Initial Environment Assessment Report

Project Number: 42079
August 2009

VIE: New Model University Project (formerly Higher Education Sector Development Project)

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Asian Development Bank

ADB TA 7105 VIE:

Preparing the Higher Education Sector Development Project -

Developing New Model Universities (NMUs) in Vietnam

Environment Assessment
Paper A - HUST

Hanoi University of Science and Technology
Report on Environment Assessment

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August 2009

[The views are those of the author, and are available to inform decisions made by the TA team for recommendations for the Final Report.]

List of Abbreviations

ADB	Asian Development Bank
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
Ha	Hectares
MPI	Vietnam Ministry of Planning and Investment
HW	Hazardous Waste
VEPA	Vietnam Environmental Protection Agency
FS	Feasibility Study
PPMO	Provincial and district Project Management Office
PMU/PMO	Project Management Unit/Project Management Office
SRV	Socialist Republic of Vietnam
TSS	Total Suspended Solids
TOR	Terms of References
QA/QC	Quality Assurance/Quality Control

A. INTRODUCTION

1 THE AIMS OF THIS EA REPORT

The project will create greater economic growth as well as enhancing institutional tools for the project-selected areas and the whole country to support knowledge and implementation of Environmental Protection Plans.

The aims of this EA report include:

(i) To analyze and assess present natural environment and the socio-economic conditions in the project area and determine the scope and extent of future positive and negative impacts. The implementation of the project is reviewed and examined in terms of environmental protection;

(ii) To determine the potential environmental impacts and to disseminate the findings to the project development and implementation teams; and

(iii) To prepare mitigation measures to reduce/eliminate the identified negative impacts and prepare an Environmental Management Plan (EMP) for pre-implementation, implementation/construction and operation of the project.

The report is prepared in accordance with the terms of reference (TOR) for compilation of the EA report between the Technical Consultant Organization here called ADB and the Local Consultant on EIA.

2. STRUCTURE OF THE REPORT

A. Introduction
B. Project Description
C. Description of the Environment
D. Forecasting Environmental Impacts and Mitigation Measures
E. Institutional Requirements and Environmental Monitoring Plan
F. Public Consultation and Information Disclosure
G. Conclusion and Recommendation

3 BASES OF ASSESSMENT

In compliance with the Asian Development Bank's (ADB's) environmental requirements, an initial environmental examination (IEE) was conducted for the Project. The Project is categorized B in accordance with ADB's *Guidelines on Environmental Assessment* (2003). The Project subcomponents to be financed by ADB showed no adverse environmental effects. Project activities with associated marginal impacts, and the main mitigation measures proposed are summarized below.

4 LAWS AND REGULATIONS

Requirements of Vietnamese legislation in Environmental Impacts Assessment

- Vietnam Environmental Protection Law (29/2005/L/CTN), approved by the Parliament of Social Republic of Vietnam on 29/11/2005 and implemented by 01/07/2006.

- Water Resource Law approved by the Parliament of Social Republic of Vietnam on 29/11/2005 and implemented by 01/06/1998.
- Decree 68/CP (01/11/1996) which provides detailed guidance of implementing Resource Law.
- Decree 67/2003/ND-CP (13/06/2003), approved by the Government on the Environmental Protection Fee of Wastewater.
- Decree 04/2007/ND-CP (08/01/2007), approved by the Government on the amendments of Decree 67/2003/ND-CP
- Decree 80/2006/ND-CP (09/08/2006), approved by the Government on detailed guidance of implementing Vietnam Environmental Protection Law
- Decree 81/2006/ND-CP (09/08/2006), approved by the Government on administrative punishment in environmental protection.
- Decree 59/2007/ND-CP (09/04/2007) on Management of Solid Waste
- Decision 22/2006/QD-BVMT (18/12/2006), approved by Minister of Ministry of Natural Resources and Environment on the enforcement of using QCVN / TCVN regulations on environment issues.
- Series of QCVN, TCVN
- Circular letter 05/2008/TT-BTNMT, issued by the Ministry of Natural Resources and Environment on the guidance of strategic environmental impact assessment, environmental impact assessment and commitment of environmental protection

Technical documents in Environmental Impact Assessment (EIA)

Technical documents used in this report are

- The detailed sub-project proposal HUST
- Technical Assistance Inception Mission (ADB) and Preparation Mission (WB) - The Aide-Mémoire: Higher Education Sector Development Project (Asian Development Bank)[1] and New-Model Universities Project (World Bank)

5 SUMMARY OF MAIN FINDINGS AND CONCLUSIONS

The project is not expected to have any significant adverse impact on the local environment. Minor environmental issues to be addressed during the construction and operational phases, will be mitigated through the implementation of proposed measures and regular monitoring.

The IEE report indicates that the adverse environmental impacts of the project will be not significant. Mitigation measures can be undertaken without difficulty through proper engineering design, incorporation of recommended mitigation measures, and community participation. The adverse impacts will be greatly offset by improvements in health, sanitation, and environmental conditions for the urban residents of project's provinces.

The IEE report confirmed that the project's under category B according to ADB's guidelines. However, according to Environmental Protection Law 2005 and the relevant environmental policies and guidelines of the Government of Viet Nam, the Environmental Protection Commitment (EPC) Report for the project's should be prepared and submitted to the People's Committee of Hanoi for approval in the detailed design phase.

[1] TA 7105-VIE: Higher Education Sector Development Project.

B. DESCRIPTION OF SUBPROJECT

6 PROJECT DESCRIPTION

The development of HUST as a New Model University is a sub-project within the overall ADB Higher Education Sector Development Project.

It is expected to commence the construction in 2010 HUST will be an institution specialized in training at undergraduate, master and doctoral level in such field as Maths, Biotechnology, Computer and Information Technology, Chemistry, Material Science and Physics with lecturers staff are scientists of VAST and those from Universities of France, and other international universities as agreed.

The university area is 65 ha land area, including 27 ha lake in Education and Training Zone in Hoa Lac High Tech Park - Hanoi.

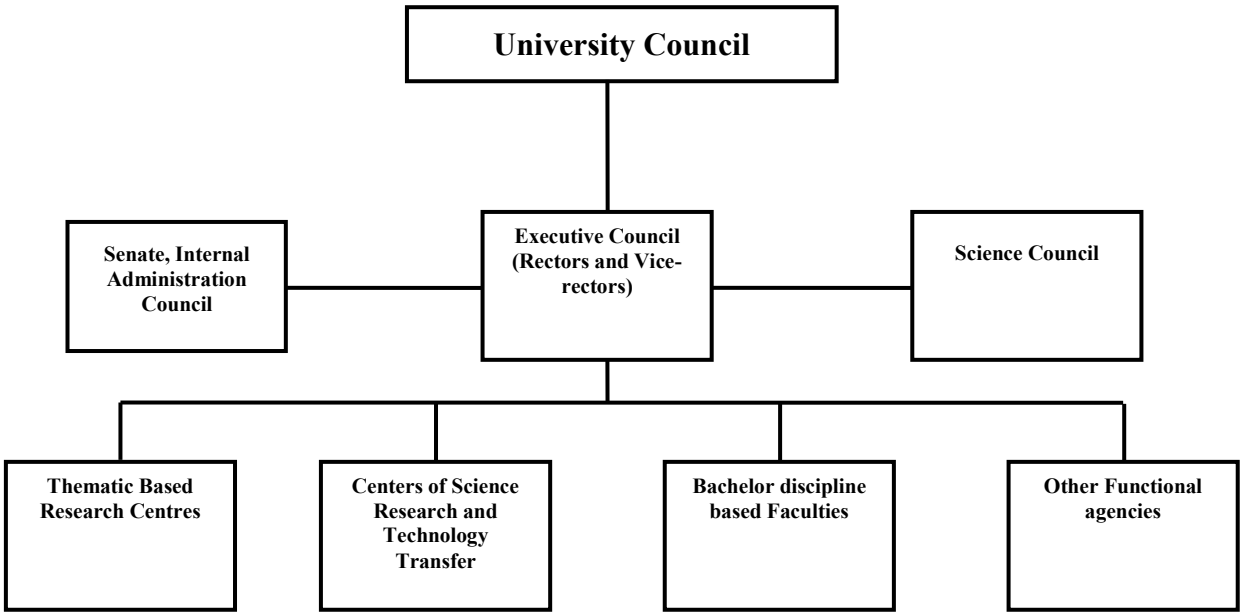
- HUST aims to become leading research based university in Vietnam, which is expected to be established in 2009 with 100 students enrolled in 2010, and basic campus construction to be completed by 2015.
- By 2016, all conditions are planned to be ready for implementing the management under international standard (50% of Vietnamese lecturers meet international standards, 10% international foreign students, scientific works will be published in international refereed scientific journals), so that by 2025 the university will meet basic criteria to be ranked in the list on international universities in the region and in the world.

HUST has the following main responsibilities:

- High academic training in fields of high demand from society at the level of undergraduate, master and doctoral level with an aim to foster talented people for the country, lecturers and research staff for universities and colleges in the higher education system and for research institutes, and provide high qualified human resource for high tech parks.
- To conduct scientific research aiming at developing basic scientific and technological knowledge and finding practical solutions for questions of the socio-economic development process; taking part in providing Party's and State's leaders at central and local levels with advises on strategies, policies and solutions for science-technology, education-training, socio-economic development, closely combining training with researching and production and science-technology service activities.
- To serve the function as a place for testing advanced models, new and more open policies on higher education management to draw lessons and experience, on which macro – policy on higher education can be adjusted as well as the guidance on practical implementation of the Decision 14/2005/NQ-CP on the basic and comprehensive renovation of Vietnam's higher education system issued by Government can be more close to the reality.
- -To provide experiences for other universities in Vietnam in terms of higher education system, academic management and scientific research, curriculum development, advanced teaching methods application, renovation of methods of researching, assessing and recruiting lecturing staff.

- To be a "lead contact" of four parties (HUST, VAST, foreign university – other local universities) on training, scientific research, and lecturers exchange. Therefore, it contributes to accelerating the renovation of Vietnam's higher education system.
- Developing languages and cultures of other partners in Vietnam; meanwhile functioning as a bridge for co-operating and exchanging between Vietnam and other industrial advanced countries in the areas of academics, culture, economics, society and investment, among others.

Figure 1 - The Organization structure is presented in figure 1 herein



7 *TRAINING SCOPE*

The training scope of HUST will be identified based on the needs of the country's socio-economic development as well as on the training capacities of the teaching staff and the physical facilities available in the University. HUST will be based on multi-disciplinary areas of research and teaching. Initially there will be six thematic areas developed with support form the French consortium of universities. These areas will be:

Figure 2 – HUST Discipline Mix

Undergraduate Disciplines	Research Themes
Physics	Biotechnology and Pharmacology
Chemistry	Aeronautics and Space
Biological Sciences	Information Technology
Information Technology	Energy
Materials Science	Materials and Nanotechnology
Engineering Science	Water, Environment and Oceanography
Mathematics	

With the existing scientific force, HUST can meet the highest requirements of teaching staff. However, in order to guarantee the training quality right from the beginning, the training scope – both in terms of number of training subjects and number of students – will be gradually expanded.

8 DEVELOPMENT STAGES OF HUST AND CAMPUS BUILDINGS

HUST is recommended to have three main stages of development:

Establishment: Initial academic development and construction of new campus - 2010-2015

Consolidation: implementing teaching and research on the new campus and operating at initial design capacity for 5000 students – 2016-2020

Expansion: expanding range of programs and student growth – 2021-2030

Construction works of HUST should ensure the following planning principles:

- The design should be modern, combined with national identity.
- Serve the design usage purposes, and be fully used.
- Serve the teaching and meet the needs of all kinds of learners in the university (people from different ethnic minorities, religions and people with disabilities, etc).
- Ensure the area for building works to be in appropriate proportion with green spaces, internal roads and appropriate with advanced universities (meeting the requirement that HUST will develop to become an institution equal to other universities in the region and in the world).
- In designing and planning, it is necessary to take into account of long-term development expectations of HUST in the future, and a proportion of land should be reserved for later expansion in an appropriate manner with the university development strategies for different stages.
- Parking area should be in line with development requirements (automobile usage should be minimised to create quite clean areas, parking area should be in the peripheral areas and in basement of high buildings; internal parking area and parking area for guests should be considered together with the possible automobile users in the next 10 years), area for parking motorbike and bicycle for students.
- Area for medical services, culture and consumption should be in line with the size of universities.
- Ensure the provision of infrastructure to be in line with the demand of usage and development (system of electricity and water supply, security, fire protection and fighting, etc).

The demand of using land for construction and buildings - works

- Land for construction is expected to account for 45% the land of the university.
- Construction area for each block of building will be calculated in details under the plan of HUST for each development stage.

Expected buildings include:

- Administration centre;
- Lecture hall blocks;
- Laboratories;
- Library;
- Field – work plant;
- Student services area;
- Sport field (football, basketball, volleyball, tennis, etc...);
- Parking areas;
- Warehouse;
- Guest house;
- students dormitory;
- Grass – green tree;
- Internal road –

9 SPATIAL PRINCIPLES FOR THE FUNCTIONAL STRUCTURES – BASIC PLANNING

The functional organizations should have spatially appropriate architecture based on centripetal principle, i.e. the central buildings are often higher-rise buildings, the surrounding blocks often have medium height – the lowest will be the exterior blocks and the fences (in case there are fences and the open-space model of campus of many international universities is not an option here). HUST buildings will comply with design principles of the Hoa Lac high Tech Park and not exceed 10 stories.

During phase 1 the key buildings of HUST main blocks will be constructed with contingent area and space appropriate for future development.

The Internal road system reasonably connects to the new Highway 21, leading to the urban transportation system. The roads will be constructed to ensure that the pedagogical environment is not affected by heavy transportation with lower than allowable level of air and noise pollution.

Reasonable space must be allocated for the studying area which also should be close to the green tree and grass covered areas. This studying area should also be associated by the supplementary equipment in order to create a suitable studying environment for students in the classrooms, outside in groups, and self-study by students.

Laboratories will be designed and constructed in designated areas of the main academic zone. They will have adequate access to the waste water treatment system and have good system for air discharge. Chemical labs will be designed to ensure the least allowable level of impact to the environment.

Student dormitories should have entertainment units such as small-size club, reading area which should be close to the sports area (football field, baseball and basketball fields, for students' usage after each day of learning.

Student dormitories generally should consist of student room, general meeting area, and sanitary areas

The service area should be located appropriately and meet students' essential needs and affordability (food and foodstuff shops, canteen, stationary, fast-food, and refreshment shops and other community services and shops).

Libraries should have design and location suitable for each type of library (traditional library, e-library, and faculty library…)

Multifunctional sports block should be constructed close to the dormitory with buffer areas of green trees and grass-covered areas in order to create airy space and reasonable distance and limit the impact on the living and studying areas.

The sporting areas include multi-purpose outdoor facilities suitable for football, tennis, baseball, and other team ball sports, running, high, long and pole jumping.

Swimming pools may be constructed in a second phase of construction investment, perhaps in the expansion phase.

10 LOCATION OF HUST.

HUST is located in the designated Education zone of the Hoa Lac High Tech Park, west of Hanoi, about 30Kms from the main urban areas of Hanoi. This zone is in the Thach That District, Hoa Lac, Hanoi)

Maps showing the location of HUST are below.

Map 1

Map 2

Map 3

.C. DESCRIPTION OF THE ENVIRONMENT

The land belongs to the HHTP in Thach That district, Hanoi. Below are some main features on natural and socioeconomic conditions of the project area

11 SOME FEATURES OF NATURAL CONDITIONS

Location, geography:
Thach That District has a half of its land to be low undulating mountainous area, locating in the North West of Hanoi Capital. Its North and North East is next to Phuc Tho district. The South and South East is next to Quoc Oai district. The West borders Son Tay Town and Ba Vi district. The South West is adjacent to Luong Son district, Hoa Binh province. Thach That district has hills in the West.

Thach That District has 20,250,85 ha area of natural land and 179,060 population, 23 internal administrative units, and communes of Bình Phú, Bình Yên, Canh Nậu, Cần Kiệm, Cẩm Yên, Chàng Sơn, Dị Nậu, Đại Đồng, Đồng Trúc, Hạ Bằng, Hữu Bằng, Hương Ngải, Kim Quan, Lại Thượng, Phùng Xá, Phú Kim, Tân Xã, Thạch Hòa, Thạch Xá, Tiến Xuân, Yên Bình, Yên Trung and the Lien Quan town

Climate:

The project area has monsoon tropical climate; the rain and storm concentrates from July to September; during heavy rainy days there may be sudden sweeping flood and large water volume which is especially dangerous with the area near springs. The average annual rainfall is 1,800 – 2,000 mm. The highest annual average temperature is 29oC and the lowest is 14oC. Three months have an average temperature of 36-370C, including is August, September and October; the coldest month is in January.

