiza	

PROGRAMA PARA ENTRENAMIENTO DE LIDERES COMUNALES
CUENCAS
PRIMERA FASE - SETIEMBRE/OCTUBRE DE 1987

DIA	HORA	TEMA	OBJETIVOS	ACTIVIDADES	MATERIALES	RESPONSABLE
	10:00-10:30	Plan global de actividades por comunidad	Coordinar un plan gobal de los 3 componentes, por comunidad, resaltando actividades comunes y evitando traslapes de acción	- Organizar cada comunidad con sus tres componentes - Presentar planes de cada componente - Unificar criterios de acción	- Planes de acción - Libreta de apuntes	
	10:30-11:00	Evaluación global del taller	- Determinar temas, metodología y actividades de impacto durante el curso - Listar recomendaciones	- Discutir preguntas formuladas - Lluvia de ideas - Resumir y formular recomendaciones	- Rotafolio - Marcadores - Tiza	

GUIA PARA LIDERES COMUNALES
II TALLER CONSERVACION DE CUENCAS SANAA-CARE
COMO OBTENER EL CONTROL COMUNAL DEL TERRENO DE LA CUENCA

Para realizar actividades en beneficio de la conservación de la cuenca se necesita - no solamente contar con la mejor voluntad de la comunidad sino que también el dere-- cho a cercar y controlar el terreno que rodea la fuente. Esta área de terreno no -- tiene una extensión definida sino que depende de la forma y características del suelo lo que hace imposible fijar una cantidad de manzanas ó metros para proteger alrededor de la fuente. En la mayoría de veces no es posible obtener los derechos sobre- todo el terreno, sin embargo en vez que nada cualquier extensión es mejor.- Por supuesto lo ideal es agotar todos los esfuerzos para conseguir todo el terreno que comprende la cuenca.

A continuación se detallan algunas acciones a realizar para facilitar la obtención - de derechos comunales sobre la cuenca de acuerdo a la tenencia del terreno.

a) TERRENO EJIDAL

Cuando la cuenca está ubicada en terreno ejidal es responzabilidad de la Alcal-- día a petición de la comunidad interesada emitir un documento que conceda el derecho a los solicitantes de proteger y conservar el área de la cuenca.
Cuando hay personas ya establecidas en éste tipo de terreno se deberán reconocer las mejoras realizadas (Ejemp. Cerco, construcciones, cultivos etc), mas no así el valor de la tierra que ya ha sido concedida por la municipalidad.

Es muy importante mantener buenas relaciones hasta dónde sea posible con la ó -- las familias que habitan la cuenca con el fin de evitar pleitos ó venganzas en - el futuro.

b) TERRENOS NACIONALES

Cuando la tenencia del terreno dónde está ubicada la cuenca es nacional el pri-- mer paso para asegurar su protección es obtener un dictamen de COHDEFOR que acre

..../

dite su condición de cuenca abastecedora de agua.

En el caso de que existan usuarios del terreno es conveniente comenzar a negociar las mejoras realizadas si existieran.

Es muy probable que en algunos casos el usuario quiera aprovecharse de la comunidad cobrando una cantidad elevada por las mejoras realizadas en el terreno en cuyo caso es converiente buscar consejo en las personas entendidas por ejemplo: Empleados del INA, quienes podrían efectuar un evalúo de las mejoras y calcular un precio justo para la comunidad.

Recuerden que en todo caso los que realmente quieren resolver el problema son ustedes por lo que nunca dejen todo en manos de otros menos interesados.

c) TERRENOS PRIVADOS

De acuerdo a la Ley de Reforma Agraria en caso de interés colectivo el INA puede indemnizar (pagar por el terreno) ó reubicar a familias que estén afectando una cuenca abastecedora de agua.-.Esta es la mejor manera de resolver el problema cuando se cuenta con la ayuda de la institución y la colaboración del dueño, pero no siempre ocurre así.

En éste último caso la comunidad debe estar bien consiente de que la única solución no violenta es llegar a una negociación directa.

