Appendix M

Environmental Impact Assessment

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1 METHODOLOGY

1.1 Target of Impact Assessment

The target projects of the Environmental Impact Assessment (EIA) are the following:

- Dinh Binh Dam Construction Project;
- River Improvement Project; and
- Agricultural Development Project.

The EIA study was subcontracted to the Center of Water Resources and Environment Technology (CWRET) and the JICA Study Team conducted EIA based on the results of the study. The environmental elements for the EIA basically correspond to those selected in the process of Initial Environmental Examination (IEE) for the Master Plan.

1.2 Data Collection

Data collection for the EIA was done based on the field investigation and on the literature survey. The field investigation, including interview survey, was carried out by CWRET, focusing on the water quality and salinity intrusion, ecology including both terrestrial and aquatic ones, and social environment components in and around the target projects.

The literature survey was conducted based on the existing books and reports on environment, EIA study reports, including the following:

- "Environmental Impact Assessment Report of Dinh Binh Reservoir Project," prepared by HEC-1, MARD, October, 1999.
- "Thi Nai Swamp Environment and Socio-economic Impact Assessment of Dinh Binh Reservoir," Ho Chi Minh City, March, 2000.
- "Feasibility Study, Dinh Binh Multipurpose Water Resources Project," prepared by Stucky, MARD, People's Committee of Binh Dinh Province, 2000.
- "Impact Assessment and Compensation Estimation, Dinh Binh Reservoir, People's Committee of Binh Dinh province, 2001.
- "Report on Loss Assessment, Compensation and Resettlement Estimate for Irrigation Areas," Sub-NIAPP, 2000.

1.3 Methodology of Impact Assessment

Environmental impact caused by the implementation of the target projects were estimated and/or predicted based on the following:

- Current environmental condition in and around the project sites;
- Size, dimension, and/or location of proposed structures; and

- Construction works involved in each target project.

Impact prediction was conducted quantitatively as much as possible when the necessary data for quantitative analysis is available. In other cases, qualitative estimation was done analogically based on the reliable data and information. In both cases, study results of similar cases in Vietnam were quoted. General theory was also considered as a bench mark or a condition of prediction.

2 CURRENT CONDITIONS OF PROJECT AREA

2.1 Physical Environment

(1) Water Quality

Water quality survey was conducted in the EIA study in order to supplement the existing data and to grasp the current condition of water quality in the Kone and the Ha Thanh rivers basin for using as a benchmark of impact prediction and its evaluation.

Water sampling was carried out in the following period:

- For dry season condition: from August 29th through September 2nd, 2002.
- For rainy season condition: from November 11th through 15th, 2002.

Sampling locations are illustrated on Figure M.1, and the results of the water quality analysis are illustrated in Tables M.1 to M.7. The results of the analysis were summarized as follows:

Kone river: The measurement results show that the water quality of the Kone river is in good condition. All parameters measured are below the Limitation Value B of the Surface Water Quality Standard of Vietnam, except for SS. The concentration of all the heavy metals and pesticides analyzed are extremely low, all of which are far below the Limitation Value A or negligibly small.

La Vi river: La Vi river is a small tributary of the Kone river, flowing through the coastal plain and suffering from waste loads of houses located along the river. The measurement results show that concentrations of DO, SS, NO_2^--N, NH_4^+-N are higher than the Limitation Value A, yet they are below the Value B.

Ha Thanh river: Water quality of upstream Ha Thanh river remains quite good, yet it gets worsened in downstream as it flows through concentrated residential area and small-scale manufacturing units or local mills in Quy Nhon city.

Reservoir: Water quality of reservoirs is in good condition as a whole, showing that all the measured parameters are below the Limitation Value A except for SS and NH_4^+-N. It was found that there is no water exchange between the bottom and the surface layers during the measurement period. Total-N and Total-P imply that the reservoir water is under the eutrophic condition to some extent judged on the general benchmark.

Groundwater: Measurement results indicate that most of the measured wells are not sanitary enough, but polluted with the wastewater infiltrating into the ground surface.

Wastewater: The bacterium contents, or Coliform and Fecal coliform, of wastewater at two monitoring points (Binh Dinh sugar factory and wastewater disposal point of Quy Nhon city) far exceed the Limitation Value B of Industrial Wastewater Discharge

Standard.

Thi Nai swamp: Biological and physical environmental parameters, or BOD and DO, indicate good condition in consistent with the limitation for aquaculture as stipulated in the Coastal Water Quality Standard. The concentrations of Pb, Cu and Fe, however, exceeded the limitation for aquaculture.

(2) Salinity Intrusion

In the course of IEE, the conditions of salinity intrusion on the Kone and the Ha Thanh rivers basin were examined based only on a few data and on the interview survey. In order to supplement the limited data, salinity measurement was conducted, by subletting to CWRET, on the following period:

- For dry season condition: from August 25th through September 8th, 2002.
- For rainy season condition: from October 15th through 29th, 2002.

Measurement locations are illustrated on Figure M.2. The results of salinity measurements are illustrated in Tables M.8 and M.9 and are summarized below:

Kone river: It was found that the salinity contents fluctuate responding to the runoff discharge of rivers and do in inverse proportionally to the distance from the river mouth. It was also observed that even in the case of low discharge, the salinity was kept below 1.0 ‰ which is generally considered to be the highest limit for plants growing.

This fact of low contents of salinity in the Kone river indicates that such structures as the De Dong dyke along the bank of Thi Nai swamp and irrigation weir installed on the two branches of the Kone river (Refer to Figure M.2) is functioning as a controller of the salinity intrusion.

Ha Thanh river: The measurement results showed that in dry season, salinity content fluctuated from 0.04 to 26.0 ‰ and in rainy season, it showed less than 0.60 ‰. Higher salinity contents in the Ha Thanh river are explained by the fact that these measurement stations are located in the downstream of the irrigation weirs and therefore they are to be easily affected by tidal flow.

2.2 Ecological Environment

Ecological survey was conducted in the EIA Study in order to supplement the existing data and to grasp the current condition of ecosystem. The survey was carried out in and around the priority projects at 15 points for terrestrial ecology, and at 6 points for aquatic ecology. The location of the survey was plotted on Figure M.3. The ecological survey was done by sample collecting and identification of specimen in laboratory, i.e. inventory survey, and interview survey.

(1) Terrestrial Ecology

a. Flora

Area of reservoir bed: The vegetation covering the area of Dinh Binh reservoir bed, i.e. area less than some 100m above sea level is dominated by bushes and secondary forests. A total of 73 flora species are recorded in the field survey. The plant species in the area are composed mainly of common ones which can be seen in this region. The indigenous tree species are rarely encountered at the surveyed locations but more often seen in the area outside the Dinh Binh reservoir area. None of the plants recorded in the survey are listed in the Vietnam Red Data Book.

Area around Van Phong weir: The vegetation in the surrounding area of Van Phong weir is the mixture of cultivated land, including slash-and-burn agriculture, and sparse forest land situated over the hill slope. Thus, terrestrial ecology around the weir is not well developed and the flora is not rich or diversified, either.

Area around quarry sites: The quarry sites for Dinh Binh dam are located both upstream and downstream of the dam site within approximately 10km from the dam site. Quarry sites for Van Phon weir has yet to be determined, but the candidate sites have just been selected. The natural condition of the candidate sites is poor in terms of integrity of the vegetation. Accordingly, it can be concluded that the terrestrial flora is not rich.

Area around the alignment of irrigation canals: The irrigation canals are planned to be aligned mostly in the existing paddy field, other cultivated land, or residential land; thus, there is no natural vegetation along the canal. Accordingly, the terrestrial flora is not rich or diversified, but those modified and managed condition by human activities.

Area along the lower reaches of the Kone river: Natural environment along the reaches where the river improvement is planned is not rich, but most of the area are occupied by paddy field, other cultivated land or residential land. Accordingly, the terrestrial flora of these areas along the Kone river is not evaluated to be rich or diversified.

b. Fauna

Area of reservoir bed: Terrestrial fauna in the area of reservoir bed is mainly composed of invertebrates living underground including Arthropoda and Annelida. As for vertebrates of this area, the main constituents are relatively small animals including Amphibia, Rrptitia and Rodentia. Large animals are rarely seen in the reservoir bed because they usually live in the area in the elevation of more than 500m, outside the area of reservoir bed. None of those observed are listed in the Vietnam Red Data Book.

Downstream area of Dinh Binh reservoir: The vegetation in and around the Van Phong weir, around quarry sites, around the alignment of irrigation canals and along the lower

reaches of the Kone river, are composed mostly of mixture of agricultural land, bushes and/or sparse forest lands. The fauna in these areas is consequently the reflection of the vegetation: most of animals are domestic ones and wild animals are rarely seen or common ones in the central region of Vietnam.

(2) Aquatic Ecology

Aquatic Ecology in the Kone river: River fish resources are comparatively poor, which is attributed to the extremely low flow in dry season and quite a large volume of runoff discharge in rainy season. A total of 18 fish species were recorded in the field survey. Most of them were common species in central Vietnam. Among the fish species recorded, there was one species, eel(*Anguilla marmorata)*, listed in Vietnam Red Data Book and Decree No.48/2002/ND-CP on "endangered species and management and conservation mechanisms." It is a catadromous fish going up the river for inhabiting to spend their juvenile period until growing up to an adult and going down the river to the sea for breeding.

Aquatic Ecology in Thi Nai swamp: According to the HEC-1 EIA report, discharge of water flowing through the swamp mouth is as follows:

- In the dry season, the average rising tidal discharge reaches 770.4 m^3/s, while average ebb tidal discharge; 1,313.3 m^3/s, and the average river discharge; 20.9 m^3/s.
- In the rainy season, the average rising tidal discharge reaches 307.6 m^3/s, while average ebb tidal discharge; 1,349.6 m^3/s, and the average river discharge; 1,027.6 m^3/s.

As for the salinity in the swamp, two major factors dominate the salinity contents and its fluctuation: one is river water brought by the flood and the other is highly saline seawater brought by the tide. There exist two masses of water in the swamp in the rainy season: the mildly saline water (average 5.1 ‰) at the surface layer and the highly saline water (approx. 19 – 32 ‰) at the whole middle and bottom layers. In dry season, the quantity of inflow of river water from through the swamp mouth falls to the least, making the surface freshwater layer almost disappear and replacing the whole swamp with the highly saline water (approx. 33 ‰) supplied by the tide.

The results of ecological survey indicate that the biological inventory of the swamp is rich and diversified supported by the dynamic flow system of rivers and tidal flow from through the swamp mouth. The survey recorded 47 species of phytoplankton, 35 species of zooplankton, and 34 fish species in the swamp. Fish species are occupied mostly by marine origin or brackish ones. The most prevailing order of fish species are herring, followed by mullet, carp and flatfish orders.

2.3 Social Environment

In order to facilitate grasping the current social condition in and around the priority projects' sites, the areas concerned are recognized as the following demarcation, especially on the demography and land use including related issues.

Dinh Binh dam area: Vinh Hoa and Vinh Kim communes of Vinh Thanh district, including the planned reservoir area.

Vinh Thanh area: Vinh Quang and Vinh Hao communes of Vinh Thanh district, including the planned irrigation command area located in downstream of Dinh Binh Dam.

Van Phong area: Tay Son district and a part of Phu Cat and An Nhon districts at the midstream of Kone river, including the planned irrigation command area where Van Phong irrigation system will be newly developed.

Ha Thanh area: A part of Tuy Phuoc district and some suburban area of Quy Nhon city, including the planned irrigation command area under Dinh Binh dam which is located in the downstream of Ha Thanh river.

Tan An Dap Da area: The delta area including the planned sites of river improvement works and the current core agricultural land. This area is mainly composed of An Nhon and Tuy Phuoc districts, and a part of Phu Cat district.

(1) Demography and ethnic minorities

Dinh Binh Dam area

There are nearly 800 households with approximately 4,000 people in Vinh Hoa and Vinh Kim communes according to the available inventory data as shown in Table M.10. The average family size is about 5.2 person/HH, and the average population density is about 14.3 person/km^2. Most of households inhabit along the National Road 637, the Kone river and its tributaries. Three villages of Vinh Kim commune are located on the left hilly area of the Kone river.

Bana group is dominant among the total households, accounting for nearly three-forth portion which consists of about 77 % in Vinh Kim commune and about 67 % in Vinh Hoa commune respectively. Most of the remainder households are Kinh group.

Vinh Thanh, Van Phong, Ha Thanh and Tan An Dap Da areas

The demographic condition of four areas are shown in Table M.11, and summarized below, based on the available data:

- Vinh Thanh area: The total population of communes concerned is 10 thou. or more. The average population density is about 90 person/km^2.
- Van Phong area: The total population of communes concerned is 200 thou. or more.

The average population density is about 45 person/km^2.

- Ha Thanh area: The total population of communes concerned is 110 thou. or more. The average population density is nearly 1000 person/km^2.
- Tan An Dap Da area: The total population of communes concerned is nearly 300 thou. The average population density is about 850 person/km^2.

On the other hand, the existing inventory data of population is shown in Table M.12 regarding the beneficiary area of irrigation system development, although the physical boundary surveyed is exclusive of Tan An Dap Da area. According to this information, the total population of irrigation beneficiary area amounts to about 330 thou., of which the labor force is more than 150 thou. About 75 % of the total labor force is categorized as agricultural sector.

Kinh group is much predominant in these areas.

(2) Land use

Dinh Binh dam area

The present land use status of Vinh Hoa and Vinh Kim communes is shown in Table M.13. The physical total area is approximately 280 km^2, and forest land is predominant which covers nearly 70 % of two communes, followed by unused land (hilly grass/bush land) covering more than 20 %. The agricultural land is accounting only for 6 %, and most of them are located on the hilly areas under upland cultivation. The residential area is also scattered along the existing road and river/tributaries, or partially on the hilly area along the river.

Vinh Thanh area

More than 80 % of the physical area of Vinh Quang and Vinh Hao communes is hilly/mountainous, which is categorized as unused land and forest. The arable land with gentle slope is generally limited along the river, which is the planned command irrigation area.

Van Phong area

Nearly half of the physical area concerned with Van Phong area can be recognized to be covered by the agricultural land followed by the forest land. Among the agricultural area, the subsidiary crop land and/or rainfed paddy land has high proportion.

Ha Thanh area

This area consists partially of the core agricultural land at the delta area. Paddy fields including rainfed ones are predominant, followed by the unused land. However, vulnerability of paddy fields can be explained by the unstable irrigation water in dry season due to unsatisfactory function of system, and by flood proneness in rainy season.

Tan An Dap Da area

This area is a core agricultural land of the province, and paddy and/or subsidiary crops areas are much dominant followed by unused land. Most of the exploitable area has been developed as agricultural land. The area of forest left is inconsiderable of which the afforested ones have high proportion.

Regional land use status of Vinh Thanh, Van Phong, and Ha Thanh areas are summarized as shown in Table M.14. And predominant land use by commune in the Project's area is shown in Table M.15, excluding Dinh Binh dam area.

(3) Social condition and community

Dinh Binh Dam area

Bana group is predominant in the area as mentioned before, and they basically have been performing slash-and-burn cultivation and shifting residences. The central and local governments commenced a program in 1975 for settling down of local people's life style, and stabilization of their life is under practice. The stable life style has become gradually popular so far, such as settled cultivation including industrial tree planting. Some portion of the agricultural production of local people has been shifted from self-consumption purpose to commodity one, although they still face such difficulties as low accessibility to the markets/towns and limited capital and knowledge of advanced farming. In addition, according to the officials of DARD, the local people become recently recognizing the importance of forests such as sustainable use of natural resources, which contributes reduction of slash-and-burn cultivation.

There is a communal cultural house in each village or hamlet. The major cultural activities of the local people is related to the wedding and funeral formalities with traditional style, which often compels a household to share a certain cost. And there exist corporative activities for long time among the villagers, reflecting the communal close relationship. A sense of competition or becoming richer is not common.

Besides, Bana group is known as progressive. The area including the above 2 communes was a center of revolutionary movement of the province during last two wartimes. There exist, in 2 communes, about 250 households as a kind of war-affected households which are entitled to earn the preferential support and assistance from government.

Vinh Thanh, Van Phong, Ha Thanh and Tan An Dap Da areas

The main income of the people in these areas comes from agriculture and agro-forestry production. The labor force engaged in this sector accounts for more than 70 %.

The farming technique is rather progressive, and the main products of crop are paddy, maize, potato, cassava, etc. And recently, there starts to be a gradual shift to cash products

of perennial crops such as mango and coffee.

According to the existing inventory data available in the past study, the following issues were revealed:

- In general, the households in these areas enjoy a relatively high living standard. However, approximately 10 % of the households are classified as poor, who can gain the average income of only equivalence to 15 kg-rice/month/capita or less (by the governmental standard). These classified households are mainly concentrated in Vin Thanh and Van Phong areas.
- Most of the households have lived their present community for a long time. Migrators from other places are only 10 % more or less out of the surveyed households, and they made inter-commune or inter-district migration generally. This suggests that the households in these areas have close relationships mutually in their community, and that the communal society is already well-developed on which the daily life of local villagers is heavily dependent.
- The widow-headed households were recognized after the previous wars, which accounted for approximately 15 % or more out of the surveyed households. The consideration on them is proposed to be given in a development program.

(4) Fishery in Thi Nai swamp

Thi Nai swamp is a typical coastal brackish water zone with diversified aquatic resources. It has a favorable condition for fishery, particularly kinds of high economic values such as tiger prawns, sea-bass and mollusk.

Shrimp culture is much popular in and around the swamp. There exists approximately 1300 ha area for raising shrimps of saline-brackish water. The productivity of shrimps reaches from 500-1,000 kg/ha, depending on the style of shrimp culture, and 1 ha of shrimp culture often reaches a value as many as 8-10 times of the land farming counterpart.