- Average annual rainfall: 1,900 mm
- Average temperature: 23,3°C, there exists the differentials between area. In summer the temperature in plain area is 36-37°C, rising to low 40osC at times. In winter, the temperature in highly mountainous area can reduce to 3°C.
- Number of hours of sun/year: 1,399 hours
- Average relative humidity: 70-85%

12 SOME FEATURES OF SOCIO-ECONOMIC CONDITIONS

The Project area locates in the North of the former HaTay Province with many important traffic routines such as National Road 32, Hoa Lac highway, National Road 21A - the linkage point that is the start of the Ho Chi Minh road connecting Thach That district with provinces in the North West; provincial road 80, 84 connects district centre with adjacent districts. Thach That has very favourable conditions for developing economy and trade.
Especially, with the establishment of HLHTP, Industrial Zone in the North of Phu Cat district, National University, Hanoi, Culture village of Vietnamese nations, together with

industrial zones of Binh Phu, Phung Xa, etc in the area, Thach That is becoming a place with the most robust industrial development in the province of HaTay and is becoming one of the strongest economic development place of current Hanoi.

With plentiful handicraft villages system (35/54 handicraft villages, with 8 villages are recognised to be handicraft villages), it has old-aged tradition of over 100 years and is well – known in the whole nation with such handicraft village of Chang Son, Phung Xa metallic and machenic handicraft village, Huu Bang village, etc. Thach That district is rated to have potential to develop industries and small industries.

Moreover, with over 400 ha area of hill of Dong Truc and many famous landscapes, historical and natural relics, Thach That also has potential to develop tourism - services; artistic architectural relics of Chua Ca (Ca Pogoda), (Sung An Pogoda) under state regulation on cultural heritage. Thach That has following historical relics: Tay Phuong Pogoda in the mountain of Cau Lau, Thach Xa commune, Thach That District, Ha Tay (30 km from Hanoi center).

With the location in the high tech park of the state and city's industrial zones, Thach That industries and small industries will have conditions to develop, bringing industrial proportion to account 40% in 2005 and 65% by 2010 in the district economic structure. Positive transition of agricultural and industrial production activities has brought back chances for service – trade in the district to be more developed in the recent years, accounting for 27.6% GDP. The value of service -trade – tourism activities increases annually 7.4%/year. Many trade and business units have existed in communes and villages. Goods markets are becoming more abundant and various, meeting consumption requirements of people and of production.

13 ENVIRONMENTAL STATUS

Air and noise quality

Samples were taken and analysed for air quality in the project area and surrounding residential area. The results are presented in Table 4.

Table 1 . Air quality in the project site.

(date of observation is 23/7/2009).

No.	Parameter	Unit	K1	K2	K3	Vietnam Standtard 5937 - 2005
01	Dust	$\mu g/m^3$	70	65	175	300
02	SO_2	$\mu g/m^3$	50	50	75	350
03	NO_2	$\mu g/m^3$	55	50	80	200
04	CO	$\mu g/m^3$	kph	kph	100	30.000
05	Ồn	dBA	65 - 67	55 -60	60 -65	60(**)

Note::

- *TCVN 5937 - 2005: Air quality – limit basic parameters in the surrounding air (average of 1 hour);*
- *(*) TCVN 5938 - 2005: Air quality - The maximum allowed concentration toxic agents in the air - (average of 1 hour);*
- *(**) TCVN 5949 - 1995: Acoustics – Noise from community and residential area – the maximum allowed noise;*
- *-Kph: not discovered*

The places where samples were taken include:

+ K1 : Surface of the road to the army area (the area belonging to the project site)
+ K2 : In the centre of the project site
+ K3 : Road of residential area that is nearest to the project (0.5 km from the project site)

Samples were taken under the climate of sun with slight wind.

Illustrations of sampling are shown in pictures below.

Picture 1 – Machine to take dust sample

Picture 2 – Measuring dust and waste in the project site

Picture 3 – Observing noise in the residential area that is nearest to the project site (0.5 km from the project site)

Picture 4 – Observing the micro-climatic condition in the residential area that is nearest to the project site

(0.5 km from the project site)

Table 5 : Micro climate condition when observing

(Date of observation is July 23, 2009).

No.	Criteria	Unit	Notation of sample		
			K1	K2	K3
1	Temperature	^{0}C	29,4	29,2	28,2
2	Humidity	%	55,6	55,4	54,5
3	Pressure	mmHg	758	757	755
4	Wind direction	-	B-TB	B-TB	B-TB
5	Wind speed	m/s	1,7	1,6	1,6

Remarks: Results of analysis in the table 5 has shown that in general the air quality in the project site is relatively good. The noise is low and under the allowed range according to standards.

Water quality

Surface water quality

Picture 5 – Taking water from lake of a household that is near the project site (Mr. Nguyen Van Thanh household) (300m from the project site).

Picture 6 - Observation of water near project site

Picture 7 – Machine for quickly measuring some parameters in water environment

The results of analysing water surface in the project site is shown in Table 6.

Table 2 : Surface water quality in the project site

(samples takes on 23/7/2009).

No.	Criteria	Unit	Notation of the sample	
			NM1	NM2
		-	7,3	7,2
2	Temperature	^{o}C	29,1	25,4
3	Electricity conductive	mS/m	83	10
4	Cloudy	NTU	32	155
5	DO	mg/l	5,31	6,8
6	BOD_5	mg/l	6,3	6,2
7	COD	mg/l	18,1	18,2
8	N total	mg/l	4,81	3,44
9	$N\text{-}NO_3^-$	mg/l	0,53	0,11
10	$N\text{-}NO_2^-$	mg/l	0,02	0,02
11	P total	mg/l	0,046	0,049
12	$N\text{-}NH^{4+}$	mg/l	0,24	KPH
13	SS	mg/l	25	79
14	Mn	mg/l	0,42	<0,01
15	Fe	mg/l	1,46	0,85
16	As	µg/l	8	8
17	Cd	µg/l	<5	<5
18	Lubricance	mg/l	KPH	KPH
19	Coliform	MPN/100ml	1500	150

Samples of surface water taken from:

NM1: water in the fish breeding lake of Mr. Nguyen Van Thanh's household (300 m from the project site)

NM2: Water of lake (200m from the project site)

Remarks:
Under the analysis result in the above table and in referring to QCVN 08 2008/BTNMT, type B1 – National Technical Standards on the surface water quality (table in annex 1) shows that almost all parameters are in the allowed range.

Underground water quality
Residents surrounding the project site use only water from wells. Two samples of underground water were taken randomly in the household wells of two families near the project site:

Samples were taken for investigating underground water near the project site from:
Sample NN1 – Mr. Nguyen Van Thanh's household (well is 12m deep, 300m from the project site)
Sample NN2 – Mr. Pham Van Vui (the well is 8m deep, 1.2km from the project site)
Results of analysing underground water quality shown in the following table:

Table 3 - Results of analyzing underground water near project site
(samples taken on 23/7/2009).

No.	Paramaters to be analyzed	Unit	Results	
			NN1	NN2
1	pH	-	6,8	7,12
2	TDS	mg/l	2.250	2.485
3	Electricity conducive		4250	4875
4	Cloudy	NTU	1,2	1,2
6	Suspended sediment	mg/l	1,2	1,5
7	COD	mg/l	15,5	17,5
8	$N\text{-}NH_4$	mg/l	11,2	12,5
9	Total N	mg/l	11,5	9,5
10	Total P	mg/l	5,2	5,5
11	Fe	mg/l	0,12	0,15
12	Coliform	MNP/100ml	15	17

Comments on underground water quality:
Results of investigation have shown that in this area people often dig shallow wells (an average of 10m). Results of analysing some main parameters of well water quality in the project site have shown that underground water has low metal content, however, water is high in salinity and polluted, containing $N\text{-}NH_4$, Coliform, which exceeds the allowed level (QCVN 09:2008/BTNMT – National Technical Standards on underground water), details as follows:
For the parameter of $N\text{-}NH_4^+$
Sample NN1 and NN2 identifies the value of $N\text{-}NH_4$ is 11,2 mg/l and 12,5 mg/l, whereas in which according to QCVN 09:2008/BTNMT (National Technical Standards on underground water quality) regulates the value of $N\text{-}NH_4$, is 0,1 mg/l

For the parameter of Coliform

Sample NN1 and NN2 identifies the value of Coliform is 15 MNP/100ml and 17 MNP/100ml, in which according to QCVN 09:2008/BTNMT (National Technical Standard on underground water quality) the regulated value of *Coliform* is 3 MNP/100ml.

Status of land environment - Soil sampling

In fact-finding trip, soil samples were taken to identify some heavy mental and some criteria of soil "agriculturalization".

Illustrations of sampling are shown in pictures below. Results of soil sampling are in Table 4.

Picture 8 – Taking soil sample in the garden of Mr. Nguyen Van Thanh's household, 300 m from the project site.

Picture 9 - Taking soil sample in the field beside the project site

Results of analyzing soil sample are presented in Table 4 :

Table 4 – Results of analyzing Soil sample

(samples taken on 23/7/2009)

No.	Criteria	Unit	Results of analysis			
			D1	D2	D3	D4
1	pH_{KCl}		7,2	7,0	7,2	7,0
2	Total of Nitơ	mg/kg	322,0	325,5	307,7	762,2
3	Total of Photpho	mg/kg	150,5	185,2	182,7	167,2
4	Flexible Al	mg/kg	9.7	7,5	8,5	8,0
5	Fe	mg/kg	17855	16567	18262	17955
6	Cu	mg/kg	9,29	7,6	8,2	9,5
7	Pb	mg/kg	5,5	5,6	7,2	5,9
8	Zn	mg/kg	40,5	42,2	41,5	42,2
9	As	mg/kg	7,7	7,5	7,0	7,7

Note: Location of soil sample is as follows:

D1 – Soil in the garden of Mr. Nguyen Van Thanh's household, 300m from the project site.
D2 - Soil in the garden of Mr Pham Van Vui, 1.2 km from the project site
D3 – Soil in the project site
D4 – Soil in the field next to the project site

Comments: Content of heavy mental is below the allowed level according to QCVN 03 : 2008/BTNMT 2008-12-30 – National Technical Standards on the allowed limit of heavy metal in land (annex).

14 ECOSYSTEM AND ANIMAL RESOURCES

Land animals:

The ecosystem of the project site is a man-made one. Vertebrate fauna near the project site are mainly black rat, brown rat, house – mouse, shrew, house gecko, lizard, several types of frog and tree frogs. Besides, there are some domestic animals such as dogs, cats, pigs, etc.

Wild animal:

20. About 10km from the project site, there is a national garden in Ba Vi. Below is the copy of list of rare and valuable animals that have been listed in Redbook (Table 9)

Table 5– List of animals in Thach That district that is considered to be rare and valuable animals in the Redbook of Vietnam

Type of Anima	Level of rareness and valuableness
Megophrys Longipes (Boulenger, 1885)	Level T
Orientalia glabra (Dang, 1967)	Level R
Kerria lacca (Kerr, 1782)	Level V
Leptocircu curius (Fabricius)	Level T

Note on Levels of threat:

Endangered (E) – Under threat of extinction
Category under threat of extinction if threatening factors are maintained. This contains categories where species numbers are reducing to an alarming level where they are in deteriorating living conditions that may lead to becoming extinct.
Vulnerable (V) – Will be under danger (possibly to be under the threat of extinction)
Category that will be under threat of becoming extinct (in the near future) if threatening factors are maintained. This contains species where the majority, or all of their community has reduced due to overexploitation, and/or living condition is sabotaged or due to other changes in living conditions. This type also contains species which, though their number is still high, can be in danger due to its high economic value for hunting and exploitation.
Rare (R) – (can be under danger)
This contains categories that have limited distribution (especially of branch – single type), or has limited number; although they have not been the targets that are or will be in danger, their long existence is fragile.
Threatened (T) – *under threat*
Categories belonging to one of the above type, however, documentation is not enough to rank them in any specific type.

Macrophyte in Tich river

The project site has the Tich river in close proximity (5km from the project site)
Results of investigating Tich river as as follows:
Macrophyte: Some macrophytes that are easy to see in Tich river are: *Marsilea quadrifolia L*, *Eichhornia crassipes*, *Ipomoea aquatic*, *Colocassia esculenta*

Phytoplankton: Normally seen are *Chlorophyta*, *Cyanophyta*, *Pyrrophyta*.
Zooplankton: Normally seen are *Copepoda*, *Rotatoria*, *Ostracoda*…
(Zoobenthos: Normally seen are *Sinotaia aeruginosa, Angulyagra polyzonata*, mussel, oyster, shrimp and crab, etc

Fish: the river contains fish of many types that are characterized as normal for the area, such as pike, eal, mud carp, carp, tilapia, etc as shown in Table 10)

Table 6 – Raised fishes that are observed in Tich river

Type	*Scientific name*
Cyprinidae	Mrigal *Cirrhinus mrigala* (Hamilton, 1822) Grass carp *Ctenopharyngodon idella* (Valenciennes, 1842) Common carp *Cyprinus carpio* Linnaeus. 1758 Silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1844) Rohu *Labeo rohita* (Hamilton, 1822)
Clariidae	catfish *Clarias gariepinus (Burchell, 1815)*
Pangasiidae	*Pangasius bocourti Sauvage, 188*
Tilapia Cichlidae	tilapia *Oreochromis mossambicus (Peters, 1852)* Nile tilapia *Oreochromis niloticus (Linnaeus, 1757)*

D. FORECASTING ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The only project activities that will have environmental considerations are the campus construction activities under component C.

15 ENVIRONMENTAL IMPACT POTENTIAL DURING PROJECT CONSTRUCTION PROCESS

Impact Source

Source related to waste

Currently, the project has completed some levelling processes and the main sources that could cause negative impacts on the environment are:

- Space levelling, materials gathering, infrastructure and university construction (classroom, laboratory, working office, entertainment area):
- Procurement, transportation, installation and pilot operation:
- Workshop/ conference in order to plan activities when the project comes into operation:

Technical and social infrastructure construction is expected to take place over four years from about 2011 to 2015.

Among all project designing and building activities, facilities building (classroom, laboratory, working office, entertainment area) is the most concerning activity due to its negative impact to the surrounding environment (table 11).

Table 7 . Activities, sources that cause negative impacts during construction phase

Ref	Activities	Sources
1	Space levelling	Bulldozers to level the space; Trucks to carry the materials for levelling.
2	Material gathering, storage, and preservation for construction	- Trucks to carry construction materials: cement, iron, sand, stone, causing dust and exhaust - Causing pollution leakage and spread from material and oil/petrol storage, etc - - Causing noise pollution
3	Building houses, transportation system, storage yard, parks, water supply and drainage system, water treatment system, ..	- Negative impact from construction machines - Thermal processing: cutting, welding, heating that cause air, land and water pollution - Air pollution from concrete and construction materials - Landslip
4	Installation of civil equipment, electrical equipments and telecom facilities, ...	- Exhaust, dust, noise from material transportation for equipment installation and machine operation, - - Thermal processing: cutting, welding, heating.
5	Activities of worker at project site	Of more than 200 workers in the construction site

Source related to non-waste

We can name here some sources related to non-waste during construction process as below (Table 8)

Table 8– Sources related to non-waste during construction process

Ref	Source
1	Rain water causes partial water logging, land and soil erosion.
2	If the area is not well reinforced, depression can happen to the surroundings
3	The gathering of certain amount of workers can be the risk to disorder the social life of local resident.

Affected Objects, Area During Construction

These can be shown in the Table 9 and Tables 10 below

Table 9 . Affected objects, area during project construction

Ref	Affected objects	Affected area
1	Project land	There can be land erosion and pollution in the whole area of project site (65 ha of land in Hoa Lac)
2	Worker and local resident	All worker taking part in the construction and neighbouring households
3	Transportation road	About 10km in the route used for material transportation such as: Lang Hoa Lac Motorway, Highway 21, road E (project belt road)
4	Atmosphere of project site	Affected within a radius of 2km from the centre of project construction site
5	Surface and underground water	Tan Xa lake will be affected - Impact level is not serious because HHTP has applied method to treat wastewater and waste.

