FINAL REPORT

VOLUME III　SUPPORTING REPORT

K. ENVIRONMENT

STUDY
ON
INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN
IN
THE REPUBLIC OF PERU

FINAL REPORT
VOLUME III
SUPPORTING REPORT

K: Environment

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Chapter 1 Initial Environmental Examination (IEE)

1.1 Introduction

An IEE for the IWRDS Cañete River projects was carried out based on JICA Environmental guidelines for Dam Construction Projects, and JICA Environmental Guidelines for Infrastructure Projects (Water Supply). The preparation of an IEE is generally an iterative assessment process that begins at the outset of the project.

Based upon JICA Environmental Guidelines, evaluation of soil, water, air, and ecosystem (wildlife), in particular the following survey items were examined in the field, for the actual field condition in the project area.

Present status and impacts on riverine fisheries in the Cañete River basin, (the aquatic environmental changes and fishing rights) were studied.

Present status of irrigation area and land use condition and status of allocation of water between landholders was analyzed.

Distribution status of historical and cultural assets in and around the dam site and reservoir were thoroughly studied.

Present status of precious ecosystem or endangered species in and around the dam site and reservoir (impacts on ecosystem of wild-lands, species or plant communities of special ecological significance) were examined.

1.2 Description of the Projects in the Study

1.2.1 Paucarcoha Dam (El Platanal Project)

The catchment area of the dam will be 297 km^2, the Paucarcocha natural lake level is 4,236 meters above the sea level (MASL), and the capacity will be increased from the existing 26.5 MCM to 55 MCM. The dam crest elevation will be 4,263 MASL, and the area of the reservoir 4.01 km^2. It will be a 30 m high rock fill dam with a central clay core connected with a slurry trench or thin wall extended in the underlying moraine. The project's EIA has been approved in August 1999.

1.2.2 Morro de Arica Dam (El Platanal Project)

The catchment area of the dam will be 1,689 km^2, and the riverbed elevation is 2,800 MASL. The storage capacity of the dam will 244 MCM, and the height will be approximately 220 meters. It will be CFRD dam, its installed capacity will be 50 MW. The dam will have inflows from Alis and Laraos rivers. The dam project proposes to control 13 upper Andean lakes where some sort of infrastructure will be established. The Morro de Arica will possibly control

648 MCM. The reservoir area has the form of a narrow canyon, with almost vertical walls. The project's EIA has been approved in August 1999.

1.2.3 Auco Dam

The catchment area of the dam will be 2,713 km^2, and its operation level elevation will be 2,015 MASL. Its active storage capacity will be 102 - 353 MCM alone, and 30 MCM with Morro de Arica implemented. It will be a rock filled dam with concrete facing or RCC. There is anticipated to be a lot of debris from a tributary upstream, to mitigate this a SABO dam will be constructed.

1.2.4 Capillucas Dam (El Platanal Project)

The catchment area of the dam will be 3,288 km^2 and the dam crest elevation 1,574 MASL. It will be a 37 m high concrete gravity type dam, with an installed capacity of 220 MW. The reservoir capacity will be 5 MCM, and total area 0.31 km^2. It will have an equalizing reservoir, tunnel area, and powerhouse. The intake will be located 5 km upstream of Chavin town. Total construction cost of this project (hydropower and irrigation) has been settled in US$ 340 millions out of which US$ 140 millions come from international and national private investors led by Cementos Lima and balance US$ 200 millions looking from external financing. The EIA has been approved for this project in August 1999.

1.2.5 San Jeronimo Dam

The catchment area of the dam will be 4,852 km^2, and its full supply level will be 1,125 - 1,152 MASL. The active storage capacity will be 125-150, or 60-132 MCM, and the dam type will be rockfill or R.C.C.

1.2.6 Zuniga Diversion Intake Dam

The catchment area of the intake dam will be 5,188 km^2, and the full supply level will be 790 MASL. It will receive inflows from Tupe, Cacra, Huangascar tributaries.

1.2.7 Zuniga - Lurin Water Supply Transmission Lines,

This project will involve constructing a 206 km long water transmission system of canals (125 km), six siphons (8 km), 11 tunnels (18 km), one rapid (2 km) and three sections of pipelines (53 km) 10 m deep, at 75 MASL. The weir will be located at Zuniga, and the water conveyance route with major facilities site up to Lurin, where at Flor de Nieve the water treatment plant will be located. It will provide 5-10 m^3/second of drinking water to SEDAPAL at the planned treatment plant. The prefeasibility study has determined that agriculture and population demand in the Cañete basin will not be negatively impacted with the diversion of water. The drinking water thus obtained will come under the jurisdiction of Cañete province. he local population in Cañete River basin feels uncertain about this project and may oppose it. The project will guarantee the availability of water for energy generation to El Platanal project. The Marca project under execution in the country is very similar to this project. The transmission system will traverse through a quarry, chicken farms, rivers and ravines, agricultural, and industrial area, and the Pachamanka Archelogical site.

1.3 Description of the Environmental Issues

1.3.1 Pollution from Mining & Agriculture

In the study area, heavy metal mining is carried out in a large to medium scale, by the largest Yauricochamine, (Centromin, Peru S.A.) and others in Jose Manuel and Satanas. The area produces silver, lead, and zinc and to a lesser proportion copper and other metals. The Yaurichocha mine is located in the Alis district, in Yauyos, at over 4,500 meters above sea level (MASL). The Jose Manuel mine is situated at Chupapunta, close to Huancachi in the District Tomas, in Yauyos at 4,000 MASL. The Satanas mine is in Pacoha, in District Laraos, province Yauyos. There is also a mine in Huancaya, its exploitation could have negative effects on the environment in the upper Canaete river, where a potential for tourism exists. Other prospective mine sites exist in Toas, Huantan, Carania, and Miraflores districts.

The Yauricocha mine discharges most of the, gray colored suspended material in the upper Cañete River basin. It uses water from the nearby Yauricoha lagoon, consuming 706,000 m^3/year of water, in producing copper, lead and zinc. The processing facility has an installed capacity of 1,550 tons/day, the daily treated average has been 1,290 tons/day. The mine concentrator treats Cu, Pb, and Zn ores. In the process of treatment it uses sodium sulfate, copper sulfate and xanthates. These and the metals are present in tailing discharged into Cañete River.

Reportedly fishes and river prawn (camarones) in the Cañete River have decreased drastically in the last 15 year. In particular, it was reported that tow years ago there was a massive discharge from the Yauricoha mine which wiped out the entire population of river camarones. A causal relationship definitely exists between toxic heavy metal discharge from the existing mines and weak biodiversity of the Cañete River. The study team’s samples were analyzed at SEDAPAL’s laboratory, those (1&2) closer to the mine have high lead and copper.

Place of Sample Taken (August 1999)	Selected Physiochemical & Metals' Analysis				
	PH	Conductivity Ohms/cm	Nitrates Mg/L	Copper Mg/L	Lead Mg/L
1) 500 m from Yauricocha mine discharge in Alis River	7.19	711.0	1.191	0.209	0.775
2) Downstrem in Alis river near Tinco	8.27	454.0	1.325	0.028	0.044
3) Auco Dam site on the upper basin Cañete River	8.36	440.0	1.191	<0.004	0.016
4) Zuniga Dam site on the lower basin Cañete River	8.62	426.0	1.265	<0.004	0.017
5) Socsi intake station lower basin Cañete River	8.36	431.0	1.697	<0.004	<0.010

In addition to the mining industry discharges, the pesticides have been detected down stream, for example, at Puente Clarita, Pan American Highway, and INRENA (1996) study had found higher than permissible levels in the table below of DDT and other pesticides.

Cañete River at Puente Clarita Pesticide Analysis		
Pesticides Brand-names	WHO Minimum Limit (mg/L)	Analysis Result (mg/L)
DDT	0.002	0.2173
Lindano	0.004	0.0347
Malatio	0.008	0.0772

Pan American Health Organizaiton (PAHO) ahs also reported that 329 kg/km^2/year pesticides are used in Peru, higher than anywhere in South America. There is now a widespread used of agro-chemicals in the Cañete River basin, however, there is no systematic study on the use and effects of agro-chemicals. Part of the explanation for increased agro-chemical use can be explained by a change in GOP policy. In 1991, MOA relaxed restrictions on pesticides when the requirement for registration was eliminated together with the accompanying certification of the active ingredients and their physical and chemical parameters and biological toxicity.

Osioro, and Lizaraga[1] have studied in Peru the effects of agrochemicals on soils,, (reduction of species diversity) on flora, fauna (including natural enemies of pests such as spiders), pollinators, and social impacts including intoxification, application, and impacts on families who work in the fields. According to FAO, due to downsizing of the public sector, there no longer exists an extension service that can support agrochemical users. This is particularly relevant to the small producers, majority in the study area, who cannot afford access to private sector assistance and who increasingly depend on the suppliers for information and often credit in the purchase of inputs.

1.3.2 Huaico-Severer Erosion

It translates in the Quechua language as the walls of mud, and they cause severe erosion. They have been identified along the Cañete River at the confluence of tributary ravines between Zuniga and Magdalena. More than twenty years ago, a lake in the Cañete River downstream of Vitis district was formed by huaico caused by a massive landslide. Erosion also occurs locally with solifluction processes and with the development of furrows and gullies, which form ravines in the terrain. The gradients and the uneven altitude cause mass movements. The erosive action of the run-off is particularly intense. The erosion in the slopes in severe, since the cover topsoil is eliminated by the erosive action. This has been due to semi-arid climatic conditions, which do not permit growth of significant vegetative cover. The erosion from run off water on the hillsides of the lower areas in considerable with huge areas affected, by active gullies and ravines. They can be attributed to a poor and/or inappropriate land use, loss of forest cover, in combination, with thinly spread soils and steep slopes.

1.3.3 Alternative Roads Construction

Building alternative roads, in place of the existing, will be necessary for many of the projects described above. There will be a negative impact on the vegetation due to new road construction activity.