Seaweed in Thi Nai swamp carries the characteristics of tropical ones, and is abundant and varied with species of high economic values for export, forage for fishes and other husbandry and processing industries.

3 IMPACT PREDICTION AND ASSESSMENT

3.1 Dinh Binh Dam Construction Project

(1) Physical Environment

1) Topography and geology

Conceivable impacts caused by Dinh Binh Dam Construction Project on topography and geology are as follows:

- Possibility of slope failure in and around dam and quarry sites;
- Possibility of soil erosion and its sedimentation in downstream area;
- Change of bed load condition caused by regulation of discharge;
- Sedimentation in the backwater section in the reservoir;
- Possibility of inducement of earthquake; and
- Possibility of disturbance of mining activity.

Possibility of slope failure in and around dam and quarry sites: The gradient of the newly created slope on the dam embankment and its surrounding area is planned as follows:

- Slope by cutting (for the case of soil) is to be created in 1:1.0,
- Slope by cutting (for the case of rock) is to be created in 1:0.3,
- Slope by banking (for the upstream face of dam) is to be created in 1:2.5,
- Slope by banking (for the downstream face of dam) is to be created in 1:2.0, and
- Slope by banking (other) is to be created in 1:2.0.

These gradients of slope are designed based on the geological and soil features identified by the geological survey, being in consistent with the standard in Japan and well enough to be kept stable. Thus, the newly created slope will be kept stable and the risk of land slide or slump is considered to be slim.

Possibility of soil erosion and its sedimentation in downstream area: According to the planned earthworks, a large area of bare land will emerge and is to be eroded easily by raindrops and a drainage stream, or overland flow, created by gathering of rainwater. This is, consequently, to accelerate sedimentation in downstream areas, including river bed, existing drainage canals, especially during construction stage.

This type of impact is difficult to prevent completely; however, this impact can be mitigated by the appropriate countermeasures such as sheet covering, planting, and/or installation of deposit pond(s) in proper places in the construction site if necessary. Provided that these countermeasures are taken, the impact of soil erosion and its sedimentation can be controlled in the acceptable limit.

Change of bed load condition caused by regulation of discharge: At the location immediately below the dam, erosion of river bed and banks can be accelerated due to

flood flow over the spillway. However, as the river bed is occupied with rock, specifically granite at immediately below the dam, it is durable from scouring. Besides, in order to protect the river bed, the spillway is to be designed as ski jump type for the energy dissipation of the overflowing water. Accordingly, the possibility of scouring is not considered to be significant.

Because bed loads and suspended loads transported from upstream reach beyond Dinh Binh dam site will be deposited in the reservoir in O/M stage, these loads will decrease in downstream reach. Thus, sedimentation will be reduced in the downstream reach of the Kone river, which may accelerate the erosion at river bed and banks. Further study is needed to make clear the change of the magnitude of this acceleration rate of the erosion.

Sedimentation in the backwater section in the reservoir: After water is stored in the reservoir, at the place where the stream flow reaches to the reservoir, the flow velocity decreases and the tractive force of the stream will be lessened dramatically. Accordingly, in the backwater area of the reservoir, including other confluence points of tributaries of the Kone river to the reservoir, sedimentation will be accelerated.

As for the backwater section of the Dinh Binh reservoir, no commune is located but some inter-communal roads are situated along the Kone river valley. Accordingly, the impacts of sedimentation in the backwater area might cause the damage to the road. The monitoring of the growth of sedimentation at the backwater area should be carried out regularly in the long run in O/M stage.

Possibility of inducement of earthquake: Based on the existing study results on earthquake aroused by a man-made water body, the necessary and sufficient conditions for earthquake acceleration are recognized as follows:

- Capacity of reservoir is over one billion m^3;
- Depth of reservoir exceeds 90 m; and
- Reservoir locates in a complex geological condition especially in a tectonic destroyable zone being in active.

Given the size of Dinh Binh dam with a height of 52.3 m and an effective storage volume of approximately 279 MCM at FWL, which is one fourth of the threshold size mentioned above. The reservoir is not situated on a geologically complex area, the possibility of seismic acceleration is considered to be quite slim.

Possibility of disturbance of mining activity: As shown on Figure M.4, there are several registered mines and ore points near the reservoir area. Among others, No.4 and No.13 are located upstream of the planned reservoir area, although their locations are outside of the reservoir area. According to the information provided by the local official of DARD, the gold mining site (Vinh Kim gold mining) has been finished to explore the gold mine

and now it is not running. Thus, there is no mining within the planned reservoir bed submerged under the reservoir and no impact will be brought about on mining activity.

2) Groundwater

Conceivable impact on groundwater is the change of groundwater level around the reservoir.

After water is stored, water level in the Kone river at the reach from Vinh Hiep to Vinh Kim will increase up to the altitude of approximately 98 m at FWL. Accordingly, the groundwater level around the reservoir will rise in accordance with the water level in it. The rising of the groundwater will, in turn, generate the increase of soil moisture and humidity of air, which may bring about the positive effects on the plants growing around the reservoir. These effects were observed at the Vinh Son A and B reservoir, so that the same conditions will be created around the Dinh Binh reservoir.

3) Water Quality

Conceivable impacts on water quality are as follows:

- Turbid/alkali water flow from construction site; and
- Possibility of eutrophication in the reservoir.

Turbid/alkali water flow from construction site: In construction stage, turbidity of the Kone river will increase mainly due to the drainage of highly turbid water spawned by earthworks, such as bulldozing ground surface, digging, cutting and/or excavating soil, rock, etc. Likewise, pH of river water will also increase due to the high alkali water drained from construction sites of concrete structures. These impacts are inevitable as far as the earthworks are executed.

The impacts, however, will be limited only in construction stage, especially in the periods when construction works that spawn such pollution loads are carried out. They are also limited within a certain reach of downstream of the dam site owing to the dilution effect and deposition. So these impacts will settle down as water runs, and accordingly they are considered to be within the acceptable limit.

Possibility of eutrophication in the reservoir: The study on previous cases revealed the following: The phenomenon of stratification was also identified in Vinh Son B, Nui Mot and Thuan Ninh reservoirs (Refer to Table M.16 and Table M.17), indicating that DO in deeper layer of the reservoirs is consumed for biological decomposition of the submerged organic matter on the reservoir bed. The phenomenon of stratification also indicates that the circulation or vertical convection of the reservoir water does not occur effectively. This fact means that the same situation can occur in the Dinh Binh reservoir.

Meanwhile, average concentration of Total-N and Total-P were 0.668 mg/l and 0.055 mg/l,

respectively, for reservoirs, and 0.631 mg/l and 0.036 mg/l, respectively, for the Kone river at the point of planned dam site (Refer to Table M.18). These results imply that these reservoirs and the Kone river waters are under the eutrophic condition to some extent.

In spite of the facts mentioned above, there are some optimistic information. One is that the typical phenomenon of eutrophication, e.g., algae blooming, has not been observed before in the aforementioned reservoirs. Another one is that more than 70 % of the run-off discharge of the Kone river is concentrated in three months; October, November and December. This fact indicates that the convection in the reservoir will strongly occur during these months, and the stratification that might have created in dry seasons can be broken easily during this period.

The formation of DO stratification depends on the degree of clearance of trees and grasses on the reservoir bed because DO in the bottom layer is to be consumed for biological decomposition. This means that if the plant clearance is thoroughly achieved, the possibility of eutrophication become low. Even if the clearance is not thoroughly carried out, after the decomposition of the remained plants has completed, water quality will return to normal gradually.

In conclusion, the possibility of eutrophication cannot be denied completely judging from the current water quality and runoff discharge although there are some optimistic perspectives. Accordingly, the monitoring of water quality in the reservoir should be carried out regularly in O/M stage.

(2) Ecological Environment

1) Terrestrial ecology

Conceivable impacts on terrestrial ecology are as follows:

- Impacts on terrestrial ecology due to the reservoir; and
- Impacts on terrestrial ecology due to the quarry site development.

Impacts on terrestrial ecology due to the reservoir: Due to the water storage in Dinh Binh reservoir with the area of 17 km^2 at FWL 98 m, all the plants community and the habitat of terrestrial fauna will be submerged under the water table. Existing plants will perish and the most of wild animals will be forced to migrate to the outside of the reservoir. Some of those animals will extinct depending on their ability of migration or the availability of breeding ground, hunting ground, abundance of food, etc. As a whole, however, the natural condition in the reservoir bed is not rich (Refer to Figure M.5) and accordingly the terrestrial flora and fauna is not diversified; hence, this impact will not be significant.

No impact will be brought about on the precious species enlisted in Vietnam Red Data

Book including endangered species, because there is no such precious species of flora and fauna growing / inhabiting in the reservoir bed.

Impacts on terrestrial ecology due to the quarry site development: As for the impacts on terrestrial ecology due to the quarry site development, the current condition of the planned quarry site is located in the river bed, bare or bush-vegetated land. Cultivated land is also included but with small surface area. Accordingly, no significant impacts will be brought about on terrestrial ecology.

2) Aquatic ecology

Conceivable impact on aquatic ecology is the modification of habitat of aquatic flora and fauna.

After the water storage in the Dinh Binh reservoir, the aquatic system will change from the current dynamic state in the Kone river to the static one, where the creatures which prefer to static state will increase, including zooplankton, zoobenthos, algae, and hydrophyte. It will spawn good conditions for aquaculture in the reservoir as well.

According to the HEC-1 EIA report, only some 20 % of the sediment load will be transported beyond Dinh Binh dam to downstream of the Kone river. This physical effect will reduce the nutrient supply in the downstream area, resulting in the decrease of ephemera and other insects and zoobenthos that are good food for fish. This impact might cause the decrease of fish population.

As for migratory fish in the Kone river system, the eel (*Anguilla marmorata)* was identified to be inhabiting in the river system. It is a fish species listed in Vietnam Red Data Book and Decree No.48/2002/ND-CP on “endangered species and management and conservation mechanisms.” The construction of Dinh Binh dam could be a barrier of their migration. Not all the individuals of eel, however, will be affected by the existence of the dam weir, because there are many other tributaries on the Kone river system. But the number of individuals of eel on the upstream of the dam weir will decrease in O/M stage.

3) Ecology in Thi Nai swamp

Conceivable impacts on Ecology in Thi Nai swamp are as follows:

- Possibility of changes of sediment load and nutrient condition; and
- Impacts on salinity profile in the swamp.

Possibility of changes of sediment load and nutrient condition: As described in the previous section, nutrients will be confined in it with some 20 %. The decrease of nutrients may affect the aquatic ecology, including the reduction of productivity of the aquaculture and fish catch in the swamp. Shrimp culture ponds spreading over mostly the northern and western part of the swamp might be also affected.

Impacts on salinity profile in the swamp: In flood season, river discharge (1,027.6 m^3/s) flowing into the Quy Nhon gulf through the swamp mouth accounts for 76 % of the sea discharge (1,349.6 m^3/s) as described in section "4.2.2 (2) Aquatic Ecology." It is obvious that the river discharge during flood season is relatively large portion in the swamp water and mostly occupies the surface layer, leading to the low salinity. After the construction of Dinh Binh reservoir, flood peak is to be cut down. This will result in alleviating the low salinity and keep brackish condition in the swamp.

In dry season, on the contrary, the river discharge is to be maintained 8.1 m^3/s at least at the river mouth of the Kone river. This will contribute to restrain the salinity of swamp water form reaching up to the same contents as that of sea water. Keeping the swamp water more brackish will be favorable for ecological richness. Thus, the Dinh Binh dam project will bring about positive effect in terms of aquatic ecology.

(3) Social environment

Land acquisition

The planned reservoir area responding to FWL 98 m amounts nearly to 17 km^2, and the loss proportion on land category basis can be understood by the figures of Table M.19. The area of 70 ~ 80 % of the total submerged area is recognized as agricultural land, whereas the forest land to be submerged will be very limited. This impact especially on the existing agricultural land within the reservoir area is negative and inevitable, and is to be managed adequately for the affected households whose livelihood is depended on the acquired land.

Quarry sites for the construction material for the dam are composed of five sites for rock, five for sand and two for soil as shown in Figure M.6. Five sites for sand area located within the river area, and no impact of land acquisition is expected. Current land use of rock/soil sites is bush or barren land except one site for soil (Soil 2 in the said figure). Upland farming is in practice in Soil 2 site of approximately 10 ha, and a small amount of compensation will be necessary.

Two routes of access road to the dam site are planned, one is the existing national road 637 and the other is a local road located along the left bank of the river. The road 637 can be used as access road without widening or extension. The local road will be widened from 3 or 4 m wide to 5 m, and some extension to access to the dam site will be necessary. However, the existing land use of the widened/extended area of the local road is not intensive, and the impact of land acquisition is expected to be negligibly small.

Diversion of the road 637 is necessary due to the inundation of the existing road 637. Although new road construction on the west hill of reservoir area is planned as the alternative road 637, the alignment and scale are unclear. It is necessary to evaluate the

magnitude of land acquisition in the next stage.

Resettlement

Vinh Kim and Vinh Hoa communes in Vinh Thanh district will be affected by Dinh Binh dam construction and its planned reservoir area. All households of Vinh Hoa commune and about 70 % of the households of Vinh Kim commune are to be resettled.

In the case of FWL of 93 m, the construction of the reservoir will directly affect 587 households with about 3,000 people, based on the existing inventory data as shown in Table M.20. In the case of about FWL 98 m selected as optimum design in the Study, the affected households would amount to more than 600 (616 households are estimated in due consideration of the reservoir area).

Issues on ethnic minority and social change

There is a possibility that Dinh Binh dam project will induce the social impacts such as i) the change of life style of minorities, and ii) the social conflict in the communities between recipients and relocatees. As mentioned above, about 70 % of the resettled households are Bana group.

And some of them are still performing a slash-and-burn cultivation for earning their daily consumption, although the successful attempt for stable settlement gradually appears in a recent decade. Thus, the careful and special attention will be necessary for the resettled households of Bana group in order to realize the smooth stabilization of their new life after resettlement.

The host communities designated as the resettlement sites will be indirectly affected because they have to share the natural resources including potential arable lands, and would be suffered from the conflicts and disorder of the society. These social conflicts between the recipients and relocatees are to be managed adequately not only through a physical compensation but also consultation among stakeholders and socail support.

Fishery in Thi Nai swamp

The flood control by Dinh Binh dam will contribute the reduction of the structure/facility destruction especially on the blackish-water aquaculture activities in and around the swamp. The allocation of the water demand for aquaculture from the new reservoir will also realize the production increment. These are recognized as positive effects on fishery activities of the swamp.

On the other hand, due to the probable occurrence of less input of sediment and nutrient loads to the downstream after completion of the dam, the conditions and resources for

fishery in the swamp would be affected in line with the change of ecosystem. The officials of the provincial Department of the Fishery raised a concern, that the nutrient load conveyed by the flood was considered to play an important role for enhancement of the existing fishery of the swamp, and that the cut of the flood magnitude might induce the negative impact on fishery.

Therefore, it is essential to conduct the monitoring in order to grasp and evaluate the impacts on fishery activities in the swamp, before and after the completion of Dinh Binh dam.

Landscape

The existing landscape will be changed due to the construction of the dam. This impact is inevitable, and it is important to harmonize the design of the structures and earth works with the existing topography to the extent possible. On the other hand, an appearance of vast water area after completion of the dam will create a new landscape spot and have a potential for enhancement of regional economic activities such as tourism.

3.2 River Improvement Project

(1) Physical Environment

1) Topography and geology

Conceivable impacts caused by River Improvement Project on topography and geology are the modification of geomorphologic feature of rivers. Five branches of the Kone river, namely, Dap Da, Nam Yang, Go Cham, Tan An and Cay My, will be improved aiming at enhancing the capacity of run-off discharge, by the following interventions: i) widening of river channel, ii) heightening of river dyke and iii) dredging of river bed.

Widening of river channel: Widening of river channel will be done on the lower reaches of Dap Da, Go Cham and Tan An rivers. The typical cross-section at widened point will be those with the width of approximately 130 m, 60 m and 150 m, respectively.

Heightening of river dyke: Heightening of river dyke will be achieved on the whole reaches of Dap Da, Go Cham and Tan An rivers. The length of reaches to be heightened of the three rivers is planned at 33.77 km, 25.83 km and 32.2 km, respectively. The height of river dyke will amount to 3 - 4 m from ground level. These dykes are to be constructed with the slope of 1: 2.0 at the landside. The embankment materials for the dyke are to be supplied from dredged materials in the river channel if the quality of the dredged material is appropriate enough from the standpoint of civil engineering. The inside of the dyke is to be protected with wet masonry, and partly with gabion. Thus, stability of the enhanced dykes is to be kept.

Dredging of river bed: Dredging of river bed will be made on the whole reaches of the

aforementioned five rivers. The depth of dredging depends on the current condition of each section. The river bed is not to be paved with concrete but to be kept as soil, sand or partly rock.

2) Groundwater

Due to the modification of the topography in the branches of the Kone river, the groundwater level will change responding to the depth of dredging in the channel. The lower reach of current river channels have narrow and shallow cross section, but there are some locations with deeper points than the planned river bed. According to the river improvement work, the shallow parts are to be excavated but the deeper points are to be remained as it is. As a whole, however, river bed will be lowered at most of the reaches. Accordingly, the groundwater level in the vicinity of river channels will be lowered, but with insignificant magnitude, because the depth to be excavated is to be less than 2 m or so at most.

Thus, it is anticipated that no significant impact on groundwater use along the river will occur. As a consequence, the phenomenon of land subsidence will not occur, either.

3) Water Quality

Conceivable impact on water quality is the turbid/alkali water flow from construction site. The same situation as that of Dinh Binh reservoir development will occur due to the river improvement works. However, the impacts will be confined within a certain period of construction works and be limited to a certain extent of downstream area. Hence, this impact is considered to be within the acceptable limit.

(2) Ecological Environment

1) Terrestrial Ecology

Conceivable impact on terrestrial ecology is the habitat modification of terrestrial flora and fauna.