De cualquier manera que se logre obtener la garantía del terreno (por arreglo directo ó por la intervención de instituciones del Gobierno) al final debe quedar un documento claro, firmado por las partes interesadas a favor no de una persona, sino de toda la comunidad para evitar malos entendidos en el futuro.

ORGANIZACION Y FUNCIONES DEL COMITE DE CUENCAS

Una comunidad interesada en conservar y mantener su cuenca necesita de una organización que le ayude y facilite hacerlo. Esto no tiene que ser algo difícil sino fácil y sencillo, uno ó dos miembros del patronato pueden representar el comité de cuencas y encargarse de organizar y participar en las diferentes actividades a realizar en la cuenca, de manera que ser el representante de cuenca no significa cargar solo con la responzabilidad, y ésto debe quedar bien claro. La responzabilidad de proteger la cuenca es de todos.

Para organizar las actividades deberá aprovecharse las reuniones del patronato ó junta Administrativa pero a falta de ellas el ó los representantes podrán perfectamente, en caso que sea necesario convocar una reunión específicamente para tratar asuntos relacionedos con problemas en la cuenca y sus posibles soluciones.

FUNCIONES

Son funciones específicas del comité de cuencas las siguientes:

- Promover la conservación de la cuenca.
- Organizar y supervisar el cercado de la fuente
- Organizar la delimitación de la cuenca.
- Organizar y facilitar la reforestación
- Organizar por grupos a voluntarios de la comunidad para patrullar la cuenca en verano.
- Organizar la colaboración en el control de las quemas agrícolas en las áreas aledañas a la cuenca, en el caso de que no se puedan evitar.
- Aforar la fuente mensualmente.
- Organizar el mantenimiento de las obras que se realicen en la cuenca.
- Reportar a la comunidad periódicamente las actividades realizadas.

Al no saber sus funciones un comité deja de tener razón de ser y por lo tanto - esto solo puede pasar en una comunidad que aún no ésta lista para responzabilizarce por el mantenimiento de su acueducto y cuenca.

SOLICITUD DE DECLARACION
DE ZONA FORESTAL PROTEGIDA O ZONA DE RESERVA MUNICIPAL

ING. _____
JEFE DE DISTRITO FORESTAL _____
DEPARTAMENTO _____

Estimado Ingeniero:

La presente tiene por objetivo la SOLICITUD DE DECLARACION DE ZONA FORESTAL PROTEGIDA O ZONA DE RESERVA MUNICIPAL, para los terrenos ubicados en la cuenca denominada _____, de la comunidad de _____, municipio de _____, en el departamento de _____. Sirvase realizar la inspección de campo respectiva y dar el dictamen legal.

La cuenca sirve de alimentación al proyecto de agua potable del Programa SANAA-CARE-COMUNIDAD, que abastece a _____ familias de las comunidades de _____, y el valor del proyecto es de Lps. _____.

Actualmente nos encontramos sumamente preocupados por la destrucción de la cuenca por agricultores y ganaderos. Le rogamos interponga sus facultades para tal efecto.

Lo anterior lo fundamos en los artículos 141-148 del REGLAMENTO GENERAL FORESTAL. Efectuado el estudio respectivo y visto el dictamen como lo establece la LEY FORESTAL vigente, esperamos se nos resuelva en definitiva.

Lugar y Fecha: _____

_____ POR: COMITE DE CUENCAS

_____ JUNTA ADMINISTRADORA AGUA POTABLE

D I C T A M E N

El suscrito encargado de la sección de protección de la unidad de manejo forestal de _____ en uso de las facultades que la ley le confiere, en base a inspección de campo efectuada en la cuenca denominada _____ _____ de la comunidad de _____ Juridicción de _____

DICTAMINA LO SIGUIENTE:

1.- Que la cuenca _____siendo efectada por agricultores y ganaderos.