1.3.4 Reallocation and compensation of People

An inventory of land ownership and assessment of its market value need to be carried out. For example, Auco dam has one village with only 20 houses in the project area. There are approximately 11,328 farmers in the study area, and the cultivated area is 3,781,317 ha. The main activity here is farming and livestock breeding. About 55.21% inhabitants cultivate parcels ranging from .5 to 5.9 ha. The Cañete province comprises of 82.75%, and Yauyos province 71.95% of farming and livestock breeding operations smaller than 5.0 ha. There is a heavy concentration of land in the peasant community.
San Jeronimo

1.3.5 Loss of Cattle Grazing Land

There will be a loss of approximately 360 to 900 ha cattle grazing land in the study area. The communities in Tanta, Tomas and Laraos also herd llamas and alpacas. The upper basin area (tropical sub-alpine at 3,900 to 4,500 MASL) offers the best conditions for the development of natural pastures, and sheep are raised here. This region is in fact solely dedicated to livestock raising activities. In Yauyos province, alfafa and pastures are most important representing 41.18%, followed by potatoes 20.18% followed by vegetables 13.46%. Raising cows is the most important activity in Yauyos. The districts of Alos and Laraos also grow corn. In 1990. this area had 9,145 headof cattle with annual milk production of 5,049 liter per cow. Currently 1,530,000 liters of milk, and 271,000 kg of meat are produced. The study area has the following:

Cattle	36,155
Sheep	90,396
Pigs	3,715
Poultry	458,767

1.4 Screening of Potential Environmental Impacts and Mitigation Measures

Table 1.4.1 Screening List for the Entire Cañete River Basin

Social Environment

Check Items			Evaluation	Reasons
Life-style	1	Change in the population Distribution within the region	Yes	Population increase due to dams & irrigation project.
	2	Resettlement	Yes	There are approx.200 houses in all the dam-sites including San Jeronimo.
	3	Change in life-style	Yes	Life-style change will take place in the basin because of multiple dam construction.
	4	Conflict among local residents	N/A	If benefits distribution be equitable conflict will be nil.
	5	Indigenous people, Minority groups, nomads	N/A	Upper Cañete basin will be carefully treated.
Economic Activities	6	Impact on agriculture and forestry sector	Yes	Afforestation & irrigation will impact positively.
	7	Impact on fishery sector	Yes	Minor impact due to multiple dams.
	8	Secondary industry (including mining)	No	No significant impacts in the entire Cañete River basin.
	9	Tertiary industry (including tourism)	No	No negative impact; long term benefits will accrue.
	10	Widened income disparities	N/A	Will mostly depend on the benefits distribution.
Communication	11	Regional disruption (including minority issue)	No	Dams will not be disruptive for most populated areas.
Transportation	12	Impact on land transportation	Yes	Only temporary during the construction period.
	13	Impact on water transportation	No	Not particularly recognized.
Water area and its utilization	14	Water rights, fishing rights, and rights relating to common use of trees	Yes	Only during construction, later more opportunities for fish, water and afforestation.
Public health & Sanitary condition	15	Occurrence and diffusion of water-borne diseases	No	Not particularly recognized.
	16	Addition use of agricultural chemicals and its accumulation	Yes	Policy for sustainable agriculture to be in place
	17	Increased production of garbage and discharge	Yes	Project implementation to promote cleaner production
	18	Deterioration of sanitary condition during construction period	Yes	Better environmental management to be implemented.
Historical & Cultural Properties	19	Deterioration or destruction of historical and cultural heritages	N/A	No known sites near the proposed projects.
	20	Disfigurement of the Landscape	No	Particular care will be taken to allow no disfigurement.

Table 1.4.1 Screening List (Continued)

Natural Environment

Check Items				Evaluation	Reasons
Soil & Land	Land character	21	Impact on induced earthquake	N/A	It is possible when the water volume is extremely large.
	Topography	22	Slope failure	No	Tree plantation to mitigate and strengthen slopes.
		23	Sedimentation in the backwater section	Yes	Bad-load transport of earth-flow into the Cañete River.
		24	Impact on downstream flow variation	Yes	Downstream will be provided minimum maintenance flow.
	Geology	25	Soil erosion	No	Provision of sand flush mechanism studied.
		26	Salt pollution	N/A	No soluble salty soil exists.
		27	Soil contamination	Yes	Upper basin mines harmful; problem to be mitigated.
Water	Hydrology	28	Water transfer	Yes	Conveyance to Lima and Concon-Topaca.
		29	Impact on groundwater	No	There is little impact.
		30	Change in flow regime	Yes	Related to the dams discharges.
	Water quality	31	Detrimental changes in water temperature	Yes	Due to the water discharge at lower temperatures
		32	Eutrophication	No	There is little impact.
		33	Water contamination	Yes	Bed-load transport of earth-flow from, Rio Alis & Tomas.
	Sediment	34	Change in sediment composition	Yes	Bed-load transport of earth-flow into Cañete River
Biology	Flora & Fauna	35	Impact on precious and indigenous species	No	Habitat of camarones and other flora already threatened.
Air	Air	36	Air pollution	No	There is little impact.
	Odor	37	Exhaust fumes/offensive odors	Yes	Due to the construction vehicles temporarily.
	Noise/ Vibration	38	Noise and vibration	Yes	Due to the construction vehicle temporarily.
Overall Evaluation: Whether or not an IEE or an EIA is necessary				Necessary	There are items which need more consideration

Note: N/A means not applicable

Table 1.4.2 Scoping List for the Entire Cañete River Basin

Social Environment

Check Item		Evaluation	Reasons
1	Change in the population Distribution within the region	B	Population inflow due to the multiple dams construction and irrigation projects.
2	Resettlement	B	Less than 100 houses to be resettled due to San Jeronimo & Auco dams.
3	Change in life-style	B	Changes following the environmental change due to the multiple dams construction.
4	Conflict among local residents	C	Depends on the benefits distribution
5	Indigenous people, minority groups, nomads	C	Attention required only in the upper basin of the Cañete River.
6	Impact on agriculture and forestry	B	Farming area enlarged due to additional irrigation area is predicted.
7	Impact on fishery	A	Fishing as exists now to change. Migratory fish such as trout should be studied & observed.
8	Secondary industry (including mining)	B	Mineral deposits are found in upper Cañete basin area, better environmental management required.
9	Tertiary industry (including tourism)	D	No negative impact is foreseen, tourism will increase.
10	Widened income disparities	C	Depends on the benefit distribution in the region.
11	Regional disruption (including minority-group issue)	D	Not particularly recognized.
12	Impact on land transportation	D/B	Not recognized for long term, only temporary during the construction of dams.
13	Impact on water transportation	D	Not particularly recognized; Lunahuana farting to be still available and better managed after the project.
14	Water rights, fishing rights, and rights relating to common use of trees	B	Legal rights and customs are established in most cased and better practices are being proposed after the project.
15	Occurrence and diffusion of water-borne diseases	D	Not particularly recognized.
16	Additional use of agricultural chemicals and its accumulation	B	As such the Cañete basin already has over use of pesticides. Better practices in the area are required.
17	Increased production of garbage/waste and discharge	B/D	Increase during the construction period of the dams; better management of environmental concerns will be implemented in the long term.
18	Deterioration of sanitary condition during construction period	B	General predict according to project.
19	Deterioration or destruction of historical and cultural heritages	C	Some Inca period monuments and ruins are the Cañete River basin but far removed from the project area.
20	Disfigurement of the landscape	D	Not particularly recognized; in the long term massive tree planting efforts will be undertaken.

Table 1.4.2 Scoping List (Continued)

Natural Environment

Check Item		Evaluation	Reasons
21	Impact on induced earthquake	C	Risks are higher only n the case of very big reservoirs straddling fault zones.
22	Slope failure	A	The soil quality of the mountainous areas is prone to ‘huaycos’; tree planting could mitigate this problem.
23	Sedimentation in the backwater channel	B	The influence of bed-load transport from Alis and Tomas Rivers.
24	Impact on downstream flow variations	B	A minimum discharge during the dry season will maintain ecological quality of the Cañete River.
25	Soil erosion	A	The massive erosion in place is recognized, tree plantation will mitigate the issue.
26	Salt pollution	C	No soluble salty soil exists; nitrates and pesticide are because of agricultural run-off.
27	Soil contamination	B	There are active and abandoned mines in this area & are harmful to the water quality.
28	Trans basin diversion (Water transfer)	B	The Cañete River basin water will be transferred to Lima and concon-Topaca.
29	Impact on groundwater	A	There is negative impact due to nitrates, and pesticides in the groundwater.
30	Change in flow reginme	A	Related to the dam discharge pattern, however, it will meet ecological quality of river.
31	Detrimental changes in water temperature	B	Due to water intake from deep reservoirs.
32	Eutrophication	D	There is activity which could induce eutrophication.
33	Water contamination	B	The influence of bed-load transport bringing mining industry contamination.
34	Change in sediment composition	B	The influence of bed-load transport earth-flow will be mitigated by sand flush facilities
35	Impact on precious and indigenous species	C	Habitat of mountain fauna to be studied. Fish and flora will be managed better after the project is implemented.
36	Air pollution	B/D	No impact is anticipated after the construction
37	Exhaust fumes/offensive odors	B	Due to the construction vehicles.
38	Noise and vibration	B	Due to the construction vehicles.

Note : he marking system under “Evaluation” refers to the degree of environmental impact as follows;

A : Serious

B : To some extent

C : Unknown (It is necessary to examine and there are possibilities that it turns out clearer as the study proceeds).

D : No (Since there is little impact it is not in the scope of IEE nor EIA).