If the area to be incorporated into the river channel was natural land such as primary forest, swamp, etc., the river improvement work would modify the habit of terrestrial flora and fauna. The current land use of the area to be incorporated, however, is paddy field, other cultivated land or residential land, the impacts of terrestrial ecology will not be significant, because the ecosystem of the cultivated land or residential land have been modified substantially by human activities, and because no natural environment is remained.

2) Aquatic ecology

Conceivable impact on aquatic ecology is the habitat modification of aquatic flora and

fauna in the Kone river.

During construction stage, aquatic ecology will be disturbed by the river improvement works, such as widening of river channel, heightening of dyke, dredging of river bed. The river bed is to be kept unpaved, so that in a certain period of time, the inside of the river channel will return to the natural condition with riffles and pools even though the meandering feature will be somewhat reduced by the river improvement work. Thus, the habit of aquatic biota will recover gradually.

During O/M stage, the Kone river will be provided with 8.1 m^3/s of maintenance flow, which is correspond to 90 % minimum fun-off discharge of the Kone river. According to this maintenance flow, the run-off discharge in the river will increase compared with the current condition in dry season, which will bring about positive condition for habitat of the aquatic biota.

Thus, the impact on aquatic ecology is not considered to be significant. However, whether or not the river channel is favorable for aquatic biota depends on not only run-off discharge but also the river structure and/or texture, including the existence of breeding ground, places where they hide from natural enemies. Attentions, therefore, should be paid on the design of river improvement considering the aquatic ecology in the design stage.

3) Ecology in Thi Nai swamp

Conceivable impact on ecology in Thi Nai swamp is that of modification of river flow regime and discharge into the swamp.

River improvement, together with the construction of Dinh Binh reservoir, is targeted at the following:

- Preventing the flood water up to 10 % for major flood; and
- Preventing the flood water up to 5 % for late flood.

The river improvement will confine flood water in the river channel, and at the same time, it will also confine sediment load and nutrients within the river channel. The decrease of nutrients may affect the aquatic ecology, including the reduction of productivity of the aquaculture and fish catch in the swamp. Shrimp culture ponds spreading over mostly the northern and western part of the swamp might be also affected.

After the implementation of river improvement work, the frequency of flood will reduce, in combination with the effect of Dinh Binh reservoir. However, these projects will not be able to cope with the remained 10 % of major flood and 5 % of late flood, but the flood water will overflow beyond the spill way equipped along the river banks. Thus, the adverse effect of nutrients reduction is to be alleviated to some extent even after the

implementation of the river improvement work.

(3) Social environment

Land acquisition

The river improvement project for the purpose of 5 % late flood control is planned for 5 rivers in the delta area of the Kone river, i.e. Dap Da, Go Cham, Tan An, Nam Yang, and Cay My rivers. The design flood capacities for the latter two rivers can be met within the existing rivers' area including the dredging works, thus no or negligibly small impact is expected on land acquisition as well as resettlement, cultural/historical heritage, and landscape.

Regarding the former three rivers, it is proposed that the following stretches near the estuaries of each river be widened:

- Dap Da: DD66 (chainage 3,330 m) ~ DD39 (14,270m)
- Go Cham: KC (0 m) ~ C232 (7,270 m)
- Tan An: TA74 (8,130 m) ~ TA 65 (12,310 m)

In case that the typical cross sections of DD63, C283, and TA71 of each river are applied, the magnitude of land acquisition due to the widening can be estimated at 100 ha more or less, with detail as follows, of which more than more than 50 % will be agricultural land along the rivers:

- Stretch of Dap Da to be widened: 40~50 ha
- Stretch of Go Cham to be widened: 10~20 ha
- Stretch of Tan An to be widened: 40~50 ha

Regarding the widening works of the stretches of Dap Da and Go Cham rivers, most of the acquired land will be agricultural land along rivers, whereas the nearly half of acquired land is considered as residential land regarding the widening work of the stretch of Tan An river. These inevitable impacts are to be compensated and managed adequately.

Besides, the remainder of the stretches of the above three rivers is not to be widened. The major river improvement works of these stretches is dredging and rehabilitation of the exiting dyke systems, meaning that the current rivers' area is expected to be maintained basically. However, dyke system rehabilitation will include the heightening of the dyke's crown, and land acquisition will be somewhat caused due to the expansion of dyke base into the existing sheltered area. These impacts are to be evaluated in the design stage.

Resettlement

The affected households due to the river improvement project can be estimated at 250 more or less in total, as shown in Table M.21. This figure includes ones which are located within the existing rivers' area, amounting supposedly to about 70 households. The

set-back type shifting to the new sheltered area along the rivers will be necessary for these affected households. Especially on the affected households located within the rivers' area, their land occupation is considered to be illegal. However, it is preferable that they are to be entitled for restoration and/or support of their living conditions.

Fishery in Thi Nai swamp

The decrement of frequency and magnitude of the flood and the change of river runoff characteristics are major conceivable factors which would cause environmental changes on the swamp. The former factor will induce the probable reduction of nutrient supply to the swamp, in combination with function of Dinh Binh dam. This factor would cause the negative impact on the fishery conditions of the swamp in same manner as the previous section. On the other hand, the existing study concluded that the latter factor would be considered to contribute to a positive effect on fishery resources of the swamp in line with the change of salinity and ecosystem conditions.

Cultural and historical heritage

Some of the cultural and historical heritages located in the delta area are towers and/or citadels. These heritages are observed basically on the land of small hills with somewhat high elevation, and river widening works will not directly affect these heritages. However, there is a possibility that the river widening works might affect a few historical sites such as Tan Giang massacre if they are located closely along the planned alignment of widening works and dyke system installation. Therefore, consideration should be paid in the next design stage for adjustment of alignment as required.

Landscape

The existing landscape will be changed due to the river widening works and/or the heightening of the existing river dykes.

Regarding the stretches of the planned widening work of the respective rivers, the factors which will change the existing landscape can be summarized below:

- Dap Da: river widening of 100 m more or less and dyke installation of about 1.5 ~ 3.5 m height from the ground
- Go Cham: dyke installation of about 2 m height from the ground
- Tan An: river widening of 100 m more or less and dyke installation of about 1.5 ~ 3 m height from the ground

And the remaining stretches are also proposed to improve the flood carrying capacity through the existing dyke heightening and dredging works.

Therefore, consideration should be given on the design to harmonize with the surroundings to the extent possible.

3.3 Agricultural Development Project

(1) Physical Environment

1) Topography and geology

Conceivable impacts caused by Agricultural Development Project on topography and geology are as follows:

- Possibility of slope failure around Van Phong irrigation weir; and
- Possibility of soil erosion and its sedimentation in downstream area.

Possibility of slope failure around Van Phong irrigation weir: The gradient of the newly created slope around the weir site is basically the same as those described in the section "4.3.1 Dinh Binh Dam Project." Accordingly, the slope will be considered to be kept stable and the possibility of land slide or slump will be slim.

Possibility of soil erosion and its sedimentation in downstream area: The possibility of this impact is basically the same as those described in the section "4.3.1 Dinh Binh Dam Project." Provided that the countermeasures are taken, when necessary, the impact of soil erosion and its sedimentation can be controlled in the acceptable limit.

2) Groundwater

Conceivable impact on groundwater is the change of groundwater level around irrigation weir.

After the Van Phong weir is constructed and water is dammed up by the weir, water level in the Kone river will rise up to some 29 m considering the effect of backwater. Accordingly, the groundwater level along the river reach will rise in accordance with the water level of the stored water by the weir. The rising of the groundwater along the river will, in turn, generate the increase of soil moisture and humidity of air, which will bring about some positive effects for the plants growing.

There is the national road (route No.19) at the immediate south along the dammed-up water body. The increase of soil moisture might cause an impact on the stability of the road, such as the risk of erosion, slope failure along the road. In order to prevent such damages, dyke system is planned to be developed along the route No.19. Owing to this countermeasure, the stability of the national road is considered to be kept.

3) Water Quality

Conceivable impacts on water quality are as follows:

- Turbid/alkali water flow from construction site; and
- Possibility of water pollution in the river.

Turbid/alkali water flow from construction site: As pointed out in previous sections, the

impacts of turbid and/or alkali water flow on water quality of the Kone river will occur due to the construction work of Van Phong weir. However, the impacts will be confined within a certain periods of construction stage and be limited in a certain extent to the downstream of the work site. Hence, this impact will be controlled in the acceptable limit.

Possibility of water pollution in the river: Water quality of the Kone river is affected by not only agricultural input but also all the other wastewater, including domestic and industrial ones, and natural pollution load is related as well. Accordingly, the possibility of water pollution caused by irrigation development was examined together with the impact of other pollution loads.

Regarding the calculation of pollution load under both current condition and in the target year of 2020, the following assumptions were set:

- Pollution load in agricultural input will increase in proportion with the increase of cropping intensity.
- Pollution load in domestic waste water will increase in proportion with the increase of population.
- Pollution load in industrial waste water will increase in proportion with the increase of planned quantity of water supply.
- Pollution load from natural origin, i.e. from forest and other natural land will not change unless the area of them is changed.
- Pollution run-off ratio will not change throughout the project implementation.

Unit load for each category itemized above was given based on the general values used in Japan because of no available data for these cases in Vietnam except for that of agricultural input. The unit load of agricultural input is given by sort of crop considering the difference of irrigated or rain-fed based on Agricultural Development Plan in the Priority Project. All the assumptions, on which the pollution load increment was calculated, are listed in Table M.22 and Table M.23.

Based on the calculation results of the increase of pollution load, water quality in 2020 in the Kone river was calculated for the case of dry season when the water quality is in generally worse condition. In this regards, parameters of BOD, Total-N, and Total-P were picked up for its calculated since these are the most typical ones for the evaluation of water quality. In addition, the parameter of Total Pesticides was also picked up for the impact evaluation of the increase of agriculture input.

The results show that in the year of 2020, BOD will increase by 1.37 times and will exceed the Limitation Value A of Surface Water Quality Standard of Vietnam (TCVN 5942-1995) unless any countermeasures for water quality control are taken. Total-N and Total-P will also increase by 1.56 times and 1.79 times, respectively, although their

quality standards are not provided at present in Vietnam. The predicted concentrations of Total-N and Total-P are not negligible but to be carefully considered. Total Pesticides (excluding DDT) will increase by 2.02 times, but its value is still far below the Water Quality Standard.

Prediction of Water Quality Change*[1)]

Parameter	Item to be estimated	Current status	2020	Increment	Water Quality Standard*[2)]
BOD	Pollution load (1,000kg/day)	47	64	1.37	-
	Water quality (mg/l)	3.5	4.8		4.0 (A)
Total-N	Pollution load (1,000kg/day)	34	54	1.56	-
	Water quality (mg/l)	0.61	0.95		Un-applicable
Total-P	Pollution load (1,000kg/day)	13	24	1.79	-
	Water quality (mg/l)	0.073	0.13		Un-applicable
Total Pesticides	Pollution load (kg/day)	116	234	2.02	-
	Water quality (mg/l)	0.00016	0.00032		0.15

*1) Figures indicate the average concentration in the dry season for the whole Kone river basin.
*[2)] Surface Water Quality Standard of Vietnam (TCVN 5942-1995)

Thus, the change of agricultural input as well as wastewater from domestic and industrial water use will bring about significant impacts on water quality unless any appropriate countermeasures are taken. Accordingly, water quality monitoring and the water quality control should be undertaken during project implementation in order to keep the current good condition. As for wastewater from domestic and industrial water use, the water treatment system is to be developed. Integrated Pest Management (IPM), which has already been introduced to Vietnam, should be followed and developed effectively.

(2) Ecological Environment

1) Terrestrial ecology

Conceivable impact on terrestrial ecology is the modification of terrestrial flora and fauna. Van Phong weir development, quarry site development and areas for irrigation alignment are located on bare land, cultivated land, residential land, or the natural land with bush or scattered forest. The natural conditions of these lands are not rich but are modified or controlled by the human activity. Accordingly, no significant impacts will be brought about on terrestrial flora and fauna.

2) Aquatic ecology

Conceivable impact on aquatic ecology is the modification of habitat of aquatic flora and fauna.

The river water is to be dammed up by the Van Phong weir in O/M stage. Accordingly, the aquatic system of the Kone river will change from dynamic flow state into more static one. With regard to aquatic flora and fauna, creatures that prefer to static state will increase. But since the river water is not completely confined in the dammed-up water

body, or 'Van Phong reservoir,' this impact is not as much as that caused by Dinh Binh dam.

The impacts of the Van Phong weir may cause the disconnection of fish migration due to the difference of water level between upstream and downstream of the weir. In dry season, water level in upstream of weir could be 10 m higher than that in downstream. According to the fish inventory, a migratory fish, eel (*Anguilla marmorata)*, was recorded. This fish will be impacted on its migratory habit, but its magnitude will not be as great as that caused by Dinh Binh dam, because the Van Phong weir can not be a complete barrier but the water flows down over it especially in rainy season.

The effect of the weir for deposition of sediment load and nutrients is not considered to be significant, since not all the water is dammed up by the weir; hence, the sediment load and nutrients form upstream can be drained beyond the weir and be supplied to the downstream area.

3) Ecology in Thi Nai swamp

Conceivable impact on ecology in Thi Nai swamp is that caused by the change of water quality in the Kone river.

As described in the section above, the water quality in the Kone river is estimated to be deteriorated due to the increased pollutant by 1.37 to 2.02 times (Refer to the table above). This estimation includes not only the impact of agricultural input but also that of other water use. If there is no countermeasure taken to mitigate it, this impact may directly extend to Thi Nai swamp, resulting in some adverse effect on aquatic ecosystem including aquaculture and fish catch.

In order to cope with this possible impact, water quality monitoring is essential to evaluate the change of water environment in the swamp.

(3) Social environment

Land acquisition

Table M.24 shows the magnitude of land acquisition estimated by each irrigation system. The estimate was carried out in due consideration of i) the expansion of Ha Thanh irrigation command area compared with the original plan (HEC-1 F/S), and ii) the extension of the canals to the La Tinh irrigation system, based on the latest inventory data. The estimated results reveal the following:

- The main and primary canals of irrigation systems, which will be newly developed in Vinh Thanh, Van Phong, Ha Thanh, and La Tinh (extension), will acquire the land of more than 400 ha in total. Approximately 60 % of the acquired land are classified as agricultural land.

- Regarding Vinh Thanh irrigation system, unused land such as the barren/bare land accounts to nearly half of the total acquired area. Whereas three-forth portion of area acquired by Ha Thanh irrigation system is recognized as agricultural land.

Local people of the land-affected depends their main livelihood on the agricultural activities, and it is necessary to manage this impact adequately for minimizing the negative aspects including compensation for loss and support for stable settlement and livelihood.

Besides, the area submerged by Van Phong weir can be estimated at 900 ha more or less when flood occurs. The submerged area will be mainly included in Tay Thuan and Tay Giang communes of Tay Son district. Although the major portion of the submerged area is considered as the river area and barren/bush land, the agriculture-used and residential lands are scattered along the river and its tributaries including illegal occupation. This impact is to be evaluated in design stage.

Resettlement

The estimated number of affected households is shown in Table M.25. More than 700 households will be resettled due to the new irrigation systems including Van Phong weir, and most of them are Kinh group. Ethnic minority (Bana group) is recognized to be limited to less than 1 %. According to the official of the provincial DARD, their life style is almost civilized and assimilated into that of Kinh.

The magnitude of resettlement due to the inundation of Van Phong weir, of which the surface water level in the event of flood is designed at about EL. 29 m, will be reduced considerably by the dykes to be equipped to protect nearby towns/villages. However, because the water way of the river is to be ensured, the impact of resettlement cannot be absolutely eliminated by the equipped dykes.

The affected households due to the inundation by the Van Phong weir will amount to 170 more or less, out of approximately 700 households to be resettled by the new irrigation system development. (166 households are estimated based on the available information.) The compensation cost for the land loss and resettlement by the weir would amount to approximately 18,500 million VND, being calculated based on the survey results by Sub-NIAPP 2000.

The necessary resettlement action for the households to be affected due to the irrigation system development should be undertaken through the set-back type shifting, and this means that the affected households will settle their new dwellings basically near the former ones. Although a remarkably negative impact such as social conflict is not expected, the adequate management for stable settlement of the affected households will be essential.

Fishery in Thi Nai swamp

Agricultural development project will induce an increment of agricultural input such as fertilizer and agro-chemicals, due to i) increasing the cropping intensity in the project area (about 160 % at present to about 230 % in the target year on an average), and ii) expansion of the irrigated area. The increasing rate of agricultural input is expected to be approximately twice as much as the present. The water quality degradation will be brought about in the river system, although the future additional pollution load depends not only on the increment of agricultural input but also on population growth and industrial development as mentioned before. These environmental changes in the river basin will cause a probable negative impact on the conditions and resources of fishery in the swamp in line with the ecological adverse effect. Therefore, it is essential to monitor the fishery activities in the swamp together with the monitoring of physical/ecological parameters.

4 ENVIRONMENTAL MANAGEMENT PLAN

The environmental management plan is to be created to ensure to maintain or enhance the current environmental condition when it is in good condition, and to mitigate the possible impacts to be affected by the priority projects. The environmental management plan is also to provide the environmental components to be managed, methodology on how to manage and the entity or organization to be responsible. The environmental management, on the other hand, is to be achieved by environment mitigation measures and environment monitoring activities.

In this section, the plans of environment mitigation measures and monitoring activities are proposed. The organizational plan to facilitate the mitigation and monitoring activities was also examined and proposed hereinafter as well.

4.1 Environment Mitigation Plan

Environmental impacts have been examined and described in the previous sections, and it was revealed that some negative impacts are to be brought about in the following environmental components:

- Physical components; topography and geology, groundwater and water quality,
- Ecological components; Terrestrial flora and fauna, aquatic flora and fauna and ecology in Thi Nai swamp, and
- Social components / issues; Land acquisition, resettlement, social change, cultural/historical heritage, fishery in Thi Nai swamp, and landscape.