2.- Que la cuenca alimenta al proyecto de agua potable de la comunidad de _____ _____ Juridicción de _____ Departamento de _____

3.- Que el terreno por su pendiente, calidad del sitio y otras características; es de vocación forestal y las actividades actualmente realizadas solo conllevan a provocar erosión, sedimentación y destruir la cuenca.

Dado en _____ a los _____ días del mes de _____ de 198 _____

_____ JEFE DE PROTECCION

_____ V°B°

SOLICITUD DE GARARANTIA

_____DE _____DE 19 _____

LIC _____

Procurador Agrario
Departamento de _____
Estimado Licenciado:

La presente tiene por objetivo la Solicitud de Garantía de los terrenos ubicados en la cuenca denominada _____ de la comunidad de _____ Juridicción de _____ Depto. de _____

Personeros especializados en el ramo efectuaron el respectivo estudio y dieron el respectivo dictamen que se presenta adjunto.

La cuenca sirve de alimentación al proyecto de agua potable del Programa SANAA-CARE-COMUNIDAD", que abastece a _____ familias de las comunidades de _____ _____ el valor total del proyecto es de Lps. ___ _____

Actualmente nos encontramos sumamente preocupados por la destrucción de la vegetación de dicha cuenca por agricultores y ganaderos.

Sirva como base el dictamen adjunto hecho por COHDEFOR y fundamentado en el respectivo -- estudio.

Le rogamos interponga sus facultades para tal efecto. Lo anterior lo fundamentamos en los Artículos N° 8, 9, 13, Inciso D, y Artículo N° 174 fe de la Ley de Reforma Agraria.

Por la atencion a la presente nos suscribimos de usted.

Atentamente,

_____ POR COMITE DE CUENCAS

_____ JUNTA ADMINISTRADORA DE AGUA POTABLE

far/

ANNEX I

RECOMMENDED PROCEDURES FOR ENVIRONMENTAL CONSIDERATION AND CRITERIA REVIEW OF VECTOR CONTROL ACTIVITIES UNDER HEALTH SECTOR II - HONDURAS

ENVIRONMENTAL CONSIDERATIONS AND CRITERIA REVIEW

In addressing environmental considerations criteria review for integrated vector-borne disease control activities under Health Sector II, only five options are available: physical larval control, house spraying (fenitrothion); larviciding (B.t.i.); chemical prophylaxis and treatment, and no long-term action. Described below are generalized situations in Honduras with available options, followed by environmental considerations and criteria review processes for the various vector control approaches that might be taken, viz., pesticides (adulticides for residual wall spraying of dwellings and larvicides for treating anopheline habitats) and physical larval control through alteration of aquatic habitats.

Should modifications be necessary during the course of the Health Sector II Project, it is expected that the review mechanisms presented here can be adapted to either modified or expanded activities.

Malaria Control Options

	Situation*	Options**
1.	Area has a low or negligible malaria incidence. Malaria incidence indicates need for vector control. Proceed to 2, below.	4.5
2.	-Urban area with known or suspected resistance to organophosphorus or carbamate compounds.	4.1.3
	-Urban areas with known vector susceptibility.	4.2.1.3
	-Rural areas with known or suspected resistance to OP or carbamate compounds.	4.1.3
	-Rural areas with known vector susceptibility.	4.2.1.3
	-Rural areas with scattered housing and well defined treatable impoundments (accessible with negligible environmental impact).	4.2.1.3
	-Rural areas with scattered housing in inaccessible or environmental impact impoundments.	4.2
	-Rural areas with concentrated housing and well defined and treatable impoundments (accessible and negligible environmental impact).	4.2.1.3
	-Rural areas with concentrated housing and inaccessible or environmental impact impoundments.	4.2.3

*Treatment Options:

1. Physical Larval Control
2. House spraying with fenitrothion
3. Larviciding with *B.t.i.*
4. Case detection and chemical prophylaxis and treatment.
5. No long-term action, but consider all options for dealing with epidemicity.

*See criteria review check list.
**Options are listed in descending order of consideration. Option 4 should be an adjunct to all vector control options.