Table 1.4.3 Overall Evaluation for Screening and Scoping

Check Items	Evaluation	Future Study Plan	Remarks
Impact on fishing industry	A	The fishing situation and fish species, i.e. trout and camarones (river prawns).	Trout is Non-endemic.
Change in flow regime	A	The water discharge pattern.	Monitor ecological minimum.
Change in the population distribution in the region	C	Land use, irrigation plans, and economic development plans in the Cañete River basins area.	More jobs!
Change in life-style	C	Sociological sketch of the life-style of residents near Auco, San Jeronimo and Zuniga.	
Impact on agriculture and forestry	D	The irrigation plans and economic development plans in the entire Cañete River basin area.	
Additional use of agricultural chemicals and its accumulation	B	How to reduce the rempant use of pesticides and fertilizers	Practice sustainable agriculture
Increased production of garbage and discharges	B	Economic development plans and incorporate them in the environmental management plans.	
Deterioration of sanitary condition during construction period	B	The sanitary condition in the project area.	
Draining area accretion	B	The influence of debris flow from the upper Cañete basin and the tributaries.	
Impact on downstream flow variations	D	Prediction of the water discharge pattern impact.	
Detrimental changes in water temperature	B	Impact prediction.	
Water contamination	B	The influence of debris flow into lower Cañete River basin.	
Change in sediment composition	B	The influence of debris flow into lower Cañete River basin.	
Exhaust fumes/offensive odors	B	Impact prediction (during construction period).	
Noise and vibration	B	Impact prediction (during construction period).	
Water rights, fishing rights, and rights relating to common use of trees	D	The vested rights and customs	
Resettlement	B	Compensation and resettlement plan for 200 houses in the entire Cañete River basin	
Conflict among local residents	C	The development plans in the project area must include provisions for public participation	
Indigenous people, Minority groups, nomads	C	The settling zones in the upper Cañete basin of these groups	
Widened income disparities	C	The development plans in the project area.	
Deterioration or destruction of historical and cultural heritages	D	The cultural heritage distribution	
Impact on induced earthquake	C	Geological risks.	
Slope failure	C	Observation of the weathering of mountain and study on the soil quality and history of ‘Huaycos’ in the area.	
Salt pollution	C	The salt accumulation and the irrigation plans.	
Impact on precious species	C	Biodiversity survey.	

1.5 Conclusions and Recommendations

Natural Environment

1) There is excessive debris from the arid surrounding conditions, in several of the study area's projects. It is recommended to construct SABO dams and provide for san flush facilities. This issue is related to the Huayco (severe erosion), which have been identified along the Cañete river at the confluence of tributary ravines between Zuniga and Magdalena.

2) High levels and fluxes of pollution from mining industry are a cause of great concern. A continuous monitoring of the heavy metals is recommended for the upper basin. A monitoring program based on the Terms of Reference in the Sector Report should be implemented.

3) Impact on groundwater is due to fertilized and pesticide use, which is widespread, however, there is no systematic study on the use and effects of agro-chemicals. Reportedly, the incidence of cancer is on increase in the valley. The groundwater table is at 5 meters depth, and many among the 6,500 farmers in the valley use groundwater. Exploitation of groundwater for different uses is estimated to be 4.4 MCM/year. There are about 90 wells in the Study area, and the water obtained and used by the local population in numbers the following breakdown, domestic 3,288 agriculture 2,665 livestock 108 and industrial 1,152. In addition, domestic 3,288 agriculture 2,665 livestock 108 and industrial 1,152. In addition, the Cañete water supply company (EMAPA Cañete) has developed 2.8 MCM/year (1998) for use in the districts of Cerro Azul, San Luis, Imperial and San Vicente.

Social Environment

4) An inventory of land ownership and assessment of its market value need to be carried out. For example, Auco has one village with only 20 houses in the project area. There are approximately 11,328 population, (2,060 households) in the Study area, and many of them need to be involved in the issue of transfer of water from the Cañete basin area.

5) About 50% of the residents of Catahuasi village (population 1,228 in 1993) might be subjected to resettlement in case of the high San Jeronimo dam. Further study will be required for resettlement involved in construction of dams and water conveyance facilities.

6) There will be a loss of approximately 360 to 900 ha cattle grazing land due to San Jeronimo and Auco dams in the Studyarea. This should be settled in and amicable way by providing liberal compensations.

7) Building alternative roads, in place of the existing, will be necessary for many of the projects described above. There will be a negative impact on the vegetation due to new road construction activity. The road construction

should be carefully implemented, taking into consideration the damage that can be caused to the flora and fauna.

The tables below provide the conclusions for the IEE of Integrated Water Resources Development Study projects, Auco dam, San Jeronimo dam, Zuninga diversion intake dam, Lima water conveyance project, and Cementos Lima projects (Paucarcocha dam, Morro de Arica dam, Capillucas intake dam).

Result of IEE for the 4 IWRD Cañete River Basin Projects

Checklist Item	Auco dam	San Jeronimo Dam	Zuniga intake dam	Lima Water conveyance
A) Problems due to the Location				
1. Resettlement/compensation	-/C	-/A	-/C	-/C
2. Land value changes	+/A	+/A	+/A	+/A
3. Encroachment of agricultural lands	-/B	-/B	o/C	o/C
4. Depreciation of forestry	-/B	-/B	o/C	o/C
5. Inundation of mineral resources	o	o	o	o
6. Loss of historical/cultural sites	o	o	o	o
7. Watershed erosion/silt run-off	-/C	-/C	o	o
8. Effects on groundwater hydrology	=	=	o	o
9. Impairment of navigation	o	o	o	o
10. Encroachment of precious ecology	=	=	o	o
11. Upstream migration of fish	-/B	-/B	o	o
B) Problems related to the Design				
1. Loss of roads	-/B	-/B	=	=
2. Water right conflicts	-/C	-/C	o	o
3. Loss of community & recreation area	=	=	o	o
4. Intensification of traffic congestion	-/C	-/C	o	o
5. Aesthetic & landscape loss	o	o	o	o
6. Prevention of accessibility	-/C	-/C	=	-
C) Problems in construction Stage				
1. Soil erosion & silt runoff	-/C	-/C	o	O
2. Hazards to workers & residents nearby	-/C	-/C	-/C	-/C
3. Spread of communicable diseases	o	o	o	o
4. Deterioration of water quality	o	o	o	o
D) Problems in Operation Stage				
1. Downstream erosion/aggradation	-/C	-/C	o	O
2. Deterioration of water quality	o	o	o	O
3. Intrusion of saline water	o	o	o	O
4. Eutrophication	o	o	o	O
5. Encroachment of precious ecology	=	=	=	=
6. Depreciation of fisheries	+/C	+/C	o	o
7. Vector disease hazards	o	o	o	o
8. Aesthetic & landscape loss	o	o	o	o

Note: (1) / : Upper side is the expected effect, and lower side is its significance
(2) o : No effect expected
\+ : Positive effect expected
\- : Negative effect expected
= : Neutral effect expected, i.e. change is neither beneficial nor harmful.
(3) A : Effect which has relatively high level of significance
B : Effect which has relatively medium level of significance
C : Effect which has relatively low level of significance

Result of IEE for the 2 Cementos Lima Projects

Checklist Item	Paucarocha dam	Morro de Arica dam	Capillucas intake dam
A) Problems due to the Location			
1. Resettlement/compensation	O/C	-/C	o/C
2. Land value changes	+/A	+/A	+/A
3. Encroachment of agricultural lands	o/C	o/C	-/B
4. Depreciation of forestry	-/B	-/B	-/B
5. Inundation of mineral resources	o	o	o
6. Loss of historical/cultural sites	-/C	-/B	-/C
7. Watershed erosion/silt run-off	o/C	o/C	o/C
8. Effects on groundwater hydrology	o	o	o
9. Impairment of navigation	o	o	o
10. Encroachment of precious ecology	-/B	-/B	-/B
11. Upstream migration of fish	o/C	-/B	-/B
B) Problems related to the Design			
1. Loss of roads	o	-/C	-/C
2. Water right conflicts	o	o	o
3. Loss of community & recreation area	o	-/C	-/B
4. Intensification of traffic congestion	-/B	-/C	-/C
5. Aesthetic & landscape loss	o/C	-/B	-/B
6. Prevention of accessibility	o	o	o
C) Problems in construction Stage			
1. Soil erosion & silt runoff	-/C	-/C	-/C
2. Hazards to workers & residents nearby	o	o	-/C
3. Spread of communicable diseases	o	o	o
4. Deterioration of water quality	-/B	-/B	-/B
D) Problems in Operation Stage			
1. Downstream erosion/aggradation	o	o	O
2. Deterioration of water quality	o	o	O
3. Intrusion of saline water	o	o	O
4. Eutrophication	o	o	O
5. Encroachment of precious ecology	-/C	-/C	-/C
6. Depreciation of fisheries	+/A	+/A	+/B
7. Vector disease hazards	o	o	o
8. Aesthetic & landscape loss	-/B	-/C	-/C

Note: (1) / : Upper side is the expected effect, and lower side is its significance

(2) o : No effect expected

\+ : Positive effect expected

\- : Negative effect expected

= : Neutral effect expected, i.e. change is neither beneficial nor harmful.

