SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

AND

SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

FOR

ANHUI ENVIRONMENTAL IMPROVEMENT PROJECT

IN

PEOPLE'S REPUBLIC OF CHINA

June 1996

CURRENCY EQUIVALENTS

(as of 31 May 1996)

Currency Unit	–	Yuan (Y)
Y1.00	=	$0.1198
$1.00	=	Y8.3463

The exchange rate of the Yuan is determined in relation to a weighted basket of currencies of the trading partners of the People's Republic of China (PRC). In this Report, a rate of $1.00 = Y8.30, the rate prevailing during Fact-finding, has been used.

ABBREVIATIONS

AEPB	-	Anhui Environmental Protection Bureau
AVP	-	Anhui Vinylon Plant
^{o}C	-	Degrees Celsius
COD	-	Chemical Oxygen Demand
CWC	-	Chaohu Water Company
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
HCFP	-	Hefei Chemical Fertilizer Plant
HCW	-	Hefei Chemical Works
HISC	-	Hefei Iron and Steel Corporation
HWC	-	Hefei Water Company
IEE	-	Initial Environmental Examination
NO_X	-	Nitrogen Oxides
PRC	-	People's Republic of China
PVC	-	Polyvinyl Chloride
SO_2	-	Sulphur Dioxide
TSP	-	Total Suspended Particulates

WEIGHTS AND MEASURES

dBA	-	decibels acoustic
ha	-	hectare
km	-	kilometer
km^2	-	square kilometer
l	-	liter
m	-	meter
m^3	-	cubic meter
m^3/day	-	cubic meter per day
m^3/hr	-	cubic meter per hour
m^3/sec	-	cubic meter per second
mg	-	milligrams
mg/l	-	milligram per liter
mg/m^3	-	milligram per cubic meter
mg/sec	-	milligram per second
mm	-	millimeter
pH	-	acidity measure
sec	-	second

NOTES

(i) The fiscal year of the Government coincides with the calendar year.

(ii) In this report, "$" refers to US dollars.

CONTENTS

I. INTRODUCTION

1. Chao Lake, the fifth largest lake in the People's Republic of China (PRC), is the main source of raw water for the industries and cities in the watershed. The lake also supports traditional fishing, agriculture, and tourism activities. The availability of rich mineral deposits, sufficient energy resources, skilled manpower, and access to international ports through the Yangtze River has transformed Hefei, the capital of Anhui Province, and the other cities surrounding the lake into major centers for heavy industries manufacturing iron and steel, chemicals, machineries, plastics, and textiles. Because of the discharge of untreated domestic and partially treated industrial wastewater into the drains, streams, and rivers flowing into the lake, the lake water quality has become unsuitable as a drinking water source although it continues to provide part of the public water supply system in Hefei and other cities. Through Canadian International Development Agency (CIDA) assistance, Anhui Environmental Protection Bureau (AEPB) completed the Chao Lake Watershed Management study in December 1995, which estimated that investments of at least $963 million over a 15-year period are required to upgrade the lake water quality. The Australian Government has provided loan assistance for the construction of a 150,000 m^3/day centralized domestic wastewater treatment plant for Hefei City. The Asian Development Bank (ADB) provided a technical assistance in 1994 to identify projects in the watershed to reduce the pollution load in consonance with the action plan promulgated by the Anhui Provincial Government and the AEPB for the 1996-2000 period.

2. While ADB's intervention in Chao Lake is classified as an environment improvement Project, the replacement of polluting and energy inefficient processes will require the disposal of materials and equipment contaminated with toxic and hazardous substances, and replacement processes could pollute the environment if the appropriate mitigating measures are not implemented. For this reason, the ADB has classified the four industrial subprojects under environment category A requiring that a full environmental impact assessment (EIA) be completed, and the two domestic wastewater treatment subprojects under environment category B which requires that an initial environmental examination (IEE) be completed. This document summarizes the EIA report of the four category A subprojects (the Anhui Vinylon Plant, Hefei Chemical Works, Hefei Iron and Steel Works, and Hefei Chemical Fertilizer Factory) and the IEE of the two category B subprojects (the Hefei Wastewater Project and the Chaohu City Wastewater Project). The complete EIA and IEE reports are available on request from the Anhui Project office. This document and the EIA and IEE reports were prepared by the subprojects and have not been evaluated or assessed by ADB. The subprojects have submitted the EIA and IEE reports to the PRC's National Environmental Protection Agency (NEPA) for evaluation, and approval is expected in July 1996.

3. All the subprojects will be required to submit to ADB an annual monitoring and compliance report confirming adherence to the environmental and safety rules and regulations in the PRC acceptable to ADB. If the subprojects are cited for violations of the environmental and safety standards within the reporting period, the subprojects are required to submit certification that the defects have been corrected or an acceptable corrective plan has been approved by the authorities. The pilot subprojects were selected based on the wastewater flow rate, type of pollutant, and social importance to the community. The locations of the Project area and the subprojects are shown in Appendixes 1 and 2.

II. ANHUI VINYLON PLANT SUBPROJECT

A. Subproject Description

4. Of the 18 major polluting industrial enterprises in the Chao Lake basin, the Anhui Vinylon Plant (AVP) plant is the third largest wastewater generator. The factory discharges into the lake 11.4 million cubic meters (m^3) of wastewater per year, containing 1,325 tons of suspended solids, 1,366 tons of organic matter, and 0.127 tons of cyanide. The factory generates 52,000 tons of alkaline calcium hydroxide wastes and 15,000 tons of soft standard lime powder from the production of acetylene from calcium carbide, the main intermediate material for the production of vinyl monomer and polyvinyl acetate. The power plant also generates 50,000 tons per year of fly ash. The main raw material used is coal, which is used to fuel the power plant and for manufacturing coke for the calcium carbide plant. The coking operation is the major source of cyanide, ammonia, phenols, and organic impurities, which ultimately end up in the wastewater system. The esterification process also contributes alcohol, acetic acid, and suspended solids to the wastewater. Acetylene production from carbide is the major source of the alkaline solid wastes.

5. The existing wastewater treatment plant is undersized and has difficulty in meeting the PRC effluent standard. The lime stock pile and the fly ash from the power plant causes contaminated storm run off to enter the lake. Within the existing factory site, the subproject will reduce the water pollution discharge by (i) converting the fly ash cooling system from wet quenching to a dry process, (ii) recovering and recirculating of the flue gas scrubbing water, (iii) segregating of the rain water from the process water by laying parallel drainage pipes, and (iv) expanding the capacity and upgrading the wastewater treatment efficiency of the existing biological wastewater treatment plant. The effluent standard in the PRC is shown in Table 1.

6. The subproject will construct a 730,000-ton per year cement plant utilizing all the solid wastes generated in the vinylon factory and upgrade the wastewater treatment facilities to meet the PRC effluent standards for industries discharging into Class-III water bodies. The cement manufacturing process consists of grinding limestone with the soft standard lime and calcium hydroxide wastes, clay, and fly ash with silica or sand. The raw materials are blended in the proper proportion and fed into the kiln to produce clinker. The clinker is ground into cement with gypsum being added to control the hardening rate, prior to bagging. The vinylon “waste materials” are thereby converted into valuable input to the cement making process. The cement plant will be built on a 25-hectare (ha) site in the existing quarry used by the factory to provide raw materials for the existing carbide production and by three other cement plants. The proposed cement plant site is 5 kilometers (km) from the existing factory site. The calcium hydroxide and fly ash solid waste from AVP will be shipped to the new cement plant by rail.