ENVIRONMENTAL CONSIDERATIONS AND CRITERIA REVIEW

Insecticides

Should it become necessary under this project to procure or use pesticides not specifically approved in this EA, an amended EA must be prepared and approved by the LAC Chief Environmental Officer prior to their use.

The selection and use of pesticides by A.I.D. supported programs are covered in great detail under A.I.D. Regulation 22 CFR Part 216, Environmental Procedures. A model procedure for the future selection of pesticides to be used in the Honduras vector control program should be based on the subject document.

The following procedure is recommended:

1. Is the proposed product or its use exempt under Reg.22 CFR 216?

   (Note: Pesticides are generally not exempt; however, in some cases, e.g., controlled experimentation exclusively for the purpose of research and field evaluation which are carefully monitored might be (216.2(c)(iii) (2)(ii)). In all cases of exemption questions, approval should be received from the appropriate A.I.D. Environmental Officer(s). Exempt:

   Yes ____ No ____

   If the intended use of the pesticide is not clearly exempted under 22 CFR 216 and appropriately approved, the Pesticide Procedures of 22 CFR. 216.3(b)(1) should be carefully addressed. (Note: It is advisable to assume that the operational use of a pesticide is not exempt.) Subject to regs.:

   Yes ____ No ____

The factors that must be considered under 22 CFR 216.3(b)(i) are as follows:

- The USEPA registration status of the requested pesticide. ____
- The basis for selection of the requested pesticide. ____
- The extent to which the proposed pesticide use is part of an integrated pest management program. ____
- The proposed method or methods of application, including availability of appropriate application and safety equipment. ____

- Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use measures available to minimize such hazards. _____
- The effectiveness of the requested pesticide for the proposed use. _____
- Compatibility of the proposed pesticide with target and non-target ecosystems. _____
- The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. _____
- The availability and effectiveness of other pesticides or nonchemical control methods. _____
- The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide in strict adherence to the label. _____
- The provisions made for training of users and applicators. _____
- The provisions made for monitoring the use and effectiveness of the pesticide. _____

2. Will the use of the pesticide impact on an endangered or threshold species? ____ ____

Aquatic Habitats*

(See following page for Criteria Review Check List)

		Yes	No
1.	Is the standing or slowly moving water problem man-made?	T	2
2.	Is the standing or slowly moving water problem to be affected by a single project (e.g., a drainage system) less than 0.1* ha in surface area during the wettest season (June-August)?	T	3
3.	Will the project affect only actively grazed pasture land?	T	4
4.	Will the project affect an area of contiguous, possibly pristine wetland (as indicated by vegetation) exceeding 0.5* ha. during the wettest season (June-August)?	DNT1	5
5.	Does the affected project area contain American crocodiles (Crocodylus acutus) or banded tiger herons (Tigrisoma fasciatum)?	DNT2	6
6.	Does the affected area contain a total area of ungrazed, but not necessarily pristine wetlands exceeding 5.0* ha.?	7	MT
7.	Has the effect or removing wetland area or downstream water quality been considered (wetlands can filter and purify runoff from surrounding watersheds) and deemed insignificant and has a search been conducted for resident animals and plants known to be endangered or threatened species with negative results?	8	DNT3
8	Does the total area of all aquatic habitat being treated within the 3 km radius exceed 1%*(28ha.)?	DNT4	MT

T - Treat
MT - Minimal Treatment. Treat only what is absolutely necessary to treat for health reasons (e.g., do not drain an entire natural pond if only the edge needs to be treated).
DNT - Do Not Treat.
* - Values are estimated according to the professional opinion of CLM and may be modified in consultation with him.
1 - Risk to uncertain wetland value seems too great; 2 - Risk to known habitat value is too great; 3 - Risk to uncertain value is too great; 4 - Risk to uncertain value seems too great.