(3) A : Effect which has relatively high level of significance

B : Effect which has relatively medium level of significance

C : Effect which has relatively low level of significance

Result of IEE for the IWRD Cañete River Basin Projects

Checklist Item	Auco dam	San Jeronimo Dam	Zuniga intake dam	Lima Water conveyance
A) Problems due to the Location				
1. Resettlement/compensation	-/A	-/A	o/C	o/C
2. Land value changes	+/A	+/A	+/A	+/A
3. Encroachment of agricultural lands	-/B	-/B	o/C	o/C
4. Depreciation of forestry	-/B	-/B	o/C	o/C
5. Inundation of mineral resources	o	o	o	o
6. Loss of historical/cultural sites	o	o	o	o
7. Watershed erosion/silt run-off	-/C	-/C	o	o
8. Effects on groundwater hydrology	=	=	o	o
9. Impairment of navigation	o	o	o	o
10. Encroachment of precious ecology	=	=	o	o
11. Upstream migration of fish	-/B	-/B	o	o
B) Problems related to the Design				
1. Loss of roads	-/B	-/B	=	=
2. Water right conflicts	-/C	-/C	o	o
3. Loss of community & recreation area	=	=	o	o
4. Intensification of traffic congestion	-/C	-/C	o	o
5. Aesthetic & landscape loss	o	o	o	o
6. Prevention of accessibility	-/C	-/C	=	-
C) Problems in construction Stage				
1. Soil erosion & silt runoff	-/C	-/C	o	o
2. Hazards to workers & residents nearby	-/C	-/C	-/C	-/C
3. Spread of communicable diseases	o	o	o	o
4. Deterioration of water quality	o	o	o	o
D) Problems in Operation Stage				
1. Downstream erosion/aggradation	-/C	-/C	o	o
2. Deterioration of water quality	o	o	o	o
3. Intrusion of saline water	o	o	o	o
4. Eutrophication	o	o	o	o
5. Encroachment of precious ecology	=	=	=	=
6. Depreciation of fisheries	+/C	+/C	o	o
7. Vector disease hazards	o	o	o	o
8. Aesthetic & landscape loss	o	o	o	o

Note: (1) / : Upper side is the expected effect, and lower side is its significance
(2) o : No effect expected
+ : Positive effect expected
- : Negative effect expected
= : Neutral effect expected, i.e. change is neither beneficial nor harmful.
(3) A : Effect which has relatively high level of significance
B : Effect which has relatively medium level of significance
C : Effect which has relatively low level of significance

Chapter 2 Environmental Monitoring System

2.1 Environmental Parameters

The monitoring system for environmental parameters in the Cañete River Basin will involve the measurement and recording of environmental, social and economic variables associated with IWRD. This system should provide information on the characteristic and functioning of variables in time and space, and in particular on the occurrence and magnitude of environmental impacts, in terms of ecosystem, water quality and public awareness. The proposed will be component of the entire project monitoring system and will improve the overall project management. It will also be used as an early warning system to identify harmful trends in the Cañete River basin before it is too late to take remedial measures. It helps in identifying unanticipated impacts. Monitoring of environmental parameters will also provide an acceptable database, which will be used in mediation between interested parties. As a result, monitoring of the origins, pathways and the final effect on the environment may identify where the responsibility lies. Monitoring of environmental parameters will be one of the most effective guarantees by SEDAPAL of its commitment to environmental quality. It will be comprise of:

1) Continuous Water Quality Monitoring
2) Terrestrial Ecology Monitoring
3) Fishery and Aquatic Biodiversity Monitoring
4) Resettlement and compensation Monitoring
5) Public Outreach and Participation Mechanism

2.1.1 Water Quality Monitoring

Continuous water quality monitoring will be required to establish base line database for heavy metals, nitrates, phosphates and pesticides. Measurements will also be needed for basic parameters, BOD, COD and bacteriological contamination. (details in Sector Report)

2.1.2 Terrestrial Ecology Monitoring

Monitoring will be carried out of the basic inventory of flora and fauna. The monitoring system will also be collecting information on soils, forest cover, grazing, timber cutting and agriculture in the Cañete River basin. Information will also be collected for habitat degradation and hunting in the upper basin.

2.1.3 Fishery and Aquatic Biodiversity Monitoring

The number of species are said to be less in the Cañete River because of toxic mining discharges, introduction of trout, and ‘Huayco’. The monitoring will be carried out to study the validity of this assessment. A monitoring program is recommended that will collect samples for fish and plankton every two months at four places.

2.1.4 Resettlement and Compensation Monitoring

The community acceptance of large dam projects is now being judged by the fairness of the resettlement and compensation procedures. Similarly, in Auco/San Jeronimo dam’s case it will not only be the amount that the affected people will receive but also whether this handled by SEDAPAL in a speedy and acceptable manner to the people linked to the land around the reservoir and the dam site. Perhaps NGO active in the region would be able to act impartially with respect to mediation between SEDAPAL and locals.

2.1.5 Public Outreach and Participation Mechanism

Carefully designed public outreach and community awareness program will be beneficial to advise and reassure the local community. Through credible NGO and locals, grassroots level participation will be encouraged and facilitated.

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SUPPORTING TABLES

Table 1

Principal Lakes & Reservoirs in the Cañete River Basin

No	Name	Province – District		Altitude	Area (km^2)
1	Ticllacoha	Yauyos	Tanta	4,429	27.4
2	Piscocoha	Yauyos	Tanata	4,405	53.7
3	Chaspicocoha	Yauyos	Tanta	4,510	11.4
4	Pariachata	Yauyos	San Juan	4,444	18.4
5	Pilicocha	Yauyos	San Juan	4,390	27.5
6	Paucarcoha	Yauyos	San Juan	4,284	213.6
7	Mollococha	Yauyos	Tanta	4,465	35.1
8	Unca	Yauyos	Tanta	4,307	14.6
9	Caico	Yauyos	Tanta	4,465	8.0
10	Pacchapata	Yauyos	Huancaya	4,465	12.7
11	Pacchapata	Yauyos	Tomas	4,360	19.0
12	Morro de Arrica	Yauyos	Tomas	4,400	1708

Table 2

Principal Population Centers in the Project Area

Names of Towns in Cañete & Yauyos Provinces	Altitude	Area (km^2)	Population
San Vicente de Cañete	38	513.15	38,234
Imperial	85	53.16	34,305
Zuniga	802	198	1,242
Yauyos	2,874	327.17	1,740
Alis	3,233	142.1	2,097
Huancaya	3,554	283.6	442

Table 3

Wild-fowl fauna in the Cañete River Basin

Scientific Name	Common Name
Podicipediae family	
Colymbiformes Podiceps occipitalis	White grebe
Podiceps chilensis	Grebe chilensis
Ardeidae family	
Lencophoyx thula	Small white heron
Casmerodius albus	Great white heron
Nycticorax nycticorax	Night heron
Threskhiornitidae	Ciconiiformes
Plegadis ridgwayi	Glossy ibis
Anatidae family	
Chloephaga melanoptera	Scooter
Lophonetta specularoides	Mountain duck
Anas flavirostirs	Yellow duck
Anas versicolor	Puna duck
Ans georgica	Jerga duck
Oxyura ferruginnea	Frog duck
Rallidae family	
Rallus sanguinolentus	Common rail
Gallimula chlorous	Water hen
Fulica Americana	Andean bald coot
Fulica gigantean	Gigantic coot
Rucurvirostridae family	
Andean recurvirostra	Andean avocet
Himanotopus himanotopus	Stilt
Charadriidae family	
Ptiloscelys resplendens	Golden plover
Phegornis mitchelli	Mountain plover
Charadrius alticola	Puna plover
Furnariidae family	
Cinclodes sp.	Tyrammi
Tyranmidae family	
Phleocryptes melanops	Totonero
Tachuris rubrigastra	Seven colors
Lessonia ruja	Brown kingbird
Cinclidae family (Dippers)	
Cinchus lencocephalus	Water ouzel

Table 4

Fauna & Flora (Macrophytes & Microphytes) in the Lower Andean Zone

1,500 Meters to Sea level

Scientific Name	Common Name
Roripa nasturtium oficialis	Watercress
Typha sp.	Horse hair
Scirpus sp.	Cat tail
Equisetum sp.	Bulrush
Phragmites communis	Ditchweed
Ginerium sp.	Giant reed
Spirogyra sp.	Greenhair
Cladophora sp.	Algae
Oscillatoria sp.	Algae
Closterum sp.	Algae
Cosmarium sp.	Algae
Pediastrum sp.	Algae
Oedogonium sp.	Diatom
Denticula sp.	Diatom
Synedra sp.	Diatom
Nitzchia sp.	Diatom
Navicula sp.	Diatom
Cymbelle sp.	Diatom
Pinnularia sp.	Diatom
Molluscs & Crustaceans	
Planorbis sp.	Snail
Pseudothelphusa sp.	River Crab
Criphiops caementarius	river Prawn
Fish	
Basilichlthys archaeus	River mackerel
Trychomycterus rivultus	Catfish
Mugil cephalus	Mullet
Bryconamericus peruanus	Carachita (carp)
Aequideus rivulatus	Mojarra
Others	
Bufo spinolosus	Toad
Telmatobius jelski	Frog

Table 5

Fauna & Flora (Macrophytes & Microphytes) in the Upper Andean Zone

3,000 – 1,500 Meters

Scientific Name	Common Name
Roripa nasturtium oficialis	Watercress
Hycrocityle umbelata	Sombrerito o patacon
Typha sp.	Cattail
Scirpus sp.	Horsetail
Equisetum sp.	Bulrush
Phragmites communis	Ditchweed
Ginerium sp.	Cane Brava (giant reed)
Spirogyra sp.	Greenhair (green algae)
Pediastrum	Algae
Scenedesmus cnadricanda	Algae
Draparnaldia sp.	Algae
Cladophora sp.	Diatoms
Cosmerum sp.	Diatoms
Closterum sp.	Diatoms
Rhopalodia sp.	Diatoms
Denticula sp.	Diatoms
Synedra sp.	Diatoms
Nitzchia sp.	Diatoms
Navicula sp.	Diatoms
Epilhermia sp.	Diatoms
Pummularia sp.	Diatoms
Cyclotella sp.	Diatoms
Molluscs & Crustaceans	
Planorbis sp.	Snail
Hyalella sp.	Camaroncillo (craylet)
Porcellio sp.	Crab
Fish	
Basilichlthys archaeus	Riversilverside
Orestias sp.	Chalhuita
Trychomycterus rivultus	Catfish
Salmo gainerii irideus	Rainbow trout
Others	
Bufo spinolosus	Toad
Telmatobius jelski	Frog

Table 6

Fauna & Flora (Macrophytes & Microphytes) in the Upper Andean Zone

4,600 – 3,000 Meters

Scientific Name	Common Name
Distichilis sp.	Slat grass
Roripa nasturtium oficialis	Watercress
Typha sp.	Cattail
Scipus sp.	Bulrush
Equisetum sp.	Horsetail
Spirogyra sp.	Green hair (Green algae)
Oedogonium	Algae
Cladophora sp.	Algae
Ulotrix sp.	Algae
Pediastrum sp.	Algae
Closterium	Algae
Sceredesnys sp.	Algae
Navicula sp.	Diatom
Comphonema sp.	Diatom
Cymbella sp.	Diatom
Synedra sp.	Diatom
Nitzschia sp.	Diatom
Epitania sp.	Diatom
Cyclotella sp.	Diatom
Gomphoreis sp.	Diatom
Denticula sp.	Diatom
Rhopalodia sp.	Diatom
Molluscs & Crustacean	
Planorbis sp.	Snail
Littorinidae sp.	Snail
Fish	
Salmo gainerii irideus	Rainbor trout
Orestias	Chalhuitas
Others	
Bufo spinolous	Toad
Telmatobius jelski	Frog

APPENDICES

APPENDIX I

Water Quality Analysis

The Study Team had collected the water samples analyzed below on 24 to 26 August 1999, during a field reconnaissance trip. The months of August and September are considered to be dry season for the river flow. The analysis was carried out by SEDAPAL's laboratory on 2 September 1999. It is to be considered as a quick analysis for providing clues about the magnitude and quality of water, viz-a-viz primarily the mining industry wastewater discharges in the Alis River, which discharges in the Canete River.