The possible mitigation measures to cope with the conceivable impacts were examined and enumerated in Tables M.26 and M.27.

4.2 Environment Monitoring Plan

Environment monitoring process is to provide information on the environmental impacts, including the affected areas, population, households and creatures, and the impact magnitude. Thus, it can contribute to evaluate and to determine whether or not the possible adverse impacts are to be mitigated. The real-time evaluation of the results of monitoring process enables to take immediate actions when in contingency, unexpected and/or bad situation. In order to achieve this, JICA Study Team examined and formulated the environment monitoring plan as illustrated in Table M.28.

4.3 Proposed Direction of Management on Social Impact

The priority projects are planned to achieve and/or enhance a socio-economic development on various fields in the Kone river basin. However, the projects' activities accompany the drastic changes of the current conditions at the project sites, including the civil works with huge scale as their own characteristics, and will incur the negative

impacts on some social aspects which are unavoidable/inevitable. Among others, the impact of land acquisition and resettlement is recognized as no doubt a major social issue to be tackled for successful completion of the projects. For this, due preparation and implementation of an action plan to manage the social impacts are indispensable as mentioned in the previous sections and tables, and a direction of management plan to be an integral part of the projects' implementation is discussed and proposed hereinafter.

(1) Dinh Binh dam

Resettlement action plan for Dinh Binh dam project has been already prepared and authorized by the provincial people's committee. The preparation of the plan was done by the Resettlement and Relocation Management Board (RRMB) under the provincial people's committee, which was established specifically to cope with the resettlement, land acquisition, and compensation issues on Dinh Binh dam.

The plan developed by RRMB can be considered to satisfy the requirement for the resettlement action on the following:

a) The plan selects and proposes seven resettlement sites as shown in Figure M.7 with investigation of the existing condition and receiving capacity of these sites. A site preparation plan is also proposed in the respective sites, including i) land use plan, ii) allocation of the land for agriculture, residential area, etc., iii) preparation of social infrastructure such as communal and inter-communal roads, electricity supply, and water supply for irrigation and domestic/miscellaneous use. (However, two sites among seven were cancelled according to an official of the RRMB site office. And the estimated magnitude of resettlement is slightly increased due to the change of the proposed dam scale comparing the HEC-1 feasibility study, as shown in Table M.29. Adjustment of the plan will be necessary to fulfill the resettlement requirement.)
b) Necessary communal facilities are proposed such as communal office and hall, schools, medical care and postal/broadcasting system.
c) Orientation of production system is examined such as agriculture, husbandry, forestry, aquaculture, and small-scale industry.
d) The supports will be provided for initial restoration of livelihood for resettled households, such as displacement allowance, exemption of tax and public services fee for initial several months/years, and food assistance for several months.
e) Eligibility of entitlement to be compensated is defined including application of land-for-land compensation policy.

Moreover, according to the officials of RRMB, the public hearing/consultation on Dinh Binh dam project was held directly by the RRMB or indirectly through the district/commune people's committee, at least 12 times since 1999. The stakeholders involved in the public hearing/consultation so far covers not only the affected households

in the planned reservoir area but also the beneficiaries of irrigation/flood control and residents of relocate-recipient communities.

According to the officials of RRMB and Binh Dinh PPC, the progress of the resettlement action plan was summarized below as of December 2002.

- A breaking ceremony on Dinh Binh dam was held in the province on May 2002, with participants from the central ministries such as MARD and MPI.
- PPC has commenced to pay the compensation amount to the affected households since November 2002.
- The affected households will commence to relocate to the new resettlement site(s) from FY 2003 under the control and arrangement of RRMB and PPC.

It can be said that the prepared plan presents enough schemes especially on the physical layouts and support for the resettlement action itself.

However, the following is proposed in order to restore the living status of affected households upto the former one and to realize their self-sustenance after resettlement action, considering the existing social condition and international and/or bilateral donors' policy requirement.

a) The cut-off date of entitlement for compensation is to be defined and to be noticed to the public for avoiding confusion of eligibility.
b) Bana group in the affected area basically has a character to perform slush-and-burn cultivation. The resettlement action will compel them to change their traditional life style, meaning the application of stable cultivation and settlement. Although the state's program for stabilization of Bana group's life style in the province shows its success gradually as mentioned before, it can not be denied that the constraints or conflicts will occur on them after completion of resettlement action. Thus, it should be considered to support them to set their new life on its way, such as instructing the stable agriculture technology continuously and carefully, and preparing the counseling system for stability of both livelihood and psychology.
c) Besides the classification of ethnic minority, the households affected by Dinh Binh dam project will include the war-affected households as probably vulnerable group. Although they have an entitlement to earn preferential support from the central government, they can be considered as the socially-disadvantaged even at present. Both before and after the resettlement action, attention and support are to be given to avoid difficulty for restoration and stabilization of their living condition as necessary.
d) Monitoring activities are essential, for confirming the progress and effectiveness of implementation of the resettlement action plan, for ensuring the restoration and stabilization of settlement and livelihood of resettled households, for maintaining the existing society of recipient communities, and for minimizing conflicts between the

existing society and new comers.

e) RRMB is considered to be a key body for successful implementation and achievement of resettlement action, and it is proposed to cover the following scopes:
   - Monitoring regarding progress of resettlement action and status of livelihood restoration and stabilization. The additional suggestion to support and assist the resettled households is to be made if necessary, based on the evaluation of monitored results.
   - Direct support and assistance to the households who are severely faced with difficulty to restore and/or stabilize the living condition, in cooperation with related agencies including a project executing body.
   - Liaison/coordination-work function including i) notifying and informing the affected people of activities and progress of the project as well as resettlement action, ii) counseling with stakeholders in regard to the question, request, complains, and issues for restoration and/or stabilization of living condition, and iii) holding ad hoc public hearing/consultation. The liaison/coordination-work function is to be available not only before but also after the resettlement action. This function should also include the coordination with local authorities (district and/or communal people's committees), the project executing body, and their superior agencies.

(2) Irrigation system development and river improvement

Irrigation system development and river improvement work will also induce socially negative impacts of land acquisition and resettlement. Both projects have a characteristic basically as linear-shape development. This means that the set-back type shifting is a preferable resettlement manner since i) the communal society will not be suffered from the serious social conflicts or destruction, and ii) the local people does not have an expectation to move a far area. And this means also that land-for-land compensation policy is not satisfactorily applicable since the new arable land nearby is very limited.

Based on the understandings on the above as well as the existing condition of the projects' site, the following direction is proposed to be integrated into the resettlement action plan.

a) The cash-compensation manner cannot be helped to be applied to the affected households whose land with small parcel will be acquired. However, the affected households, whose land with a certain scale (approximately 20 % or more for example of the similar case) will be acquired, are to be given the priority for allocation of the public arable land as much as possible. And also the readjustment way of agricultural lots in line with a due of benefit and loss is to be examined when necessary.
b) The support and assistance to the affected households are necessary for resettlement

or shifting of the dwellings, including displacement allowance and support for initial restoration of living condition.

c) The partial loss of agricultural land by acquisition will induce some damage on the income or livelihood of households. It is preferable to prepare or provide, if feasible and possible, i) the skills training opportunity to obtain employment and/or earn livelihood, ii) small-scale income generating scheme, and iii) rural industry development plan which can realize new employment opportunity. Especially on the socially-disadvantaged such as widow-headed and poor households, the attention and priority should be paid when some of them are recognized as affected households.

d) The illegal land occupants are occasionally found within the existing river area, for cultivation or dwellings. The current legal frame will not give them the entitlement to be compensated when the project implementation affects them. However, it is recommendable that some countermeasures to restore their former living standard be considered.

e) In due consideration of experiences and issues proposed in the previous section of Dinh Binh dam case, it is important, i) to hold public hearing/consultation before and after the resettlement action, ii) to conduct the monitoring and evaluation activities on the resettlement action, iii) to build or establish a unit/committee for proper management of resettlement action, and iv) to realize the liaison/coordination-work function in the unit/committee and related bodies.

4.4 Organization to Implement the Environmental Management

Environmental Management should be implemented as a part of watershed management as mentioned in the River Environment Management Plan in the Master Plan. In this regard, DOSTE should be incorporated as one of stakeholders to conduct the management activities of the Master Plan.

On the other hand, mitigation and monitoring against the environmental impacts caused by the priority projects is to be basically implemented under the responsibility of a project executing body. However, project-oriented management activities should cover the various environment-related fields. Thus, the close cooperation with and instruction from the relevant organizations/agencies are prerequisite for the executing body. The organizations/agencies to be involved in the project-oriented management activities are mainly DOSTE and DOF, and others including NGOs will be asked to participate in the activities on the specific issues as required.

Regarding the management for social issues related to land acquisition and resettlement, a specific unit/committee should be designated or established for respective projects, such as RRMB in Dinh Binh dam case. The unit/committee should manage the social issues including investigation, impact estimation and evaluation, preparation and

implementation of due action plans, and following up the various stakeholders in parallel with monitoring. To achieve and complete these tasks, the unit/committee should build and keep the well-organized relationship among the project executing body, local authorities, relevant departments and their superior agencies, and other stakeholders.

5 ENVIRONMENTAL EVALUATION AND RECOMMENDATIONS

5.1 Environmental Evaluation for the Priority Projects

Based on the results of the field survey and the contents of the priority projects, conceivable environmental impacts have been examined for the following three aspects: physical, ecological and social environment. Environmental management plan, including impact mitigation and monitoring plans, has been also examined and proposed in order to avoid or mitigate the possible negative impact, and to maintain and/or enhance the current environmental conditions.

Through all the examination and prediction of environmental impacts, and on the basis of necessary consideration and management activities required, JICA Study Team has obtained the following conclusions:

(1) The priority projects will not cause the serious impacts that damage the projects' feasibility and, therefore, they are evaluated to be environmentally valid.

(2) The following environmental impacts, however, are still to be considered and monitored in the design, construction and O/M stages because un-negligible adverse effects are predicted to occur:

- The possibility of eutrophication in the Dinh Binh reservoir.
- The possibility of water quality degradation in the Kone river.
- Adverse effect on aquatic ecology in the Kone river system, including Thi Nai swamp.
- Considerable magnitude of land acquisition and resettlement due to the priority projects' implementation.
- Probable social conflicts/problems accompanied with land acquisition and resettlement.
- Probable impacts on the fishery resources and conditions in Thi Nai swamp.

5.2 Recommendations

Considering the environmental evaluation mentioned above, JICA Study Team recommends the following for the environmental sustainability of the projects:

(1) The environment mitigation measures and monitoring activities proposed in environmental management plan should be certainly followed. A project executing body is to be under responsibility on it.

(2) The project executing body will require the cooperation and instruction from relevant organizations/agencies in order to accomplish the above. Among others, DOSTE is considered to be a key agency to support and cooperate with the executing body. Thus, capacity building and/or organizational strengthening of DOSTE is to be considered as required.

(3) The directions of management on social issues should be followed in order to promote the socially acceptable resettlement and livelihood support program; thus, to minimize or restore the socially negative affects on individuals / households / communes, etc., including ethnic minority. Public consultation and monitoring of social issues are also essential in order to manage the social issues properly.

(4) Besides, according to the legal EIA procedure in Vietnam, the EIA report(s) on the priority projects should be prepared by MARD, and be submitted to MOSTE (new MONRE), before the projects' implementation. Especially on Dinh Binh dam project and irrigation development project, EIA approval from MOSTE/MONRE is prerequisite for implementation, since those projects are to be classified as Class I projects which are listed in Circular No. 490/1998/TT-BKHCNMT as those necessary for following EIA procedure.

Table M.1 Result of Water Quality Analysis - Kone river

No.	Parameters	Unit	VN Standard 5942 - 1995		Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s			12.2	0.0	29.4	425.9	100.0	1136.8
2	Temperature	^0C			30.4	23.3	32.9	26.0	24.3	28.8
3	pH		6-8.5	5.5-9	7.37	6.45	8.00	7.49	7.22	7.75
4	Turbidity	NTU			37	16	68	84	16	245
5	Conductivity	MicroS/cm			92	56	304	85	42	256
6	Color	mgPT/Co			174	50	390	153	45	300
7	Transparency	cm			46	31	78	32	12	71
8	COD	mg/l	<10	<35	9.45	6.48	14.40	6.57	4.80	7.52
9	BOD	mg/l	<4	<25	4.20	2.38	8.55	3.63	2.90	4.42
10	DO	mg/l	>=6	>=2	5.83	4.21	6.70	7.14	6.29	7.50
11	SS	mg/l	20	80	53	40	70	144	55	310
12	Total N	mg/l			0.574	0.514	0.694	0.795	0.630	0.925
13	NO_3^-- N	mg/l	10	15	0.123	0.060	0.210	0.149	0.063	0.318
14	NO_2^-- N	mg/l	0.01	0.05	0.015	0.001	0.040	0.012	0.003	0.022
15	NH_4^+- N	mg/l	0.05	1	0.027	0.014	0.091	0.064	0.030	0.118
16	Total P	mg/l			0.065	0.025	0.104	0.067	0.032	0.100
17	PO_4^{3-}- P	mg/l			0.037	0.018	0.066	0.045	0.020	0.074
18	Coliform	Coli/100ml	5,000	10,000	545	310	960	1,371	360	2,300
19	Fecal.coliform	F.c/100ml			220	120	370	459	180	700
20	Cl.ferfrigens	10ml			9	4	14	11	7	19
21	Cd	mg/l	0.01	0.02	0.0004	0.0001	0.0011	0.0017	0.0001	0.0063
22	Pb	mg/l	0.05	0.1	0.0108	0.0051	0.0229	0.0108	0.0063	0.0178
23	Cu	mg/l	0.1	1	0.0155	0.0113	0.0263	0.0177	0.0132	0.0253
24	As	mg/l	0.05	0.1	0.0067	0.0012	0.0135	0.0015	0.0005	0.0034
25	Fe	mg/l	1.0	2.0	0.2463	0.1867	0.4456	0.6576	0.3150	0.9100
26	Padan	µ g/l			0.0098	0.0036	0.0157	0.0121	0.0044	0.0191
27	DDT	µ g/l	10	10	0.0068	0.0023	0.0112	0.0189	0.0099	0.0269
28	Lindan	µ g/l			0.0072	0.0040	0.0098	0.0054	0.0034	0.0074
29	Total pesticides (excluding DDT)	µ g/l	150	150	0.1588	0.1037	0.1974	0.2270	0.1913	0.2981

Sampling Points:

(1) Downstream of Vinh Son hydropower plant
(2) Proposed dam site
(3) Tien Thuan commune
(4) 1km from sugar mill to the upstream (Tay Son town)
(5) 1km from sugar mill to the downstream (Tay Son town)
(6) Tay Son Town (bridge to Tay Son church)
(7) Bridge on the National road no.1 upstream to Thach Hoa dam (An Nhon town)
(8) River mouth at Tan Giang

VN Standard 5942 - 1995 :

A : Applied for the source of domestice water supplied with appropriate treatment.
B : Applied for the water other than the source of domestic water.

Table M.2 Result of Water Quality Analysis- La Vi River

No.	Parameters	Unit	VN Standard 5942 - 1995		Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s			11.0	9.4	12.6	79.9	38.8	121.0
2	Temperature	^0C			30.6	28.3	32.9	27.9	27.8	28.0
3	pH		6-8.5	5.5-9	7.24	7.00	7.47	7.20	7.17	7.22
4	Turbidity	NTU			45	40	50	55	50	60
5	Conductivity	MicroS/cm			69	47	91	59	52	67
6	Color	mgPT/Co			228	225	230	108	90	125
7	Transparency	cm			30	22	38	39	36	42
8	COD	mg/l	<10	<35	9.60	8.64	10.56	6.32	5.60	7.04
9	BOD	mg/l	<4	<25	3.64	2.68	4.60	3.89	3.18	4.60
10	DO	mg/l	>=6	>=2	5.77	5.24	6.30	6.39	6.07	6.70
11	SS	mg/l	20	80	44	40	48	67	60	73
12	Total N	mg/l			0.741	0.688	0.794	0.684	0.682	0.685
13	NO_3^-- N	mg/l	10	15	0.210	0.160	0.260	0.107	0.078	0.135
14	NO_2^-- N	mg/l	0.01	0.05	0.025	0.010	0.040	0.008	0.008	0.008
15	NH_4^+- N	mg/l	0.05	1	0.051	0.021	0.081	0.044	0.038	0.049
16	Total P	mg/l			0.103	0.095	0.110	0.068	0.055	0.080
17	PO_4^{3-}- P	mg/l			0.058	0.053	0.063	0.039	0.036	0.041
18	Coliform	Coli/100ml	5,000	10,000	685	550	820	1,200	1,100	1,300
19	Fecal.coliform	F.c/100ml			270	230	310	350	340	360
20	Cl.ferfrigens	10ml			13	10	15	12	11	12
21	Cd	mg/l	0.01	0.02	undetected	undetected	undetected	0.0001	0.0001	0.0001
22	Pb	mg/l	0.05	0.1	0.0016	0.0016	0.0016	0.0035	0.0035	0.0035
23	Cu	mg/l	0.1	1	0.0018	0.0018	0.0018	0.0097	0.0097	0.0097
24	As	mg/l	0.05	0.1	0.0347	0.0347	0.0347	0.0006	0.0006	0.0006
25	Fe	mg/l	1.0	2.0	0.4845	0.4845	0.4845	0.4890	0.4890	0.4890
26	Padan	μ g/l			0.0072	0.0072	0.0072	0.0083	0.0083	0.0083
27	DDT	μ g/l	10	10	0.0050	0.0050	0.0050	0.0112	0.0112	0.0112
28	Lindan	μ g/l			0.0211	0.0211	0.0211	0.0189	0.0189	0.0189
29	Total pesticides (excluding DDT)	μ g/l	150	150	0.1869	0.1869	0.1869	0.2166	0.2166	0.2166

Sampling Points:

(1) Bridgeon the national road No.1 (Kieu An bridge), La Vi river (Phu Cat)

(2) Chanh Huu Bridge

VN Standard 5942 - 1995 :

A : Applied for the source of domestice water supplied with appropriate treatment.