Table 10 . Affected objects, area during project implementation

Ref	Affected objects	Affected area
1	Flora	Flora (mainly rice, forest tree: Acacia mangium)
2	Project land	Whole land of project site is changed for different use-purpose
3	Transportation road	Increase vehicle flow in local transportation road and inter-regional road.
4	Atmosphere of project site	Mainly in Project land and some area surround (200m away from project border)
5	Surface and underground water	Impact level is not serious because wastewater is well treated before flowing to the receiving stream.

16 ENVIRONMENTAL IMPACT ASSESSMENT DURING CONSTRUCTION

Space levelling, material gathering, facilities and infrastructure building (classroom, laboratory, working office, entertainment area

Impact on the air

Space levelling process

Impacts on the **air** during construction period includes:

- Dust due to soil levelling, material transportation (stone, sand, cement, iron,..)
- Dust and gas (SO_2, NO_2, CO, THC) due to vehicle exhaust during material transportation for levelling and construction
- Heat radiation from thermal process, welding fumes (cutting, welding, Bitum heating).

Air pollution due to levelling and construction material gathering at project site
Air pollution from levelling materials:

Construction area is approx 620,000 m^2, the average height of the space is 0.9 m. The total amount of soil and sand for levelling is approximately at 830,000 m^3. Therefore, the amount of trucks estimated to carry in and out the above mentioned soil and sand is 33,200 vehicle turn (each truck will be carrying about 25 m^3).

Table 11. Amount of trucks used during levelling phase

Levelling area (m^2)	Amount of vehicle needed to transportation (trucks)	Flow (vehicle/day)
620,000	33,200	426
Remark: A month consists of 26 days (3 implementation-months)		

Vehicle flow for levelling process is at the peak of 426 vehicle/day. The average number of vehicle running within one hour is 426 : 8 ~ 53 turn/hour.
In accordance with World Health Organization (WHO), a DO & Diesel consuming vehicle with capacity of over 16 tons will produce the following figures:

- Dust: 1,6 kg/1000km/vehicle
- CO: 3,7 kg/1000km/vehicle
- SO_2: 7,43S kg/1000km/vehicle
- VOC: 3,0 kg/1000km/vehicle; and
- NO_2: 24,1 kg/1000km/vehicle.

The amount of sulphur in Diesel is 1%, so the polluted amount can be calculated as below:

- Amount of dust: E_b = 53 x 1,6 = 84,8 kg/1000km.h = 84,8 g/km.h
- Amount of CO: E_{CO} = 53 x 3,7 = 196,1 kg/1000km.h = 196,1 g/km.h
- Amount of SO_2: E_{SO2} = 53 x 7,43 x 1 = 393,79 kg/1000km.h = 393,79 g/km.h
- Amount of NO_2: E_{NO2} = 53 x 24,1 = 1277,3 kg/1000km.h = 1277,3 g/km.h
- Amount of VOC: E_{VOC} = 53 x 3 = 159 kg/1000km.h = 159 g/km.h.

Infrastructure construction phase

During the infrastructure building, there will be many means of transportation and machinery equipments. Besides that, the number of material transporters will increase local transportation flow. These machines will cause pollution to the air during their operation.

- Polluted by dust/soil
- Polluted by exhaust from means of transportation in and out project site
- Polluted by exhaust from vehicle during implementation process.

According to BVMT (US EPA) and WHO, the amount of pollutants caused from petrol consuming vehicles and trucks are as below in Tables 12 and 13:

Table 12: Amount of pollutants from petrol consuming vehicles

Pollutants	Amount (g/km)		
	Engine <1400cc	Engine 1400-2000cc	Engine >2000cc
Dust	0,07	0,07	0,07
SO_2	1,9 S	2,22 S	2,74 S
NO_2	1,64	1,87	2,25
CO	45,60	45,60	45,60
VOC	3,86	3,86	3,86
Remark: S is the amount of sulphur in oil and petrol (%)			

Source: WHO, Rapid Environmental Assessment, 1993.

Table 13 : Amount of pollutants from running vehicles

Pollutants	Amount (g/km)					
	Load capacity <3,5 tons			Load capacity: 3,5-16 tons		
	Within city	Outside city	Highway	Within city	Outside city	Highway
Dust	0,20	0,15	0,30	0,90	0,90	0,90
SO_2	1,16 S	0,84 S	1,30 S	4,29 S	4,15 S	4,15 S
NO_2	0,07	0,55	1,00	1,18	1,44	1,44
CO	1,00	0,85	1,25	6,00	2,90	2,90
VOC	0,15	0,40	0,40	2,60	0,80	0,80
Remark: S is the amount of sulphur in oil and petrol (%)						

Source: WHO, Rapid Environmental Assessment, 1993.

In order to identify the amount of pollutants caused by vehicle during construction implementation we have to base it on vehicle flow within project site. It is assumed that standard means of transportation is the vehicle with loading capacity of 3,5 - 16 tons. It is estimated that project vehicle flow is 60 vehicle/hour and the number of service means of transportation is 12 vehicle (5% of standard vehicle). Thus, the number of vehicle running in project site is 72. So, the amount of pollutants is shown in Table 14.

Table 14: Amount of air pollutants during infrastructure construction phase

Pollutants	Exhaust coefficient (g/km/vehicle)	Turn (vehicle/hour)	Amount (g/km.h)
Dust	0,90	72	64,8
SO_2	4,15	72	298,8
NO_2	1,44	72	103,68
CO	2,90	72	208,8
VOC	0,80	72	57,6
Remark: S is the amount of sulphur in oil and petrol (%)			

Source: WHO, Rapid Environmental Assessment, 1993.

Noise pollution caused by means of transportation during construction process

Apart from exhaust and dust, means of transportation also produces noise that has a negative impact on the local environment. Noise and vibration arising during infrastructure construction are mainly from means of transportation, concrete mixing machine, etc

In accordance with Vietnamese standard for permitted noise level (TCVN 3985 - 1985) and the maximum limit for noise at public area (TCVN 5949 - 1995), it is required that noise levels do not exceed 85dBA in researching, teaching area and 40dBA in library and school areas (22 h to 6h next day)

The Reference from technical documents, the calculated noise level generated by means of transportation and machinery equipment is shown in Table 15

Table 15 . Noise level from means of transportation and machinery equipment

Ref	Equipment	Noise level (dBA), from distant 15 m	
		Document (1)	Document (2)
01	Bulldozer	93,0	-
02	Rammer &compressor	-	72,0 - 74,0
03	Front bucket excavator	-	72,0 - 84,0
04	Tractor	-	77,0 - 96,0
05	Land- rimming machine	-	80,0 - 93,0
06	Paving machine	-	87,0 - 88,5
07	Truck	-	82,0 - 94,0
08	Concrete-mixer	75,0	75,0 - 88,0
09	Concrete-pump	-	80,0 - 83,0
10	Mobile derrick	-	76,0 - 87,0
11	Compressor	80,0	75,0 - 87,0

Source:
Document (1) - Nguyen Dinh Tuan and associates;
Document (2) - Mackernize, L.da, year1985.

Therefore, almost machinery equipments exceed the maximum level for permitted noise standard. The project will have to provide appropriate solution to minimize these impacts to worker participating in project construction and local resident.

Impact from wastewater and rain water

During infrastructure building process

- *Wastewater discharge from construction activities*

Wastewater for washing building materials; water pumped out from foundation ditches during the construction phase; the excavation for construction works; the composition of wastewater are mainly sediment, soil, cement and oil

According to Centre for Environmental Engineering of Towns and Industrial Areas (CEETIA) concentration of pollutants discharge by construction wastewater is as in Table 16

Table 16 : Concentration of pollutants in construction wastewater

Ref	Criteria	Unit	Construction wastewater	Vietnamese standard 5945 - 2005 (B)
1	pH	-	6,99	5,5-9
2	SS	mg/l	663,0	100
3	COD	mg/l	640,9	80
4	BOD_5	mg/l	429,26	50

5	NH_4^+	mg/l	9,6	10
6	Total N	mg/l	49,27	30
7	Total P	mg/l	4,25	6
8	Fe	mg/l	0,72	5
9	Zn	mg/l	0,004	3
10	Pb	mg/l	0,055	0,5
11	As	µg/l	0,305	0,1
12	Oil	mg/l	0,02	5
13	Coliform	MPN/100ml	53.10^4	5.000

Source: Centre for Environmental Engineering of Towns and Industrial Areas (CEETIA)

Based on the analysis from the above table, some criteria for wastewater are in the permitted level as per Vietnamese Standard 5945 - 2005 for industrial waste discharged to source B (drainage channel). Criteria for SS is 6 times than the permitted level, the amount of COD is 8 times higher, BOD_5 is 8.6 times higher and coliform is 108 times higher. There will be negative impact to the surrounding environment if there is no control over these substances.

Recommendations for control of wastewater discharged through construction activities:

- Develop a drainage system in the construction site which is appropriate with the surrounding topography.
- Construction machines and tools shall be prohibited to be washed off in those locations that could lead the polluted water into the common water source. The storm-water run-off from construction sites shall not lead to sedimentation in current water sources, canals and ditches of the local area.
- Solid waste (disposed materials, sands, stones, etc) and waste oil from construction machines and equipments shall not be disposed of into any water streams. Wastes of all kinds shall be collected, classified and disposed of into proper locations as stipulated.
- Oil containing waste will be collected, treated and buried away from water sources.
- Waste grease and lubricants, as well as other waste from transported vehicles and construction machines shall be collected, treated and disposed of properly to avoid polluting water sources.
- Regularly examining and dredging the drainage system, so that sediments and solid waste cannot block the wastewater flow. That will help to avoid flow blockage and sanitation problems for project activities, as well as adverse impacts on irrigational systems and farming activities of people living in project area. .
- Building materials shall not be stored nearby drainage system to avoid leakage into the drainage sewers.

Recommendations for control for domestic wastewater

Building workers' domestic wastewater will be treated by septic tanks available in construction site.

Recommendations for reducing pollution caused by storm-water run-off:
During construction phase, it is necessary not to discharge wastewater directly into canals and ditches nearby. There should be a water tank provided in the project area for initial sedimentation of wastewater before being discharge into the drainage system in the construction site.

Wastewater from domestic activities
It is expected there could be 200 or more worker at the construction site during peak periods. According to Vietnamese Construction Standard (TCXDVN 33-2006) attached with Decision 06/2006/ QĐ-BXD dated 17/03/2006, each worker in the construction site consumes 25-45l of water per day. Therefore, the water volume that will be used by workers at peak period is: 45x200 = 9 m^3/person/day. Domestic wastewater is calculated by 80% of consuming water. Therefore, domestic wastewater during project construction phase is:

$$Q_{NTSH(gđ\ xây\ dựng)} = 9 \times 80\% = 7,2\ m^3/person/day$$

Therefore, using WHO standards, the daily amount of pollutants to the environment during construction phase is calculated as in Table 17 :

Table 17: Amount, concentration of pollutants in domestic wastewater during construction phase

Pollutants	Discharge coefficient (g/person/day)	Total amt discharged (kg/day)	Concentration of pollutants (mg/l)	TCVN 6772-2000, Level III
BOD_5	45-54	9,00-10,80	562,5-675,0	40
COD	75-102	15,00-20,40	937,5-1275,0	-
TSS	70-145	14,00-29,00	875,0-1812,5	60
Ammonia	2,4-4,8	0,48-0,96	30,0-60,0	40 (NO_3^-)
Total N	6-12	1,20-2,40	75,0-150,0	-
Total P	0,8-4,0	0,60-0,80	10,0-50,0	-
Oil	10-30	2,00-6,00	125,0-375,0	20
Coliform (MPN/100ml)	10^6-10^9	-	10^6-10^9	5000 MPN/100ml
Faecal coliform (MPN/100ml)	10^5-10^6	-	10^5-10^6	-

Source: WHO, Rapid Environmental Assessment, 1993.CVN 6772-2000: Standard for domestic wastewater (level III)

The above analysis shows that if environment sanitation and treatment measures are not properly implemented, domestic wastewater will generate significant problems to the local water environment, causing high risk of infectious diseases for people, especially those working staff within project site who will get the most direct impact.

Impact of rainwater overflow
The overflow of rain water can be stagnant, hindering construction process if there is not any proper drainage method. Besides that, rainwater can sweep away soil and other pollutants from land surface to water surface, causing sediments and negative impact on the water environment, directly affecting water life forms.

Generally speaking, the impact of rainwater overflow during construction phase is not much. Rainwater has high turbidity due to soil, or material dropping during construction. However, the HHTP has proper methods to minimize impact from rainwater overflow during construction phase.

Impact of solid waste

Sources that dispose solid waste during Infrastructure construction phase

Solid waste from construction

The construction phase will require disposal of various kinds of solid waste including: spoils, bricks, timber, oil sediments of construction machines from levelling work, road paving, foundation laying, machine installation. It is estimated that about 500kg/day of such solid waste disposed everyday; and the amount of oil discharged from machines is estimated at about 1000l/month.

Solid waste from domestic activities

During the construction phase, there will be about 200 workers in the construction site at peak period, the average solid waste disposed everyday is 0.5kg/person/day. Thus, the total of domestic solid waste everyday is:

$$\text{Domestic solid waste}_{(\text{gđ xây dựng})} = 0.5 \times 200 = 100 \text{ kg/day}$$

The wasted materials and domestic solid waste, though not much in quantity, could cause adverse impacts on the environment if not treated properly.

Solid waste disposed by workers can be classified by two types: non-biological disintegration (tin, beer can, nylon bag, glass bottles …) and biological disintegration (give-away food, fruit skins, give-away parts for fruit and vegetables, papers …).

- If there is no method to effectively cover the truck tank during transportation of materials, it can generate solid waste. And this solid waste can cause direct or indirect pollution (swept by rainwater), contaminating surface water (making water more turbid).
- Construction phase can cause solid waste such as fragments of bricks, irons, cement covers, timber stake, etc... However, these are usable waste, so the HHTP can reuse or selling to other units if they have demand to buy. So, if appropriately managed this kind of solid waste does not really pollute the environment.
- the possibility that this type of waste will generate too much pollution is low risk because the HHTP has implemented limits to the level of material gathering at construction sites within the Park, by providing for a system of purchasing materials at a place near the project site and preserving some elements, such as cement, irons, and oil materials in special sand based storage places.
- Facility maintenance on-site can also cause oil sediments, oil cans and oiled clouts… These can create serious solid waste, even when there is relatively small amounts disposed of. The HHTP should extend its control mechanism to include these and support their treatment as per the regulations on serious waste treatment, in order to minimize their potential negative impact on the regional environment.

Procurement, transportation, installation, pilot operation:
The negative impacts caused by procurement, transportation, installation, pilot operation of equipment are: air and noise pollution due to equipment transportation, installation, operation and storehouse building. Workshop/ conference can be planned to prepare for activities taking place in the project implementation.

Table 18 (next page) outlines some activities to manage this

Table 18- Source of impact related to waste

Component		Activities	Number of times		Number of participants/ time	Environment				
			Project design and construction phase	Project operation phase		Air environment	Water environment	Solid waste	Risks/ Problem	Socio-Economy
Construction policies										
1	To develop a detailed manual about the management of environmental impacts during construction	Workshop/ conference	1	1	Up to 30	Dust and exhaust from vehicle used in transportation of workshop representative	Domestic waste-water	Solid waste and laboratory		Laying a concrete foundation for education and training development
B: Development of training for workers to implement the policy										
1	To establish short training workshops for all workers involved on site for environmental management during construction	Workshop/ conference	1	1	Up to 30	Dust and exhaust from vehicle for transportation of workshop	Domestic waste-water	Waste water discharged by office activities		Laying a foundation to develop training
C: School building and facility supply Design, Building and facilities supplying for new-model universities.										
1	Design and build new-model universities.	Construction of (classroom, laboratory, working office, entertainment area …)				Dust & exhaust due to levelling space, material transportation -ion, noise pollution			Problem due to improperly implementation of regulation on safe labour during material transportation process	Laying a foundation to develop XXX training

2	Provide facility and equipment for new-model universities.	Procurement, transportation of equipment and facility				Dust and exhaust from vehicle during transportation of equipment				Access modern technology
		Installation and pilot operation of equipment and facility				Noise pollution due to installation of equipment			Problem due to improperly implementation of regulation on safe labour during material transportation process	Access modern technology
D: Management of project implementation										
1	Project management	Workshop, Conference		6	30	Dust and exhaust from vehicle for transportation of workshop	Domestic waste-water	Waste water discharged by office activities		Laying a foundation to develop training

Remark:
Project design, construction phase: Workshops and conferences are held within 2 years
Project operation phase: Workshops and conferences are held within the first year of operation

Air pollution

There are potential effects from:

- Air pollution due to dust and exhaust from vehicle of representatives and workers coming to workshop.
- Partially increase the vehicle flow at area nearby the university, leading to the risk of traffic jam and accidents.
- Making noise to local residents and surrounding offices due to meetings, entertainment and parties, etc..