	Selected Physiochemical & Meta1s' Analysis				
Place & Date of Sample Taken	PH Units	Conductivity Ohms/cm	Nitrates Mg/L	Copper Mg/L	Lead Mg/L
1) 500 m from Yauricocha mine discharge in Alis River 8/26/99	7.19	711.0	1.191	0.209	0.775
2) Downstream in Alis river near Tinco 8/26/99	8.27	454.0	1.325	0.028	0.044
3) Auco Dam site on the upper basin Canete River 8/24/99	8.36	440.0	1.191	<0.004	0.016
4) Zuniga Dam site on the lower basin Canete River 8/24/99	8.62	426.0	1.265	<0.004	0.017
5) Socsi intake station lower basin Canete River 8/24/99	8.36	431.0	1.697	<0.004	<0.010
6) Morro de Arica dam site middle basin Canete River 8/25/99	8.19	503.0	1.042	<0.004	<0.010
7) Alis River before the discharge from Yauricocha mine 8/26/99	8.62	273.0	0.863	<0.004	<0.010
8) Canete River near Huancaya at Inca period bridge 8/26/99	8.52	433.0	0.759	<0.004	<0.010
E.U. Water Quality Standard for Drinkng & PotableWater	6.5-8.5	-	-	0.01	0.003

The samples 1 and 2 were taken from places close to the discharged wastewater source. The analysis shows a very high level of copper and lead. The E.U. Water Quality Standard for Drinking and Potable for lead is 0.003 mg/L and for copper is 0.01 mg/L. Further downstream, in sample 3, and 4 only lead is present in higher quantity. The presence of high amount of copper and lead is alarming. These sites should be monitored continuously at regular intervals to provide a comprehensive picture of the situation.

It was reported by the people in the town of Tinco near Alis River, that Yauricocha mines periodically flushes large amounts of wastewater during the night. It was also reported downstream in Lunahuana that yes flushes of wastewater from the mine has been a fact in the past.

The nitrates are lower (7,8) in upstream river basins and higher in downstream (5). The higher pH, in all the samples denotes an alkaline medium because of the limestone karst in the basin.

In the Canete River basin metal ore mining and processing is resulting in metal pollution. This is of concern because of the potential toxic effects and the ability of many metals to bioaccumulate and cause public health risks. In solution metal form complexes with hydroxide ions and carbonate ions. Stronger complexes are also formed with chelating agents such as organic matter. Metals also form complexes with particulates such as oxides, clays and particulate organic matter. Toxicity is usually related to the dissolved, uncomplexed forms of metals, rather than to the adsorbed, chelated, or complexed forms which are more common. The concentration of the toxic dissolved, uncomplexed forms are reduced at high pH due to competition of ions with the metals. The table below provides historical water quality data carried out by SEDAPAL.

Water Quality Analysis(5/97)

	Units	4,380 m Mollococa	3,000 m Morro de Arrica	1,500 m Catahusasi	Sea & Boca del Rio
Temerature	°C	10.6	14.1	20.1	25.4
PH		6.6	7.6	7.57	7.13
Conductivity	Us/an	160	580	429	453
Oxygen	Mg/l	3.2	10.5	5.06	6.9
Turbidity	NTU	0.46	0.95	0.47	1.0
SS	Mg/l	82	380	290	349
Hardness	Mg/l	66	258	210	208
Sodium	Mg/l	2.65	9.4	12.5	16.2
Potassium	Mg/l	1.53	2.92	3.04	3.9
Mangnesium	Mg/l	1.55	13.4	11	10.6
Calcium	Mg/l	24.6	83	62.8	64.4
Sulfates	Mg/l	8.2	87.4	71.7	70.6
Chloride	Mg/l	3.0	15	16	22
NH4-N	Mg/l	N.D.	N.D.	N.D.	N.D.
Nitrate	Mg/l	0.06	N.D.	0.25	N.D.
Phosphate	Mg/l	0.01	N.D.	0.03	N.D.
Fe	Mg/l	N.D.	N.D.	0.13	N.D
Manganese	Mg/l	N.D.	N.D.	N.D.	N.D
Zinc	Mg/l	N.D.	N.D.	N.D.	N.D
Copper	Mg/l	N.D.	N.D.	N.D.	N.D
Lead	Mg/l	N.D.	N.D.	N.D.	N.D
Cadmium	Mg/l	N.D.	N.D.	N.D.	N.D
Silver	Mg/l	N.D.	N.D.	N.D.	N.D

N.D.: not detectable by the laboratory instruments

APPENDIX II

Monitoring the River Water Quality and Mining Industry Discharges based on a Continuous System Using the Best Available Technology

Technical Specification

1. General Description of the Project

1.1 Introduction

The Canete River upper basin is rich in mineral resources. The mining areas are located in Yauyos, Miraflores, and Tomas, Vitis, and Yauricocha. The industry primarily mines for heavy metals including copper, lead, zinc, cadmium etc. The mining activity impacts an area of 273 ha of ecologically sensitive area in the Canete River upper basin. The largest mine in the river basin is Yauricocha mine operated by the public sector Centromin, Peru S.A. The Yaurichocha mine is located at above 4,500 meters altitude in the AIls district, Yauyos.

The wastewater effluents of the mine are from the three main areas, (1) Yauricocha wastewater lagoon into the Chumpe ravine. (2) Chumpe ravine into Tinco River, and (3) Huacuypacha River into Tinco River. These effluents outflow into the Alis River and on to the Canete River. The mine uses water from the nearby Yauricocha lagoon, consuming 706, 000 m^3/year of water, producing copper, lead and zinc. The processing facility has an installed capacity of 1,550 tons/day, the daily treated average has been 1,290 tons/day. The quality of water is affected by the above mine's effluents and tailings discharged into the AIls and Canete Rivers. The mine complex's concentrator treats copper (Cu), lead (Pb), and zinc (Zn) ores. In the process of treating metal ores, sodium sulfate, copper sulfate and xanthates are used, all of these compounds and the metals are present in effluents and tailings.

The Jose Manuel mine is located at 4,000 meters altitude, at Chupapunta, close to Huancachi in Tomas district. The Satanas mine is located Pacocha, in Laraos district. They mined for silver, lead, and zinc and to a lesser extent for copper and other metal ores. In addition, there is a mine in Huancaya, when it begins production, it will also have negative effects on the environment in the upper Canete river. Other mine sites exist in Tomas, Huantan, Carania, and Miraflores districts. Small-scale mining is also carried out here and could be a source of water contamination. There is also widespread use of agro-chemicals in the Canete River basin, however, there is no systematic study on the use and effects of agro-chemicals.

1.2 Location of the Project

Six monitoring stations parallel to river flow discharge monitoring stations would be located at Tanta, Agua Calientes, Tomas Siria, Tinco de AIls, Chavin and above Socsi intake station. In addition, monitoring stations would be located at the known critical mining industry discharge areas, now for example at the Chumpe Ravine, Chumpe area Tinco River, Huacuypacha River and Tinco River, Alis River, Chupapunta area, near Tomas River, and Laraos River where it meets Canete River.

2. Objectives

Continuous monitoring (24 hours) of the river water quality, with emphasis on the mining discharges into Canete River, including the largest Yaricoacha mine, district Alis, Jose Manuel mine at Chupapunta, and Satanas mine at Pacocha in district Tomas. In addition, monitoring stations will be built at six sites planned for discharge flow measurement stations listed above. The water quality will be measured for all the basic parameters and for arsenic, cadmium, chromium, copper, iron, lead and zinc. The monitoring system would be cost effective which must utilize the most advanced monitoring system. The monitoring program will be a continuous system in designated places, using the latest available technology.

3. Scope of Work

The Scope of work of the Monitoring Program is described in the Terms of Reference (TOR) which is annexed in this document. All the survey shall be performed in accordance to the Technical Specifications and the TOR.

4. Monitoring Program

The program will comprise of monitoring the entire mining industry's effluents discharged into Canete River and its upper region tributaries, based on a 24-hour system using the latest technology.

The monitoring stations will be designed to carry out: (1) Continuous monitoring of the river water quality at designated in Canete River & tributaries. (2) Detection of fluxes and accidental pollution loads from the mining activity, (3) Compile data concerning the overall water quality in Canete River.

ANNEX 1

Terms of Reference
for
Monitoring the River Water Quality and Mining Industry Discharges based on a Continuous System Using the Latest Technology

1. Introduction

The river water quality analysis presented in table below was carried out by SEDAPAL's laboratory. It provides a quick analysis for clues about the present status of quality of river water quality, and the mining industry wastewater discharges in the Alis River, which discharges in the Canete River.

Place & Date of Sample Taken	Selected Physiochemical & Meta1sAnalysis				
	PH Units	Conductivity Ohms/cm	Nitrates Mg/L	Copper Mg/L	Lead Mg/L
1) 500 m from Yanricocha mine in Alis River 8/26/99	7.19	711.0	1.191	0.209	0.775
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The samples 1 and 2 were taken from places close to the discharged wastewater source. The analysis shows a very high level of copper and lead. Further downstream, in sample 3, and 4 only lead is present in higher quantity. The presence of high amount of copper and lead is considered alarming. These sites would be monitored continuously at regular intervals to provide a comprehensive picture of the situation.