B. Description of the Environment

7. The proposed cement factory site is in an unpopulated area between the Dongfeng Cement Plant and the Chaohu Cement Plant. The proposed plant site is located in the existing AVP limestone quarry site. The site is connected to the Chaohu Highway by dirt road and a standard gauge railway line. The railway line is used to haul and transport the quarried lime, cement, and rocks to Chaohu City and the factories. The railway is also used to haul the coal to the cement plants. The dirt road is used mainly by the workers. The location of the proposed subproject site is shown in Appendix 3.

Table 1: Maximum Allowable Discharge Concentrations of Pollutants (mg/l except for pH)

	Pollutants	Class I Standard		Class-II Standard		Class III Standard
		New or Expanded Plant	Existing Plant	New or Expanded Plant	Existing Plant	
1.	Acidity (or pH)	6-9	6-9	6-9	6-9	6-9
2.	Colorimetry	50	80	80	100	-
3.	Suspended Solids	70	100	200	250	400
4.	BOD^{A}	30	60	60	80	300
5.	$COD_{cr}{}^{b}$	100	150	150	200	500
6.	Petroleum	10	15	10	20	30
7.	Animal/plant oils	20	30	20	40	100
8.	Volatile phenol	0.5	1	0.5	0.5	1
9.	Cyanides	0.5	0.5	0.5	0.5	1
10.	Sulfides	1	1	1	2	2
11.	Ammonia Nitrogen (or N)	15	25	25	40	-
12.	Fluorides	10	15	10	15	-
13.	Phosphorous	0.5	1	1	2	-
14.	Formaldehyde	1	2	2	3	-
15.	Anilines	1	2	2	3	-
16.	Nitrobenzene	2	3	3	5	5
17.	Cationic synthetic detergent	5	10	10	15	20
18.	Copper	0.5	0.5	1	1	2
19.	Zinc	2	2	4	5	5
20.	Manganese	2	5	2	5	5

Source: National Environmental Protection Agency

[a] BOD^{5} - Biochemical Oxygen Demand (5 day method)
[b] $COD_{cr}{}^{b}$ - Chemical Oxygen Demand (chromium method)

8. The climate in the Chao Lake basin is typically subtropical with humid monsoon rains in the summer. The average annual temperature is 15°C. August is the hottest month, with an average temperature of 28 °C, and February is the coolest month, with an average temperature of 2.6 °C. The average annual precipitation ranges from 1,000 to 1,150 millimeters (mm)/year. Most of the precipitation takes place during spring and summer. The average wind speed is 2.4 meters (m)/second (sec), primarily in the east-northeast direction and secondarily in the northeast direction.

9. The average water level of Chao Lake is 8.3 m above mean sea level. The lake has an area of 760 square kilometers (km^2) and contains 1.9 billion m^3 of water. The average depth of the lake is 2.5 m. In the upper reaches of the lake, the pH ranges from 7.5 to 7.7, suspended solids (SS) from 41 to 203 milligrams (mg)/liter (l), organic pollutant expressed as chemical oxygen demand (COD) from 1.0 to 2.5, total nitrogen from 3.77 mg/l to 8.4, and phosphorus from 0.03 to 0.23 mg/l. In the lower reaches of the lake, the pH ranges from 8.2 to 8.4, suspended solids from 49 to 273 mg/l, COD from 1.5 to 4.5 mg/l, total nitrogen from 3.8 to 4.6 mg/l, and phosphorus from 0.1 to 0.38 mg/l. The allowable nitrogen concentration for Class-III water (suitable for municipal use) is 1.0 mg/l and for phosphorus it is 0.05 mg/l. The nitrogen

and phosphorus concentrations exceed these levels and have more than tripled in the past 10 years. Surface runoff from low quality water-soluble fertilizer used on farms and untreated sewage is the major source of nitrogen and phosphorus pollutant. The increase in the water pH is from the reduction in the carbon dioxide concentration in the lake from algal photosynthesis and discharge of alkaline wastes such as the lime from AVP. The organic wastes are mostly from the households, factories and other industries in the area.

10. The original water level of Chao Lake was influenced by the annual flooding of the Yangtze River. In 1962, a sluice gate was constructed to control the inflow from the Yangtze River and prevent flooding of the settlements along the lake shore. The lake is eutrophic. Taxonomic studies shows 65 genera and 72 species of phytoplankton dominated by blue algaes, 28 families, 42 genera, and 94 species of fish. Of the 94 fish species, 20 species are of commercial importance to the area. The main fish specie of commercial importance are anchovy, mackerel, carp, grass carp, black carp, silver carp, and variegated carp. There are no protected or endangered plant or animal species in the lake.

11. The air quality was measured at 11 sampling stations at distances of 220 to 2000 from the proposed cement plant site. The 24-hour average value for sulfur dioxide (SO_2) ranges from 0.015 to 0.019 mg/m^3, the nitrogen oxides (NO_x) from 0.01 to less than 0.1 mg/m^3, and total suspended particulate (TSP) from 0.1 to 0.54 mg/m^3. The air quality standard in urban centers for a 24-hour average is 0.30 mg/m^3 for TSP, 0.10 mg/m^3 for NO_x and 0.15 mg/m^3 for SO_2. All the air quality monitoring values in this SEIA are based on 24-hour average time. The TSP levels were exceeded 40 percent of the time at the commercial and residential areas east and west of Chaohu City, 80 percent of the time at Tambu Village, and 60 percent within the AVP factory site and at the forestry center at Juzheng. The TSP levels at the quarry site and the two existing cement factories are within the standard. The ambient air quality at all monitoring points meets the national SO_2 and NO_x standards.

12. The original forest cover in Lake Chao watershed was destroyed centuries ago. The existing forest cover in the watershed consists of secondary growth forest, generated as part of the Government's on-going reforestation program. The main tree species are Japanese black pine, China fir, mason pine, elm, bead tree, and Chinese scholar tree. The main bird species in the reforested areas are sparrows, turtledove, and crested myna. No protected animal or plant species are found in the secondary forest or reforested areas.

13. The proposed subproject site is bare from the quarrying activities. Rice and vegetables are cultivated by the quarry workers in areas unaffected by the quarrying activities. The five temporary houses are used by the quarry operators. There are no families living within the proposed subproject site.

C. Anticipated Environmental Impacts and Mitigating Measures

14. The main environmental impact during construction is dust and noise. Some workers will live within the construction site. Sanitation and water supply will be provided to the construction workers' temporary quarters. The water supply system will use a ground water aquifer close to the lake. Dust will be minimized by wetting critical areas, such as piles of excavated soil and roads. Noise is not critical because the nearest residential area is almost 2 km from the subproject site. Equipment fabricated and manufactured off site will be delivered using the railway system. The subproject will have minimal impact on the existing road traffic.

15. The cement crushing plant, grinding rooms, bag house, and storage areas will be enclosed and the exhaust air will be treated in a cyclone scrubber to remove the dust. The flue gas from the kiln will pass through an electrostatic precipitator to remove the particulate matter. Coal will be purchased from collieries within the province. The coal stock pile will be provided with a water sprinkler system to control the dust and minimize potential fire hazards. Excess water from the coal pile will be treated in a facultative pond and used for dust control in the surrounding areas.