CRITERIA REVIEW OF VECTOR CONTROL ACTIVITIES UNDER HEALTH SECTOR II

1. Project Area

1.1 Project Habitat Description

Rain forests
Riverine habitats _____
Irrigation channels _____
Estuaries _____
Lakes and ponds _____
Cultivated wetland (e.g., rice) _____
Natural wetland _____
Rivers and streams _____
Coastal lowland _____
Human settlements _____
Grazed pastures _____
Natural drainage channels _____
Manmade drainage channels _____

1.2 Size of Project Area

0.1 - 0.5 ha. _____
0.5 - 2.0 ha _____
2.0 - 5.0 ha. _____
5.0 ha. or greater _____

1.3 Human population of Area

Dense _____
Moderate _____
Sparse _____

1.4 Malaria incidence

Low (API 0 - 2.0) _____
Medium (API 2.0 - 9.0) _____
High (API 10 or greater) _____

1.5 Project site distance to town or village

Less than 1 km. _____
1 to 3 km. _____
3 to 5 km. _____
5 km. or more _____

1.6 Malaria transmission pattern

Seasonal _____
Permanent _____
Endemic _____

1.7 Economic character of area
- Agricultural _____
- Industrial _____
- Geological _____
- Other _____

1.8 Vector susceptibility to insecticides
- Confirmed resistance _____
- Confirmed tolerance _____
- Susceptible _____

1.9 Agricultural insecticide pressure present
- None to negligible _____
- Low _____
- Medium _____
- High _____

1.10 Water-use Pattern
- Irrigation _____
- Used by animals _____
- Growing fish _____
- Bathing _____
- Washing clothes _____
- Human consumption _____
- Other _____

1.11 Disease control methodology prior to project
- Physical measures _____
- Chemical measures _____
- House spraying with residuals _____
- Drug treatment _____
- Other _____
- None _____

1.12 Land Ownership
- Private _____
- Public _____
- Other _____

2. Proposed Methodology for Larval Control

2.1 Physical Measures
- Shore line alteration _____
- Water course management _____
- Sloping of banks _____
- Removing vegetation _____
- Channeling _____
- Deepening _____
- Filling _____
- Draining _____

Sumping _____
Other _____

2.2 Chemical Measures
Use of *B.t.i.* _____
Other _____

2.3 Biological Measures
Use of larvivorous fish _____
Other _____

2.4 Project Design
Engineering input needed _____
Engineering input not needed _____

ANNEX II

ENVIRONMENTAL REVIEW SURVEY FOR A RURAL COMMUNITY WATER SYSTEM AND SANITATION PROJECT

Person _____ Date _____

A. Name and Location of Community (Caserio, Aldea, Municipio, Departamento)

(Note: Provide community profile data per regular MSP or SANAA/PRASAR forms)

B. Watershed Factors

1. Present Condition:

	Yes or No	Comments
Excellent:		
Without erosion and deforestation problems, little human impact, quantity and quality water is excellent, positive stability tendency, natural regeneration occurring.	__	__
Good:		
With small problems of deforestation and limited human impacts, quantity and quality of water is good, some negative stability tendency, mostly natural regeneration occurring.	__	__
Poor:		
Much deforestation and erosion, moderate level of human impact, quantity and quality of water is variable, stability tendency is negative, little natural regeneration.	__	__
Bad:		
Very bad deforestation and erosion, high level of human impacts, quality and quantity of water is very variable, stability tendency is negative, very little natural regeneration.	__	__

	Yes or No	Comments
2. Activities in Watershed:		
Traditional Agriculture: Corn and Beans, Sacate		
Production Agriculture: Bananas, Coffee, Sugar Cane		
Cattle Grazing		
Forest Harvesting		
Family Dwellings		
No Present Activities		
Other (identify)		

3. Land Ownership in Watershed (Describe)

Private Lands : _____
National Lands: _____
Undocumented Lands: _____

	Yes or No	Comments
4. Conservation Potential for Watershed and Water Source		
Community Land Rights Established in Watershed e.g., legal process through CODEHFOR and INA		
Reforestation Methods Applicable e.g., planting, vegetation conversion		
Protection Methods Applicable e.g., fencing		
Management Practices Applicable e.g. erosion controls, alternative grazing lands		