While theoretically possible, the impact from the above mentioned activities is assessed as not high and not more than would be caused by normal traffic activity around the sites involved. This is because of the fact that the number of participants is not much (average of 30 persons per time), and they are divided into several times during 2 years and at different places at both centre and local.

Wastewater

Amount of wastewater

The amount of wastewater discharged from workshop activities for managing environmental impact during project design and construction phase is estimated to be negligible.

(**Development of training activities**). And most of the rest is: 30 m3/ day

(According to Vietnamese standard, the average wastewater of 100l/ day, accounting for 70% of water supplied while the water supplied after year 2010 is 150l/person/day).

Calculation of contamination due to domestic wastewater

Forecast results show that:

- In case domestic water is not treated

Polluted level of wastewater discharge from workshop/conference activities per day:

- The lowest: 1 kg/day BOD and 1,74 kg/day C0D (item 2: component B);
- The highest: 1,5 kg/day BOD and 2,61 kg/day C0D (item 1, component A and item 1, 3 of component B)

(In line with quick assessment of EPA on Pollutant concentration)

- Untreated

$BOD_{5=}$ = 50 (g/person-day)

COD = 87 (g/person-day)

- treated

$BOD_{5=}$ = 15 (g/person-day)

COD = 27 (g/person-day)

- In case wastewater is treated

The polluted level of domestic wastewater decreases considerably after treated, in detailed:

- The lowest: 0,3 kg/day BOD and 0,54 kg/day C0D
- The highest: 0,45 kg/day BOD and 0,81 kg/day C0D

Solid waste

Solid waste includes:

- Office solid waste (unused papers, ribbon, pen, floppy disk, broken and unused stationery. It is estimated to be 10 kg – 20 kg each workshop, conference.
- Solid waste disposed by representative to workshop and conference:
  + The maximum of domestic waste per day is 15 kg-day (for workshop and conference with capacity of 30 participants)
  + The minimum of domestic waste per day is 10 kg-day (for workshop and conference with capacity of 20 participants)

  (Based on 0,5kg waste/ person-day).

In general, most of these solid wastes can be recycled, easy to be disintegrated. They can be gathered and treated together with waste disposed from other activities.

Possible impact on the society

- Making the market price fluctuant (when purchasing food)
- Risk of spreading infected diseases

17 ENVIRONMENTAL IMPACT ASSESSMENT DURING PROJECT OPERATION PHASE

Impact source related to waste

Activities and source that cause negative impacts on the environment during project operation phase are as below:

Table 19 . Activities, sources that cause negative impacts during operation phase

Activities	Source
Means of transportation	Noise and exhaust containing pollutants such as SO_x, NO_x, CO, CO_2, THC, dust,…, causing air pollution.

Impact source related to non-waste

These sources are shown in the below table:

Table 20 . Source that cause impacts related to non-waste during operation phase

Ref	Source
1	Rainwater can cause partial water logging at project site if there is not any plan to ensure an effective water drainage.
2	More people working in the region can cause disorder in the area if there is not an effective management plan from project owner.

18 FORECAST ABOUT ENVIRONMENTAL RISKS

ENVIRONMENTAL RISKS DURING DESIGN AND CONSTRUCTION PHASE

Labour or traffic accidents

Generally speaking, labour or traffic accidents can happen suddenly during implementation period, however we can outline some cases as below:

- Accidents can happen when a worker cross the road to come in or get out of the construction site or it can happen right on-site due to construction equipment or material transportation vehicle
- Installation, construction and material transportation with high vehicle flow, noise and vibration can also cause labour accidents
- Carelessness and lack of labour safety facilities, or workers' shortage of awareness to follow labour safety regulations. All of these reasons can lead to unexpected accidents
- Hard work and continuous working duration may affect to workers' health, making them tired, exhausted or faint right on-site
- If one of these accidents happens, it can have serious impact not only on worker's health but also life, which is a great spiritual loss of the victim's family. Therefore, labour guarantee for worker on-site must be paid due attention.

Fire and explosion risks

Fire and explosion can happen during fuel transportation and storage or due to unsafety of temporary electricity system, generating loss of human beings and physical property during implementation. Reasons identified are as below:

- Fuel storage (paint, petrol, DO oil) for machines, technical devices during implementation period is the reason. If accidents happen, it can cause an adverse impact on human beings and physical property
- Power supply system for machinery, equipment can cause electrical shock, leakage, fire or explosion, … leading to economic loss or accident for workers
- Usage of thermal processing equipment (welding, boiling, heating of Bitumen for road paving...) can cause fire, burns or accidents if there is not any preventive methods.
- In general, fire and explosions rarely happen during implementation. However, once it happens, it will have great impact on human beings, property and environment.

ENVIRONMENTAL RISKS DURING PROJECT OPERATION PHASE

As this is planned project area, there should be low possibility to have any environmental risks. However, if there preventive methods and solutions are not applied, there will be great loss on human beings and economy if risks do occur. Some risks are listed as below:

- Fire and explosion: This will cause burning of the whole system, having adverse impact on people's health and working facility of teachers and students.
- If the foundation reinforcement is not well done, there will be wall cracking and building subsidence, causing loss for the university and the surroundings.
- project activities can cause traffic accident and traffic jam, partial water-logging if the project is not properly designed from the beginning.

Impact to human and biological resources

All the above activities have direct or indirect impacts to human and biological resources

at the project area.

Toward biological resources:

In general, there are limited living beings at the project area relative to other (eg like Ba Vi).. Adverse impacts on biological resources may mainly occur during land clearance and ground levelling and construction. Construction having impacts on biological resources can be as follows:

- During the mixing and pouring concrete to the ground, on-surface wastes and other kinds of wastes from residential area have impacts on land environment, leading to adverse impacts on underground creatures such as worms, crickets and other insects. Other creatures living underground also have to move to other places because most of the project area has been covered by concrete or bitumen.
- Rain-water flowing over the land surface of project area can bring together with it several contaminants such as concrete, oil scum, wastes from workers' residential area etc. which contaminate the water source, directly affecting water creatures living there.

In general, adverse impacts to living beings as mentioned above are trivial and can be reduced successfully when the construction contractors manage the construction process appropriately and in accordance with environmental principles.

Toward human impacts:

Several impacts from construction process toward human can be brief as follows:

- Soil and smoke dust and potential gases such as SO_X, CO, NO_X, THC reduce the air environment quality of the surrounding area, affecting to human's health (causing respiratory related diseases).
- Heat radiation from construction process (such as cutting, welding and heating bitumen to spread bitumen) do harm directly to workers at construction site.
- Noise, shaking from means of transport, concrete mixer, etc. heavily impacts the surrounding area.
- The area covered by trees will lose some of is the green layer, which will make the surrounding air temperature increase, causing heat and inconvenience.
- Several incidents such as labour accidents, fire, etc. can occur, causing damage on both human and materials.
- The higher density of means of transport during the construction period will increase the possibility of traffic accidents within the project site and increased dust and noise will affect normal life of people living along the transportation road.

Impacts toward the social economic aspects in the area:

Adverse impacts on socio-economic are very small. These can be as follows:

- Positive impacts regarding job creation toward a large number of labours in the locality.
- Due to the concentration of many workers at construction site, local order and security can be under threat.

- Living environments that are badly impacted can do harm on people's health for both workers and local residents.

Summary of negative impacts during construction phase

Table 21. Assessment on the summary of negative impact on the environment during construction phase

Activities	Land	Water	Air	Biological resource	Socio-Economic
Space levelling	+++	++	+++	++	+
Building foundation, houses, transportation system, parks	++	+	++	+	+
Building water supply and drainage and wastewater treatment	+	+	++	+	+
Material transportation for project use	+	+	+++	+	+
Material storage and preservation for project use	+	+	++	+	+
Normal activities of worker on-site	+	++	++	+	+

Remark:

\+ : Little affected.

++ : Medium affected

+++ : Highly affected

19 ENVIRONMENTAL IMPACT ASSESSMENT DURING UNIVERSITY OPERATION (AFTER COMPLETION OF NEW CAMPUS CONSTRUCTION)

IMPACT SOURCE

Source related to waste

Main activities during project operation include:

- Workshop/ conferences:.
- Teaching and learning activities
  + Lecturing
  + Operation of laboratory

Sources that cause air pollution:

- Exhaust discharged from electrical generators (not of great impact and electrical generators are rarely used except public power cut)
- Dust disturbed from the ground due to activities of teachers and students (minimal because 100% interior and exterior road are paved with bitumen and concrete);
- Exhaust discharged from oil/petrol consuming vehicles such as motorbikes, cars, trucks. These are the main source that cause pollution, but will be reduced by campus design that allows for green usage and limited vehicle movement within the campus).
- Noise arising from means of transportation within project site and some exterior means. (similar to above, this will be minimised by limits on vehicle access to te the campus site).

Teaching and Research activities within the university

Assessment on the air pollution

Dust and transportation exhaust

As the affected level of all sources is not high, the scope of this assessment is within project site and surroundings.

According to "Study on methods to control roadway air pollution in Ho Chi Minh City", the average amount of fuel for motorbike is 0,03 l/km, petrol consuming automobiles 0,15 l/km and oil consuming automobile is 0,3 l/km.

At full design capacity for 5000 students it is estimated that up to 6000 person could at the same time in project site. In later expansion phases it is likely that there will be up to 20,000 persons on the site of the university at any given time. In the first phases, about 40% of teachers and students will stay at the university dormitory accommodation. So, the number of running vehicle within project site is about 800 (excluding bicycles) and 60% of which is motorbike and 40% accounting for automobile and trucks; Oil consuming vehicle accounts for 40% of automobile (cars, trucks), and the rest will be petrol consuming vehicle.

Supposing that the average travelling length for each vehicle is 10 km/day, the fuel needed to be supplied for transportation activities is shown in this table

Table 22. Amount of fuel for transportation activities within one day

Ref	Engine	Turn	Consuming (litter/km)	Total oil/petrol consumed (litter)
1	Motorbike > 50cc	450	0,045	135,0
2	Engine < 1.400cc	100	0,225	150,0
3	Engine 1.400cc - 2.000cc	75	0,225	112,5
4	Engine >2.000cc	35	0,225	52,5
5	Light truck <3,5 ton (oil driven ones)	90	0,45	270,0

Pollutant coefficients in transportation exhaust:

According to quick assessment of WHO, the project is affected by pollution caused by transportation exhaust and is described as in below table:

Table 23 . Pollution coefficient due to transportation exhaust – WHO

Ref	Engine	Pollution coefficient (kg/ton of fuel)				
		Dust	SO_2	NO_2	CO	VOC
1	Motorbike > 50cc	-	20S	8	525	80
2	Engine < 1.400cc	1,1	20S	23,75	248,3	35,25
3	Engine 1.400cc-2.000cc	0,86	20S	22,02	194,7	27,65
4	Engine >2.000cc	0,76	20S	27,11	169,7	24,09
5	Light truck <3,5 ton (oil consuming)	3,5	20S	12	18	2,6

Based on the table above, the pollution amount caused by means of transportation is shown in the table below:

Table 24. Forecast of air pollution amount caused by means of transportation

Ref	Engine	Pollution amount (kg/day)				
		Dust	SO_2	NO_2	CO	VOC
1	Motorbike > 50cc	-	0.023	0.928	60.952	9.288
2	Engine < 1.400cc	0.142	0.0258	3.063	32.03	4.547
3	Engine 1.400cc-2.000cc	0.083	0.019	2.13	18.837	2.675
4	Engine >2.000cc	0.034	0.009	1.223	7.661	1.088
5	Light truck <3,5 ton (oil consuming)	0.813	0.046	2.787	4.18	0.603
Total		*6,433*	1.072	1.238	10.133	123.66

Remark : (-) : very little.

Dust and exhaust discharged from electrical generators

- *Amount of exhaust from electrical generators*

The university should be equipped with generators of at least 600KVA capacity and DO consuming. The fuel consumption quota during operation is 320 kg DO/hour.

Based on WHO standard, pollutant amount discharged from generator can be explained as below:

Table 25 . Pollutant amount discharged from electrical generator

Ref	Pollutants	Coefficient (kg/ton)	Amount	
			kg/h	g/s
1	Dust	0,71	0,227	0,063
2	SO_2	20S	3,200	0,889
3	NO_2	9,62	3,078	0,855
4	CO	2,19	0,701	0,195
5	THC	0,791	0,418	0,116

Remark: S is the sulphur amount in DO, S = 0,5%.

- *Concentration of exhaust from electrical generator*

Normally, the fuel is burnt, the excess air is 30%. If the exhaust temperature is 200^0C, the amount of exhaust for burning 1kg DO is 38 m^3. With a quota of 320 kg DO/hour, we can calculate that the respective exhaust amount is 3,38 m^3/s. The concentration of exhaust from electrical generator is as below:

Table 26 . Concentration of exhaust from electrical generators

Ref	Pollutants	Concentration at real condition (mg/m^3)	Concentration at standard condition (mg/Nm^3)	TCVN 5939 : 2005 – column B (mg/Nm^3)
1	Dust	18,7	-	180
2	SO_2	263,2	455,9	450
3	NO_2	253,2	438,6	765
4	CO	57,6	99,9	900
5	THC	20,8	36,1	-

Remark:

- Nm^3: Air volume at standard condition
- TCVN 5939 : 2005 (Column B) – Maximum permissible limit for dust and inorganic substances from industrial exhaust to the atmosphere.

Comment:

Results show that concentration of most of pollutants from generators can meet the permissible standard (TCVN 5939: 2005 - Column B), except SO_2, concentration of which exceeds the permissible standard a little. However, the construction contractors should install generator's chimney at high position (higher than the highest building in the project site) to spread diffuse pollutants so as to minimize negative impact of exhaust on all residents.

Impact of noise, air pollutants are summarized in the below table.

Table 27. Impact of noise, air pollutants

Ref	Coefficient	Impact
1	Dust	- Respiration stimulation, lung sclerotization, lung cancer; - Harm the skin, cornea, digestive disease.
2	(SO_x, NO_x).	- Affect respiratory system, spread to blood; - SO_2 can be harmed through skin, decreasing alkali in blood; - Creating acid rain to hinder the development of flora and plant; - Increasing metal corrosion, destroying concrete materials and houses; - Negative impact on the climate, ecology and ozone layer.
3	Oxide carbon (CO)	Reducing the ability oxy transmission to organs combining of CO and Haemoglobin to make carboxyl-haemoglobin.
4	CO_2	- Respiratory disorder; - Green house effect; - Do harm to ecology
5	Hydrocarbon (THC,VOC)	Causing acute poisoned: asthenia, dizzy, sense disorder, sometime death
6	Noise	Noise and high vibration affect health such as insomnia, tiredness and unpleasant mood. Noise also reduces productivity. Working in noisy condition for a long time will reduce hearing ability, leading to deaf.

Noise and vibration

Noise and vibration are caused mainly from means of transportation of campus residents, and some passing vehicles. Different vehicles generates different noises, for example, noise from tourist automobile is 77 dBA, trucks - buses: 84 – 95 dBA,

automobile: 94 dBA,…Noise can also come from electrical generators. The noise level of electrical and vehicle are described in the table below:

Table 28. Noise from vehicle

Type of vehicle	Noise (dBA)	Standard noise at project site (TCVN 5949:1998)	
		Day time (dBA)	Night time (dBA)
Tourist automobile	77	60	45 - 55
Mini bus	84		
Sport car	91		
Trucks	93		
4-stroke automobile	94		
2-stroke automobile	80 -100		
Electrical generator	>90		

Data from the above table shows that electrical generators and most of vehicles produce excess noise at project site. The University needs to consider methods minimize impact of noise. Internal campus transport will be limited, as one means to minimize the noise and emission of other pollutants.