16. During operation of the facilities, the main SO_2 sources are the boiler and the kiln where 853 mg/sec and 797 mg/sec will be emitted. The NO_x emission at the kiln is estimated at 30,200 mg/sec. The subproject includes a 100-m high stack to disperse the emissions from the kiln and a 35-m high stack for the boiler emissions. As the SO_2 and NO_x are acid anhydrides and the conditions inside the kiln are highly alkaline, a large portion of the emission will be retained with the clinker. The emissions are based on the worst expected case, wherein NO_x and SO_2 formed during combustion will be released into the atmosphere. The TSP emission from the kiln is estimated at 20,000 mg/sec. The flue gas emission rate from the kiln is estimated at 100 m^3/sec. A Gaussian plume dispersion model was used to predict the dispersion of the pollutant. The maximum ground level impact of the subproject's emission is 2.1 km downwind from the plant site, where the subproject will cause an increase of 0.00046 mg/m^3 of SO_2, 0.13 mg/m^2 of TSP, and 0.017 mg/m^3 of NO_x concentration. The NO_x and SO_2 are projected to remain within the PRC ambient air quality standard. The additional 0.13 mg/m^3 of TSP near the subproject site will increase the total TSP level to 0.23 mg/m^3, still within the permissible range. Areas with existing TSP levels near or above the critical levels are far from the subproject site and will not be affected.

17. AVP will test disposal of the sludge from the wastewater treatment plant in the cement kiln. AVP is also studying the possibility of dewatering the lime sludge and accepting lime sludge from other industries in the area for treatment in the cement kiln. The impact of expanding and upgrading the existing wastewater treatment plant at AVP will reduce the effluent discharge, as the treated water will be recycled in the cooling water system. The wastewater treatment plant effluent will meet the PRC effluent standard for discharge into a Class-III water body as shown in Table 1.

18. The wastewater generated from surface runoff in the coal and raw material stock pile is estimated at 6,000 m^3/day; domestic sewage from office and personnel housing is estimated at 220 m^3/day; and industrial wastewater from bearing cooking and boiler bleed off is estimated at 350 m^3/day. The raw materials inventory on site is minimal as the mines are within the immediate vicinity of the subproject. The peripheral drains will be built around the raw material stock pile area to collect the surface runoff. The collected runoff will be pumped to an abandoned quarry pit and used during the dry season to water the greenbelt. Domestic sewage will be pretreated in a septic tank. The septic tank effluent will be combined with the surface runoff. The main impurities in the industrial wastewater, oil, grease, and suspended solids, will be flocculated and removed by sedimentation and sand filtration. The filtrate will be recycled to the cooling water system. Substandard products and raw material will be disposed of in the abandoned quarry pit.

19. The main noise sources in the plant are (i) crushers, (ii) grinders, (iii) blowers, and (iv) the exhaust fan. The noise level from this equipment varies from 90 to 100 dBA decibels acoustic (dBA) with the mufflers and silencers in place. The noisy machineries will be housed in concrete buildings as far as possible from the boundary of the factory. The entire factory site will

be fenced with 2-3 m high brick wall. The noise level outside the factory site is estimated at 60-70 dBA.

20. The subproject will maintain a 10-m-wide greenbelt around the factory site. Areas of the quarry site that are no longer in use will be covered with a thin layer of topsoil and planted with grass and shrubs.

21. The subproject will generate employment for an additional 660 people from Chaohu City, 465 operating workers, 73 service personnel, and 122 administrators.

D. Alternatives

22. The alternatives to the subproject will be for AVP to (i) continue the present lime disposal practices; (ii) give the lime to other potential users (i.e., farmers and brick makers); and (iii) send the lime to existing cement plants. Lime is an alkaline and corrosive substance. Containment of a large volume of lime, as is currently done at AVP, is difficult. Rains wash the lime into the lake. If the lime is shipped to potential users, AVP would retain responsibility for the proper use of the waste, and AVP does not have the capability to monitor the users' compliance with environmental and safety standards on the use of the waste materials. The lime from AVP contains impurities from the coke used in the manufacture of calcium carbide, such as heavy metals. Sending the lime to other cement plants is an option for AVP, but the cement plants are reluctant to receive the waste lime.

E. Cost-benefit Analyses

23. The subproject benefits come from the sale of cement and disposal of the solid wastes. The subproject cost is from producing the cement. The subproject has an economic internal rate of return (EIRR) of 16.0 percent.

F. Environmental Monitoring Requirement and Program

24. AVP has an environmental unit to operate and monitor the performance of the wastewater treatment plant. With the subproject, AVP will create another organization to operate and monitor the performance of the air and water pollution control facilities. AVP will organize the unit into three crews for: (i) dust collection; (ii) greenbelt maintenance; (iii) dust control and solid wastes disposal; (iv) the wastewater treatment plant; and (v) the monitoring station and laboratory. The environmental unit will have 25 persons, 8 of which are professional staff. The environmental unit will operate 24-hours per day and report directly to the plant manager.

25. Under the Project, the environmental unit will acquire the following monitoring equipment: (i) a stack gas monitor; (ii) a high volume sampler; (iii) a portable meteorological meter; (iv) a noise meter; (v) a spectrophotometer; (vi) a pH meter; (vii) an oven and a refrigerator; and (viii) various glassware and analytical equipment for quantitative and qualitative analysis. The monitoring equipment and laboratory for the cement plant will be operated independently from existing facilities at AVP.

G. Public Involvement

26. The residents of Caojia and Qiatou villages, about 3 km distant, the nearest settlement to the subproject site, were consulted. The consultation involved 100 families. The residents

were agreeable to the construction of the cement plant, as it will improve their employment opportunities.

H. Conclusion

27. The subproject's positive environmental impacts include the utilization of the solid wastes consisting of fly ash, lime and standard limestone from AVP, thereby protecting Chao Lake from polluted runoff. The subproject will reduce the effluent discharged into the lake by recycling the treated water into AVP's cooling system. The effluent quality will be upgraded to meet the Class-III water quality standard. The only land affected is an existing uninhabited quarry. The cement plant will have state-of-the-art pollution control facilities, and the air emissions will meet national standards.

III. HEFEI CHEMICAL WORKS SUBPROJECT

A. Subproject Description

28. The product lines of Hefei Chemical Works (HCW) are based on caustic soda and on chlorine, hydrogen, and oxygen, which are by-products of caustic soda manufacturing. The HCS plant was built in 1957 and has an annual production capacity of 75,000 tons of caustic soda, 24,000 tons of calcium carbide, 25,000 tons of polyvinyl chloride (PVC) resin, 6,000 tons of ferric chloride, 30,000 tons of liquefied chlorine, 5,000 tons of hydrochloric acid, 100,000 m^3 of acetylene, and 8,000 tons of pesticide. Caustic soda is produced by electrolytic decomposition of sodium chloride using asbestos-coated graphite anodes and graphite cathodes, commonly called the diaphragm process. The wastewater is generated primarily from spent salt solution and the asbestos coating workshop. The wastewater contains asbestos, tar, lead, and salt. Vinyl chloride monomer is also generated in trace quantities at the PVC manufacturing line.

29. The subproject will replace the diaphragm process with the membrane process. The membrane process requires less energy and has a higher yield of caustic soda per unit of salt input. The caustic soda produced in the membrane process does not add asbestos, lead, or heavy metals to the product. The subproject will provide for the decommissioning of the existing diaphragm process equipment, decontamination of the soil, disposal of contaminated soil and equipment in a secured landfill, installation, commissioning of a 45,000-ton/year caustic soda plant using the membrane process, and expansion of the existing wastewater treatment facilities. The new process and wastewater treatment plant will be built within the compounds of the existing factory located in Hefei City (see Appendix 4).