B : Applied for the water other than the source of domestic water.

Table M.3 Result of Water Quality Analysis - Ha Thanh River

No.	Parameters	Unit	VN Standard 5942 - 1995		Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s			0.17	0.0	0.33	106.3	37.5	175.0
2	Temperature	^0C			33.8	32.6	35.0	27.7	24.5	30.9
3	pH		6-8.5	5.5-9	7.75	7.00	8.50	7.02	6.98	7.05
4	Turbidity	NTU			24	16	32	37	26	48
5	Conductivity	MicroS/cm			3776	63	7490	77	47	107
6	Color	mgPT/Co			138	120	155	85	85	85
7	Transparency	cm			36	36	36	56	50	62
8	COD	mg/l	<10	<35	11.70	7.08	16.32	7.44	7.36	7.52
9	BOD	mg/l	<4	<25	5.49	3.04	7.94	5.26	5.00	5.51
10	DO	mg/l	>=6	>=2	6.40	5.34	7.45	7.23	7.10	7.35
11	SS	mg/l	20	80	38	35	40	53	46	60
12	Total N	mg/l			0.975	0.492	1.458	0.785	0.715	0.854
13	NO_3^-- N	mg/l	10	15	0.045	0.030	0.060	0.154	0.139	0.168
14	NO_2^-- N	mg/l	0.01	0.05	0.250	0.020	0.480	0.006	0.005	0.006
15	NH_4^+- N	mg/l	0.05	1	0.028	0.022	0.033	0.031	0.030	0.032
16	Total P	mg/l			0.080	0.068	0.092	0.046	0.042	0.050
17	PO_4^{3-}- P	mg/l			0.055	0.047	0.062	0.030	0.027	0.033
18	Coliform	Coli/100ml	5,000	10,000	145	0	290	2,250	600	3,900
19	Fecal.coliform	F.c/100ml			85	0	170	1,025	250	1,800
20	Cl.ferfrigens	10ml			3	0	6	31	9	53
21	Cd	mg/l	0.01	0.02	0.0072	0.0072	0.0072	0.0086	0.0086	0.0086
22	Pb	mg/l	0.05	0.1	0.0006	0.0006	0.0006	0.0028	0.0028	0.0028
23	Cu	mg/l	0.1	1	0.0017	0.0017	0.0017	0.0117	0.0117	0.0117
24	As	mg/l	0.05	0.1	0.0377	0.0377	0.0377	0.0011	0.0011	0.0011
25	Fe	mg/l	1.0	2.0	0.4315	0.4315	0.4315	0.2360	0.2360	0.2360
26	Padan	µ g/l			0.0088	0.0088	0.0088	0.0105	0.0106	0.0106
27	DDT	µ g/l	10	10	0.0162	0.0162	0.0162	0.0171	0.0172	0.0172
28	Lindan	µ g/l			0.0225	0.0225	0.0225	0.0242	0.0242	0.0242
29	Total pesticides (excluding DDT)	µ g/l	150	150	0.2215	0.2215	0.2215	0.2521	0.2522	0.2522

Sampling Points:

(1) Upstream Ha Thanh river at Van Canh Town

(2) Duong Thien

VN Standard 5942 - 1995 :

A : Applied for the source of domestice water supplied with appropriate treatment.

B : Applied for the water other than the source of domestic water.

Table M.4 Result of Water Quality Analysis - Reservoir

No.	Parameters	Unit	VN Standard 5942 - 1995		Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s			-	-	-	-	-	-
2	Temperature	^0C			29.4	28.1	30.3	24.9	22.6	26.3
3	pH		6-8.5	5.5-9	7.23	6.50	7.90	7.08	7.06	7.09
4	Turbidity	NTU			18	12	28	24	18	28
5	Conductivity	MicroS/cm			56	42	65	45	41	52
6	Color	mgPT/Co			128	100	145	70	65	75
7	Transparency	cm			61	30	112	88	71	120
8	COD	mg/l	<10	<35	8.16	7.20	9.36	5.17	4.96	5.44
9	BOD	mg/l	<4	<25	3.51	3.24	4.02	2.65	1.85	3.70
10	DO	mg/l	>=6	>=2	7.21	7.12	7.39	7.45	7.16	7.78
11	SS	mg/l	20	80	35	30	40	52	40	60
12	Total N	mg/l			0.630	0.498	0.758	0.706	0.615	0.824
13	NO_3^-- N	mg/l	10	15	0.107	0.040	0.210	0.057	0.042	0.080
14	NO_2^-- N	mg/l	0.01	0.05	0.007	0.002	0.010	0.018	0.002	0.037
15	NH_4^+- N	mg/l	0.05	1	0.022	0.016	0.026	0.053	0.042	0.064
16	Total P	mg/l			0.060	0.054	0.066	0.049	0.045	0.054
17	PO_4^{3-}- P	mg/l			0.030	0.026	0.036	0.025	0.021	0.030
18	Coliform	Coli/100ml	5,000	10,000	247	200	330	850	700	1,100
19	Fecal.coliform	F.c/100ml			128	95	190	427	320	600
20	Cl.ferfrigens	10ml			5	3	6	9	8	10
21	Cd	mg/l	0.01	0.02	undetected	undetected	undetected	undetected	undetected	undetected
22	Pb	mg/l	0.05	0.1	0.0015	0.0006	0.0024	0.0010	0.0008	0.0012
23	Cu	mg/l	0.1	1	0.0064	undetected	0.0064	0.0053	0.0027	0.0078
24	As	mg/l	0.05	0.1	0.0258	0.0238	0.0277	0.0012	0.0012	0.0012
25	Fe	mg/l	1.0	2.0	0.0465	0.0105	0.0824	0.1985	0.1700	0.2270
26	Padan	µ g/l			-	-	-	-	-	-
27	DDT	µ g/l	10	10	-	-	-	-	-	-
28	Lindan	µ g/l			-	-	-	-	-	-
29	Total pesticides (excluding DDT)	µ g/l	150	150	-	-	-	-	-	-

Sampling Points:

(1) Vinh Son hydropower reservoir
(2) Nui Mot reservoir
(3) Thuan Ninh reservoir

VN Standard 5942 - 1995 :

A : Applied for the source of domestice water supplied with appropriate treatment.
B : Applied for the water other than the source of domestic water.

Table M.5 Result of Water Quality Analysis - Groundwater

No.	Parameters	Unit	VN Standard 5944 - 1995	Dry Season (Aug.29 - Sep.02,2002)			Rainy Season (Nov.11-15, 2002)		
				Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s		-	-	-	-	-	-
2	Temperature	^oC		29.2	26.8	31.4	26.4	25.9	26.9
3	pH		6.5 - 8.5	7.0	6.8	7.6	7.0	6.6	7.5
4	Turbidity	NTU		2.8	0.0	8.0	23.3	2.0	70.0
5	Conductivity	MicroS/cm		610	160	1,152	761	106	2,590
6	Color	mgPT/Co	5 - 50	6	0	20	75	20	215
7	Transparency	cm		98	98	98	-	-	-
8	COD	mg/l		3.72	2.40	6.72	2.60	1.24	4.92
9	BOD	mg/l		1.89	1.08	3.36	1.31	0.56	2.41
10	DO	mg/l		-	-	-	-	-	-
11	SS	mg/l	750 - 1,500	10	2	28	19	10	29
12	Total N	mg/l		4.063	0.921	8.020	5.656	2.048	9.150
13	NO_3^-- N	mg/l	45	3.140	0.060	7.180	2.990	0.029	6.511
14	NO_2^-- N	mg/l		0.003	undetected	0.010	0.050	0.007	0.221
15	NH_4^+ - N	mg/l		0.016	0.005	0.049	0.050	0.015	0.117
16	Total P	mg/l		0.091	0.040	0.140	0.157	0.046	0.367
17	PO_4^{3-}- P	mg/l		0.070	0.022	0.109	0.128	0.023	0.330
18	Coliform	Coli/100ml	3	16	3	40	26	6	56
19	Fecal.coliform	F.c/100ml	undetectable	3	0	10	9	0	21
20	Cl.ferfrigens	10ml		1	0	3	1	0	3
21	Cd	mg/l	0.01	0.0003	undetected	0.0004	0.0004	undetected	0.0005
22	Pb	mg/l	0.05	0.0015	0.0001	0.0031	0.0012	undetected	0.0025
23	Cu	mg/l	1	0.0122	undetected	0.0313	0.0068	0.0028	0.0218
24	As	mg/l	0.05	0.0171	undetected	0.0492	0.0021	undetected	0.0052
25	Fe	mg/l	1 - 5	0.0767	0.0012	0.3013	0.2395	0.0460	0.4100
26	Padan	µ g/l		-	-	-	-	-	-
27	DDT	µ g/l		-	-	-	-	-	-
28	Lindan	µ g/l		-	-	-	-	-	-
29	Total pesticides (excluding DDT)	µ g/l		-	-	-	-	-	-

Sampling Points:

(1) Well of Mr.Nguyen Thach, Vinh Hao commune
(2) Well of Mr.Ba Manh, Vinh Quang commune
(3) Well of Mrs.Tran Thi Bich, Town I, Tay Son dist.
(4) Well of Mr.Nguyen Minh, Ngo May Town 29/08/2002
(5) Well of Mr.Nguyen Minh, Ngo May Town 02/09/2002
(6) Well of Binh Dinh hydraulic structure management company, Nhanh Hoa commune, An Nhon district
(7) Well of Mr.Doan Van Duong, Nhan Hoa commune, An Nhon district
(8) Well of Mr.Nguyen Van Cuong, Phuoc Thuan commune, Tuy Phuoc district

Table M.6 Result of Water Quality Analysis - Wastewater

No.	Parameters	Unit	VN Standard 5945 - 1995			Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	C	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s				-	-	-	-	-	-
2	Temperature	^0C	40	40	45	31.6	31.5	31.6	26.2	25.6	26.7
3	pH		6 - 9	5.5 - 9	5 - 9	7.70	7.20	8.20	7.24	6.76	7.72
4	Turbidity	NTU				29	20	38	29	12	45
5	Conductivity	MicroS/cm				901	716	1,085	828	563	1,093
6	Color	mgPT/Co				145	105	185	75	20	130
7	Transparency	cm				-	-	-	30	30	30
8	COD	mg/l	50	100	400	30.12	22.80	37.44	39.16	26.32	52.00
9	BOD	mg/l	20	50	100	19.90	15.30	24.50	25.30	19.60	31.00
10	DO	mg/l				3.34	0.98	5.69	2.68	2.15	3.20
11	SS	mg/l	50	100	200	105	100	110	122	120	123
12	Total N	mg/l	30	60	60	3.671	2.764	4.578	4.351	3.876	4.826
13	NO_3^-- N	mg/l				1.095	0.110	2.080	0.731	0.299	1.162
14	NO_2^-- N	mg/l				0.010	undetected	0.010	0.132	0.011	0.252
15	NH_4^+- N	mg/l	0.1	1	10	0.227	0.018	0.435	0.378	0.047	0.709
16	Total P	mg/l	4	6	8	0.394	0.250	0.537	0.367	0.280	0.454
17	PO_4^{3-}- P	mg/l				0.301	0.194	0.408	0.323	0.220	0.425
18	Coliform	Coli/100ml	5,000	10,000	-	85,000	75,000	95,000	92,500	90,000	95,000
19	Fecal.coliform	F.c/100ml				19,000	18,000	20,000	65,000	60,000	
20	Cl.ferfrigens	10ml				145	130	160	157	153	160
21	Cd	mg/l	0.01	0.02	0.5	undetected	undetected	undetected	-	-	-
22	Pb	mg/l	0.1	0.5	1	0.0009	0.0009	0.0009	-	-	-
23	Cu	mg/l	0.2	1	5	0.0088	0.0088	0.0088	-	-	-
24	As	mg/l	0.05	0.1	0.5	0.0713	0.0713	0.0713	-	-	-
25	Fe	mg/l	1	5	10	0.1504	0.1504	0.1504	-	-	-
26	Padan	µ g/l				-	-	-	-	-	-
27	DDT	µ g/l				-	-	-	-	-	-
28	Lindan	µ g/l				-	-	-	-	-	-
29	Total pesticides (excluding DDT)	µ g/l				-	-	-	-	-	-

Sampling Points:

(1) Wastewater discharged from sugar mill - Tay Son Town

(2) Points wastewater at Qui Nhon - Bach Dang road

VN Standard 5945 - 1995 :

A : Applied for wastewater discharged into water body used for sources of domestic supply

B : Applied for wastewater discharged into water body used for navigation, irrigation, bathing, aquatic breeding or cultivation, etc.

C : Wastewater with concestration of greater than B bu tnot exceeding C is discharged only into specific water bodies permitted by authority agencies. Wastewater with concentration of greater than C shall not be discharged into surroundings.

Table M.7 Result of Water Quality Analysis - Thi Nai Swamp

No.	Parameters	Unit	VN Standard 5943 - 1995			Dry Season (Aug.29-Sep.02, 2002)			Rainy Season (Nov.11 - Nov.15, 2002)		
			A	B	C	Average	Min	Max	Average	Min	Max
1	Discharge	m^3/s				-	-	-	-	-	-
2	Temperature	^0C	30	-	-	31.4	31.3	31.5	28.6	28.5	28.7
3	pH		6.5 -8.5	6.5 - 8.5	6.5 - 8.5	7.25	7.10	7.40	7.26	7.22	7.30
4	Turbidity	FTU				13	12	14	47	44	50
5	Conductivity	MicroS/cm				36,600	34,100	39,100	217	137	296
6	Color	mgPT/Co				85	75	95	93	85	100
7	Transparency	cm				63	60	66	33	30	35
8	COD	mg/l				10.32	10.20	10.44	9.22	8.20	10.24
9	BOD	mg/l	<20	<10	<20	6.01	5.20	6.83	3.99	2.27	5.70
10	DO	mg/l	>=4	>=5	>=4	7.48	7.19	7.77	6.71	6.51	6.91
11	SS	mg/l	25	50	200	43	40	45	64	62	65
12	Total N	mg/l				1.561	1.354	1.768	2.117	2.018	2.215
13	NO_3^- - N	mg/l				0.045	0.040	0.050	0.058	0.115	0.161
14	NO_2^- - N	mg/l				undetected	undetected	undetected	0.031	0.029	0.032
15	NH_4^+ - N	mg/l	0.1	0.5	0.5	0.054	0.027	0.081	0.069	0.068	0.069
16	Total P	mg/l				0.071	0.065	0.076	0.076	0.082	0.095
17	PO_4^{3-} - P	mg/l				0.057	0.048	0.066	0.059	0.050	0.068
18	Coliform	Coli/100ml	1,000	1,000	1,000	0	0	0	2,200	2,100	2,300
19	Fecal.coliform	F.c/100ml				0	0	0	1,800	1,700	
20	Cl.ferfrigens	10ml				0	0	0	15	14	16
21	Cd	mg/l	0.005	0.005	0.01	undetected	undetected	undetected	-	-	-
22	Pb	mg/l	0.1	0.05	0.1	0.0688	0.0688	0.0688	0.0320	0.0320	0.0320
23	Cu	mg/l	0.02	0.01	0.02	0.3355	0.3355	0.3355	0.1276	0.1276	0.1276
24	As	mg/l	0.05	0.01	0.05	undetected	undetected	undetected	undetected	undetected	undetected
25	Fe	mg/l	0.1	0.1	0.3	0.2385	0.2385	0.2385	0.3200	0.3200	0.3200
26	Padan	µ g/l				0.0104	0.0104	0.0104	0.0186	0.0186	0.0186
27	DDT	µ g/l				0.0217	0.0217	0.0217	0.0227	0.0227	0.0227
28	Lindan	µ g/l				0.0199	0.0199	0.0199	0.0206	0.0206	0.0206
29	Total pesticides (excluding DDT)	µ g/l	50	10	50	0.2783	0.2783	0.2783	0.3377	0.3377	0.3377

Sampling Points:

(1) Swamp water - north of Thi Nai swamp

(2) Swamp water - south of Thi Nai swamp, near Qui Nhon gulf

VN Standard 5943 - 1995:

A : Applied for the water in Bathing and Recreation Area

B : Applied for the water in Aquatic Cultivation Area

C : Others

Table M.8 Summarized Result of Salinity Measurement (Daily Average)

(From August 25 to September 8, 2002)