Impact caused by wastewater and rainwater

Wastewater and rainwater sources:

Wastewater source of project is generated from activities of staff and students in the campus. Rainwater runs through project site bringing soil and sediments or substances on other surfaces (oil, rubbish,..), which can be high risk of contaminating the local environment, especially to the receiving source. Water supply for campus use includes water for researching, teaching and learning. The Water supply is from the Da river.

In detail:

- Water for domestic use for 6000 students, staff and other workers at approximately year 2022, at about: 315 m^3/person *(based on standard of 150 l /person-day).*
- Water for researching, teaching and learning: 320 m^3/person
- *(based on standard of 200 litter /student-learner-researcher -day.*
- Water for plant watering, road cleaning, workshop washing: 20 m^3/ng.đ
- Besides, there must be spare water for fire prevention

Table 29 : Demand for water use during project operation phase

Usage purpose	Supply amount (m^3/ng.đ)
Water supply for laboratory	600
Water supply for activities of school staff and students	630
Water supply for plant watering, road cleaning and workshop washing	40
Water spare for fire prevention	40
Total	**1310**

Some impacts of pollutants in wastewater are summarized in the below table:

Table 30. Impact of pollutants in wastewater

Ref	Coefficient	Impact
1	Temperature	Affecting water quality, concentration of oxy dissolved in water (DO), effecting to dissolving speed and type of organics in water.
2	Organic	Reducing the concentration of oxy dissolved in water, effecting water beings.
3	Suspended solid	Increasing water turbidity, badly affecting water quality and water beings.
4	Nutrition (N, P)	Causing eutrophication, affecting water quality and water beings.
5	Bacteria and parasite	Bacteria effected water is the reason causing typhoid, dysentery, cholera; - Coliform is the bacteria causing bowel disease; - E.coli (Escherichia Coli) belongs to Coliform group, appearing in human faeces.

In order to calculate daily domestic wastewater, we should base on demand for water use of the project. If there are maximum 6000 persons, criteria for water use is 315 m3-/day, domestic water accounts for 70% of demand for water use, the total amount of domestic water for this project will be 420,5 m^3/day.

Domestic wastewater contains sediments, suspended substances, inorganic and bacteria. According to the WHO quick assessment document, in developing countries, the daily amount of pollutants discharged by individual (untreated) is shown in the table 35 below. Based on coefficient of pollutants caused by domestic wastewater regulated by WHO and project's population, it is estimated that the amount of pollutants in wastewater is described in Table 35.

- *Concentration of pollutants in domestic wastewater:*

Concentration of pollutants in domestic wastewater is calculated based on the volume of wastewater and the amount of pollutants in wastewater. Calculation result of the initial pollution concentration of domestic wastewater and experience in treatment of domestic wastewater in septic tank are described in the table below:

Table 31. Total amount of pollutants in domestic wastewater during project operation

Ref	Pollutants	Amount (kg/day)
1	BOD_5	54 - 64.8
2	COD	86.4 - 122.4
3	Suspended solid	84 - 174
4	Non-mineral oil	12 - 36
5	Total Nitrogen	7.2 - 14.4
6	Ammonia	2.88 - 5.76
7	Total Phosphorous	0.96 - 4.8

Table 32. Concentration of pollutants in domestic wastewater

Ref	Pollutants	Concentration of pollutants (mg/l)		
		Untreated	*Septic tank*	*TCVN 6772 : 2000 (level II)*
1	BOD	280 - 336	100 – 200	30
2	COD	448 - 635	170 – 340	72*
3	Suspended solid	435 - 902	80 – 160	50
4	Oil (food)	62 - 187	42 – 125	20
5	Total nitrogen	37 - 75	20-40	27*
6	Ammonia	15 - 30	10 – 20	9*
7	Total phosphorus	5 - 25	3-10	5,4*
8	Coliform	10^6 - 10^9	10^4	1.000

Remark:

- TCVN 6772 : 2000: Limited elements in domestic wastewater;

- (*): TCVN 5945 - 2005, Column B (supplementary): Industrial wastewater – Limited parameter and pollution concentration (Q ≤ 50m^3/s; 500< F≤5000m^3/24h).

Results from the table above shows that untreated water has high pollution concentration and after being treated by family-sized septic tank, the pollution concentration still exceeds the permitted standard.

Thus, in the project master plan, a centralized wastewater treatment system should be built in the area of 5000 m^2 with productivity of 1000m^3/day. So, treated domestic sized wastewater units will flow to the centralized wastewater treatment system for further treatment. Wastewater treated by the central wastewater system will meet the criteria of Vietnam TCVN 6772:2000 (level I) before flowing to the common drainage.

Impact of rainwater overflow

Rainwater flows over the ground of project site sweeping away with soil and other pollutants to receiving stream. If the source is not well managed, it will have negative impact on the environment.

According to WHO statistics, the normal concentration of rainwater overflow is 0,5 -1,5 mg N/l, 0,004-0,03 mg P/l, 10-20 mg COD/l, 10-20 mg TSS/l. In the construction plan, project owner should install nets, railing and deposition tanks on the drainage line to classify different waste, sediments. Manholes should be regularly dredged. Waste mud should be properly treated at waste treatment station.

Some impacts of pollutants in wastewater are summarized in the below table.

Table 33. Impacts of pollutants in wastewater

Ref	Coefficient	Impact
1	Temperature	Affecting water quality, concentration of oxy dissolved in water (DO), effecting to dissolving speed and type of organics in water.
2	Organics	Reducing the concentration of oxy dissolved in water, effecting water beings.
3	Suspended solid	Increasing water turbidity, badly affecting water quality and water beings.
4	Nutrition (N, P)	Causing eutrophication, affecting water quality and water beings.
5	Bacteria and parasite	Bacteria effected water is the reason causing typhoid, dysentery, cholera; - Coliform is the bacteria causing bowel disease; - E.coli (Escherichia Coli) belongs to Coliform group, appearing in human faeces.

Impacts of solid wastes

Sources of solid wastes

In general, solid wastes from the campus are mainly are easily treated.

There are some sources for solid wastes such as:

- Solid wastes from daily life of people living in apartment and supporting houses (waste paper, nylon bags, waste food, plastic bottles, packages, etc.).
- Solid wastes from roads, pavements, parks, etc. (leaves, nylon bags, soil and sand, packages thrown away by pedestrians, etc.)
- Mud and sediments from canal dredge, etc.
- Harmful wastes can also be found in batteries, oil remains, oil infected clouts (from parking area and garages), etc.

Amount of solid waste

Solid waste from residential area:

The Average amount of solid waste from residential area is calculated as about 1.0 Kg/person/day. With a total population of nearly 6000, the total weight of solid waste daily would be 2.05 ton/day; Solid wastes can be in the forms of mud, waste from canal dredge, leaves and several other kinds on roads. However, apart from the wastes on roads, almost other kinds of wastes are not frequent and collected periodically.

Harmful solid wastes:

Harmful solid wastes within the campus area could include some toxic substances, (as noted above) A maximum is not able to be calculated. A waste management plan for solid waste will need to be developed by the university and relevant staff trained in its implementation.

Negative impacts from contaminated solid wastes:

- The disintegration process of organic wastes such as H_2S, CH_4 will create noxious smell, directly impacting the surrounding air environment and affecting daily life and other economic activities in the area.
- Inert components in wastes such as paper of different kinds, nylon, plastics, metals, glass, etc. will affect the general looking of the area.
- Harmful components such as broken neon lights, oil or mercury infected clouts, etc will contaminate water source, soil and can be very harmful to human health as well as ecosystem, etc.

Operation of laboratory

Pollution caused by exhaust from laboratory, Types of waste

- Normal Municipal waste (general)
- Recyclable waste
- Broken Glass
- Biological / Medical waste
- Chemical waste
- Sharps, Broken Glass
- Radioactive material waste
- Electronic and computer waste

Hazardous laboratory Waste

Any waste that directly or indirectly represents a threat to human health or to the environment by introducing one or more of the following risks:

- Explosion or fire
- Infections, pathogens, parasites or their vectors
- Chemical instability, reactions or corrosion
- Acute or chronic toxicity
- Cancer, mutations or birth defects
- Toxicity or damage to the ecosystems or natural resources
- Accumulation in the biological food chain, persistence in the environment or multiple effects

Table 34 - **The component parts of the work should be examined for the following types of hazard:**

Hazard	Type Examples
General	Slips, trips and falls
Biological	Micro-organisms
Physical	Mechanical hazards from autoclaves or associated equipment, manual handling, hot surfaces, steam and hot water, lack of cooperation/coordination during maintenance/repair work
Sharps	Glassware, needles, sharp edges on equipment
Chemical	Disinfectants, laboratory reagents and other substances
Electrical	Lack of maintenance of equipment, water coming into contact with electricity, lack of cooperation/coordination during maintenance/repair work
Radiation	Radiochemical and contaminated items for disposal

Each kind of wastes had its own character, for example:

Biological waste

Biological waste is any waste that is potentially bio-hazardous, infectious, or pathological. The categories of regulated biological waste are defined as follows:

- *Cultures and Stocks of Infectious Agents and Associated Biological.* All cultures and stocks of infectious agents are designated as infectious wastes because of the high concentration of disease causing organisms typically present in these materials. Included in this category are specimen cultures and stocks from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biological, and discarded live and attenuated vaccines. Also culture dishes and devices used to transfer, inoculate, and mix cultures are designated as infectious wastes.
- *Pathological Waste.* Human or animal pathological wastes including bodies/carcasses, tissues, organs, body parts, body fluids and their containers, that were involved in any medical or research procedure.
- *Human Blood and Blood Products.* All waste, human blood, serum, plasma, and other blood products or components are considered infectious wastes. Items that are saturated and/or dripping, and/or caked with human blood, including but not limited to: serum, plasma, other blood components and their containers.
- *Contaminated Sharps.* All discarded sharp materials (sharps) which have been used in animal or human patient care, treatment or research, present the double hazard of inflicting injury and inducing disease. All needles, syringes (with or without the attached needle), blades, scalpels, vials, culture dishes (regardless of the presence of infectious agents), slides and cover slips, and broken glass are considered sharps. All sharps used in patient care are considered infectious wastes because of the possibility of undiagnosed blood borne diseases (i.e., Hepatitis or AIDS).
- *Unused Sharps.* Unused discarded hypodermic needles, suture needles, syringes and scalpel blades.
- *Animal Waste.* Contaminated animal carcasses, body parts, and bedding of animals known to have been exposed to infectious agents during research (including research in veterinarian hospitals), production of biological, or testing of pharmaceuticals.
- *Isolation Wastes.* Biological waste and discarded materials contaminated with blood, excretions, exudates, or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.
- If regulated biological waste is mixed with non-hazardous solid wastes the waste stream shall be regulated as a biological waste.

Environmental risks

In general, the environmental risks in the campus could be high and therefore requires that there be laboratory management plans in place and maintained. Some environmental risks during operation phase can be listed as below:

- Risks of electrical leakage, fire and explosion
- Chemicals and fuel leakage during transpiration through campus Thunder-strike
- Building /establishment depression
- Partial water-logging due to rain
- Risks from laboratory accidents

Table 35 - Example of possible hazards, risks, probabilities and consequences

Possible hazards/risks	Probabilities/Consequences
Risk of infection	Incidence is low, but consequences could be severe
Autoclave incidents	Major accidents are rare, but consequences severe
Electric shock	An ever-present hazard, could be fatal
Manual handling	High frequency of injuries leading to chronic debilitation
Sharps injury	Not uncommon, unpleasant and stressful, but rarely, although potentially fatal
Skin contamination	Irritant or severe, may restrict individual's work area
Inhalation	May be acute or chronic effects with long-term consequences

Fire and explosion limit is specified in the below table

Table 36 Fire and explosion limit for several solvents and air

Substances	*Limit %*		*Substances*	*Limit %*	
	Below	**Above**		**Below**	**Above**
Ammoniac	15,5	27	CO	12,5	80
Axton	2,6	12,2	resin	0,7	
Acetylene	1,53	82	Toluene	0,12	4,9
Alcohol Butyric	1,9	5	petrol	1,1	5,4
Alcohol Ethylic	3,4	17,2	Acide Acetic	4,7	6,8
Benzene	1,1	6,8	Ethyl acetate	3,55	16,8
Hydro	4	80	Ethan	2,5	14,9
Methane	2,5	14,4	H_2S	4,3	44,5

Preventive methods must be taken to minimize the risks, ensuring stable life for campus residents.

Table 37- Classification of Fires

Class A	fires are ordinary materials like burning paper, lumber, cardboard, plastics etc.
Class B	Fires involve flammable or combustible liquids such as gasoline, kerosene, and common organic solvents used in the laboratory.
Class C	Fires involve energized electrical equipment, such as appliances, switches, panel boxes, power tools, hotplates and stirrers. Water is usually a dangerous extinguishing medium for class C fires because of the risk of electrical shock unless a specialized water mist extinguisher is used.
Class D	Fires involve combustible metals, such as magnesium, titanium, potassium and sodium as well as pyrophoric organo-metallic reagents such as alkyllithiums, Grignards and diethylzinc. These materials burn at high temperatures and will react violently with water, air, and/or other chemicals. Handle with care!!
Class K	fires are kitchen fires

Impact on health caused by working with office equipment and facility

People working in office usually have health problems such as runny nose; pharyngitis; headache… *For example*

Impact of photocopier on health

- *Photoconduction materials: inorganic or organic.* People working with photocopier may contact with some materials containing photoconduction
- The components of the *toner* including minute steel, silica, ferrite beads are mixed with polymer, carbon black. The user may contact with components of the toner
- *Toner dust*: super fine, may stimulate the respiration. The toner dust may spread into the air while copying and toner dust also spreads out of the machine through the fan to the air, Some research indicates that the toner dust may cause problems to the lung
- *Carbon black*: About 7% of toner is carbon black. According to some research, carbon black may cause cancer and gene-changing.
- *Polymer resin*: may be different depending on producers. The temperature needed to stabilize the last copy photo can make polymer melting. So, it is necessary to control the evaporation at this stage
- *Liquid toner*: Photocopier using liquid toner, carbon black and polymer resin are mixed in solvent. In copying process, the isodecane dispersant make the copy wet and then dry, which make solvent to evaporate in the air.
- *Isopar* should be kept out of touch. Breathing in with high volume of isopar may cause dizzy and nausea. Using photocopier in normal condition does not cause this problem unless used in small room with low ventilation, too much photocopying can accumulate high volume of isopar.
- *Ozone*: is instable molecule and easy to transform into oxygen, especially in contact with things. Ozone has strong smell, may effect to the eyes and respiratory system. Impact due to long contact is not adverse. People with respiratory diseases may find it hard to breathe when the atmosphere they are breathing containing ozone. Ozone volume is produced when the machines operates in special conditions (some photocopiers have ozone filter to minimize its impact)
- *Light and ultraviolet rays*: Lighting bulbs generate visible and invisible radiation. The contact level of photocopier users with ultraviolet is under permissible level. However, lighting from photocopier may damage the eyes and make it unpleasant for users. It is recommended to well cover while copying
- *Noise and heat*: may vary depending on the producer and type of machine. Some photocopiers are very noisy; some machines operating with high speed or high intensity of using generate considerably high temperature. Some parts of the photocopier machine getting hot may injure users when they want to fix paper jam

- photocopier operation machine may cause the pollution because of organic evaporation

The possibility to get diseases usually depends on

- The environment surrounding the place where there are laser printers and photocopiers with various polluted level and used status
- the ventilation, temperature, humidity of the working place as well as individual's resistance to the exterior factors

In general, when the campus operates, it will have various negative impacts on the air, surface water; biological resources, socio-economy due to wastes discharged and environmental risks. Therefore, university must take effective measures to properly prevent, control negative impacts on the local environment

Socio-economic impact

Project activities that have some impacts on the socio-economic environment are described as below:

- Regional population increase may cause complicated problems in cultural and security stabilization in project area. If the area is not well managed, social evils may occur like drug using, prostitution and pillage, etc.
- Making contribution to stabilize living for a rather populous region (5800 persons), creating a fresh and friendly environment (green-tree park and sport centre, etc.);
- Changing regional living conditions towards improvement of living standard, generating more income of local people, creating development for other added services (food and beverage, and others), pushing local urbanization speed.

In general, the university operation should generate positive benefits to students and also to existing local people, if the environmental impacts are well managed. . If it is well managed by the project owner as well as local government, the project will develop sustainably.