B. Description of the Environment

30. The climate, meteorology, lake water quality, and terrestrial and aquatic ecology of the Chaohu watershed are described in paragraphs 8,9 10, and 12. The HCW factory site occupies approximately 400 ha of land 7 km from Hefei City center. The factory is bounded on the west by Hefei Iron and Steel Company and by two special railway tracks on the other side. The air quality in the area is quite poor, exceeding the PRC standard for TSP, 70 percent of the time, 50 percent of the time for carbon monoxide, and 20 percent of the time for NO_X. TSP ranges from 0.03 to 1.8 mg/m^3 compared to the PRC standard of 0.15 mg/m^3. The carbon monoxide concentration ranges from 0.33 to 5.7 mg/m^3 compared to the PRC standard of 4 mg/m^3, and NO_X ranges from 0.007 to 0.152 mg/m^3 compared to the PRC standard of 0.1 mg/m^3. Most of the air pollutants are generated by Hefei Iron and Steel Company.

31. At present, HCW discharges 37,000 m^3/day of wastewater containing 210 mg/l of suspended solids, 142 mg/l of COD, 0.94 mg/l of phosphorus, 11 mg/l of total nitrogen, 6.5 mg/l of sulfide, 0.16 mg/l of vinyl chloride monomer and with a pH of 12.2. The wastewater is discharged to the Nan Fei River, a tributary of Chao Lake. HCW also generates 290 tons/day of solid wastes, primarily lime, sodium hydroxide, silica, barium sulfate, mercuric chloride catalyst, and magnesium hydroxide. The solid wastes also contain traces of asbestos, lead, and tar from the electrolytic cells. Lime and silica are given to brick makers. The mercuric chloride catalyst is sent to the mercury mine in Anhui for processing with the mercury ores. The remaining solid waste streams are used to fill low lying areas within the factory sites.

C. Anticipated Environmental Impacts and Mitigating Measures

32. The subproject's environmental impacts are highly positive. The expansion and upgrading of the wastewater treatment facilities will allow HCW to recycle the cooling water and wastewater. This will reduce the wastewater flow rate by 15 times to 2,400 m^3/day from the existing flow rate of 37,000 m^3/day. A biological wastewater treatment process followed by coagulation, flocculation, sedimentation, and filtration will reduce the COD in the effluent to 35 mg/l, phosphorus to 0.1 mg/l, total nitrogen to 9 mg/l, and vinyl chloride monomer to 0.1 mg/l. There will be no asbestos, lead, or tar in the wastewater.

33. The subproject negative impacts will occur during decommissioning of the existing diaphragm process and construction. Asbestos as well as materials and equipment contaminated with asbestos will have to be properly identified, labelled, packed, and disposed of in a secured landfill which will be developed in the abandoned quarry site near the AVP cement plant. Workers will be briefed on the hazards, danger and procedures of working in areas contaminated with asbestos and provided with the proper protective clothing. Equipment contaminated with asbestos will be demolished and removed under pressure lower than atmospheric pressure so that the fibers will not spread to other areas of the factory. The air vented from the demolition site will be blown into a water tank to strip any asbestos fiber. The noise level at the periphery of the factory will be similar to that outside subproject, at a 65 dBA level during night and 70 dBA during the day. The subproject is also exploring the possibility of using the AVP cement plant and related solid waste handling facility for disposal of the solid wastes.

34. The subproject will utilize the existing workshop for caustic soda production which is located within the existing 3 ha factory site. The subproject will not involve any resettlement or displacement of people. The subproject will have a beneficial effect on the health and safety of the factory workers with the elimination of asbestos pollutant. The subproject will not have any impact on wildlife or endangered specie.

D. Alternatives

35. The diaphragm process for caustic soda production was an improvement of the original mercury cell process, which was a major cause of mercury pollution. The caustic soda produced using the diaphragm process contains traces of lead and asbestos and for this reason the process is now being phased out. Caustic soda produced from the mercury cell and diaphragm processes commands a lower price in the market because of the impurities. The alternative to the subproject will be for HCW to close down the caustic soda production facilities. This alternative is not financially or economically viable, as the whole production line is dependent on caustic soda.

E. Cost-benefit Analyses

36. The economic benefits of the subproject include: (i) lower energy and raw material required per ton of caustic soda produced; (ii) lower wastewater discharge; (iii) lower freshwater consumption; (iv) elimination of asbestos wastes; (v) elimination of lead and asphalt vapor; and (vi) better market price for the caustic soda produced. Secondary benefits that were not quantified include the reduction of lead and asbestos contaminant to end users of the caustic soda. The cost factors are: (i) subproject capital; (ii) subproject operation and maintenance; and (iii) clean up of the polluted workshop. The benefit cost analysis has a ratio of 1.2 or an EIRR of approximately 15 percent.

F. Environmental Monitoring Requirement and Program

37. As part of the subproject, HCW will acquire analytical equipment to monitor the environmental noise and air quality of the entire factory site, the surrounding public places, and from time to time the nearest residential areas. HCW will also monitor the Nan Fei River quality 50 m upstream and downstream of its effluent discharge point and the effluent quality of the wastewater treatment plant. With respect to air pollution monitoring, HCW will measure continuously for 24 hours every five days the TSP, chlorine, and hydrogen chloride concentration. The wastewater treatment plant effluent will be sampled daily with one grab sample taken every three shifts and composited. The samples will be analyzed for pH, suspended solids, turbidity, vinyl chloride monomer, total nitrogen, phosphorus, and COD.

38. Environmental monitoring will be carried out by the Safety and Environment Department of HCW. At present there are 10 persons working in this department. HCW will prepare an annual report collating the monitoring results to the AEPB.

G. Public Involvement

39. The nearby residential areas are mostly HCW and Hefei Iron and Steel Corporation (HISC) staff houses. HCW has informed HISC, the adjacent factory, of the subproject. Most the factory workers are aware of the subproject. Social analysis was carried out to determine the residents' perception of the subproject. Two hundred residents were interviewed and they were all supportive of the subproject.

H. Conclusion

40. The subproject will be built within the premises of the factory. The potentially negative impacts of the subproject could occur during decommissioning of the existing diaphragm process and removal of materials and equipment contaminated with asbestos. The negative impacts will be mitigated using established procedures and technologies for handling and disposal of asbestos. Once the subproject is operational, the environmental impacts are positive, with 35,000 m^3/day reduction in untreated wastewater and elimination of toxic wastes, including asbestos and lead.

IV. HEFEI IRON AND STEEL CORPORATION SUBPROJECT

A. Subproject Description

41. HISC produces annually 500,000 tons of pig iron, 700,000 tons of steel, and 400,000 tons of hot and cold rolled steel. The main raw material used in the manufacture of those products are iron ore, coking coal, and lime. The factory operates a 160,000 ton/year coking plant, out of the total annual requirement of 500,000 tons/year. The factory purchases 340,000 tons/year of coke from small coking plants in neighboring provinces. The location of the factory is shown in Appendix 4.

42. The coking plant operation is a major air and water pollutant source as well as safety hazard. The by-product recovery system is inefficient. Large quantities or aromatic hydrocarbons, sulfur dioxide, ammonia, tar, and coking gases escape from the coking oven. The atmosphere within 100 m of the coking plant contains high levels of ammonia, SO_2, and aromatic hydrocarbons, which are known carcinogenic substances. The existing wastewater treatment plant is undersized. The main pollutants in the wastewater are suspended solids, a mixture of organic impurities expressed as COD, ammonia, phenols, and cyanide. The wastewater is aerated without proper pretreatment to stabilize the ammonia, causing ammonia to be discharged into the atmosphere.