5. Hydrologic Characteristics
   a. Duration of Rainy Season: _____
      Duration of Dry Season: _____
      Duration of Canicula: _____
   b. Approx. Precipitation Annually: _____
      Approx. Size of Watershed: _____
      Approx. Cover of Natural Vegetation, Percentage: _____

c. Sources of Contamination, Describe if applicable:

Dwellings: _____
Pesticides: _____
Fertilizers: _____
Cattle: _____
Erosion: _____
Others: _____

d. Existing Users of Proposed Water Source
Describe if applicable:

Animal Use, e.g., Cattle: _____
Irrigation Uses: _____
Family Use: _____
Others: _____

e. Water Quality of Water Source
Chemical/Physical: _____
Bacteriological: _____
Pesticide/Hydrocarbons (if suspected): _____

C. Groundwater Factors

	Yes or No	Comments
1. Present Conditions:		
Low Groundwater Table: (below 40 to 50 m) No hand dug wells possible in community; little contamination potential from latrines to water sources		
Moderate Groundwater Table: (4 to 40 m) Hand dug wells possible in community, possibility of contamination from latrines, unless 100' separation from latrines is maintained		
High Groundwater Table: (0 to 3 m) Latrine contamination potential is high without protection measures or special designs, with or without hand dug wells		

2. Seasonal Variation in Groundwater Table (Describe)
Dry Season: _____
Wet Season: _____

3. Existing Wells in Community
   Number: _____
   Average Depth: _____
   Static Water Level: _____

4. Existing Latrines in Community
   Number: _____
   Average Age: _____
   Pit or Surface Type: _____

5. Reports of Groundwater Quality Related Problems (e.g., contamination, teeth problems.)
   Describe: _____

6. Records of Tests of Groundwater Quality
   Chemical/Physical: _____
   Bacteriological: _____
   Other: _____

D. Land/Geologic Factors

	Yes or No	Comments
1. Drainage Conditions within Watershed:		
Mountainous: Lands very steep with high peaks and deep valleys, generally high in elevation		
Rough: Some steep lands and valleys, moderately sloped lands occurring, moderate elevation		
Undulating: Rolling lands with few steep parts, some gradual slopes, moderate elevations		
Plains:		
Mostly flat lands, little natural drainage, low elevations		
2. Drainage Conditions within Community:		
Mountainous/Rough: Broken up and mostly steep slopes with very defined natural drainage ways		

	Yes or No	Comments
Undulating: Some natural drainage due to elevation differences, some flat areas with ponding waters	__	_____
Flat: Many flat areas with ponding waters, poor natural drainage	__	_____

3. Soils:
   a. Watershed Soils
      1. rocky, little top soils (less than 30 cm) __|__|_____
      2. medium soils (30-90 cm) __|__|_____
      3. deep soils (90 cm) __|__|_____
   b. Community Soils
      1. rocky, little top soils (less than 30 cm) __|__|_____
      2. medium soils (30-90 cm) __|__|_____
      3. deep soils (90 cm) __|__|_____
   c. Degree of Erosion Evident
      1. Watershed erosion, describe:_____
      2. Community land erosion, describe:_____
   d. Soils Conservation Practices Evident:
      1. Watershed practices, describe:_____
      2. Community Practices, describe:_____

ANNEX III

ENVIRONMENTAL REVIEW MATRIX
FOR
RURAL WATER AND SANITATION PROJECTS

ENVIRONMENTAL REVIEW MATRIX
FOR
RURAL WATER AND SANITATION PROJECTS

Note:

Information to be based on a completed Environmental Review Survey.

I. WATERSHED FACTORS

A. Present Condition Implications and Appropriate Actions

Excellent: |_| Primary actions to take should be preservation oriented, especially community land rights establishment. Watershed restrictions/preservation are the most feasible techniques.

Good: |_| Preventive measures need emphasis, community land rights, conservation techniques, some reforestation, fencing of defined area to protect water source/watershed.