20 MEASURES TO MITIGATE NEGATIVE IMPACTS, PREVENT AND DEAL WITH ENVRONMENTAL RISKS

PREVENTION OF NEGATIVE IMPACT RIGHT IN PROJECT DESIGN AND CONSTRUCTION PHASE

Project planning is one of the crucial matters in the prevention and mitigation of pollution in the whole area. Understanding the importance of this issue, the project orientation and designing plan for project as below:

Planning

- The East: is for administration zones
- The centre and south: is for academic zones
- The North: is for student dormitory, and sport areas

Prevention and reduction of air pollution

The main sources causing air pollution from construction period include dust from ground, from construction materials, exhaust fumes and noise from construction machines and trucks. In order to minimize these sources, it is recommended that the Project owner should apply the following solutions:

- Cover all the truck's wagons with canvas which often spread dust during its way.
- Give priority to material suppliers near the project site to reduce the transportation time as well as reduce the storing period to minimize dust, wastes and to reduce the possibility of accidents.
- In case of materials such as concrete, steel, oil, etc. must be gathered at construction sites, they should be stored carefully in houses to avoid adverse impacts from weather, causing damages and to reduce the possibility of spreading dust and other pollutants to the environment.
- Regarding construction sand, it can be stored outdoor but must be covered by canvas to avoid dust spreading and loss when raining. Regarding bricks, stone, etc. which do not spread pollution much and are less impacted by natural environment, we can leave them outdoor without any preservation.
- Water tank trucks should spread water to the project's nearby roads when it's hot and dusty. Pour water to the construction site at different times when it causes dust.
- According to construction progress, internal roads will be built and covered with a concrete - bitumen layer before starting to build other works in order to reduce dust from roads and ensure the convenience for transportation means during construction period; and
- Remind drivers to avoid gathering too many transportation means and reduce speed at site to avoid traffic accidents.

Collection and treatment of waste water and overflow rain-water

Toward waste water from residential area

In order to minimize pollution from waste water in the construction site, construction managers should hire 5 mobile smart toilets to treat waste water.

Toward overflow rain-water

In order to limit the stagnant of rain-water which causes partial flood and reduce the spreading of rain-water with surface pollutants, the following solutions are recommended:

- During ground levelling (about 3 months), do it by small area at a time and create slight slope to margins with existing sanitation system (sanitation of the project area). Overflow rain-water, after being concentrated at this area, will be deposited in small ponds before overflowing to the general sanitation canals of the area.
- After the ground levelling period, prioritize to execute and install the sanitation system of Project and connect to the general system of the area to ensure rain-water will be separated with waste and deposited before pouring to receiving source, minimizing pollution.

Control and treatment of solid waste

- Apply optimal solutions to minimize solid wastes from construction site and surrounding area.
- Cover carefully transportation means when transporting construction materials to reduce solid waste on roads.
- Use concrete mixer to reduce scattering materials and concrete.
- Organize general meals at construction site to limit food bags and bottles which contribute to solid water at site.
- Assign 1 hygiene worker in charge of collecting solid wastes at site to timely treatment.
- Toward solid wastes from residential area: Collect and gather at hired waste area to conveniently ask for public waste collecting units to gather at general treatment areas.
- Toward beams, woods, and other materials during and after construction which are value to reuse, collect to recycle or sell to individuals or organizations who are interested (beams used in ground levelling, wood panels for burning materials or other works, etc.)
- Toward oil infected clouts, collect separately in tanks with tight cover to hire relevant units for gathering and treatment under current regulations.

Prevention methods, minimizing environmental risks

- Provide workers with necessary safety facilities such as anti-dust and air comforter, projection cap, gloves, glass, glass guard for welding and safety devices in working with electricity, safe belt (very important in the construction of high buildings),...
- Supervise to avoid labour accident, quickly provide help and solution in bad cases in order to ensure workers' health and life on-site and withdraw lesions if the same thing happen (once an accident happened, it is necessary to provide first aid and immediately transfer to a nearest health care centre or hospital).
- Follow safe food direction for workers at construction site by setting up refectory, appointing a good and experienced person-in-charge to serve workers with clean and nutritious food, ensuring good health to work on-site.
- Depression and land-slide prevention during construction process.
- Project owner must always ensure the task of consolidating the foundation firmly (concerning filling materials, filling thickness, compaction degree, duration of waiting settlement, etc.) because if depression occurs, it will cause huge damage for the work of the owner in terms of both economic as well as laboring.
- Firing and lightning resistance option.

Fire or explosion may also occur during construction process, which will cause huge damages for the work and labour. Thus, it is recommended that the project owner adopt plans for fire and explosion prevention, including:.

- To ensure the security for the work from lightening during the construction and operation phase, installation of lightning arresters and ground connector systems. Lightning arresting system is installed at all high buildings and some other locations of the project.
- All covers of electrical substations, technological equipment, cabinets, cable cover box and other metal made stuff which are used when installing the electrical equipment and power system are to be connected to ground by uncovered copper made ground connectors . The power supply systems installed have to ensure high safety, convenience and aesthetics.
- For the option of fire prevention, all works must comply with Vietnam Law on fire prevention. The Fire prevention option of the campus must be appraised and certified by Hanoi Public Security (Department of Fire Prevention).

21 PREVENTION AND MITIGATION OF NEGATIVE IMPACTS ON REGIONAL SOCIO- ECONOMY.

Land compensation and supports for affected residents will be implemented by the project owner. In construction process, the project owner also applies measures in order to mitigate negative impacts on the socio-economy of the region as follows:

- Where feasible, local labourers can be given priority for selection in local labour

teams, in order to make use of idle labour source, contributing to increase income for local people. Opportunities may be limited where high skilled construction labour is required or later, during operation where technical skills are required.

- Making security fences between residential or crowded traffic areas and work sites, slowing down vehicle speed, covering the trucks' body to prevent dusts when transferring materials to the project sites so as to mitigate impacts on the region such as traffic accidents, and environmental pollution.
- The effective management of site workers to limit overnight stay in site huts to minimize public disorder in the region.

22 POLLUTION CONTROL AND MITIGATION DURING PROJECT OPERATION

MANAGEMENT

To ensure smooth implementation of project activities, the project owner, first of all, should formulate management options for activities which may have impacts on the project area such as:

- Establishing a safeguard team for the project area to ensure timely detection and handling of problems such as disturbing actions or local residents' activities that influence project area;
- Establishing workers teams to take care of environmental sanitation and green plants, grasses for the campus (in public areas, apartments, blocks, primary schools, etc.).
- The sanitation team of the project will be responsible for solid waste management and treatment, centralized wastewater treatment system and task of planning as well as hiring consultancy and supervision bodies for project's environment on the periodical basis and other related environmental issues.
- Establishing a vehicle keeping team for garages in project areas (especially in high building areas) to ensure the sanitation and safety in keeping vehicle, contributing to maintaining vehicle order along roads or sidewalks.
- Not allowing any action for researching, teaching and studying as well as services that cause pollution.
- If some small scale services for daily needs of people (such as vehicle cleaning, private clinic, etc.) are allowed, their scale and pollution causing possibility must be addressed to make it conform to environmental regulations of local and branches (setting up and appraising environmental commitment or EIA, waste treatment meeting existing Vietnam environmental standards) before starting operation.

SPECIFIC ENVIRONMENTAL IMPACT CONTROL AND MITIGATION OPTIONS

Measures for controlling and mitigating air pollution

To control negative impacts caused by project activities on the air environment, following measures are recommended to be applied by the project:

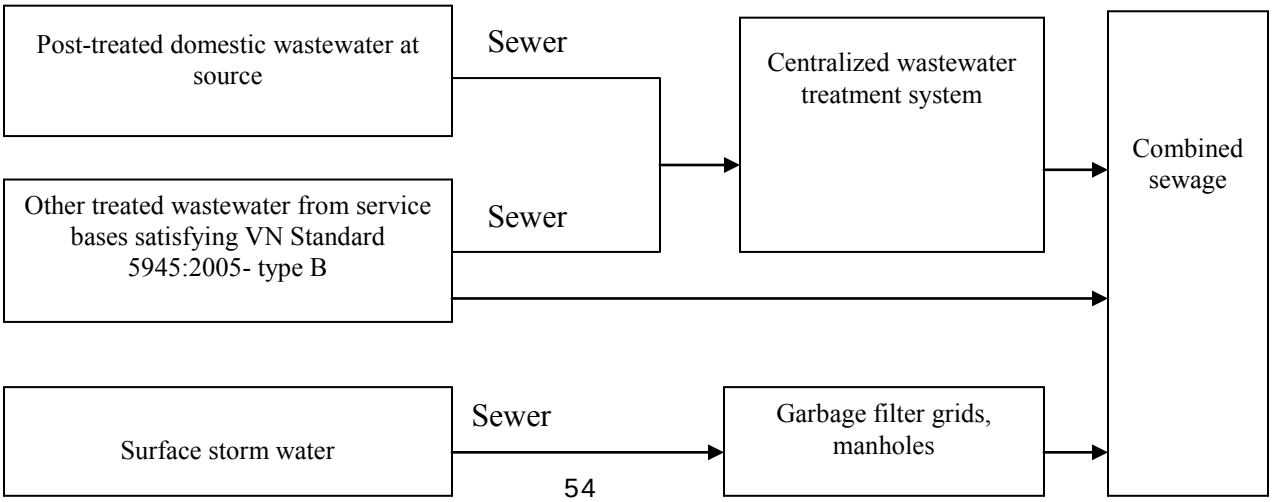
- Appropriately growing green trees in the area, along roads systems inside and outside project belts to minimize the spread of dusts and noise. Enhancing the growing of green trees and grasses to create environment friendly landscapes. Ensuring green trees planted covering at least 15% of the whole area.
- Forbidding trucks without carefully covering which can drop dusts when transferring rocks, soils, and other kinds of materials.
- Cooperating with traffic police to conduct traffic divergence, install prohibition signs for over-size vehicles, poultry carrying trucks and materials transferring trucks which likely cause pollution by dusts, exhaust and noises.
- Collecting and treating thoroughly solid wastes daily generated from roads, sewers, wastewater treatment system. Wastes from garbage cellars of apartment's area as well as from Villars must be treated to prevent bad smells resulted from organic decomposition which can pollute the common environment.
- Regarding exhaust and noise from stand-by power generators:
  - minimize the likely direct impacts of the exhaust fume of power generator on the environment and people in the region,
  - Power generators shall be installed on firm concrete foundation surrounded by a protection wall to minimize the noise and vibration which may negatively influence the project area.
- The project will arrange truck watering trees every morning, and watering roads when it is hot and sunny to decrease pollution causing dusts...

Option for controlling and mitigating pollution caused by wastewater and storm water.

Possible Option for combined drainage for the whole project

Chart of collection, treatment and combined drainage

Options for the overall wastewater collection and treatment of the whole project is as follows in *Figure 3.*



Overall wastewater collection and treatment of the project

Description of the combined drainage option

All domestic wastewater treated in the septic tank at the source but still not yet meeting the standard will be collected and transferred through the combined sewer of the project area, then to the centralized wastewater treatment plant. Wastewater after treated at the centralized treatment plant will satisfy Vietnam Standard 6772:2000 - level I. Overflow storm water at insignificant pollution level should be drained to the separate drainage, then after being garbage filtered (by garbage grids) and sedimentation through manhole systems, it can be discharged to the combined drain of the region.

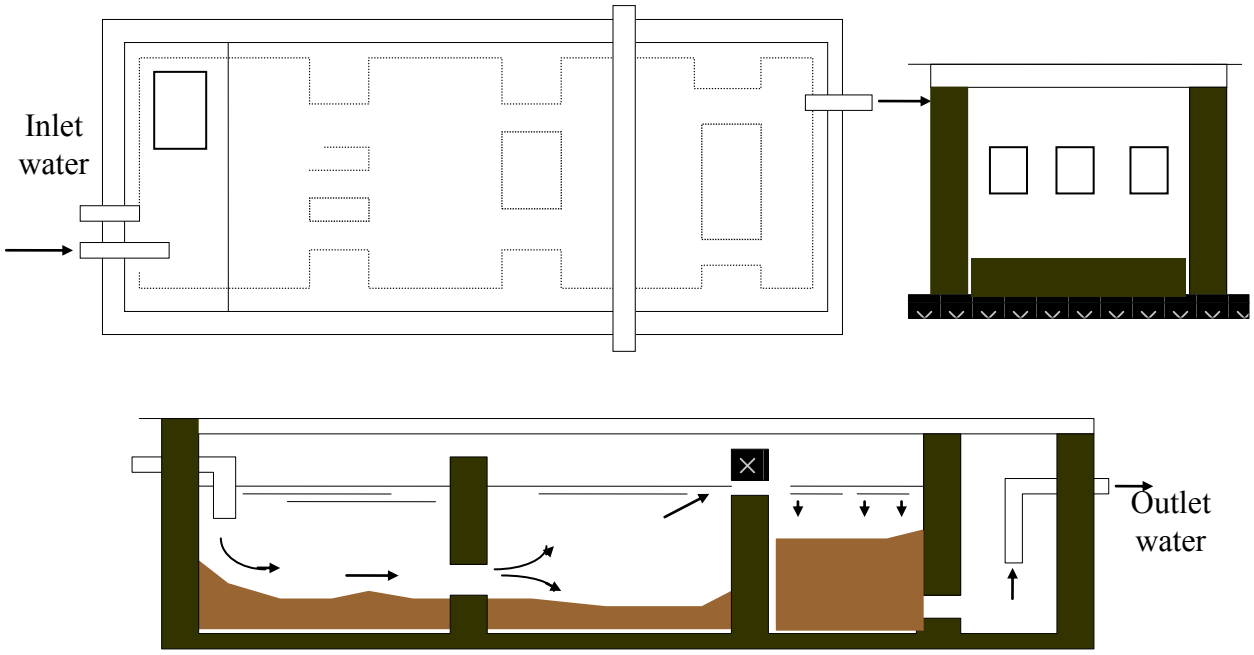
Wastewater treatment technology

At source domestic wastewater treatment technology

Designing and constructing septic tanks must conform to the construction standard. Septic tanks constructed under the project have 3 cells. Septic tank has such 2 functions as clarification and sludge digestion. Sludge is kept in the septic tank within from 6 to 8 months, with the effect of amphimicrobian; organic substances will be gradually decomposited. According to statistics, it needs 0,2 - 0,3 m^3 for each person meanwhile there are totally 2,100 residents in the project area, total volume of septic tanks needed to be constructed in the region is 420 – 630 m^3.

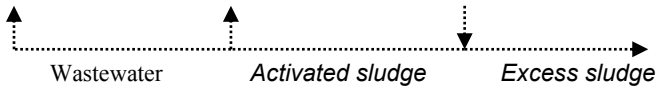
The content of pollutants in domestic wastewater after being treated in septic tanks is still high (see the Table 3.20), therefore, it will be further treated at the centralized treatment plant so as to meet the standard (TCVN 6772:2000 - level I) before discharging to the combined sewage of the industrial zone.

Figure 4 **-** Illustration of septic tank technology for domestic wastewater treatment.



Centralized wastewater treatment technology
Centralized wastewater treatment process:
Centralized wastewater treatment process of the project is as follows:
Wastewater --> regulation --> aerobic tank --> standing clarifier --> antiseptic treatment - ->combined sewage of the region

Figure 5 -



Description of technology:
Wastewater from generating sources after being partially treated will be drained through the combined sewer system to the regulating pond (passing through the garbage filtering system) to stabilize its flow and content. Under the regulating pond, aerators are installed to aerate wastewater in order to prevent aerobic fermentation which can cause bad smell. Wastewater after being treated partially but still having high content of pollutants, exceeding permitted limits should be transferred to aero tank with suspended activated sludge. Thanks to oxygen provided by aerators, organic substances will be oxidized by activated sludge (amphimicrobian) to become unharmful substances (CO_2 + H_2O). The oxidization process of organic substances in wastewater is summarized in the following equation: $C_5H_7NO_2 + O_2 + \text{microbial} \rightarrow CO_2 + H_2O + \text{new cell} + \text{energy}$ (in which $C_5H_7NO_2$ stands for organic substances existing in wastewater)

After aerobic treatment, wastewater containing a huge volume of sludge (mainly microbial biomass) is drained to the standing clarifier. At this stage, suspended sludge in wastewater will be precipitated at the bottom of the tank. In order to compensate for the activated sludge lost in the clarifier to stabilize the aerobic treatment process, a part of sludge in the clarifier will be pumped return to the Aerotank, excess sludge will be carried to the sludge pressing tank, then de-watered by machine and discharged to solid waste treatment site. The content of pollutants in wastewater after the clarifier significantly decreases and wastewater has high clearness level. However, it still contains disease causing microbial. So, it should be further treated in antiseptic tank, using preservative agent of chlorine. Chlorine will be put into the antiseptic tank by dozing pumping system. Wastewater after antiseptic treatment will satisfy Vietnam Standard 6772:2000 - level I as regulated and be discharged to the combined sewer of the region. Post treated wastewater can be used for watering trees, streets in order to decrease the using of fresh water. Solid waste generated from wastewater treatment system includes wastes from garbage filtering grids, activated sludge; dried sludge (total

volume of about 1.5 tons/day) will be disposed to a site and then carried to the regional dumpsite for treatment by hired environmental service units.