43. The subproject will replace the existing 150,000 ton/year coking plant with a 600,000 ton/year coking plant, upgrade of the wastewater treatment facilities and reuse the treated water for quenching and coal washing. The proposed coking plant is expected to recover 27,500 tons of tar, 7,000 tons of benzene, 1300 tons of sulfur, and 2,674 million m^3 of cooking gas annually that would have been discharged to the atmosphere from existing outdated facilities either at HISC's own plant or in the smaller "dirty" plants from which HISC purchases 340,000 tons annually. The subproject includes the decommissioning of the existing coking facilities and decontamination of the soil around the existing facilities. The manufacturing facilities and environmental conditions in the coking plants where HISC currently purchases 340,000 tons/year of coke are primitive and more polluting than those at HISC. The subproject is expected to compete with and economically force the closure of a number of the small and polluting coking plants, with the overall beneficial impact on reduced greenhouse gases.

B. Description of the Environment

44. The subproject will be constructed within the 21.5 ha lot occupied by the existing coking plant, which will be dismantled. Although the subproject capacity is almost three times that of the existing coking plant and will require storage areas for the recovered by-projects, the area requirement is almost the same because of improved process equipment layout, piping, and material handling system. The area is adjacent to the HCW factory and the air quality is similar except in localized areas near specific polluting processes such as the coking plant. In the vicinity of the coking plant, the TSP ranges from 0.72 to 1.6 mg/m^3, which exceeded the PRC standard of 0.3 mg/m^3 at all times and the carbon monoxide ranges from 2.5 to 33.7 mg/m^3, which exceeded the PRC standard 80 percent of the time. SO_2 ranges from 0.006 to 0.087 mg/m^3, which is within the PRC standard of 0.15 mg/m^3, at all times as well as NO_x, which ranges from 0.06 to 0.1 mg/m^3 compared to the PRC standard of 0.1 mg/m^3. The air has a heavy odor of phenols and aromatic hydrocarbons. No quantitative measurements of specific aromatic hydrocarbon concentration in the air has been carried out because the needed analytical equipment is not available.

45. The ground surrounding the coking plant is covered with a thick layer of soot and tar. Soil samples show that heavy metal concentration in the soil is still within the range of background concentration in unpolluted areas of Anhui Province. The noise level near blowers

and heavy machineries ranges from 90 to 100 dBA, and in the perimeter from 48 to 70 dBA, which exceeds in some instances the PRC standard of 65 dBA for industrial areas.

46. The climate, meteorology, water quality, and terrestrial and aquatic ecology in Chaohu watershed is described in paragraphs 8, 9, 10, and 12.

47. Social services provided to employees include a primary, middle, and technical school with 120 classes, 504 teachers, and 3,000 students. HISC maintains a 330-bed hospital with 190 doctors and 154 nurses. Of the 3,860 patients treated in 1993, 25 per cent (978) were suffering from respiratory diseases, 12 percent (442) from injury and poisoning, and 5 percent (202) had tumors or cancer.

C. Anticipated Environmental Impacts and Mitigating Measures

48. The environmental impact of the subproject is positive. The new cooking plant will reduce air emissions and recover useful by-products. The subproject includes dust control facilities in the coal and coke stock yards to reduce fugitive dust emissions. The dust control facilities will utilize the effluent from the wastewater treatment plant. Expansion of the wastewater treatment plant will reduce the cyanide, phenols, and aromatic hydrocarbons in the effluent discharged to the Nan Fei River.

49. The subproject will be constructed within the existing factory compound. The only negative impact of the subproject will occur during the construction phase. The soil in the vicinity of the coking plant has to be scraped and disposed of in a secured landfill, preferably the abandoned coal mines near Hefei. The bricks in the existing cooking oven will be disposed of in the secured landfill to prevent reuse by residents for houses and buildings. The subproject will have no direct impact on wildlife and endangered species.

50. The subproject is expected to have a positive impact on public health especially a reduction in the incidence of respiratory disease among the workers at HISC and HCW. Reduction in the tumor incidence will not be evident within 4-5 years because of the long gestation period for such diseases. The incidence may even rise in the next 4-5 years, because of the long maturation period for cancer.

D. Alternatives

51. Alternatives to the subproject are to: (i) close the existing facilities and increase coke purchase from various smaller manufacturers; (ii) scale down coke consumption and steel production; and (iii) move the coke production to another location. Coke is used in a number of industries, including small foundries and large steel mills, as a reducing agent and high temperature fuel source. Coke available in the market is often produced by small- and medium-scale enterprises with limited capital and technology base where the pollution control facilities and by-product recovery is almost nonexistent. Closing the existing coking plant will reduce the immediate pollution load in the factory's vicinity through the total pollution load to the environment from this one source will increase considerably. However, this will be more than offset by the elimination of coke purchase from small "dirty" producers in the region. A number of air pollutants generated during coke production have been known to move with the global weather pattern across continents. Steel demand in the PRC is increasing, and it is difficult to scale down the steel production. The supply of scrap iron, which will not require coke for steel production, is limited. Relocating the coke production lines will require acquisition of new land

and construction of roads and utilities to move the raw materials and finished products. This option would also increase HISC's operating costs.

Cost-benefit Analyses

52. The subproject benefits are: (i) improvement in workers' health; (ii) improvement of the workers productivity; (iii) recovery and sale of the by-projects; (iv) reduction of the waste load to Chao Lake; and (v) reduction of air pollutant emissions in terms of both local and global levels. The subproject costs include: (i) capital cost of the subprojects; (ii) operating and maintenance cost; and (iii) future cost of decommissioning the subproject. Some of the subproject benefits are nonquantifiable, such as improvement in workers' health and the global impact of emission reduction. The subproject's EIRR is estimated at 15 percent.

F. Environmental Monitoring Requirement and Program

53. Environmental monitoring is the responsibility of the Safety and Environmental Protection Department under the direct supervision of the deputy general manager. Of the department's 27 personnel, 16 are assigned in the environmental protection section and 11 in the safety section. Twelve persons are assigned to operate the air, water, and noise monitoring stations. Of the 12 monitoring personnel, 10 are assigned to the coking plant because this plant is the major pollution source in the factory. The Environmental Protection section is responsible for: (i) formulating the annual plan and development program for environmental monitoring; (ii) conducting environmental audit; (iii) monitoring performance of new equipment and modifications for compliance with environmental requirements; (iv) investigating pollution accidents; and (v) coordinating submissions of reports with research institutes and government agencies.

54. Air quality will be monitored for five consecutive days every three months for TSP, SO_2, and NO_x, The wastewater flow rate will be monitored continuously and the wastewater will be analyzed for pH, suspended solids, COD, phenol, cyanide, petroleum extract, ammonia, nitrogen, and hydrogen sulfide. Noise will be measured once a week for 24 hours at major noise sources and at the plant boundary. HISC will compile the monitoring results and submit them to AEPB.

G. Public Involvement

55. The subproject will be constructed within the factory premises and will not involve relocation or resettlement of any households. The air pollution in the vicinity of the coking plant is so severe that the workers are currently rotated once every three months. Existing air pollution is so severe that insects and rodents are driven away by the acrid smell of tar and phenols. Public perception of the subproject was assessed in the residential area of Ganghong, Gangnan, Gangbei, and Gangzhong villages. A number of residents in the villages work for HISC or the adjacent factories such as HSW. A number of residents are aware of the subproject, having been informed by their neighbors who work for the factory. The survey showed everyone was in favor of the subproject.