In addition to the above result, it was reported to the study team by the people in the town of Tinco near Alis River, that Yauricocha mines periodically flushes large amounts of wastewater during the night. It was confirmed downstream, to the study tam in Lunahuana that, indeed, flushes of wastewater from the mines have impacted negatively in the past.

The above is of concern because of the potential toxic effects and the ability of many metals to bioaccumulate and cause public health risks. In solution metal form complexes with hydroxide ions and carbonate ions. Stronger complexes are also formed with chelating agents such as organic matter. Metals also form complexes with particulates such as oxides, clays and particulate organic matter. Toxicity is usually related to the dissolved, uncomplexed forms of metals, rather than to the adsorbed, chelated, or complexed forms which are more common. The concentration of the toxic dissolved, uncomplexed forms are reduced at high pH due to competition of ions with the metals.

2. Objectives

Continuous monitoring (24 hours) of the river water quality, with emphasis on the mining discharges into Canete River, including the largest Yaricoacha mine, district Alis, Jose Manuel mine at Chupapunta, and Satanas mine at Pacocha in district Tomas. In addition, monitoring stations will be built at six sites planned for discharge flow measurement stations listed above. The water quality will be measured for all the basic parameters and for arsenic, cadmium, chromium, copper, iron, lead and zinc. The monitoring system would be cost effective which must utilize the most advanced monitoring system. The monitoring program will be a continuous system in designated places, using the latest available technology.

Furthermore, the possibility of adding a measurement capacity for more parameters specific to the site as needed. And the ability to process and communicate the result of analysis in a quick response mode.

3. Scope of Work

In situ preparation of samples based upon the analysis conditions of each measureable parameters.

Required apparatus should include capability for the measurement of:
1) Turbidity
2) Temperature, pH, conductivity, and dissolved oxygen
3) Total heavy metals
4) BOD and nutrients (nitrates, nitrites, phosphates etc.)
5) Pesticides for selected stations downstream.

Refrigerated sampling capability to enable delayed laboratory analysis.
The system should have data acquisition and storage, and automatic processing facility. The latest equipment available in Lima, Peru include OVA3000, Chemtronics (Australia) On-line Voltammetric Analyzer for heavy metals, various models of Seres (France) water analyzers for basic and heavy metal parameters. Sigma (USA) water quality instrumentation., and TOA and Horiba (Japan) water quality analyzers.

4. Time Schedule

To be determined by SEDAPAL

ANNEX 2

Information about Heavy Metal Chemical Characteristics and Guidelines

1. Arsenic

Arsenic can be discharged as arsenic ore into river waters with mining tailings and that used in agricultural insecticides and herbicides. Arsenic chemistry in water is very complex. Arsenic can exist in four different oxidation states depending on whether conditions are oxidizing or reducing. Arsenic binds strongly to particulate matter, and can coprecipitate with iron oxides. In river waters a significant portion of the total arsenic is associated with particulates. Organic is relatively non-toxic to aquatic organisms. The organic forms of arsenic are bioaccumulated in fish and shellfish. USEPA guidelines for arsenic in river water should not exceed 190 ppb in freshwater.

2. Cadmium

Cadmium is usually found in surface water with zinc and lead but ata much lower concentration, it is commonly found in tailings in the mines, which produce lead and zinc. The predominant form of cadmium in the environment is as cadmium ion (Cd^{2+}) It also can form complex molecules with organic matter and particulates to a significant extent. In anoxic sediments, cadmium precipitates as cadmium sulfide. The cadmium ion and some organic and inorganic complexes are toxic to fish. Guidelines for cadmium in river water are 0.5 ppb for soft water and 5 ppb for hard water.

3. Chromium (Hexavalent)

Under oxidizing conditions, as existing in freshwater, chromium exists in the hexavalent (Cr) form. A large amount of chromium is found associated with suspended solids and sediment. In natural waters chromium can bioaccumulate in aquatic organisms. Chromium is highly toxic to aquatic organisms in its hexavalent form. The toxicity of chromium is greater in soft acidic water. USEPA guidelines for chromium range between 5 to 50 ppb for salmonid fish.

4. Copper

Mining discharges are an important source of copper (Cu) in the river environment. Copper types in natural waters commonly include the cupric ion (Cu^{2+}) and copper hydroxide and carbonate complexes. In addition, copper forms strong complexes with dissolved organic matter and particulate matter. These complexes typically control the aqueous copper and/or cupric ion concentration in the river. In bottom sediments, copper can precipitate out as sulfides, hydroxides and carbonates. Concentrations of copper in water are typically around 2 parts per billion, (ppb). E.U. guidelines for salmonid fish range between 1 to 10 ppb of copper. Higher concentrations will occur in polluted rivers. Copper is very toxic to aquatic organisms, however, it has low toxicity for mammals and humans.

5. Iron

Iron (Fe) is found in two, oxidation state in natural systems. Ferrous iron (Fe^{2+}) is the reduced form and ferric (Fe^{3+}) is the oxidized form. The reduced form of the metal which predominates in non-oxygenated (anoxic) waters is relatively soluble while the oxidized form which predominates in non-oxygenated (anoxic) waters is very insoluble. The simplest method for removing reduced iron is to retain water for one or two days in a holding pond, which will allow the reduced forms (ferrous iron) to naturally oxidize to the oxidized forms (ferric iron), precipitate and settle out. A conservative recommended general standard of less than 0.01 mg 1^{-1}.

6. Lead

The major sources of lead in river waters include lead ore mine waste and vehicular pollution deposition and highway runoffs. At pH 6 the lead ion (Pb^{2+}) and hydroxides dominate, and at higher pH carbonates and hydroxides dominate. Lead also commonly forms sulfate and carbonate precipitates. It also forms complexes with organic matter and particulates. There is evidence that lead forms organometallic compounds in the natural systems which get accumulated in fish. Lead toxicity is higher at lower pH levels. Guidelines for lead should not exceed 3.2 ppb for freshwater.

7. Zinc

Zinc (Zn) enters surface waters as a result of mining discharges and other industrial activities. In low alkalinity waters, zinc exists as the zinc ion (Zn^{2+}) and hydroxide complexes. Zinc can precipitate at high pH as zinc hydroxide and cuprecipitate with calcium carbonate. It also readily forms complexes with organic matter or particulate matter. It is toxic to aquatic organisms. EU guidelines for salmonid fisheries range between 8 to 125 ppb.

ANNEX 3

A. Current European Union (E.U.) Water Quality Regulations

A.1.1 EU. RUNNING WATER STANDARDS AND PARAMETERS

	I Excellent Blue	II Good Green	III Fair Yellow	IV Poor Orange	V Bad Red
Oxygen regime:					
DO% epilimnion	90-110	70-90, 110-120	50-70, 120-130	30-50, 130-150	<30, >150
Hypolimnion	90-70	70-50	50-30	30-10	<10
Total	90-70	70-50, 110-120	50-30, 120-130	30-10, 130-150	<10, >150
DO mg/l	>7.00	7.00-6.00	6.00-4.00	4.00-3.00	<3.00
BOD_5 mg/l O_2	<3.00	3.00-5.00	5.00-9.00	9.00-15.0	>15.0
COD-Mn mg/l O_2	<3.00	3.00-10.0	10.0-20.0	20.0-30.0	>30.0
Eutrophication:					
Total P µg/l P	<10(<15)	10-25(15-40)	25-50(40-75)	50-125(75-190)	>125(>190)
Total N µg/l N	<300	300-750	750-1500	1500-2500	>2500
Chlorophyll a µg/l	<2.5(4.0)	2.5-10(4-15)	10-30(15-45)	30-110(45-165)	>110(>165)
Acidification:					
PH	6.5-8.5	6.5-6.3	6.3-6.0	6.0-5.3	<5.3
Alkalinity mg/l $CaCO_3$	>200	>200-100	100-20	20-10	<10
Harmful substances:					
Heavy metal and cyanides:					
Aluminium µg/l (pH<6.5)	n.a.		<5	5-75	>75
µg/l (pH>6.5)	n.a.		<100	100-500	>500
Arsenic µg/l	<10		10-50	50-100	>100
Cadmium[3] µgl	<0.07		0.07-0.7	0.7-1.8	>1.8
Chromium[2] VI µg/l	<1		1-11	11-16	>16
Copper[3] µg/l	<2		2-6.5	6.5-9.2	>9.2
Lead µg/l	<0.1		0.1-1.3	1.3-34	>34
Mercury[2] µg/l	<0.003		0.003-0.012	0.012-2.4	>2.4
Nickel[3] µg/l	<15		15-88	88-790	>790
Zinc[1] µg/l	<45		45-59	59-65	>65
Cyanides µg/l	<0.5		0.5-5.0	5.0-22	>22
Others:					
Dieldrin µg/l	0		<0.0019	0.0019-2.5	>2.5
Chlordane µg/l	0		<0.0043	0.0043-2.4	>2.4
DDT and metabolites µg/l	0		<0.001	0.001-1.1	>1.1
Endrin µg/l	0		<0.0023	0.0023-0.18	>0.18
Heptachlor µg/l	0		<0.0038	0.0038-0.52	>0.5 2
Lindane µg/l	0		<0.08	0.08-2.0	>2.0
Malathion µg/l	0		0	<0.1	>0.1
Parathion µg/l	0		<0.013	0.013-0.065	>0.065
Pentachlorophenol[3]	0		<3.5	3.5-5.5	>5.5
PCBs µg/l	0		<0.001	0.001-2.0	>2.0
Toxaphene µg/l	0		<0.2	0.2-730	>730
Radioactivity[4]					
Microbial pollution					
Median No/100 ml					
Thermo-tolerant coliforms	<10	10-30	30-100	100-1000	>1000
Fecal streptococci	<10	10-30	30-100	100-1000	>1000

(1 Calculated for standard hardness of 50mg CaCO3Il. Adjustment for different levels of hardness, see table below.
(2 Calculated for standard hardness of 50mg CaCO3/l. Adjustment formula for different levels of hardness currently under development.
(3 Calculated for standard pH of 6.51. Adjustment formula for different pH values.
(4 Ranges will be specified according to test results.