Poor: |_| Comprehensive approaches needed, interagency coordination essential, need for community land rights, reforestation, fencing of water source/watershed; water system longevity in jeopardy.

Bad: |_| Lands may be beyond repair, potential for water system to serve useful life of 20 years very poor, comprehensive rehabilitation may be needed before establishing a water system.

B. Activities in Watershed/Contamination Potential

Heavy Agricultural Use: |_| Danger from uncontrolled uses of chemicals and pesticides, erosion controls needed with conservation emphasis, water sources highly vulnerable.

Cattle Grazing: |_| Contamination potential if no fencing containments used, field rotation needed with conservation emphasis to avoid erosion from overgrazed land, water

sources highly vulnerable, possibility should be investigated to relocate cattle and retire/preserve watershed areas.

Family Dwelling: |_| Degree of contamination potential proportional to dwelling densities, emphasis needed on community land rights establishment, conservation practices, fencing watershed and reforestation. Also wastes control, e.g., latrines.

No Present Activities: |_| Emphasis on community lands rights establishment, conservation/preservation practices, fencing and monitoring by community.

C. Land Ownership in Watershed

Private Lands: |_| Communities may work through INA to pay for lands to be reserved or to relocate dwellings. Direct negotiations with land owners needed. Financial costs may be high.

National Lands: |_| Communities must work through COHDEFOR and INA. Negotiations with land dwellers needed to limit activities, establish boundaries, and improve watershed. Negotiated payments may be necessary to restrict watershed lands, INA can assist in negotiations. Financial costs should be reasonable.

Undocumented Lands: |_| Community must petition local municipal mayor (Terreno Ejidal) for land rights to protect and conserve watershed. Land dwellers practices can be modified or alternatives sometimes found, e.g., relocate cattle grazing lands. Financial costs should be reasonable.

C. Conservation Potential for Watershed and Water Source

Community Land Rights Established in Watershed: |_| Best potential to establish watershed restrictions and conservation; fencing protection possible and ability to undertake reforestation program if needed; longevity of water source enhanced, costs usually dependent on land ownership and size of protection area defined as necessary.

Reforestation Methods Applicable: |_| Emphasis on appropriate species planting, lowest cost alternatives selection, community participation and usually represents intensive efforts combining soils conservation techniques and watershed protection measures, e.g., fencing and monitoring. Three nurseries may be needed to allow average 5 month growth followed by planting and monitoring for min. 2 years to establish new growths. Can be an expensive undertaking but essential to rehabilitate areas in need.

Protection Methods Applicable: |_| Emphasis on preventive measures, restricted access, fencing, community monitoring, prohibited activities like cutting, burning and planting; limits on additional dwellings, cattle, grazing. Reasonable costs usually associated.

Management Practices Applicable: |_| Emphasis on erosion control, soils conservative techniques, possible relocation and rotation of grazing lands, natural fertilizer use and promotion of permanent types of agriculture. Cost dependent on degree of activities undertaken. Where needed, conservation techniques are essential to prevent further watershed deterioration. Also essential to protect long term water quality of water source.

Restricted Water Source Usage, i.e., at the Source: |_|

Community restricted use has best potential to allow physical protection at a water source; fencing possible; minimizes competition for water; longevity dependent on watershed conservation. Overuse, e.g., water to be shared with irrigation or animal watering may compromise community water use.

D. Water Quality Tests

Bacteriological Analyses: |_|

Usually most important test to establish potability, tests may indicate human or animal fecal contamination occurring and need for immediate preventive actions, chlorine addition offers disinfection and a degree of safeguarding from recontamination. Continual testing, record keeping and monitoring highly recommended.

Chemical/Physical Analyses: |_|

Useful for initial determination of potability, little modification potential if outside boundaries of chemical quality; treatments possible for physical parameter control, e.g., filtration, sedimentation techniques. Also useful to perform periodically to monitor water quality changes overtime, impacts form watershed activities and seasonal variations.