H. Conclusion

56. The subproject will have major positive impacts. The existing coking plant is a major source of air and water pollution in Hefei and Chao Lake. The air pollutant from the coking operation contains phenols, tar, naphthalene, and various aromatic hydrocarbons. A number of

aromatic hydrocarbons are known to be carcinogenic. The incidence of tumors among HISC worker is above the statistical average for the general population. Current wastewater discharges contain phenols, cyanide, and hydrogen sulfide, which are toxic substances. The subproject will remove toxic pollutants and recover useful chemical by-products. However, past neglect to control the air and water pollution has contaminated the areas around the coking plant, requiring that the soil be removed and disposed of in a secure landfill.

V. HEFEI CHEMICAL FERTILIZER FACTORY PLANT SUBPROJECT

A. Subproject Description

57. The Hefei Chemical Fertilizer Plant (HCFP) was established in 1958 and the factory is currently modernizing and expanding its ammonia production capacity to 90,000 tons per year. In 1993, HCFP produced 30,000 tons of ammonia, 50,000 tons of soda ash, 50,000 tons of ammonium chloride, 60,000 tons of ammonium carbonate, 50,000 tons of melamine, and 20,000 tons of sodium polytriphosphate. HCFP discharges 40 m^3/hr of wastewater containing 1294 mg/l of ammonia, 246 mg/l of suspended solids, 331 mg/l of organic pollutant expressed as COD, and 11.4 mg/l of phosphate into the Shiwuli River, a tributary of Chao Lake. The factory also uses 3,420 m^3/hr of cooling water and 470 m^3/hr of scrubbing wastewater from the gasification plant. HCFP air emissions are primarily from the coal-powered plant and ammonia from the ammonia production plant and ammonium carbonate warehouses. The plant location is shown in Appendix 4.

58. HCFP intends to phase out the ammonium carbonate product line by further processing the ammonium carbonate to urea. Ammonium carbonate easily decomposes to ammonia and carbon dioxide, resulting in high loss of the nitrogen content in the fertilizer during transport, application, and usage. HCFP researchers estimate that 2-5 percent of the ammonia is lost during storage and transport, and another 13-17 percent is lost during application. In addition, this type of fertilizer is highly soluble in water and tends to be washed into drains and receiving streams causing further wastage and contamination of the lake. The subproject will provide granulated urea production, reducing this problem, and expansion and upgrading of the wastewater treatment facilities to reuse the treated effluent in the factory.

B. Description of the Environment

59. The factory is located in the southeastern suburb of Hefei City in Changang township. The factory is bounded on the north by the Qimen Road, on the east by Hean Road, and on the west by farmlands. The factory is approximately 7 km from the town center of Hefei. The terrain is slightly hilly, sloping from the west. The subproject will be constructed in an open space on the western side of the factory. The subproject will occupy 5,000 square meters (m^2) of the total factory area of 19.3 ha.

60. The climate, meteorology, and aquatic and terrestrial ecology of Chao Lake are described in paragraphs 8, 9, 10, and 12.

61. Changang township is composed of 19 villages and 174 groups with a population of 34,244. Of the working age population, 64 percent work in the industry. Aside from the fertilizer factory, there are textile, chemical, machine, hardware, printing, food, and garment factories in the area. The topsoil in the area is thin, normally less than 0.3 m thick. Vegetable growing and animal husbandry are prevalent agricultural activities in the area.

C. Anticipated Environmental Impacts and Mitigating Measures

62. The subproject will consist of an additional process to convert the ammonium carbonate to urea. The subproject will reduce the ammonia losses from the ammonium carbonate during storage in the factory, distributors' warehouse, and on the farms. Urea is more stable than ammonium carbonate, especially in alkaline soil. Plant utilization efficiency of the nitrogen in urea is higher than from ammonium carbonate. Nitrogen in surface runoff will be reduced. Reduction of the nitrogen into Chao Lake from farmlands is estimated at 10,000 to 25,000 tons/year. The negative impact of the subproject is limited to dust and noise during construction, as the subproject will not require demolition or decommissioning of existing process equipment. Nitrogen is one of the major causes of the eutrophication of Chao Lake. The major beneficiaries of the subproject area are the farmers who will be spending less for fertilizer and the various water users of the Chao Lake. The main EIA report included a risk analysis of the existing ammonia production lines, which involves high pressure and temperature. The environmental impacts of those processes are not included in this summary as they are not part of the subproject.

D. Alternatives

63. The alternatives to the subproject will be for HCFP to continue to produce ammonium carbonate or to produce ammonium sulfate instead of urea. Ammonium carbonate is a major cause of wastage, and of pollution in the lake and the continued production of ammonium carbonate is undesirable. To produce ammonium sulfate, HCFP would have to construct a sulfuric acid plant and abandon the existing facilities producing ammonium carbonate. The construction of a sulfuric acid plant is viable if a cheap sulfur source is available or when the sulfuric acid plant could be considered a treatment process, as in copper smelters. For HCFP to open a sulfuric acid plant it will have to overcome problems regarding (i) personnel retraining; (ii) additional expenses on sulfuric acid storage facilities; and (iii) abandonment of newly installed facilities for ammonium carbonate production. Urea is a more environmentally "friendly" fertilizer than ammonium sulfate.

E. Cost-benefit Analyses

64. Capital investment for the in-plant pollution control facilities and the urea plant will cost ($155.8 million/Yuan). The annual operating cost of the pollution control facility is ($1.3 million/Yuan). The benefits of the subproject include better fertilizer utilization by the farmers and a lower nitrogen load to Chao Lake. Better fertilizer utilization on the farm is reflected by the farmers' willingness to pay a higher price for urea than ammonium carbonate. The shadow price for lower nitrogen loading is estimated from the cost of removing the nitrogen from the lake. The subproject EIRR is estimated at 16.9 percent.

F. Environmental Monitoring Requirement and Program

65. The factory has an environmental protection department reporting directly to the plant director. The head of the environment protection department has the rank of deputy director. The environmental department is responsible for (i) water, air, noise, and solid wastes monitoring in each of the workshops within the factory at least once a month; (ii) preparation of guidelines for operation of the pollution control facilities; (iii) custody of all records related to environmental quality control; (iv) investigation of accidents and violation of environmental regulation; (v) conduct of environmental education for the staff in other department; (vi) preparation of all environmental reports; and (vii) supervision of compliance with the EIA during

construction and alterations of major unit processes. The environmental protection department has a staff of five persons and with the subproject five additional personnel will be hired. The environmental department personnel does not include the operators of the pollution control facilities that are under the operations department.

66. The factory maintains a mobile air pollution laboratory in addition to three fixed monitoring stations within the factory. The air pollution monitoring equipment consists of: (i) five samplers; (ii) one smoke meter; (iii) one carbon monoxide detector; (iv) four high volume samplers; and (v) two stack samplers. The water pollution monitoring equipment consist of: (i) one pH meter; (ii) one COD apparatus; (iii) one automatic water sampler; (iv) one gas chromatograph; (v) one spectrophotometer; and (vi) various glassware and titrating equipment for chemical analysis. The factory also has two noise meters. The air, water, and noise samples are taken at least once a month.

G. Public Involvement

67. The subproject will be built within the existing factory site. No residents will be displaced or directly affected by the subproject. A risk analysis was carried out on the ammonia plant under construction and the existing facilities. Critical process equipment and storage facilities are well within the factory premises and provided with fire fighting facilities and with barriers to contain the effects of an explosion.

68. Although the subproject will be constructed within the existing premises of the factory, a public consultation meeting was held with the factory workers, environment workers, residents in nearby villages and representatives of the People's Political Consultative Conference. Questionnaires were also distributed to document public perception of the subproject from those who could not attend the meeting. Ninety one percent of the meeting participants and 70 percent of questionnaire respondents supported the subprojects. The remainder had no opinion on the subproject.