Station	Dap Da River (A branch of Kone River)				Tan An River (A branch of Kone River)												Ha Thanh River			
	Hung My		Chanh Huu		Quang Dien		Tan My		Huu Thanh		Go Boi		Tan Giang		Xuan Phuong		Duong Thien		Deo Son	
Date	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s
Aug. 25	0.01	7.91	0.17	7.24	0.00	5.47	0.02	15.4	0.14	4.55	0.23	6.97	0.76	4.93	0.11	2.20	3.72	0.102	25.8	-0.242
26	0.01	10.5	0.11	7.07	0.00	5.36	0.01	16.7	0.12	4.13	0.14	6.69	0.39	4.93	0.10	2.10	2.96	1.47	26.0	0.087
27	0.01	8.02	0.10	6.75	0.00	4.93	0.00	7.37	0.08	2.62	0.10	5.75	0.19	5.27	0.07	3.06	4.25	0.065	25.9	0.514
28	0.06	6.91	0.09	7.54	0.07	4.22	0.06	4.02	0.10	1.81	0.11	5.23	0.24	5.41	0.09	2.97	4.48	-0.957	25.5	0.378
29	0.06	5.45	0.10	6.21	0.10	2.43	0.10	3.01	0.13	1.29	0.17	4.54	0.50	5.02	0.11	1.13	5.72	2.37	22.4	0.109
30	0.03	9.40	0.06	11.1	0.10	4.23	0.08	3.32	0.17	1.29	0.11	5.43	0.63	5.85	0.10	1.53	6.84	9.92	20.3	1.46
31	0.01	32.8	0.02	27.6	0.10	4.88	0.03	13.6	0.04	11.0	0.02	18.8	0.10	15.0	0.04	6.40	5.07	10.2	21.3	0.679
Sep. 01	0.01	40.2	0.02	37.7	0.11	15.7	0.06	13.6	0.07	7.69	0.02	20.5	0.10	14.4	0.00	6.10	3.14	7.84	16.4	-0.870
2	0.01	40.2	0.01	38.1	0.04	19.8	0.04	15.1	0.06	10.2	0.01	26.0	0.10	19.0	0.00	7.40	2.32	14.4	2.18	1.14
3	0.01	34.2	0.00	32.6	0.05	14.2	0.06	21.9	0.06	8.98	0.03	25.9	0.10	24.4	0.00	8.88	2.49	18.0	0.76	3.32
4	0.01	34.2	0.00	32.9	0.03	22.4	0.03	24.8	0.03	11.8	0.00	27.5	0.07	20.4	0.00	7.62	2.28	21.2	0.63	3.41
5	0.00	51.4	0.00	50.7	0.00	18.8	0.00	18.1	0.02	14.7	0.00	40.2	0.00	24.2	0.00	8.44	0.10	21.6	1.43	2.63
6	0.00	10.0	0.00	62.4	0.00	25.6	0.01	35.3	0.03	43.7	0.00	34.9	0.00	47.2	0.00	18.7	0.06	23.4	1.99	2.59
7	0.00	10.5	0.00	71.7	0.00	9.83	0.00	28.3	0.01	23.6	0.00	38.4	0.01	33.8	0.00	17.8	0.04	26.6	2.56	2.59
8	0.00	12.0	0.00	74.2	0.01	12.7	0.00	25.6	0.00	23.5	0.00	34.4	0.01	39.4	0.00	17.5	0.06	16.6	0.17	2.83

S: Salinity Q: River Flow

Source: Report on Initial Environmental Examination in Kone and Ha Thanh River Basin, CWRET, 2002

Table M.9 Summarized Result of Salinity Measurement (Daily Average)

(From October 15 to 29, 2002)

Station	Dap Da River (A branch of Kone River)				Tan An River (A branch of Kone River)												Ha Thanh River			
	Hung My		Chanh Huu		Quang Dien		Tan Huu		Huu Thanh		Go Boi		Tan Giang		Xuan Phuong		Duong Thien		Deo Son	
Date	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q M^3/s	S $^0/_{00}$	Q M^3/s	S $^0/_{00}$	Q M^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s	S $^0/_{00}$	Q m^3/s
Oct. 15	0.00	21.00	0.00	32.30	0.00	9.05	0.00	5.26	0.00	6.98	0.00	25.90	0.07	32.40	0.00	5.58	0.10	46.00	0.53	2.70
16	0.00	28.40	0.00	23.10	0.00	9.40	0.00	5.81	0.00	5.60	0.03	13.70	0.10	25.00	0.00	5.88	0.10	43.80	0.60	2.70
17	0.00	45.00	0.00	61.20	0.00	10.60	0.00	4.43	0.00	5.48	0.00	19.00	0.10	21.90	0.00	6.31	0.10	50.70	0.50	8.79
18	0.00	31.20	0.00	36.70	0.00	9.66	0.00	4.19	0.00	5.07	0.10	26.60	0.10	29.10	0.00	5.40	0.10	30.80	0.60	4.68
19	0.00	19.10	0.00	31.20	0.00	8.47	0.00	3.81	0.00	3.84	0.13	27.70	0.13	9.03	0.00	5.87	0.10	22.00	0.37	5.05
20	0.00	21.00	0.00	25.70	0.00	8.46	0.00	4.57	0.00	3.46	0.03	13.10	0.10	7.10	0.00	3.73	0.10	15.00	0.20	8.95
21	0.00	17.50	0.00	18.00	0.00	5.86	0.00	2.63	0.00	2.94	0.10	8.42	0.10	4.36	0.00	3.26	0.17	7.30	0.30	4.55
22	0.00	21.10	0.00	22.20	0.00	6.85	0.00	2.72	0.00	2.88	0.10	11.80	0.10	7.63	0.00	4.13	0.27	10.00	0.33	9.66
23	0.00	10.60	0.00	17.80	0.00	7.01	0.00	3.95	0.00	3.13	0.10	9.51	0.10	7.52	0.00	3.06	0.37	8.34	0.23	7.10
24	0.00	10.60	0.00	29.50	0.00	8.14	0.00	4.60	0.00	5.12	0.10	10.00	0.10	16.20	0.00	3.25	0.33	7.06	0.23	7.14
25	0.00	11.70	0.00	57.90	0.00	14.80	0.00	9.02	0.00	7.92	0.00	23.90	0.10	23.60	0.00	8.18	0.33	5.60	0.23	8.46
26	0.00	235	0.00	108	0.00	269	0.00	166	0.00	75.6	0.00	178	0.00	227.0	0.00	86.9	0.00	132	0.30	62.30
27	0.00	110	0.00	138	0.00	178	0.00	91.60	0.00	70.5	0.00	148	0.10	227.0	0.00	77.0	0.00	141	0.10	59.00
28	0.00	137	0.00	175	0.00	120	0.00	46.10	0.00	55.3	0.00	74.60	0.10	173.0	0.00	33.6	0.00	85.60	0.30	46.90
29	0.00	65.10	0.00	163	0.00	40.00	0.00	27.60	0.00	28.3	0.03	66.70	0.13	106.0	0.00	15.5	0.07	57.80	0.10	21.80

S: Salinity Q: River Flow

Source: Report on Initial Environmental Examination in Kone and Ha Thanh River Basin, CWRET, 2002

Table M.10 Demographic Condition in Dinh Binh Dam Area

Administrative Unit	Nos. of Households					Population				
	Total	Of which (by ethnic)				Total	Of which (by ethnic)			
		Kinh	Bana	Thai	Muong		Kinh	Bana	Thai	Muong
Vinh Kim commune	535	123	410	1	1	2,721	519	2192	3	7
Of which (by village)										
K93	94	13	81			506	39	467		
K10	69	32	36		1	306	135	164		7
N3	53		53			291		291		
State farm *1	58	58				240	240			
K74	82	4	77	1		362	15	344	3	
K6 *2	70	2	68			423	10	413		
O3 *2	37	14	23			209	80	129		
O5 *2	72		72			384		384		
Vinh Hoa commune	231	77	154			1,227	448	779		
Of which (by village)										
K11	46	1	45			261	5	256		
L9	24	6	18			136	35	101		
N6	49	15	34			254	171	83		
L4	47	47				208	208			
L6	65	8	57			368	29	339		
Total	**766**	**200**	**564**	**1**	**1**	**3,948**	**967**	**2971**	**3**	**7**

*1: Mulberry tree farm managed by Sericulture Company II (state-owned enterprise)
*2: Villages located on the left hilly area of the Kone river.

Source: Report on impact assessment and compensation estimation of Dinh Binh reservoir, Binh Dinh PPC, 2001

Remark: The above figure in the source report was quoted from the inventory data surveyed in 1998 by Sub-NIAPP.

Table M.11 Demographic Profile of the Project Area (except Dinh Binh Dam Area)

Area	District	Commune	Physical land area (km^2)	Population *1 (1,000 person)	Popu. density (per/km^2)
Tan An Dap Da	Phu Cat	Cat Nhon	21.8	10.6	487
		Cat Thang	8.5	9.2	1085
		Cat Chanh	9.2	7.5	819
		Cat Hung	44.9	8.0	177
		Cat Tien	19.4	10.7	551
		Total	*103.8*	*46.0*	*443*
	An Nhon	Nhon Hung	8.3	12.3	1473
		Nhon Hau	12.3	14.3	1164
		Nhon My	18.4	13.1	714
		Nhon Khanh	8.6	9.5	1110
		Nhon An	8.8	10.7	1217
		Nhon Phong	8.3	9.6	1168
		Nhon Hanh	10.9	11.9	1095
		TP Binh Dinh	6.1	19.1	3116
		Total	*81.6*	*100.5*	*1232*
	Tuy Phuoc	Phuoc Quang	10.1	13.8	1373
		Phuoc Thang	14.1	11.0	778
		Phuoc Hoa	19.4	16.4	847
		Phuoc Hung	10.2	13.5	1331
		Phuoc Son	25.0	20.8	832
		Phuoc Thuan	26.9	15.1	561
		Phuoc Hiep	16.7	16.6	997
		Phuoc Loc	11.2	15.1	1348
		Phuoc Nghia	6.1	5.3	875
		TT Tuy Phuoc	N.A.	13.0	N.A.
		Total	*139.6*	*140.7*	*915 *2*
		Total of Tan An Dap Da Area	*325.0*	*287.2*	*844 *2*
Ha Thanh	Quy Nhon City	Nhon Binh	12.3	15.3	1239
		Nhon Phu	10.7	15.3	1429
		Quang Trung	N.A.	23.0	N.A.
		Total	*23.0*	*53.6*	*1328 *3*
	Tuy Phuoc	Phuoc Thuan	26.9	15.1	561
		Phuoc An	20.9	18.6	889
		Phuoc Loc	11.2	15.1	1348
		TT Dieu Tri	N.A.	11.7	N.A.
		Total	*59.0*	*60.5*	*827 *4*
		Total of Ha Thanh Area	*82.1*	*114.1*	*967 *5*
Van Phong	Phu Cat	Cat Hiep	38.9	7.8	201
		Cat Tuong	24.7	16.2	655
		Cat Hanh	35.3	14.0	397
		Cat Nhon	21.8	10.6	487
		Cat Tan	25.9	15.2	588
		Cat Trinh	67.2	12.3	183
		TT Ngo May	6.4	11.1	1751
		Total	*220.2*	*87.3*	*397*
	An Nhon	Nhon Thanh	12.7	16.4	1292
		Nhon Hau	12.3	14.3	1164
		Dap Da	5.1	19.0	3755
		Nhon My	18.4	13.1	714
		Total	*48.4*	*62.8*	*1298*
	Tay Son	Binh Thanh	55.4	11.2	201
		Binh Tan	65.3	7.5	114
		Binh Thuan	34.5	8.6	250
		Binh Hoa	12.4	9.2	744
		Tay An	12.0	6.3	527
		Tay Vinh	6.6	8.1	1220
		Tay Binh	6.3	6.9	1087
		Total	*192.5*	*57.8*	*300*
		Total of Van Phong Area	*461.1*	*207.9*	*451*
Vinh Thanh	Vinh Thanh	Vinh Quang	68.4	7.8	115
		Vinh Hao	60.2	3.6	61
		Total of Vunh Thanh Area	*128.5*	*11.5*	*89*

Source: Dinh Binh Multipurpose Water Resources Projcect, Feasibility Study, Stucky, 2000

*1: as of 1998

*2: Excluding TT Tuy Phuoc

*3: Excluding Quang Trung commune

*4: Excluding TT Dieu Tri

*5: Excluding Quang Trung commune and TT Dieu Tri

Table M.12 Population in Irrigation Beneficiary Area

Unit: person

Irrigation System	Population	Of which labor force
Vinh Thanh	16,602	6,640
Van Phong	179,897	75,560
Ha Thanh	135,032	72,630
Total	331,531	154,830

Source: Report on loss assessment, compensation and resettlement estimate for irrigation areas, Sub-NIAPP, 2000

Table M.13 Land Use Status of Vinh Hoa and Vinh Kim Communes

Unit: ha

Item	Total area	Of which	
		Vinh Hoa	Vinh Kim
I. Agricultural land	1,660	715	945
II. Forest land	19,160	4,410	14,750
III. Special used land	54	19	35
IV. Rural residential land	47	16	31
V. Unused land	6,649	3,084	3,565
Total physical area	27,570	8,244	19,326

Source: Report on impact assessment and compensation estimation of Dinh Binh reservoir, Binh Dinh PPC, 2001

Table M.14 Land Use Status of Vinh Thanh, Van Phong, and Ha Thanh Areas

Unit: %

Categories	Total	Of which		
		Vinh Thanh Area	Van Phong Area	Ha Thanh Area
Agricultural land	35	10	46	47
Forest land	35	50	35	3
Specially used land	9	2	13	14
Residential land	2	1	2	4
Unused land	19	37	4	32
(Total)	(100)	(100)	(100)	(100)

Source: Report on loss assessment, compensation and resettlement estimate for irrigation areas, Sub-NIAPP, 2000

Note: The original data of the source material is presented in “ha” unit. However, the boundary of the presented data is not delineated and definite. Therefore, the data above is converted into “%” from original data in order to grasp the tendency of land use status.

Table M.15 Land Use Status of the Project Area (except Dinh Binh dam area)

Area	District	Commune	Predominant Land Use	Second Ranked Land Use
Tan An Dap Da	Phu Cat	Cat Nhon	Unused land	Rice
		Cat Thang	Rice	Unused Land
		Cat Chanh	Rice	Forest
		Cat Hung	Unused land	Rice
		Cat Tien	Unused land	Rice
	An Nhon	Nhon Hung	Rice	Residential
		Nhon Hau	Rice	Other annual crops
		Nhon My	Rice	Unused Land
		Nhon Khanh	Rice	Other annual crops
		Nhon An	Rice	Residential
		Nhon Phong	Rice	Residential
		Nhon Hanh	N.A.	N.A.
		TP Binh Dinh	N.A.	N.A.
	Tuy Phuoc	Phuoc Quang	Rice	Other annual crops
		Phuoc Thang	Rice	Unused Land
		Phuoc Hoa	Rice	Unused Land
		Phuoc Hung	Rice	Residential
		Phuoc Son	Rice	Unused Land
		Phuoc Thuan	Unused land	Rice
		Phuoc Hiep	Rice	Unused Land
		Phuoc Loc	Rice	Unused Land
		Phuoc Nghia	Rice	Unused Land
		TT. Tuy Phuoc	N.A.	N.A.
Ha Thanh	Quy Nhon City	Nhon Binh	Rice	Unused Land
		Nhon Phu	Residential	Rice
		Quang Trung	Residential	N.A.
	Tuy Phuoc	Phuoc Thuan	Unused land	Rice
		Phuoc An	Rice	Unused Land
		Phuoc Loc	Rice	Unused Land
		TT Dieu Tri	N.A.	N.A.
Van Phong	Phu Cat	Cat Hiep	Unused land	Forest
		C.Tuong	N.A.	N.A.
		C. Hanh	Unused land	Rice
		Cat Nhon	Unused land	Rice
		C. Tan	Unused land	Rice
		C.Trinh	Unused land	Rice
		TT Ngo May	N.A.	N.A.
	An Nhon	Nhon Thanh	Rice	Unused Land
		Nhon Hau	Rice	Other annual crops
		Dap Da	N.A.	N.A.
		Nhon My	Rice	Unused Land
	Tay Son	Binh Thanh	Forest	Unused Land
		B. Tan	Unused land	Forest
		B. Thuan	Unused land	Forest
		B. Hoa	Rice	Forest
		Tay An	Unused land	Rice
		Tay Vinh	Rice	Residential
		Tay Binh	Rice	Unused Land
Vinh Thanh	Vinh Thanh	Vinh Quang	Forest	Unused land
		Vinh Hao	Forest	Unused land

Source: Dinh Binh multipurpose water resources project, Feasibility Study, Stucky, 2000

Table M.16 Water Quality Profile in Vinh Son B Reservoir Observed in Aug.,1995

Unit: mg/l

Depth (m)	pH	Turbidity	DO	COD	Fe_{ls}	Ca	Mg	NO_3-N	PO_4-P
0.3	8.1	12.8	8.4	6.7	1.8	3.9	3.0	0.02	0.010
8.0	7.5	15.2	7.5	8.7	2.2	3.6	3.5	0.03	0.025
18.0	7.1	24.3	5.2	10.8	2.9	4.7	3.9	0.04	0.023
VN Standard	6-8.5	20	>6	10	1.0	-	-	-	-

Source: "Environmental Impact Assessment Report of Dinh Binh Reservoir Project," HEC-1, MARD, October, 1999.

Table M.17 Vertical Profile of DO and Temperature in Reservoirs in Kone River Basin Observed in Aug., 2002

Measurement depth	Vinh Son B		Nui Mot		Thuan Ninh	
	DO (mg/l)	Temp. (^oC)	DO (mg/l)	Temp. (^oC)	DO (mg/l)	Temp. (^oC)
Dry season (Aug. 2002)						
Surface (1 m)	7.1	26.1	7.13	29.5	7.52	29.2
Middle (3 m)	3.8	25.2	5.73	28.0	5.80	28.1
Bottom (6 m)	0.2	23.0	0.12	26.7	0.21	26.5

Rainy season (Nov. 2002)

Measurement target	Depth (m)	DO (mg/l)	Temp. (^oC)	Depth (m)	DO (mg/l)	Temp. (^oC)	Depth (m)	DO (mg/l)	Temp. (^oC)
Surface	1.5	7.16	24.0	2.0	7.40	25.3	1.5	7.78	25.5
Middle	6.0	4.67	23.6	8.0	4.06	24.4	5.5	3.70	25.0
Bottom	12.0	2.52	23.6	14.0	2.60	24.2	9.0	1.90	24.6

Source: "Final Report on Initial Environmental Examination in Kone and Ha Thanh river basin," Prepared by CWRET, JICA, November, 2002.