Pesticides/Hydrocarbon Analyses: |_|

Useful for baseline determination of potability, especially if chemical applications occurring in watershed; may indicate necessity to control/change practices in watershed. Determinations needed during rainy and dry seasons to understand variations and effects of runoff. Very useful for long term monitoring and contaminant control in sensitive watersheds.

II. Groundwater Factors - Water Wells & Latrines

A. Water Table	Implications & Recommended Actions.
Low, below 40 or 50 meters: |_|	Usually little potential for hand dug wells unless handpump of expensive design is used; little groundwater cross-contamination potential if standard sanitary protection is used at a well e.g. deep well with mechanical pump. Water quality usually stable, low monitoring level necessary.
Moderate, 4 to 40 meters: |_|	Hand pumped wells applicable with normal designs, emphasis needed on proper locating and protection complimentary with proper latrine promotion; contamination potential exists if sanitary protection measures ignored; water quality is vulnerable, continual water quality bacteriological monitoring is needed.
High, 0-3 meters: |_|	Implies need for special designs of latrines to prevent cross contamination in water table; may be impossible for pit-type latrine to function, surface composting latrine types are applicable if maintained & compatible in design with the community. Any water wells need regular bacteriological monitoring & maintenance up-keep to maintain potability.

B. Existing Wells or Latrines in Community	
Significant Number Present, e.g., multifamily wells and family latrines are common	Implies need to determine present potential of cross contamination and adequacy of designs in place, may result in design modifications necessary before additional wells/latrines can be safety provided.
Low Number Present, e.g., few wells & family latrines	Less potential impact from present wells or latrines, some care needed in locations where present designs are inadequate to protect new installations, e.g., avoid wells in vicinity of

latrines in high groundwater table areas.

III. Land/Geologic Factors

A. Drainage Conditions in Watershed

Mountainous or Rough Lands: |_| Erosion potential high, soils conservation emphasis needed, watershed management program essential to establish for longevity of a water source; contamination prevention measures are critical, see Section I-C.

Undulating or Flat Lands: |_| Some erosion potential and soils conservation measures needed. Watershed management program essential to establish for longevity of water source; contamination prevention measures are usually less difficult but still essential, see Section I-C.

B. Drainage Conditions In Community

Mountainous or Rough Lands: |_| Soils conservation practices needed, adequate drainage usually not problematic, water wells and latrines need standard protection from runoff intrusion.

Undulating or Flat Lands: |_| Drainage improvement measures may need attention and possible construction of cross ditching, piping, drainage pits. Recontamination potential is high for standing pools of water; disease carrying vectors can breed also. Emphasis needed also on individual drainage pits at well sites and family water discard locations.

C. Soils

Watershed soils:

Rocky less than 30 cm.: |_| Most erosion potential and need for soils conservation techniques and watershed management program; most potential

for contamination of water source; may imply need of serious rehabilitation measures in a watershed, i.e., if deforestation has occurred, see Sector I-C.

Medium 30-90 cm.: |_| Moderate erosion potential, need for soils conservation to preserve watershed, watershed management program needed to preserve water source longevity, see Section I-C.

Deep 90 cm.: |_| Excellent soils with good potential longevity of a water source if watershed protection measures are applied. Most feasible areas to establish new vegetation and soils conservation measures to minimize erosion, see Section I-C.

Community Soils:

Rocky less than 30 cm.: |_| May imply need for surface type-composting latrines. Hand dug wells may be impossible and need for mechanical well drilling. Surface runoff contamination potential is high with need to protect any wells and latrines from intrusions. Used water may need piping to reach absorption areas.

Medium to Deep 30-90 cm.: |_| Standard latrine designs usually applicable if no high groundwater problems. Hand dug wells also feasible if water table is no deeper than 30 to 40 meters. Contamination potential less but still imperative to provide protection from runoff intrusions and proper drainage of used waters.

Reviewer Comments:

_____

_____

_____

Positive or Negative Environmental Evaluation (Based on Environmental Factors Presented):

_____

_____

_____

By: _____ Date: _____