H. Conclusion

69. The subproject will utilize an open space within the existing factory site. Because it involves an additional manufacturing process, the subproject will not involve the decommissioning and disposal of obsolete equipment. The positive environmental impact of the subproject are: (i) reduction of nitrogen entering the lake from surface run-off from farmlands; reduction of ammonia losses during storage and transport; and (ii) lower fertilizer usage by farmers. The only negative environmental impact of the subproject will occur during construction, from noise and dust from moving equipment and erection of the unit process equipment.

VI. HEFEI WASTEWATER SUBPROJECT

A. Subproject Description

70. Hefei City received loan assistance from the Australian Government to build a 150,000 m^3/day wastewater treatment plant and the related sewer system to serve about 40 percent of Hefei's population. Hefei City also operates a 4,000 m^3/day pilot sewage treatment plant for a government housing project. Hefei Municipal Government intends to double the area served to 80 percent and construct a second sewage treatment plant with a capacity of 150,000 m^3/day. The sewage treatment plant will also serve a large number of small- and medium-scale

industries. The small- and medium-scale industries will be required to pretreat their wastewater to the sewer standard under consideration by the Hefei Municipal Government. The proposed sewer standard will protect the sewer system and prevent overloading and the introduction of toxic substances into the centralized biological wastewater treatment plant.

71. The subproject consist of constructing: (i) a 150,000 m^3/day sewage treatment plant using the aeration ditch variation of the activated sludge process; (ii) 90.8 km of interceptors (300 to 2,000 mm in diameter) and gravity sewers; (iii) 3.4 km force main (600 to 1,200 mm in diameter); and (iv) four lift stations. The subproject will have positive environmental impacts on aesthetics and odor with the removal of sewage from open drains, streams, and rivers, restoration of the aquatic ecology in the rivers, reduction in the organic and nutrient load to Chao Lake, and the resulting improvement of public health. The negative impacts of the subproject are: (i) disposal of sludge possibly containing heavy metals and intractable industrial pollutants; and (ii) nuisance problems to the surrounding areas and households and commercial establishments during pipe laying, and construction of lift stations.

B. Description of the Environment

72. Climate, meteorology, water quality, and aquatic and terrestrial ecology in the Chao Lake water basin is described in paragraphs 8, 9, 10, and 12. The construction area for the pipe lines and lift station is the northern half of the built up area of Hefei City. Hefei City is the capital and largest city in Anhui Province, and has a population of about 1.1 million (see Appendix 4).The population is expected to increase to 3 million by 2020. At present, wastewater from Hefei enters the Shiwuli and Nan Fei Rivers and is carried about 15 km to discharge into the lake. The Shiwuli River mouth is only 2 km from Hefei's largest water supply intakes, and the Nan Fei River's mouth is only 6 km from the other Hefei City and industrial water supply intakes. Pollution loads from nutrients create algal blooms, whose decay creates problems in treatment and palatability of the public water supply. The Hefei Water Supply Company (HWC) pumps all the polluted dry-weather flows in the Shiwuli River into the Nan Fei River from behind a temporary dike on the riverbanks. This limits the impacts from ammonia and other pollutants from industries and population in the Shiwuli when lake water levels and stream flows are low. Powdered activated carbon is used in the public water supply, but a significant portion of Hefei's consumers complain of odors, color, and taste in the public water supply, imparted by excessive algal growth.

73. Hefei City has a population density of 2,377 persons/ m^2. The average life expectancy is 71.3 years. Typical with rapidly growing metropolitan areas in the PRC, the average age of the population is only 26.6 years. Seventy-seven percent of the population had primary education and six percent have completed a university degree. Although there are 23 cultural minority groups living in the city, they composed only 0.7 percent of the population. The Han Chinese account for 99.3 percent of the population. Fifty-seven percent of the population is employed in industry, 20 percent in the service and social sector, and 23 percent in agriculture. There are 655 industrial enterprises in the city. Small- and medium-scale industries account for more than 50 percent of the industrial output in the city. In 1993, the total industrial output in Hefei was estimated at ($1.46 billion/Yuan).

C. Potential Environmental Impacts

74. A negative impact of the subproject is related to construction. Trenches from 2 to 10 m deep will be dug to lay the gravity sewer and interceptors. Dust will be generated from the heavy equipment and from the excavated material and building material stockpile. The heavy

equipment will also increase the noise level. The vehicular traffic volume in Hefei is light in comparison to the road width and density. Hefei has strong urban planning regulations characterized by wide streets laid in a grid pattern and traffic interruptions because of the project will be negligible. The land-use pattern includes a mix of industrial, residential, institutional, and commercial uses, especially around large state-owned enterprises that are mandated to provide housing, education health, and other facilities to their workers thereby reducing traffic. The dust level in the city is quite high, as coal is the main fuel source in industry and house heating. The dust from construction activities will be incremental to the existing dust levels. The subproject contractor will be required to minimize the excavated material and construction material stockpile in the working area. Excavated materials needed for backfilling will be wetted frequently to reduce the dust problem.

75. Eight to ten families will be relocated for the construction of the pumping stations, into a newly remodeled housing apartment where a number of HWC workers are located. HWC is taking advantage of the remodeling to rationalize the land use and alignment of its property. One of the lift stations is located in this block. The pumping station will be built after the remodeling is completed. The 4-6 families affected by the other pumping stations will be accommodated in one of HWC's employee housing projects. One of the pumping stations is already operational and a second has been constructed but is not yet operational. The 25-ha site for the wastewater treatment plant was acquired with the 25-ha used for the Phase 1 project, and has no housing or other activity on it. The area is an old earth quarry with a number of ponds. Some areas that were not affected by the quarry operation were formerly planted with mustard and vegetables. The site is now a grassland.

76. The other potential negative impact of the subproject is related to the disposal of the sludge. The sludge from the secondary clarifier will be treated with lime to improve its dewatering and to keep phosphorous from entering the filtrate. The sludge will be dewatered in a filter belt press. The dewatered sludge will be mixed with soil and used as compost in the grass and greenbelt areas within the wastewater treatment plant site and pumping stations. The grass and greenbelt area within the wastewater treatment plant covers 10 ha. The sludge application rate is estimated at 5 kg/m^2per year. The remaining sludge cake will be disposed of to agricultural areas, to areas being reforested, or to landfill. The greenbelt will be used to screen the wastewater treatment plant and serve as wind break to reduce potential nuisance for neighboring properties. Equipment with potential odor problems such as the sludge filter press, sludge storage, and primary treatment units such as the grit tanks and fine screens are located near the center of the wastewater treatment plant site to maximize the distance to the adjacent properties. HWC has requested the municipal government to maintain the existing agricultural uses around the wastewater treatment plant and prevent the development of residential and institutional buildings in the area. If necessary, the surrounding areas could be used for light industries.

77. The subproject will remove 385 tons of nitrogen, 40 tons of phosphorous, and 11,000 tons of organic matter (COD) from the annual pollutional load to the lake. The subproject will help reduce eutrophication and diversity the ecological balance in the lake.

D. Institutional Requirements and Environmental Monitoring

78. For the last ten years, HWC has been monitoring the lake water quality near the intake structure. Water samples are taken from the lake three times a year and analyzed for COD, suspended solids, total nitrogen, and phosphorus. With the operation of the lift stations and the wastewater treatment plant, HWC will expand the laboratory facilities to monitor the influent and

effluent quality of the wastewater treatment plant. The wastewater treatment plant influent and effluent will be analyzed for COD on a daily basis, and weekly for total nitrogen and phosphorus. The sludge will be analyzed on a monthly basis for heavy metals and pesticides. Noise will also be measured at the periphery of the wastewater treatment plant once a month. The flow rate will be measured continuously. A separate laboratory for wastewater analysis is now under construction as part of the Phase I project. The laboratory will be equipped with a spectrophotometer, gas chromatograph, pH meter, and standard analytical equipment and glassware.