Table M.18 Water Quality (Total-N and Total-P) in Reservoirs and Kone River Observed in Aug., 2002

Unit: mg/l

Reservoir / River	Total-N		Total-P	
	Dry season	Rainy season	Dry season	Rainy season
Vinh Son B	0.498	0.68	0.054	0.054
Nui Mot	0.635	0.615	0.066	0.048
Thuan Ninh	0.758	0.824	0.060	0.045
Average	0.630	0.706	0.060	0.049
	0.668		0.055	
Kone river at dam site	0.528	0.734	0.040	0.032
Average	0.631		0.036	

Source: "Final Report on Initial Environmental Examination in Kone and Ha Thanh river basin, Annex 2" JICA, November, 2002.

Table M.19 Magnitude of Land Inundation (Dinh Binh Dam)

Unit: km^2

Land use	Total area	by commune	
		Vinh Kim	Vinh Hoa
Total physical area	17.6	9.0	8.6
Agricultural land	13.5	6.5	7.0
Of which: Annual crops	10.6	4.8	5.8
Of which: Perennial crops	2.8	1.6	1.2
Special used and residential land	0.9	0.5	0.4
Unused land	3.2	2.1	1.1

Source: Report on impact assessment and compensation estimation of Dinh Binh reservoir, Binh Dinh PPC, 2001

Note: The above figures are ones estimated in case of FWL 98.7m, according to the originally investigated data which was quoted in the source report.

Table M.20 Nos. of Resettlement Households (Dinh Binh Dam)

Administrative Unit		Households					People				
		Total	by Ethnic				Total	by Ethnic			
			Kinh	Bana	Thai	Muong		Kinh	Bana	Thai	Muong
Vinh Kim Commune		356	107	247	1	1	1,705	429	1,266	3	7
Of which:	K93 Village	94	13	81			506	39	467		
	K10 Village	69	32	36		1	306	135	164		7
	N3 Village	53		53			291		291		
	Mulberry State Farm	58	58				240	240			
	K74 Village	82	4	77	1		362	15	344	3	
Vinh Hoa Commune		231	77	154			1,227	448	779		
Of which:	K11 Village	46	1	45			261	5	256		
	L9 Village	24	6	18			136	35	101		
	N6 Village	49	15	34			254	171	83		
	L4 Village	47	47				208	208			
	L6 Village	65	8	57			368	29	339		
TOTAL		587	184	401	1	1	2,932	877	2,045	3	7

Source: Report on impact assessment and compensation estimation of Dinh Binh reservoir, Binh Dinh PPC, 2001

Note: The above figure indicates the magnitude of resettlement in the case of FWL 93 m. However, the tendency of households affected by the dam can be understood, and the magnitude of total affected households in case of FWL 98 m would amount to more than 600.

Table M.21 Estimated Nos. of Resettlement Household* (River Improvement)

Unit: Household

River	Total	Of which	
		Ones affected by widening or dyke improv.	Ones within existing river area
Dap Da river	88	46	42
Go Cham river	58	46	12
Tan An river	102	102	14
Total	248	180	68

*: Set-back type shifting.

Note: The above estimate was made based on the existing available topo-maps, proposed alignments of the river improvement, and proposed typical cross sections.

Table M.22 Change of Each Factor Affecting Pollution Load

Factor	Category	2001	2020
Population (Kone river basin)	-	1,001,126	1,293,641
Surface area by land use (ha)	Whole basin	364,000	364,000
	Cultivated land	54,500	54,500
	Forest land	273,100	273,100
	Others (10%)	36,400	36,400
Industrial water supply (m^3/d)	Rural industrial water supply	49,300	195,367
	Water supply for industrial zone	0	108,500
	Total	49,300	303,867
	Industrial wastewater (90% of water supply)	44,370	273,480
Total cultivated area per year in project area of F/S (ha)	Irrigated	25,300	69,995
	Rainfed	24,377	0
	Total	49,677	69,995
	Overall cropping intensity	1.60	2.25

Table M.23 Unit Load by Category of Wastewater

Origin	Category	Unit	BOD	Total-N	Total-P
Domestic wastewater*1)	Feces and urine	g /capita/day	13	9.0	0.77
	Other effluent	ditto	31	3.0	0.46
Natural origin (Back ground) *1)	Cultivated land	g /ha/day	5 to 10	7.6	1.0
	Forest land	ditto		19	0.5
Industrial wastewater *2)	-	mg/l	19.9	3.67	0.39

*1) Quoted from "Methodology of water quality analysis for water supply," Research group on water supply problem, 1997.

*2) Measurement result of water quality analysis for wastewater conducted by JICA Study Team, 2002.

Table M.24 Estimated Magnitude of Land Acquisition (Irrigation System)

Irrigation system	Unit	Area to be acquired	Of which				
			Agricultural land	Forest land	Specially used land	Residential land	Unused land
Vinh Thanh	ha	81	32	2	5	3	39
	%		39%	3%	6%	4%	48%
Van Phong	ha	221	143	25	8	6	39
	%		65%	11%	4%	3%	18%
Ha Thanh	ha	47	36	2	3	4	3
	%		76%	4%	5%	9%	5%
La Tinh	ha	80	52	9	3	2	14
(extension)	%		65%	11%	4%	3%	18%
Total	ha	429	264	38	18	16	96
	%		61%	9%	4%	4%	22%

Note:
1. The above estimation was made on main and primary canals of each irrigation system.
2. The inspection roads were considered for the main canal with 5 m wide except Ha Thanh.
Reference for estimate:
Report on loss assessment, compensation and resettlement estimate for irrigation areas, Sub-NIAPP, 2000

Table M.25 Estimated Nos. of Resettlement Households* (Irrigation System)

Irrigation System	Estimated Nos. (HHs)	Remark
Vinh Thanh	51	
Of which		
Vinh Hao commune	14	
Vinh Quang commune	30	
Tay Thuan commune	7	
Van Phong	414	
Of which		
An Nhon district	18	
Tay Son district	287	Of which ones due to Van Phong weir
Phu Cat district	109	are estimated at 166.
Ha Thanh	159	estimated based on the latest inventory
La Tinh (extension)	89	estimated based on the latest inventory
Total	713	

*: Set-back type shifting.
Reference for estimate:
Report on loss assessment, compensation and resettlement estimate for irrigation areas, Sub-NIAPP, 2000

Table M.26 Possible Mitigation Measures for the Conceivable Negative Impacts (Natural Environment)

	Environ. Element	Conceivable negative impacts	Possible mitigation measures	Stage*[1)]
Physical environment	1) Topography and Geology	· Soil erosion in and around construction site and its sedimentation in downstream site.	· Inevitable to some extent. Sheet covering, afforestation, planting grasses, installation of deposition pond when necessary.	C
		· Erosion at immediately below the dam site.	· Due consideration in the design of dam for the energy dissipation of overflowing water.	C
		· Reduction of sediment load and acceleration of erosion in Kone river.	· River bank protection by means of gabion and/or other structures.	O/M
		· Sedimentation in back water section in reservoir.	· Monitoring on the sedimentation and accumulation of transported material and its clearance when necessary.	O/M
		· Change of river morphology in Dap Da, Go Cham and Tan An river	· Monitoring on stability of river dikes and bank protection when necessary.	C & O/M
	2) Groundwater	· Rising of groundwater level around both Dinh Binh and Van Phong reservoirs.	· Monitoring on stability of ground near the Dinh Binh and Van Phong reservoirs and protection when necessary.	O/M
	3) Water quality	· Turbid / alkali water flow from construction site.	· Inevitable to some extent. Installation of deposition pond when necessary. · Consideration on weather in earthwork planning.	C
		· Possibility of eutrophication in reservoir.	· Clearance of existing trees, bushes, and others on the reservoir bed before the storage of water.	O/M
		· Degradation of water quality in Kone river.	· Water quality control including wastewater treatment for domestic and industrial water use. · Consideration in agricultural input based on IPM.	O/M
Ecological Environment	1) Terrestrial ecology	· Habitat loss for terrestrial wild animals and disturbance of terrestrial ecology.	· Inevitable to some extent. Further information is needed for effective countermeasure. · Reforestation in head water area for wild animals' resettlement / migration.	O/M
	2) Aquatic ecology	· Reduction of nutrients supply for aquatic biota in Kone river.	· Inevitable to some extent. Further information is needed for effective countermeasure.	O/M
		· Habitat modification of aquatic biota in Kone river.	· Due consideration in design of river improvement, especially for the creation of favorable condition for aquatic biota.	O/M
		· Habitat disturbance in and around back water area of weir.	· Inevitable to some extent. Further information is needed for effective countermeasure.	O/M
	3) Ecology in Thi Nai swamp	· Reduction of nutrients supply for fish, including cultured species.	· Inevitable to some extent. Further information is needed for effective countermeasure.	O/M
		· Reduction of flush out effect due to the decrease of flood frequency.	· Inevitable to some extent. Further information is needed for effective countermeasure.	O/M
		· Degradation of river water quality and adverse effect on aquatic ecology.	· Water quality control including wastewater treatment for domestic and industrial water use. · Consideration in agricultural input based on IPM.	O/M

*[1)] C: Construction stage, O/M: Operation and Maintenance stage

Table M.27 Possible mitigation measures for the conceivable negative impacts (Social environment)

Env. Element	Conceivable negative impacts	Possible mitigation measures	Stage
1) Land acquisition and resettlement	· Impacts of land acquisition and resettlement by Dinh Binh dam construction.	· Due implementation of resettlement action plan prepared by PPC. · Ad hoc public consultation with stakeholders in parallel with the implementation of resettlement action plan (not only before the construction but also after completing action plan).	P, C, and O/M
	· Impacts of land acquisition and resettlement by a dam-related civil works.	· Preparation and implementation of due compensation plan for quarry development (one soil quarry site). · Detail impact evaluation on the alternative road of No. 637, and preparation of countermeasures if necessary.	P, C, and O/M
	· Impacts of land acquisition and resettlement by river improvement and irrigation system development.	· Preparation and implementation of due plans on land compensation and resettlement (set-back type shifting), in parallel with ad hoc public consultation with stakeholders in the same manner as Dinh Binh dam case. · Detail impact evaluation on the river improvement works carried out within the stretches of non-widening design.	P, C, and O/M
2) Social and communal issues	· Conflict between new comers and recipient communities of resettlers by Dinh Binh dam.	· Preparation and implementation of society development program for solution of conflict. · Due management, liaison work and consultation enhancement by the existing RRMB after completion of resettlement action.	P, C, and O/M
	· Life style change of ethnic minority (Bana group) by Dinh Binh dam.	· Support and assistance for smooth life stabilization such as stable cultivation and settlement.	P, C, and O/M
	· Difficulty of restoration of living status on socially vulnerable group.	· Support and assistance to war-affected and/or widow-headed households for their self-sustenance. · Due consideration and care, such as a specific entitlement, for illegal land occupants who use the river area.	P, C, and O/.M
3) Fishery in Thi Nai swamp	· Impacts on fishery conditions and resources due to reduction of nutrient supply.	· Inevitable to some extent. Monitoring is essential.	O/M
	· Impacts on fishery conditions and resources due to increment of agricultural input.	· Inevitable to some extent. Monitoring is essential. · Due application of and compliance with IPM.	O/M
4) Cultural and historical heritage	· Impact on historical heritages by river improvement.	· Design consideration and adjustment of the alignment for river widening works.	P
5) Landscape	· Change of existing landscape due to civil work of Dinh Binh dam and river improvement.	· Design consideration including i) minimization to the extent possible of topographical change by earth work, and ii) application of sodding on the cut/embanked slope.	P

P: Pre-construction stage, C: Construction stage, O/M: Operation and Maintenance stage
RRMB: Resettlement and Relocation Management Board for Dinh Binh dam
IPM: Integrated Pest Management

Table M.28 Environmental Monitoring Plan

	Area/Target		Locations	Monitoring parameters	Frequency	Stage*[1)]	Methodology
Physical Environment	1) Topography and Geology	Construction site	Around Dinh Binh Dam site.	Erosion and sedimentation.	When necessary.	C	Ocular observation.
		Dinh Binh reservoir	Backwater section of the reservoir.	Sedimentation of transported loads from upstream.	When necessary.	O/M	Ditto
		Dap Da, Go Cham and Tan An rivers	Dikes of widened reaches.	Stability of dikes.	Ditto	O/M	Ditto
	2) Groundwater	Van Phon Reservoir	Areas along protection dike of national road, route No. 19.	Groundwater level and stability of ground along the reservoir.	Ditto	O/M	Ditto
	3) Water quality	Dinh Binh dam, Van Phong weir and quarry site	Downstream area of construction site and quarry site	Turbid / alkali water flow from construction site.	Ditto	C	Ditto
		Dinh Binh reservoir	Center of the reservoir, at vertically 3 depths.	Temperature, pH, Salinity, Turbidity, BOD, COD, DO, SS, Total-N, Total-P and others if necessary.	Two times a year (In dry season and rainy season). 10 years after completion.	O/M	Site survey, water sampling and laboratory test.
		Kone river	Same location as those selected in EIA Study (8 locations).	Ditto	Ditto	O/M	Ditto
Ecological Environment	1) Terrestrial Ecology	Ecological change of reservoir basin	Outside of reservoir bed (area to be submerged) in Vinh Thanh district.	Inventory of terrestrial flora (vascular plants) and fauna (mammals, birds, reptiles, amphibians and others if necessary).	Two times: before and after the water storage in Dinh Binh reservoir.	Pre-C & O/M	Field investigation and laboratory identification.
	2) Aquatic Ecology	Dap Da, Go Cham and Tan An rivers.	Widened reaches.	Inventory of aquatic biota, including phytoplankton, zooplankton, benthos, nekton, and others if necessary. Migratory fishes should be focused on.	Two times every two year (In dry season and rainy season). 10 years after completion.	O/M	Field investigation and laboratory identification.
	3) Ecology in Thi Nai swamp	Water quality of Thi Nai swamp	Three stations in the swamp: 1) North part. 2) Center. 3) Estuary mouth.	Temperature, pH, Salinity, Turbidity, BOD, COD, DO, SS, Total-N, Total-P, Pesticides and others if necessary.	Ditto	O/M	Site survey, water sampling and laboratory test.
		Aquatic biota	Ditto	Inventory of aquatic biota, including phytoplankton, zooplankton, benthos, nekton, and others if necessary.	Ditto	O/M	Field investigation and laboratory identification.
Social Environment	1) Land acquisition, resettlement,	Effectiveness of compensation and resettlement plan	Dinh Binh dam, resettlement sites. Areas along the stretches of river improvement. Areas along new canal systems including Van Phong weir.	Actual progress of and compliance with the plan. Socio-economic conditions and requirement of stakeholders.	Once at pre-construction stage, and continuously after work starts until achievement of self-sustenance.	Pre-C, C and O/M	Field observation, interview or inquiry, consultation
	2) Social/ communal issues	Restoration of livelihood and life stabilization	Ditto.	Socio-economic conditions of vulnerable households comparing with former one.	Ditto.	Ditto	Ditto.
	3) Fishery in Thi Nai swamp	Fishery conditions and resources	Areas in and around the swamp	Catch amount of fishing by kind. Production of aquaculture by breeding.	Two times every two year (In dry season and rainy season). 10 years after completion.	O/M	Statistic data collection and consolidation, field observation, interview or inquiry, consultation

*[1)] Pre-C: Pre-Construction stage, C: Construction stage, O/M: Operation and Maintenance stage.