APPENDIX III

Terms of Reference
for
Wet Season Surface Water Quality Data Compilation &
Ground Water Quality Evaluation

1. Introduction

The following is the scope of work for the environmental expert for the Study reported in the Inception Report, April 1999:

- Data collection & analysis of nature, ecology & environmental information.
- Analyses of present conditions of water quality, ecology, and environment.
- Conducting Initial Environmental Examination and review of necessity of EIA.
- Preparation of TOR for EIA, discussion with the Counterpart Agency.
- Study on water environmental management plan.
- Evaluation of M/P from environmental aspect
- Procurement of 'Environmental Study' in Feasibility Study stage.
- EIA for the priority projects based on the Environmental Study.

Poor water quality, is becoming a widespread and pervasive problem. The major discharges in surface water primarily comprise of mining industry in the upper Canete River basin, and in the lower Canete River basin untreated domestic wastewater and non point sources from agro-chemicals and urban run-off.

2. Wet Season Surface Water Quality Data Compilation

During the first field works, surface water quality data from the Canete River for the dry season, was collected. The mean monthly discharges averaged 10.81 and 9.36 m^3/s for August and September 1990s, respectively. For a complete and comprehensive water quality assessment, data for wet season will be required. The mean monthly dischages during February and March 1990s have averaged 137.29 and 147.08 m^3/s respectively. As the discharges during the wet season are more than 10 times higher they also carry with them higher pollutant loads especially the run-offs of nitrates and pesticides from the agriculture sector activities.

It will be important to carry out wet season analysis of water quality during February and March. The complete and comprehensive picture for water quality will be obtained when data for both dry and wet season are analyzed.

3. Groundwater Quality Evaluation

The Canete River valley has become very contaminated because of fertilizer and pesticide use. There is now a widespread use of agro-chemicals in the Canete River basin, however, there is no systematic study on the use and effects of agro-chemicals. Reportedly, the incidence of cancer is on increase in the valley. The groundwater table is at 5 meters depth, and many among the 6,500 farmers in the valley use.

Exploitation of underground water for different uses is estimated to be 4.4 MCM/year. There are about 90 wells in the Study area, and the water obtained is used in the following breakdown, population 3,288, agriculture 2,665, livestock 108, and industrial 1,152. In addition, the Canete water supply company (EMAPA Canete) has developed 2.8 MCM/year (1998) for use in the districts of Cerro Azul, San Luis, Imperial and San Vicente. An evaluation of the groundwater quality will be carried out during 2000.

APPENDIX IV

Scope of Work for Environmental Survey

The following is the scope of work for the environmental survey to be carried out during February to June 2000:

Scope of Work

The survey to be carried out by the contractor will cover the following individual areas:

(1) Wet Season Surface Water Quality Data Collection
(2) Groundwater Quality Evaluation
(3) Ecological Conditions
(4) Fisheries
(5) People Affected

The survey will undertake data collection and provide analysis for the above categories of the present status and historical information where available.

(1) Wet Season Surface Water Quality Data Collection

During the first field works, surface water quality data from the Canete River for the dry season, was collected (see Attachment). The mean monthly discharges averaged 10.81 and 9.36 m^3/s for August and September 1990s, respectively. For a complete and comprehensive water quality assessment, data for wet season will be required. The mean monthly dischages during February and March 1990s have averaged 137.29 and 147.08 m^3/s respectively. As the discharges during the wet season are more than 10 times higher they also carry with them higher pollutant loads especially the run-offs of nitrates and pesticides from the agriculture sector activities.

i) Collect 1 liter water samples from Upper, Middle and Lower reaches of the Canete River. The attachment lists the places where the samples were taken during August and September. Same places should be included in addition to sites that may have special relevance during the wet season.

ii) A complete water quality analysis should be obtained by combining data for both dry and wet season.

(2) Ground water Quality Evaluation

The Canete River valley has become very contaminated because of fertilizer and pesticide use. There is now a widespread use of agro-chemicals in the Canete River basin, however, there is no systematic study on the use and effects of agro-chemicals. Reportedly, the incidence of cancer is on increase in the valley. The groundwater table is at 5 meters depth, and many among the 6,500 farmers in the valley use this as their sole source of water.

Exploitation of underground water for different uses is estimated to be 4.4 MCM/year. There are about 90 wells in the Study area, and the water obtained is used in the following breakdown, population 3,288, agriculture 2,665, livestock 108, and industrial 1,152. In addition, the Canete water supply company (EMAPA Canete) has developed 2.8 MCMIyear (1998) for use in the districts of Cerro Azul, San Luis, Imperial and San Vicente. An evaluation of the groundwater quality will be carried out during Febrary and March 2000.

i) Carry out an evaluation of groundwater conditions in the upper and middle Canete River basin area including important tributaries i.e. Alis and Tomas.
ii) Review and evaluate the existing groundwater information available with area's water supply companies.
iii) Collect samples of the important identified groundwater sources for water quality analysis.

(3) Ecological Conditions

i) A base level data inventory will be carried out for the entire flora and fauna and siltation, and all ecological parameters.
ii) Deforestation, primarily due to the conversion of forest to agricultural lands,
iii) Information will be collected downstream flow variations.
iv) Information on soil erosion, severe soil erosion (huayco) soil contamination, salt pollution, soil contamination,
v) Information on change in sediment composition, water contamination and eutrophication.
vi) Detrimental changes in water temperature.

(4) Fisheries

i) Collect data for fish and the aquatic ecosystems. The data will be used to inventory fish distribution and abundance. The Survey will be organized to inventory fish, macro-invertebrates and all the Canete river biodiversity.
ii) Conduct an investigation into the causes of lack of fish species in the Canete River. The initial assessment should consider the effects on fish due to 1. Huayco, 2. Toxic contamination of river waters, and 3. Rainbow Trout as a predatory and dominant species.
iii) The Survey will report on the direct alteration of flow regimes, such as, diversion of water for consumption purposes, and other transfer of water. In addition, direct changes to physical and chemical characteristics of the water such as discharge of effluents, or change of water temperature due to various activities.

(5) People Affected

i) Inventory potential resettlement and changes in life style before, during and after the project.
ii) Collect information about local residents and issues of income disparity

iii) Collect information on impact of agriculture, fishery and forestry including social forestry.
iv) Collect information on secondary industry including mining activities, and tertiary industry including tourism.
v) Collect information on water rights, fishing rights, and rights relating to common use of trees.
vi) Collect information on occurrence and diffusion of water borne diseases, effects of use of rampant agricultural chemicals and its accumulation.
vii) Collect information on production of garbage, waste, and discharges, and sanitary conditions.

Appendix V

World Bank Projects in Water Supply & Sanitation

1. Peru-Lima Water Sector Restructuring and Rehabilitation Project

Sector Water Supply

Implementing Agency SEDAPAL

July 1994

1. Introduction. The Bank is considering a US$150 million equivalent loan to the Government of Peru to help finance a water sector restructuring and rehabilitation project. The project would be implemented by Lima's water supply and sanitation agency, which would also provide about US$50 million equivalent in counterpart funds. The contents of this PID are subject to change, and the components described may not necessarily be included in the final project.
2. Background. Less than 60% of the people in Peru live in dwellings connected to safe public water supply systems and only about 45% have access to safe sanitation. The quality of the services received by the population has deteriorated steadily during the last two decades, particularly during the second part of the 80s. Water service is provided on an intermittent basis even in major urban centers. In Lima, water pressures in 70% of the districts are below the minimum recommended pressure. In urban centers other than the three major cities, about 30% of the population has water service less that 10 hours a day and only about 20% has service more than 20 hours a day. The quality of water delivered continues to deteriorate, particularly in small and medium size cities for lack of chemicals and control laboratories. Facilities have suffered a serious deterioration due to lack of appropriate maintenance and investment. Service coverage, reliability and quality levels are having an adverse effect not only on population health but also on the overall economy as well. Morbidity of water borne diseases increased 2.2 times from 1980 to 1985. Unreliable services have forces many industries and households to build storage reserve and pumping facilities at great economic cost as the scale economies of these services are not captured. And to compound the problem, the ongoing cholera epidemic has increased considerably the demands on both water and sanitation systems. For instance, the raw water arriving at La Atarjea—the water treatment plant for about 75% of Lima's supply, is currently contaminated with cholera.
3. The regionalization process initiated in 1989 has radically transformed the sector institutional organization, shifting responsibilities from the central

government to the regional and local level. The Servicio Nacional de Agua Potable y Alcantarillado (SENAPA) had transferred its subsidiary companies and operational units to the municipalities, with the exception of the Servicio de Agua Potable Alcantarillado de Lima (SEDAPAL) and the water company of Trujillo.

However, the implementation of the new legislation is not yet complete and has created plenty of confusion. The transfer of some water and sanitation systems has been done in haste without due concern for maintaining continuity in all phases of operations, including commercial and financial systems. While some municipalities have conserved and strengthened the systems' original organization, others have limited themselves to accepting the systems without taking any initiative to create independent and autonomous entities. The Water and Sewerage Rate Regulatory Commission (CORTAPA) has practically ceased to operate.

Under a reorganization process that started in December 1991, the Ministry of Housing and Construction (MHC) is now being eliminated and most of its functions—including its responsibility for the water and sanitation sector, transferred to the Ministry of Transport and Communications. A new Ministry of the Presidency will be responsible for SEDAPAL. The urgency of restructuring and rehabilitating the sector is clear. The reformulation of sector organization and objectives should place primary emphasis on improved efficiency, through the use of commercial practices in all entities, regulatory arrangements which foster competition among service providers, and increased private sector participation.