E. Findings, Recommendations, and Conclusion

79. The subproject will have beneficial impact on public health, water supply, and the lake ecology. It will treat the wastewater from 500,000 residents and hundreds of small- to medium-size industries to meet national standards. The subproject's only negative impacts are mostly related to the construction phase, and are temporary and reversible. With proper planning and coordination of the construction activities with the traffic management authorities, the problems related to partial closure of some roads for periods ranging from one week to a month will be minimized. The vehicular traffic volume in Hefei is still low and the problem is not expected to be of major concern. The sludge will be disposed of in the greenbelt and grass areas within the wastewater treatment plant and lift stations sites. The wastewater treatment plant site has been acquired as part of the Phase I project, and quarrying and vegetable farming activities have been abandoned for sometime.

VII. CHAOHU CITY WASTEWATER SUBPROJECT

A. Subproject Description

80. Chaohu City has a population of 793,000, which is projected to reach 923,000 in 2010. Chaohu City has total land area of 2,063 km^2 but the urbanized area is only 18 km^2 with a population of 170,000 people. The subproject will serve the urban population, which is forecast to reach 250,000 in the year 2010 (see Appendix 3).The subproject in Chaohu City will consist of: (i) a 30,000 m^3/day sewage treatment plant; (ii) 15.9 km of interceptor and trunk sewers (500 to 1600 mm diameter); (iii) 65.5 km of secondary sewers (200 to 500 mm diameter); and (iv) five lift stations. The sewage treatment plant will use the aerated ditch variation of the activated sludge process. The effluent outfall will be 5 km downstream from the lake on the Yuxi River, bypassing the lake.

B. Description of the Environment

81. The climate, meterorology, water quality, aquatic and terrestrial ecology in Chaohu water basin is given in paragraphs 8, 9, 10, and 12. Like Hefei, Chaohu City, the second biggest city in the Chao Lake watershed, has brown rapidly in the last 40 years in a closely planned and tightly controlled manner. As a result, the urban population is well served by housing and urban infrastructure, including complete public water supply coverage, although the water quality in Chaohu City is inferior to that of Hefei City because of an older water treatment plant that is not able to overcome the increasing pollution in Chao Lake.

82. Chaohu City lies adjacent to the lake and the sluice gate, which controls the lake water levels and outflows to the Yuxi River. Wastewater is discharged to an antiquated, undersized network of storm drains that discharge to the river channels and canals that predominate in the low lying areas of the city. Many of the canals are used for storage of storm water, which is

pumped over the dikes into the lake. A series of dikes protect the city from flooding when the lake water is high. The city is served by two short water intakes in the lake. The older intake was recently affected by algal bloom and industrial wastewater discharged to a storm channel west of the city. The new intake, which started operating in July 1995, is affected by turbidity and organic wastes from the storm water channel west of the city.

83. The current conceptual planning to the year 2000 is to develop Chaohu City into a lake-side city with an industrial base of textile, machinery, construction materials, processed food, and chemical industries. The growth of industrial output over the last four years has averaged 68.6 percent per annum. The industrial growth rate is expected to continue at high levels until past the year 2000.

84. In Chohu City, housing is of three major types. About 40 percent are multistory multiple units, 40 percent are single family units, and about 20 percent are single units arranged around a courtyard. More than 50 percent of the dwellings are privately owned with the remaining 50 percent being owned by work units or state enterprises. Water-related diseases are prevalent, with more than 16 percent of the population reportedly affected in 1994.

85. Compared to Hefei City, Chaohu City has more government functionaries, workers, private businesses and diversified private enterprises. More people in Chaohu City own their houses than in Hefei.

C. Potential Environmental Impacts

86. Like the Hefei subproject, most of the negative impacts are related to construction activities, specifically in laying the sewer pipelines and constructing the wastewater treatment plant and lift stations. Chaohu City is currently undertaking a major urban renewal program to upgrade the housing and commercial areas along the riverbanks. The houses were built 40-50 years ago, and are currently in poor condition. Fifty percent of the urban renewal has been completed. The city plans to lay the main interceptors following the pathways and roads closest to the river to utilize the natural gradient. The city will have to break the newly constructed pavement in the portion where the urban renewal is completed. For the other half of the interceptor line, the city intends to coordinate the pipe laying with the construction of the pavement. In other sections of the city, pipe laying will follow the normal pattern as in Hefei City. Chaohu Water Company (CWC) officials are working in coordination with HWC on the mitigating measures during construction, monitoring plan, and operation of the wastewater treatment plant. The mitigating measures for negative impacts during construction will be similar to those in Hefei.

87. The wastewater treatment plant will be built on a 2.5 ha site in an uninhabited rice paddy area at the edge of the Yuxi River. The area is enclosed by flood protection dikes. However, a portion of the site is flooded during the rainy season. The general area is cultivated with rice and vegetables. Some fish farms are built in depressed areas, but the fish ponds are not very productive because of the polluted water. CWC intends to use the abandoned fish ponds for the wastewater treatment plant. CWC will have to backfill some portion of the site. A greenbelt will be planted 5 m wide along the sides of the wastewater treatment plant site. The sludge after dewatering will be mixed with soil and used as compost in the greenbelt. CWC personnel will be trained on the operation and maintenance using the existing 4,000 m^3/day wastewater treatment plant at Hefei.

88. Only 8-10 households will be affected by land acquisition, mostly for the five lift stations. The affected families will be accommodated in the ongoing municipal housing renewal project. CWC will compensate the farmers and the residents for the land acquired for the wastewater treatment plant and for the pump stations. Under the PRC''s existing laws, all lands are owned by the state but residents will be reimbursed for the improvements (housing) on acquired sites. The land outside the proposed wastewater treatment plant will be reapportioned to the farmers. The farmers will receive land similar in area to that they had before the change. A number of farmers prefer employment in industry and will discontinue tilling the land. CWC will give the farmers the option of continuing to till the land or being retrained to work in the maintenance of the sewer system and the grounds of the wastewater treatment plant.

D. Institutional Requirement and Environmental Monitoring

89. CWC has a laboratory to monitor the lake water quality near the two intake structures. The laboratory also measures the quality of the public water supply. With the subproject, the laboratory facilities will be expanded to carry out laboratory analysis for the raw and treated sewage. The laboratory will also acquire an atomic adsorption spectrophotometer to analyze the heavy metals in the sludge. The sewage flow rate will be measured continuously as part of the process control equipment supplied with the wastewater treatment plant. The raw and treated sewage will be analyzed daily for COD, suspended solids, pH, and turbidity. Once a month, the dewatered sludge will be analyzed for lead, copper, cadmium, chromium and nickel. Once every six months, sludge samples will be sent to Hefei for pesticide analysis. Water samples will be taken weekly at a point 500 m upstream and downstream of the treatment plant. The effluent discharged will be analyzed for COD, suspended solids, total nitrogen, and phosphorus. CWC will hire two chemists and one assistant for the additional monitoring program.

E. Findings, Recommendation, and Conclusion

90. The subproject will have major positive environmental impacts on public health, improvement in lake and river water quality, urban renewal, removal of odor nuisance, and reduction of insect vector populations within the city. The only negative impacts are short term, related to normal construction activities. The only land affected is in an uninhabited rain flood plain area with marginal agricultural use.