Table M.29 Comparison of Resettlement Magnitude on Dinh Binh Dam

Item	Case of FWL=93.3m (HEC-1 F/S)	Case of FWL=98.3m (JICA Study)
Estimated nos. of resettled HHs (nos.)	587	616
Total resettlement cost estimated (mill. VND)	128,243	134,656
Of which (mill. VND)		
Compensation for property loss	39,516	41,898
Support for moving/resettling	12,735	13,502
Livelihood support	12,931	13,710
Public work	5,536	5,869
Infrastracture development	35,734	37,886
Preparation and manegement cost	21,792	21,792

Reference for estimate: Feasibility Study Report on Dinh Binh Reservoir Project, HEC-1, 2000

No	Mine and ore points	Main minerals	Size	Origines
4	Vinh Kim	Gold(silver)	Ore points	Thermal solution
5	Nui Hon Lap	Gold	Ore points	"
6	Tien Long	Gold	"	Mineral sands
12	Vinh Thinh	Felspat	Ore points	Pegmatit
13	Vinh Thanh	"	"	"

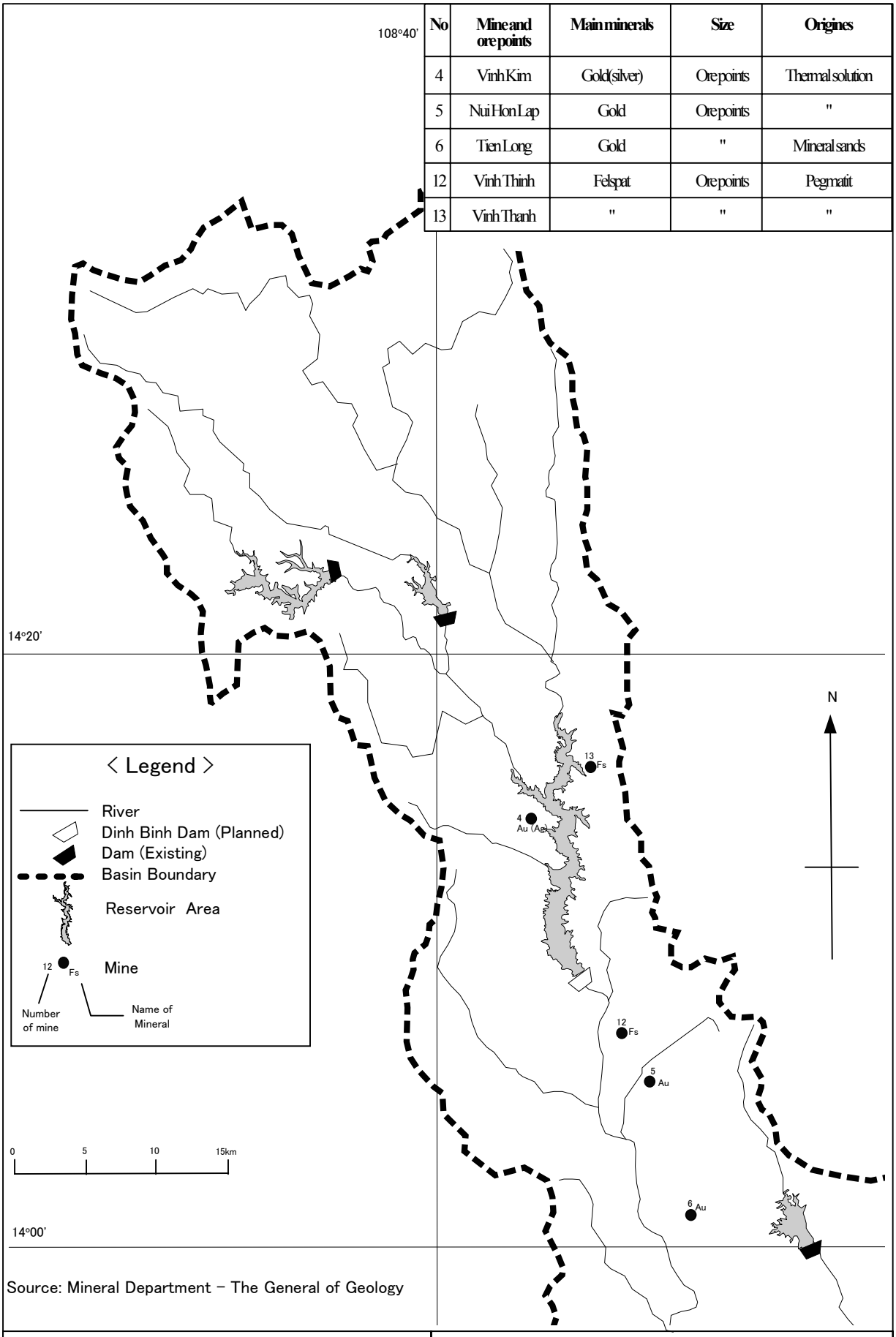

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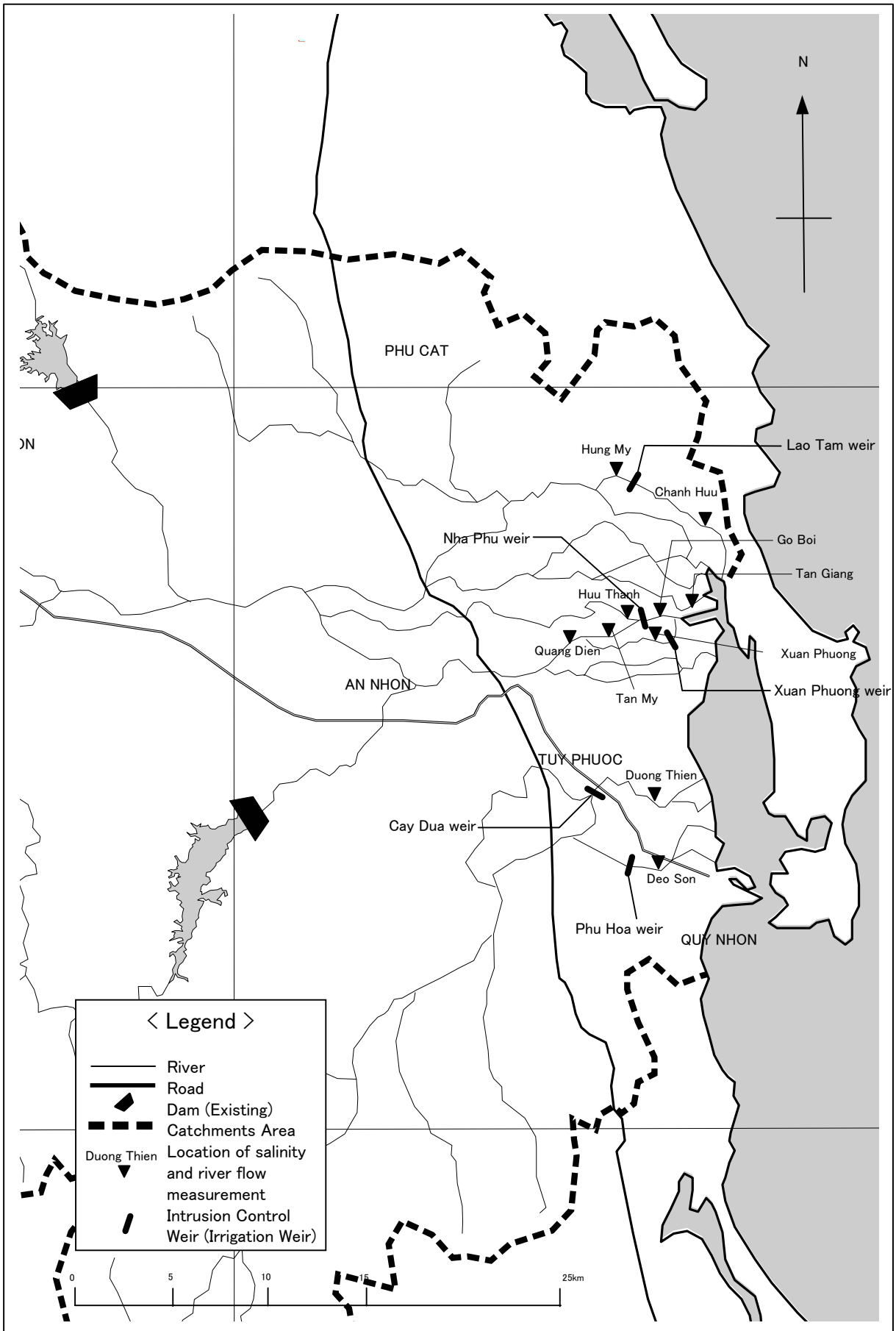
Figure M.1
Locations of Ongoing Mines and Planned Reservoir Area at FWL.



The Study on Nationwide Water Resources Development and Management in the Socialist Republic of Vietnam JAPAN INTERNATIONAL COOPERATION AGENCY	**Figure M.2** **Locations of Salinity Measurement and Intrusion Control Weir**

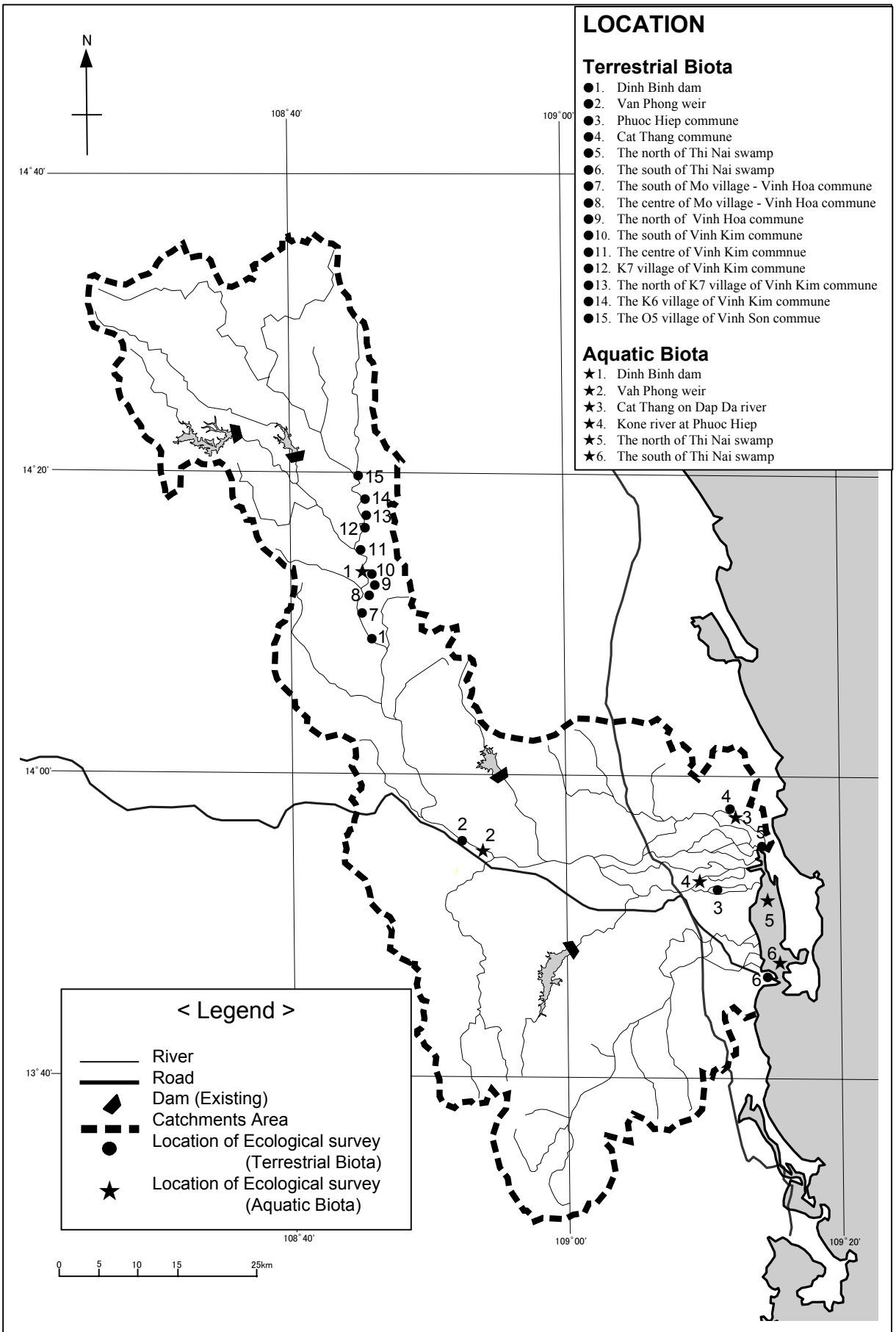


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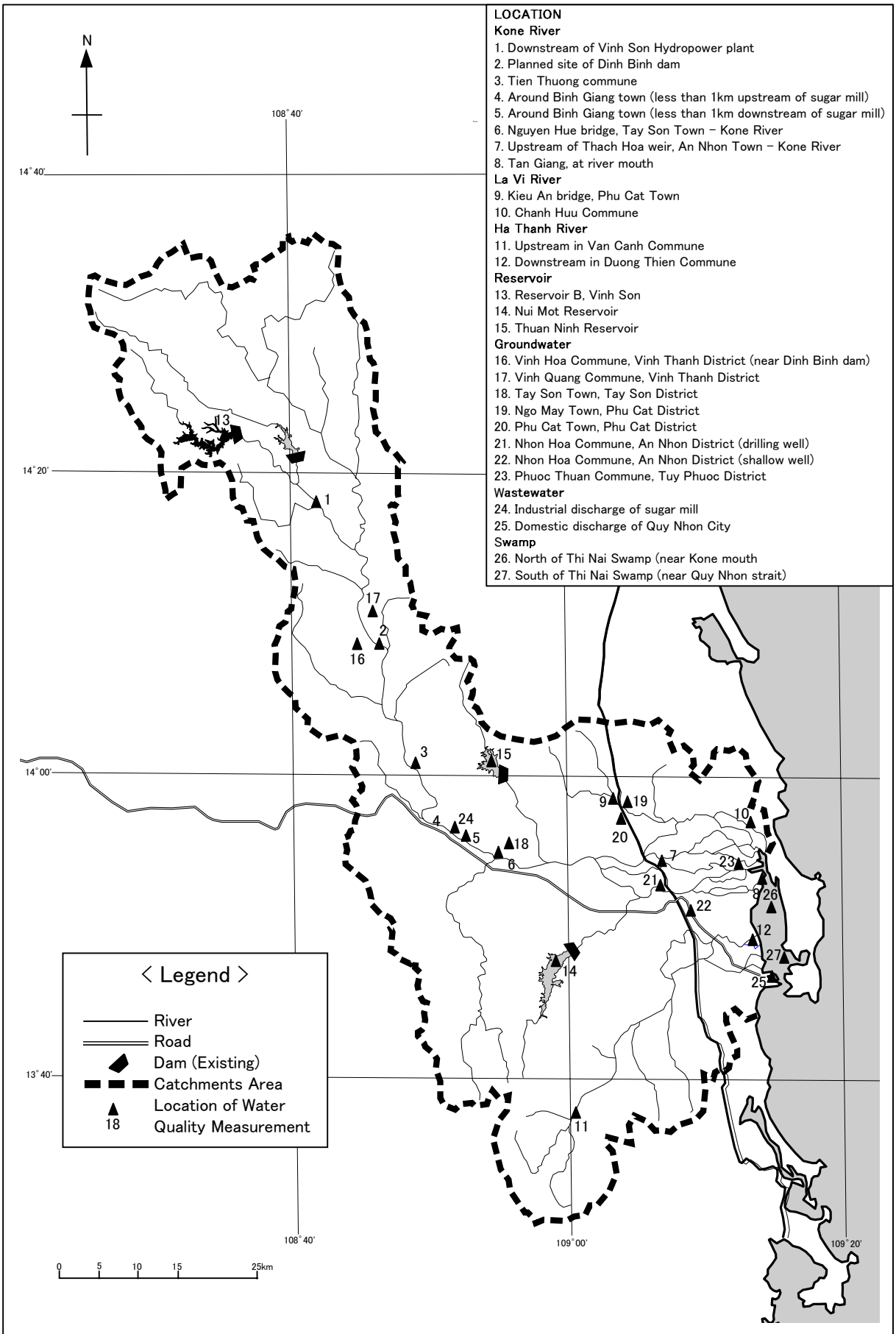
Figure M.3

Locations of Ecological Survey



The Study on Nationwide Water Resources Development and Management in the Socialist Republic of Vietnam	**Figure M.4**
JAPAN INTERNATIONAL COOPERATION AGENCY	**Locations of Water Quality Measurement in Kone and Ha Thanh River Basin**

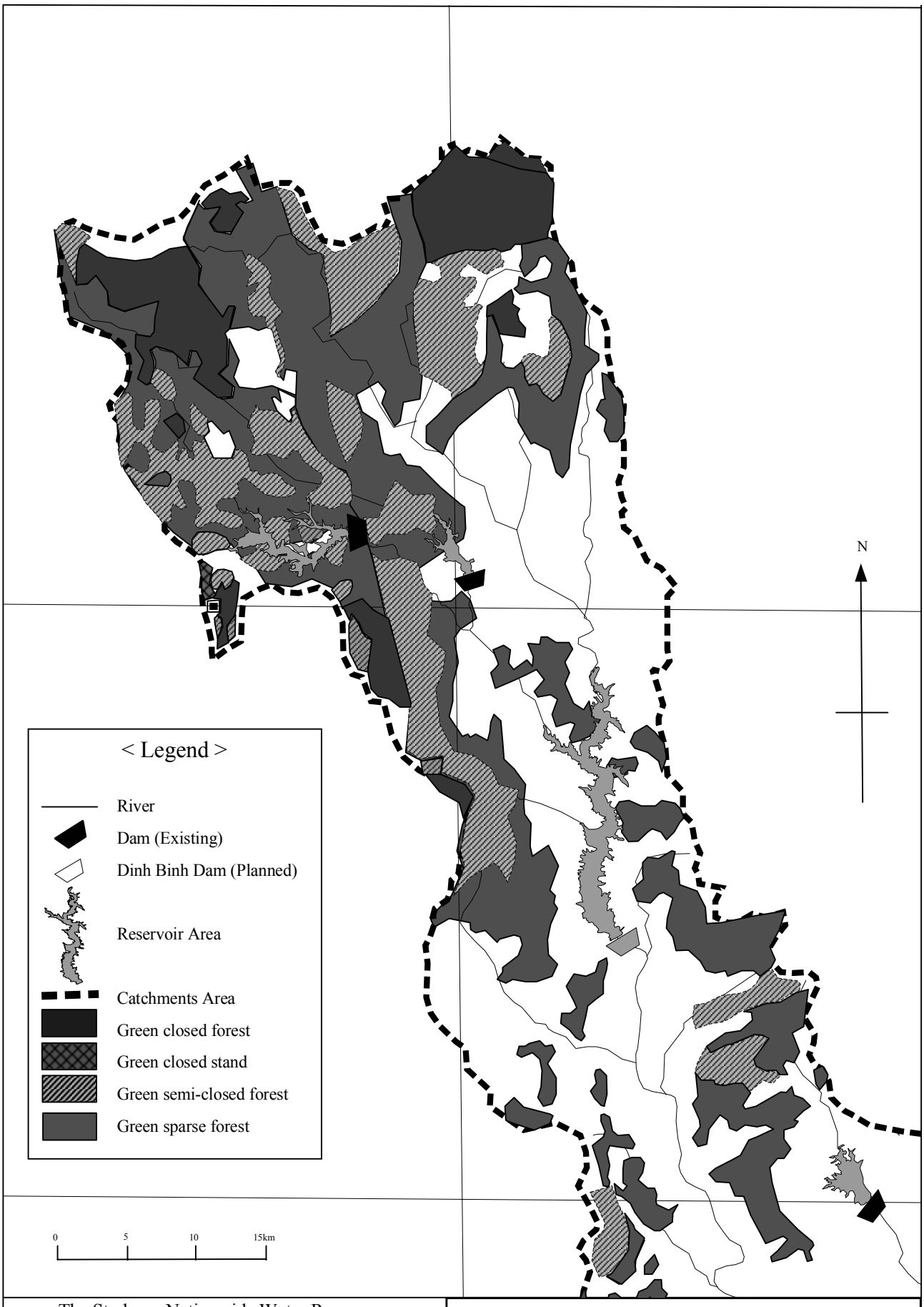


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Figure M.5
The relationship between existing forest land and the planned reservoir area at FWL