4. Project Objectives. The main objectives of the proposed project are: (i) to reduce the government role in the Peruvian water sector to regulatory and strategic planning functions, eliminating its current complete control of SEDAPAL's management; (ii) to induce a large scale privatization of Lima's water and sanitation services; and (iii) to improve Lima's environmental and health conditions, through the rehabilitation and/or expansion of water supply and sewerage services. To achieve these objectives a three-phased approach has been formulated. The first phase, to be funded with the proceeds of a Japanese Grant and the Structural Adjustment Loan (SAL), will: (i) set in place a new legal and regulatory framework for the sector; (ii) change SEDAPAL's statutes to guarantee its management and operational autonomy; and (iii) approve a new national tariff law for the sector based on the principles of economic efficiency, financial self-sufficiency, and distributional equity. The second phase, to be financed with the Bank Loan, will: (i) support the reforms introduced in phase one; (ii) create a Lima Water Authority with the participation of the municipalities and the regional government; (iii) reorganize SEDAPAL into 5 self-accounting units operated on commercial principles; (iv) grant management and service

contracts for specific functions; (v) complete the preparatory work for large scale involvement of the private sector; and (vi) initiate the rehabilitation and/or expansion of water supply and sewerage services. In the third phase, a full reliance on market mechanisms, including private sector participation, will be orchestrated and put in place.

5. Project Description. The proposed project has been designed as follows: during an initial phase of 12 to 18 months—to be launched as soon as the Japanese Grant or the SAL become effective, the Bank loan should be prepared and approved. During the second phase, with a duration of about 3 to 5 years depending on the speed towards full scale private sector involvement, the project should be completely implemented. The project would consist of: (i) an institutional component to finance actions and studies focusing on completing sector reforms initiated in phase one; (ii) a rehabilitation component which would help finance the critically damaged infrastructure and remove some carefully selected major bottlenecks; (iii) a cholera prevention component which would help finance urgently needed infrastructure for safe disposal of sewage into the ocean; and, (iv) actions and investments to improve service quality and coverage in the large slums areas of the city of Lima. The institutional component would provide resources for: (i) studies and actions to complete sector restructuring; (ii) training and technical assistance for the Lima Water Authority; (iii) preparation for bidding the management contracts; and (iv) preparation of bid documents for a large scale private sector involvement.

6. Project Implementation. The borrower will be the Government of Peru. The executing agency will be Lima's Water Supply and Sanitation Agency, after approval by the Government of SEDAPAL's statutory reform, in terms satisfactory to the Bank. Selection criteria for subprojects would include use of least-cost solutions, carefully selected per-capita investment ceilings, and long-run average incremental costs (LRAIC). The Project's execution period would be 1993-1997.

7. Benefits. The project's rehabilitation and/or expansion of water supply and sewerage systems would directly benefit Lima's population. The project's institutional component would assist sector authorities and agencies to update and strengthen their policies and operational systems, which in turn will permit the urgently needed extension and efficient operation of water systems on a commercial and financially sustainable basis.

2. Peru-Lima Wastewater Management and Coastal Pollution Control Project

Sector Water Supply & Sanitation

Executing Agency PROMAR

November 1997

1. Background. Water pollution is a major problem in the Lima Metropolitan Area, and in view of the rapid urbanization which still takes place the problem will grow in magnitude in the future. An inadequate water supply, sanitation and solid waste system in the Lima Metropolitan Area, and industrial, mining and domestic discharges in major rivers and waterways feeding Lima's water system are the main causes of water pollution. Raw sewage is currently discharged into the ocean at a rate of 17-18 m^3 per second. The remaining wastewater is used for irrigation of food crops, mainly vegetables, and parks. Hence, water pollution generates an array of problems relating to health, productivity and environment quality.

2. Institutional Arrangements and Sectoral Reform. The legal framework for water pollution control management presently consists of the Environmental Code. The prevailing Water Law (Ley General de Agua) will shortly be replaced by the Water Resources Management Law (Ley Organica de Agua) that is currently before Congress. This new law aims to improve the efficiency in the use of water resources through the creation of water markets and establishing private water-use rights. Yet, the new water law refers to the Environmental Code and Environmental Authority to set and enforce water quality standards. Although this legal framework lays some foundation for the future development of the sector, these laws need to be further complemented to mitigate water pollution.

3. The Government uses a sectoral approach to wastewater management and coastal pollution control. However, this approach seems to be a major cause for the fragmentation of institutional responsibilities in the sector. Currently, the Ministries of Health, Agriculture, Industry, Mining and Energy all have responsibilities for policy formulation and enforcement in water pollution control, yet there is little coordination among these ministries. The fragmentation of environmental functions has resulted in an overlap of responsibilities, and lack of transparency. Moreover, public support for and participation in wastewater management and coastal pollution control is still very limited, but will be needed to support the successful implementation and enforcement of policies and projects.

4. Implementation of measures to mitigate the impact of inadequate wastewater management and coastal pollution control has serious financial repercussions as capital investments will be large. Currently, most water pollution control instruments have a regulatory character. The Government

can also use economic instruments. These instruments have the advantage that they reduce the fiscal burden of the proposed measures, because they accept the ‘polluter-pay’ principle as a starting point.

5. Project objectives. The main objective of the project is to restore and protect the environmentally deteriorated coast of Lima, and to improve the quality of the rivers that feed Metropolitan Lima (Rímac, Lurín, and Chillón). Specifically, the project aims to: (i) finance environmental infrastructure for the interception, treatment, and disposal of sewage to reduce water pollution along the coast of Lima Metropolitan area—the 40 km wide zone between the rivers Chillón and Lurín—to acceptable limits for human use, and to optimize water reuse; (ii) retrieve the coastal zone of the Miraflores Bay and the embankments of the rivers Chillón, Lurín, and Rímac for recreation and transportation purposes; (iii) develop a legal and regulatory framework to control coastal pollution in Lima Metropolitan; and (iv) strengthen Peru’s—country wide—institutional capacity to enforce water quality and pollution control regulations.

6. Project description. The proposed project consists of three major components:

   Part I: Infrastructure for wastewater management in the Lima Metropolitan Area, including: (US$230 million)

   - construction of about 20 km of large interceptors to transport sewage to treatment and final disposal facilities
   - two primary treatment plants for the elimination of solids and floating materials
   - several small secondary treatment plants for the treatment of domestic sewage, for disposal in the metropolitan rivers (Chillón, Lurín, and Rímac) and reuse
   - two ocean outfalls for final wastewater disposal in the ocean

   Part II: Infrastructure for coastal management and river channel recovery, including: (US$50 million)

   - clean-up and protection of beaches and cliffs in the coastal zone of the Lima Metropolitan Area
   - restoration of river channels and embankment protection of the Chillón, Lurín, and Rímac rivers
   - construction of about 10 km long coastal road between the district of San Miguel and La Punta (Callao)
     recreation facilities and linear parks along the coastal zone and river embankments

Part III: Develop the regulatory and institutional framework for pollution control in the coast of Lima, and to improve environmental management of the coastal zone and urban channel sections of the rivers Chillón, Lurín, and Rímac, including: (US$20 million)

- development of a regulatory and legal framework for pollution control in the Lima Metropolitan Area;
- development and enforcement of a water quality monitoring system in the Lima Metropolitan Area
- supporting the creation of a management entity for the coastal zone of Lima
- strengthening the management capacity of municipalities to operate and maintain linear parks, river channels and embankments
- community mobilization and civil society involvement programs to support environmental management in Lima Metropolitan
- training and human resource development
- project management

7. Project Financing. The project is tentatively scheduled to be confinanced jointly by the Bank (33%), OECF (33%) and the Government of Peru (33%). The overall preparation of the project has been supported by a Japanese PHRD grant of US$ 2.5 million.

8. Project implementation. The borrower would be the Government of Peru, and the executing agency would be the Ministry of the Presidency. The project will be prepared by a project management unit, Proyecto de Manejo de Aguas residuales de Lima (PROMAR) within the Ministry of the Presidency. The investments under Part I of the proposed project are the responsibility of SEDAPAL, and the private operator after the privatization of SEDAPAL. Part II will be carried out by the municipalities of Lima and Callao. Project management of the overall project will be under PROMAR, including implementation of Part III of the project.

9. Project sustainability. The 1994 Ley General de los Servicios de Saneamiento requires cost recovery for investments in the water and sanitation sector. Hence, treatment and final disposal of sewage will have to be fully recovered through tariffs. These tariffs should internalize externalities. During project preparation, the feasibility of recovering the costs of large infrastructural investments through tariffs, user fees and charges will be analyzed. Moreover, the creation of a institutional and regulatory framework for managing the coastal zone in the Miraflores Bay and the urban sections of river channels, and the subsequent development of a water quality monitoring system for the Lima Metropolitan Area will help to ensure the long-term sustainability of the project.

10. Lessons from Past Operations in the Sector. There has been no previous IBRD project in Peru that has directly focused on waste water management and coastal pollution control. The Lima Water Rehabilitation and Management Project included a large water demand management component, aiming at reducing the consumption of water and hence the production of wastewater. Experience in other countries indicate the importance of widespread participation in the preparation and implementation of these type of projects, full government commitment, and a suitable institutional and regulatory framework. These lessons will be fully incorporated in the project design.

11. Poverty Category. Not applicable.

12. Environmental aspects. The project has been classified as Environmental Category A. Therefore, a full environmental assessment (EA) will be prepared before appraisal. Although the project is directed towards improving deteriorated environmental conditions in the Lima metropolitan area, key environmental issues remain to be resolved: (i)water quality and ecological impacts in wastewater discharge areas in both river and marine water bodies; (ii) social and economic impacts (including needs to resettle population) on or along major infrastructure site; (iii) human health impacts of wastewater reuse; (iv) groundwater pollution and depletion; (iv) and cumulative impacts from inadequate solid waste disposal along beaches and aquatic ecosystems and industrial pollution. Feasibility studies will analyze alternatives on their technical economical and environmental merits. Public and community consultation will take place during EA preparation.

13. Program Objective Categories. The project’s principal contribution is toward environmentally sustainable development. It would also address the program objective of economic management through strengthening the public sector’s capacity to manage its water resources more efficiently.