Treatment efficiency of the centralized wastewater treatment plant:
As the design of the centralized wastewater treatment plant of the project, treatment efficiency is estimated as in following table.

Table 38 Estimated treatment efficiency of the centralized wastewater treatment plant of the project

No	Pollutants	Unit	Input wastewater	Treated by centralized treatment plant	Treatment efficiency (%)
1	BOD	mgO_2/l	200	25	87
2	COD	mgO_2/l	340	45	87
3	Suspended solid substance	mg/l	160	30	81
4	PP	mg/l	10	3	70
5	N	mg/l	45	12	50
6	Coliform	MPN/ 100 ml	10^4	5.000	50

Collection and drainage calculation and arrangement

For storm water drainage.

Storm water flowing over the project's site will run into the drainage system with sand, soil, residuum which can cause bad consequences on the regional and surrounding ecological environment if there is no appropriate collection and treatment system. For this reason, it is recommended the project owner will design and constructed storm water drainage network with following criteria:

- Using underground laid reinforced concrete culverts to thoroughly drain storm water, avoiding local flooding.
- Drains are installed under the sidewalks and the distance between the curb and the centre line of drains is from 0.8m to 1.0m.
- Pipes are connected in principle of peak alignment and installed at depth of at least 0.6m.
- The calculation of drained storm water flow is based on the method of limited rainfall intensity with flow coefficient calculated based on average method.
    - Selected overflow frequency: T = 2 years.
    - Selected designed water level: 1.49 m.

For wastewater sewage network.

Option for draining wastewater of the project is that: constructing receiving and draining sewers around villa areas, high buildings, etc. Selected draining direction of wastewater is toward to the combined sewer (where there is wastewater treatment system), draining slope of the sewer is 0.3%. Wastewater sewage system for the region includes reinforced concrete culverts of D200 and collecting manhole, inspection manhole, draining manholes are installed at distance of every 40-50m. At manholes, it is needed

to arrange waiting pipes of PVC D200 with the length of 2m for later connection to indoor draining pipes and they have to be covered at the plug.

Option of solid waste management and treatment

Detailed option of solid waste management and collection in the project of the project owner as follows:

At source solid waste collection

For public area

- Project owner will arrange waste bins along streets, parks, entertainment sport areas
- Arranging casks with covers and shelters at the areas storing hazardous wastes collected and classified at source by the people.

For campus and service areas.

It should be required that all individuals and organizations be informed about environment management standards and to make commitments to follow regulations before starting working or living in project area. Standards recommended include:

- domestic wastes must be put in waste bins and left at disposal points along roadsides in every morning.
- For people living in high buildings, domestic wastes can be collected and kept in plastic bag and put in wastes pipes of each floor, then wastes will run down to an available wastes keeping site on the ground.

For hazardous wastes once they are generated, will be separated and stored in covered bins. These wastes will be periodically carried to the disposal site for hazardous wastes arranged for each area of project to facilitate the treatment.

Option of collection and treatment of sanitation team

- Work teams involved in solid wastes collection, treatment and transfer, must be certified by DONRE of Hanoi. In case of not being permitted to directly transfer and treat wastes, this team can contract, on behalf of the project, with other legal service units operating in environmental sanitation for solid wastes collection and treatment.
- Everyday, the collection team has to collect solid wastes from wastes bins and tanks by approved collection means.
- Apart from collecting wastes from bins, sanitation team is also responsible for cleaning and collecting wastes along operational roads.
- Sanitation team also takes responsibilities for dredging and collecting sludge in manholes along sewers, transferring sludge from the centralized wastewater treatment plant to the treatment site.

All above-mentioned kinds of solid wastes must be put in big specialized trucks (at disposing points) before being transferred to the solid wastes treatment sites of the

region. For hazardous wastes, collecting them has to be permitted by functional agency (DONRE).

The SPMU will ensure that the local Regulations on common responsibilities for waste treatment will be disseminated to all users, and that users sign the commitment before using all facilities in project area.

E. Institutional Requirements and Environmental Monitoring Plan

23 LIST OF ENVIRONMENT TREATMENT WORKS

Environment treatment works of the project include waste and non-waste materials.

- *Main waste treatment works of the project*
  - Septic tanks
  - Drain systems to collect and discharge waste water
  - Waste water centralized treating station
  - Specialized waste containing bins.
- *Non-waste environment treatment works:*
  - Rain water drainage system
  - Fire preventing and fighting system.

24 ENVIRONMENT MANAGING PROGRAM

PROJECT MANAGEMENT UNIT'S PERSONNEL

The Sub-Project Management Unit (SPMU) located at HUST will be responsible for developing competence in environmental management for the university. This will initially be for the project campus under construction and later will be adapted to form a permanent unit within the university to manage all aspects of environmental controls.

The SPMU will appoint an environment manager and vice managers, specifically stating the responsibilities of each personnel, and the experience qualifications suitable for the positions. The PMU will consist of different groups including one responsible for the project's safety and environment.

Personnel of safety and environment group include:

- Group leader : 1 person
- Deputy group leader : 2 people
- Group member : 5 people

This group will be established and commence soon after project effectiveness.

TASKS OF ENVIRONMENT GROUP

The Group leader works through 2 deputy group leaders (one in charge of safety and the other of environment). The Leader is also responsible to the SPMU director for safety and environment at the worksite and also of the university once operational at the new campus. The environment group will have the following responsibilities:

- Define planning options, using technology solutions and reliable modern procedures to prevent and lessen environmental pollution and problems during the construction phase and under the operations phases of the new campus.
- manage all activities to lessen environmental pollution during the process of construction, such as collecting solid waste for treatment, clearing other materials at the work and watering the road to reduce dust…
- Supervise progress of executing and quality of works for treating and reducing environmental pollution such as building waste water treatment system, waste water and rain water drainage network…
- Regularly check the safety and prevent problems at work during project implementation and university operation.
- Supervise and ensure all work contractors and employees take actions to reduce dust, noise…
- Plant and maintain landscaping gardens to reduce dust and polluted air and create an environment friendly space.
- Supervise and require all individuals living and working in the project to follow all common regulations about environment sanitation and safety.
- Manage waste collection and treatment to reduce other negative impacts to the project area.
- Be responsible for solid waste management and treatment, waste water treatment system management of the Project and other related environmental issues.
- Make plans and monitor environmental quality of the project and nearby area (supervise the quality of air – noise, waste water...)
- On behalf of the university, present to the national and local environmental managing agencies when needed, execute the supervision and checking of environmental agencies.
- Synthesize and make public all data about safety and environment, give consultancy to the project owner about additional options to reduce and prevent environmental pollution and problems in order to better improve the environment in the area.

25 ENVIRONMENT SUPERVISING PROGRAM

The university Environment Group will cooperate with functional agencies to create environment supervising program, collect sample to supervise environmental quality at the campus and surrounding rivers so as to continually assess current status of environment's quality, and provide information for to contribute to the HHTP's environmental management.

Laboratory Waste Management

The environment Group will be responsible for supervising management of the waste from laboratory activities, and the Laboratory management Centre will have primary

responsibility for executing the tasks to ensure proper management of the daily waste generated from laboratory activities. The Group shall liaise and work with the Laboratory Management Centre in undertaking this work. Figure 4 shows an illustration of the possible relationships with the academic personnel in responsibilities for laboratory waste management. More detail is also in **Appendices 4 and 5** on management of laboratories wastes and on handling of laboratory chemicals and other materials.

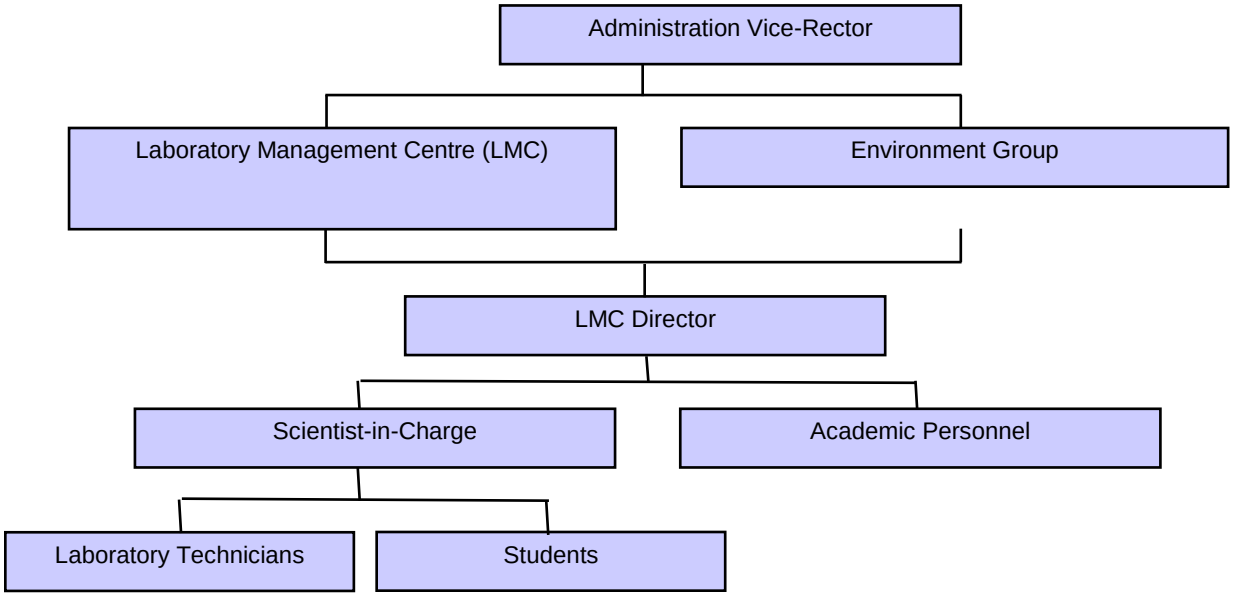


Figure 6 - Responsible for Laboratory Waste

WASTE MANAGEMENT

Supervising the quality of waste water

- Supervising location: 2 sites (one at the waste water receiving place of the centralized waste water treatment system and the other at discarding place of the centralized waste water treatment system to Chom arroyo).
- Assessing norms include: pH, SS, BOD, COD, Nitrit, Nitrat, Sunfat, Clorua, Amoni, total Phospho, Phenol, total Coliform, mineral oil, vegetable oil and fat;
- Supervising frequency: 04 times/year
- Sample collecting equipment and analyzing methods: standard method;
- Comparison standard: TCVN 6772:2000 - level I.

Solid waste supervising

- Supervise the management and treatment of solid waste of the project.
- Supervising frequency: 4 times/year
- Solid waste management diary of the project will be updated periodically and reported to local environmental agencies (Department of Environment and Resources)

SURROUNDING ENVIRONMENT SUPERVISING

Supervising air quality

- Selected parameters: total dust, SO_2, NO_2, CO, noise;
- Number of sampling sites: 8
  + Project area: 03 sites, inclusing one at waste water treatment system area
  + Project surrounding area: 04 sites (FPT Univerisity, road to project and nearby area.
- Frequency of collecting sample and analysing: 02 times/year;
- Sample collecting equipment and analyzing methods: standard method;
- Comparison standard: surrounding air standard (TCVN 5937:2005, TCVN 5938:2005)

Surface water quality supervising

- Number of sample: 04
  + 02 from canals near the project
  + 02 from ponds and lakes near the project
- Assessing norms include: pH, BOD_5, COD, DO, TSS, Amoniac, Nitrat, Nitrit, Sunfat, Florua, iron, lead, oil and fat, total Phenol, Cyanua, E.Coli, total Coliform;
- Supervising frequency: 02 times/year
- Sample collecting equipment and analyzing methods: standard method;
- Comparison standard: TCVN 5942:1995 (type B).

26 ESTIMATED COST FOR ENVIRONMENTAL WORKS

Estimated costs are given for all critical environment monitoring and management activities. Costs are estimated based on various government circulars, and in 2009 prices – but these are indicative only and are likely to be minimum costs. The university will be responsible for making annual estimates for inclusion in operating budgets to ensure that it is able to maintain a high quality environment service throughout the campus that exceeds the minimum.

Estimated Cost For Pollution Treatment Works

Indicative cost for environment treatment works are presented in Table below.

Table 39 – Estimated cost for establishing and building environment treatment works

No	Works	Cost (total)VND
1	Rain water collecting and drainage system	6.276.530.000
2	Waste water collecting and drainage system	5 378.580.000
4	Waste water treatment station	3.800.000.000
5	Public garbage	100.000.000
6	Rubbish van	800.000.000
Total		24.355.110.000

Indicative Budget for operating and maintaining centralized waste water treatment station is estimated to be VND 1,500/m^3, then the cost for one day operation is about VND 1,800,000/day.

Estimated Cost For Environment Quality Supervising

The university will annually spend budget on supervising environment quality. Budget for this is calculated according to Joint circular of Ministry of Finance and Ministry of Environment and Resources number 15/2005/TTLT/BTC-BTNMT dated 22/02/2005 about Guiding on managing and using of establishment budget to implement environment protection and circular number 83/2002/TT-BTC dated 25/09/2002 of Ministry of Finance stipulating the regime of collecting, handing and managing fees about quality measuring standard, specifically as follows:

Budget For Supervising Air Quality

Indicative Budget for supervising air quality is presented in Table below.

Table 40 Budget for supervising air quality

STT	Parameter	Price unit (VND)	No of samples (sample)	Supervising frequency (times/year)	Total (VND)
01	Dust	60.000	8	2	960.000
02	SO_2	300.000	8	2	4.800.000
03	NO_2	300.000	8	2	4.800.000
04	CO	300.000	8	2	4.800.000
06	Noise	20.000	8	2	320.000
	Total				**15.680.000**

Budget For Waste Water Supervising

Indicative Budget for waste water quality supervising is presented in Table 41.

Table 41. Budget for waste water quality supervising

STT	Parameter	Price unit (VND)	No of samples (sample)	Supervising frequency (times/year)	Total (VND)
1	pH	30.000	2	4	240000
2	BOD	80.000	2	4	640000
3	COD	80.000	2	4	640000
4	SS	50.000	2	4	400000
5	NO_2^-	50.000	2	4	400000
6	NO_3^-	50.000	2	4	400000
7	SO_4^{2-}	50.000	2	4	400000
8	Clorua	50.000	2	4	400000
9	NH_3 - N	60.000	2	4	480000
10	Total Photpho	60.000	2	4	480000
11	Phenol	300.000	2	4	2400000
12	Total Coliform	60.000	2	4	240000
13	Mineral oil and fat	300.000	2	4	2400000
14	Vegetable oil & fat	300.000	2	4	2400000
	Total				**12.160.000**

Budget For Supervising Surface Water Quality

Indicative Budget for supervising surface water supervising is presented in Table 42

Table 42. Budget for supervising surface water supervising

STT	Parameter	Price unit (VND)	No of samples (sample)	Supervising frequency (times/year)	Total (VND)
1	pH	30.000	4	2	240.000
2	BOD_5	80.000	4	2	640.000
3	COD	80.000	4	2	640.000
4	DO	60.000	4	2	480.000
5	TSS	50.000	4	2	400.000
6	Amoniac	60.000	4	2	480.000
7	Nitrat	50.000	4	2	400.000
8	Nitrit	50.000	4	2	400.000
9	Sunfat	50.000	4	2	400.000
10	Florua	50.000	4	2	400.000
11	Iron	60.000	4	2	480.000
12	Lead	60.000	4	2	480.000
13	Oil and fat	300.000	4	2	2.400.000
14	Total Phenol	500.000	4	2	4.000.000
15	Cyanua	60.000	4	2	480.000
16	E.Coli	60.000	4	2	480.000
17	Total Coliform	60.000	4	2	480.000
	Total				**13.280.000**

Budget For Solid Waste Supervising
Indicative Total budget for supervising solid waste (4 times/year) is: VND 4,000,000/year

Total Budget For Environment Supervising
Indicative Total budget for environment supervising is VND 45,120,000/year.
If adding shipping cost and cost for report synthetising, then the total cost for supervising will stand at VND 49,000,000/year.

F. PUBLIC CONSULTATION AND DISCLOSURE

The MOET-PMU and the University SPMU should be committed to disclosure of information about environment impacts and management reports to ensure surrounding local communities have a high degree of confidence that no adverse impacts of the campus developmental or operation of the university laboratories will affect their living environment of personal health. A regular (annual) public consultation and advisory publication plan should be developed and implemented during the construction of the campus and established as a permanent feature of the ongoing operation of the university.

A public consultation mechanism is consistent with the Environmental Protection Law 2005 (Clause 8, Article 20), which requires the public consultation in the EIA process as follows ""*Comments from the People's Committees at communal, quarter and/or township level (hereinafter called "Communal Level") and representatives from residential communities where the implementation of projects takes place; objections to the location of projects at localities or to proposed environmental protection solutions, must be included into the environmental impact assessment reports*". The public consultation is required only for EIA report, but not required for strategic environmental assessment (SEA), additional environmental impact assessment and environmental protection commitment (EPC). Therefore, there is no legal requirement on public consultation during preparing the EPC report.

Coherence of indicators: During construction and operation phases, the Environmental Management Program should be implemented by the university to achieve the following objectives and results:

- Providing data for accessing the environmental impacts of the project
- Providing initial instruction in case where the environmental control measure could not meet the requirement standards
- Monitoring the implementation of the project and effectiveness of the mitigation measures in environmental protection
- Appraising the forecasted impacts on the environment described in the EIA report
- Evaluating the compliance to the requirements, standards, policies and regulations of the Government

- Proposing activities to mitigate the consequences in case of incident or unacceptable impacts
- Providing data to environmental audit.

Promotion of Environmental Agenda: According to the Resolution No 41/NQ-TU dated November 15, 2004 issued by the PolitBureau on Environmental Protection in the period of enhancing industrialization and modernization in the country, the public environmental protection activities will be funded by the government. The budget arranged for the activities is not less than 1% of the annual national budget. To advocate, disseminate extensively and implement strictly the Resolution No. 41-NQ/TW; Decision No. 34/2005-QD-TTg dated 22/02/2005 of the Prime Minister issuing the Action program of the Government on implementing the Resolution 41-NQ/TW of the Politbureau; Decision No. 153/2004/QD-TTg dated 17/08/2005 of the Prime Minister issuing Strategic Orientation for sustainable development in Vietnam (Vietnam Agenda 21) have been issued.

G. FINDINGS, RECOMMENDATION AND CONCLUSIONS

The project is not expected to have any significant adverse impact on the local environment. Minor environmental issues to be addressed during the construction and operational phases, will be mitigated through the implementation of proposed measures and regular monitoring.

The IEE report indicates that the adverse environmental impacts of the project will be not significant. Mitigation measures can be undertaken without difficulty through proper engineering design, incorporation of recommended mitigation measures, and community participation. The adverse impacts will be greatly offset by improvements in health, sanitation, and environmental conditions for the urban residents of project's provinces.

The IEE report confirmed that the project's under category B according to ADB's guidelines. However, according to Environmental Protection Law 2005 and the relevant environmental policies and guidelines of the Government of Viet Nam, the Environmental Protection Commitment (EPC) Report for the project's should be prepared and submitted to the People Committee of project's provinces for approval in the detailed design phase..

Commitment To Undertake Methods To Reduce Negative Impacts

To ensure the positive Environment assessment, it is expected that the Project Owners will give the following undertakings:

- To undertake all methods to prevent and reduce bad impacts during the period of project establishing and operating as specifically stated in this report.
- To apply methods to prevent problems and reduce pollution as presented in the report, at the same time, improve the training for environment officers to raise the environment managing competency at project area and make sure no environmental pollution will be caused.

- To cooperate with functional agencies during the process of designing and executing pollution controlling methods to adjust pollution level in order to meet the environment standards and effectively prevent all possible problems.
- To apply Methods to control pollution and limit project's negative impacts presented and recommended in the report are possible ones which can ensure Vietnam's environmental standards.
- To ensure the environment treatment work is undertaken in a timely manner in the construction phase and later during the operation of the university.

Commitment To Implement All Common Methods And Regulations About Environment Protection Relating To The Project

Project owner commits to ensure all environment standards during project establishing and operating as follows:

- Surrounding air environment: air pollution causing substances of the project meet the standard of surrounding air quality (TCVN 5937-2005) and standard of maximum concentration possible of some toxic substances in the surrounding air (TCVN 5938-2005);
- Level of noise: make sure level of noise causing from the operating of the project meets the standard of maximum level of noise possible at public sites and in the area (according to the similar sound, TCVN 5949-1998);
- Waste water after centralized treatment: make sure to meet the standard of living waste water (TCVN 6772:200, level I) before being discarded to canals or other water treatment units
- Solid waste: living solid waste are collected and transported to treating area according to the sanitation requirements.
- Living waste is collected and treated as the regulations of treating living waste
- Project owner also commits to take full responsibility when violating international convention and Vietnamese standards and when causing environmental pollution.

The MOET, working in close cooperation with the HHTP, will be the executing agency responsible for allocating the required counterpart funding and providing policy directions through the SPMU to implement. An environment oversighting committee may be established as a sub-committee of the Ministerial Steering committee, and may include: MOET-PMU; HHTP; Peoples' Committee Of Hanoi; Department of Construction (DOC), Department of Planning and Investment (DPI), Department of Finance (DOF), DONRE, Viet Nam Women's Union (VWU), and other relevant institutions .

The Project will collaborate with the Environmental Monitoring and Protection Centre within the Department of Natural Resources and Environment, Department of Science and Technology, and DOH to test air quality and noise. Environmental monitoring results will be documented to ensure that signs of adverse impacts are detected at the earliest

possible time. Monitoring results before and during construction will be reported monthly by the designated environment specialist in each SPMU. An annual monitoring report will be prepared by the EMU and submitted to the MOET-PMU head, who will in turn submit to DONRE for endorsement before submitting to the MSC, which will submit annual reports to ADB.

APPENDICES

APPENDIX.1 – ENVIRONMENT IMPACT OF CONSTRUCTION

Environment impacts of the component – Building and upgrading infrastructure of universities

Small component	Activities	Impacts
Road building and upgrading	Construction period:	- Increase of dust and noise as dismounting buildings - Increase of dust from digging activities - Increase of noise and exhaust fumes from means of transport and executing equipment, mainly at sites applying mechanical executing methods - Temporary storing of materials causing obstruction to the community and to the traffic - Increase of the volume of on-site workers' living waste - - Temporary affect small business activities of people
	Operating period:	Increase the volume of spreading water
Lighting system installing	Construction period:	- Increase of the volume of spreading water - Increase of dust as executing and digging activities - Temporary power cut
	Operating period:	- No impact
Water drainage system building	Construction Period	- Increase of noise and exhaust fumes from means of transport and executing equipment - Bad smell from mud dredging process - Transporting and throwing dredged mud - Increase of the volume of on-site workers' living waste - Contaminate the water supplying pipes - Temporary delay of water drainage system - Temporary inundation when raining - Temporary delay of power, telephone and TV cable supply… - Temporary storing of materials causing obstruction to the community and to the traffic - Temporary affect small business activities of people - Cause damage to road surface and other public benefits - - Risks of accidents
	Operating period:	- Waste water stagnant causing bad smell - Bad smell when dredging sewerage - Transporting and throwing dredged mud - Affect the underground water due to sewerage leak
Water supplying system building	Construction period:	- Increase of dust as executing and digging activities - Increase of the volume of on-site workers' living waste - Temporary delay of water supply - Digging land cause obstruction to the community and traffic - Cause damage to road surface and other public benefits
	Operating period:	- No impact
Public	Construction period:	- Increase of dust as executing and digging activities

entertainment parks building (playing grounds, sport house…)		- Increase of noise during executing process - Increase of on-site worker living waste - Temporary delay of water supply and drainage and power supply system
	Operating period:	- Increase of living waste from entertainment activities
School building (classrooms, stores, laboratories…)	Construction period:	- Increase of dust as executing and digging activities - Increase of noise and exhaust fumes from means of transport and executing equipment - Increase of the volume of on-site workers' living waste - Temporary storing of digging materials and land causing obstruction to the community and to the traffic - Temporary delay of business activities - Temporary delay of water supply and drainage and power supply system - - Working safety
	Operating period:	- Polluted by organic waste - Increase of waste water - Increase of air pollution and smell - Risks of safety for surrounding households when fire occurs

Impacts during executing period

Source of impact

Main activities causing impacts to the environment during the execution of Building and Upgrading infrastructure for universities component include:

(i) Installing new roads
(ii) building water supply and drainage system
(iii) Building public lighting system
(iv) building public sporting area (playing ground, sport houses…
(v) building university facilities (classrooms, stores, laboratories…)

Main sources of impact during this period include:

- *Dust, exhaust fume and noise:* caused by such activities as road upgrading and expanding, landing digging to install water drainage pipes, waste transporting and machinery and equipment operating. All these activities will cause exhaust fumes and noise.
- *Waste water and spreading water:* the upgrading and expanding of roads and alleys as well as the installing of water supply and drainage pipes can lead to waste water spreading and stagnant. Apart from that is the living waste water from workers executing on the site.
- As the demolishing of water drainage pipes may block the current, rain water cause inundation.
- *Solid waste:* solid waste include: (i) digging land from road, opening drains to install water supply and drainage pipes and tension poles; and (ii) living solid waste from workers working on the site.
- *Traffic obstruction:* traffic obstruction may occur during rush hours due to such causes as: the storing of materials on main roads may affect traffic in the area.

Objectives and scale of impacts

- Air environment
- Surface water environment
- Households in executing area and on transporting route
- Traffic in and around executing area
- Business households on the roads being executed
- Workers repairing and maintaining water drainage sewerage
- Impact time: estimated within 1 year for the project.

Assessing the impact

The process of upgrading water supply and drainage pipes and power may lead to the following impacts:

- *Dust, exhaust fume and noise*: Air environment as well as people in the area are affected. In this scale, this impact is considered small and short term since being executed mainly by manual method.
- *Waste water and spreading rain water*: During the executing process, temporary inundation may occur, causing bad smell to the surrounding area, especially in the rainy season. In case execution time is extended or the execution of main and sub water drainage routes do not synchronize, then people's life in the area may be affected. Technological solutions and management to fully limit these impacts are needed and referred to in the part of "solutions to reduce impacts to environment".
- *Solid waste*: dug land will be collected and transported daily so there is no significant impact. The volume of solid waste of workers on the site is rather small, so if being daily collected and transported then the surrounding environment will be little affected. Currently, most of the project areas are provided with the service of on-site rubbish collecting by the urban environment company so this type of impact can easily be controlled.
- *Other impacts:*
    - *In terms of traffic:* During the process of execution, dug land and materials need to be transported out of the area. This will affect people's travelling. The temporary storing of digged land and materials outside executing area also cause some impacts on local traffic. Yet, since the collecting volume is quite small and the main means of transport here are bicycles and motorbikes so there are few impacts.
    - *Temporary delay of power, water, telephone and TV cable supply:* due to the moving of tension pole, telephone and cables and water supply pipes, yet this is just short term impact.
    - *Temporary affect people's business:* several small business households will be affected during the process of water drainage pipes installing, yet these are just short term impacts.

  - *Socio security:* the increase in number of workers working on the site as well as the gathering of numerous equipment and machinery in the area will cause negative impacts to socio security in the area.

- *Impacts during operation period*

Source of impact

- *Exhaust fume and smell*: The main source of pollution during project operation is toxic gas releasing from closed sewerage system with higher concentration in rainy season than in dry season and highest when being dredged, repaired or maintained. The periodical repairing, maintaining and dredging of water drainage system cause some certain impact on workers and people living near the area. The transporting and throwing of dredged mud also affect the surrounding area and the mud flat area.
- *Waste water and spreading water:* concrete road surface reduce the ability of absorbing water and increase the volume of spreading water. Besides, during the project operation process, there is living waste water from family households and small business activities.
- *Living solid waste:* releasing from family households and business activities at about 0,86kg/person/day on average.

Objectives and scale of impacts

- Household living in the project area after being upgraded.
- Workers repairing and maintaining water drainage sewerage

Assessing the impact

- *Exhaust fume and smell*: Exhaust fume from closed sewerage system cause bad smell, this impact occurs mainly in dry season. Apart from that, gas releasing from periodically maintaining and dredging water drainage system may have some certain impact on workers as well as people living near the area.
- Mud transporting and throwing from dredging also cause some impact on the area surrounding the mud flat.
- *Waste water and spreading water:* rain water not being discarded on time may cause inundation when it rains
- *Living solid waste:* living solid waste if being placed on the road can cause bad smell to the area.

APPENDIX 2 - SUMMARY OF IMPACTS CAUSED IN THE PERIOD OF CONSTRUCTING AND OPERATING RE-SETTLEMENT AREAS.

Sub-component	Activities	Impacts
Construction period:		
	- Site clearance - Infrastructure construction - Construction of residential areas	- Impacts on trees and vegetation cover - Requisition of agricultural land - Increase in dust and noise due to tearing down of works - Increase in dust due to excavation and back filling; construction - Increase in noise and exhaust fumes resulted from transport means and construction equipments - Increase in amount of life waste resulted from workers in the construction site. - Temporary flooding when it rains - Possible traffic jam in the transport lines - Oil leak - Accident risks - Labour safety and worker's health - - Possible settlement and crack of neighbouring works, excavation of foundation for construction of residential areas.
Operation period:		
		- Increase in amount of wastewater - Stagnant wastewater causes terrible smell - Smell from dredge of sewerage - Transport and discharge of dredged mud - Impacts on underground water due to leaked, cracked sewerage and catch basin - - Increase in amount of solid waste

Impacts in the construction period

Sources causing impacts

Main activities during the construction period of residential areas include: site clearance, infrastructure construction such as transportation network, water supply and drainage, lighting, construction of residential areas. Sources causing impacts are as follows:

- *Loss of trees and vegetation cover*: some trees and vegetation cover will be destroyed for site clearance.
- *Loss of agricultural land*: existing agricultural land will be resumed for construction of the campus and for re-settlement areas.
- *Dust, exhaust fumes and noise:* resulted from tearing down and construction activities such as excavation, back filling, subgrading, construction of infrastructure and re-settlement areas.

- *Wastewater and overwhelming rain-water:* wastewater discharged from workers in the construction sites, overwhelming rain-water from higher-level subgraded areas, which can cause temporary flooding for neighbouring areas.
- *Solid waste:* solid waste is resulted from construction period including (i) remaining soil and (ii) solid waste from workers' life activities.
- *Traffic obstacles:* Traffic jam can happen in the rush hour because of increase in transport flow for income and outcome delivery of remaining soil and construction materials.
- *Accidents:* can happen during the construction period such as labor accidents, traffic accidents…
- *Settlement and crack of neighbouring works*: deep excavation of foundation can have impacts on surrounding structures.

Objectives and scale of impacts

- Air
- Surface water environment
- Households in executing area and on transporting route
- Traffic on transporting route
- Workers working on the site
- Impact time: estimated within 1 year of executing resettlement areas

Assessing the impact

- *Dust, exhaust fume and noise*: cause bad impact to workers and people living around the area
- *Waste water and spreading rain water: not much and could be managed so impact is little*
- *Solid waste*: not much but if not being collected and treated then they can cause bad sanitation and smell.
- *Traffic obstruction*: mainly affect transporting routes with high traffic density and narrow roads
- *Accident:* can occur, causing material damage to workers…
- *Causing sinking and cracking to the adjoining works*: this impact, if there is, will affect the structure of the work, causing danger to people living nearby.
- *Impacts during operation process*

Source of impacts:

During the executing process, main sources of impacts to the environment of resettlement areas include:

- Exhaust fumes and smell: The main source of impact in resettlement area executing process is the smell and toxic gas from closed sewerage system and this impact is bigger in dry season than in rainy one.

- *Waste water:* stagnant waste water in the sewerage will cause bad smell, waste water from leaks in sewerage and gas hole systems can infiltrate to the land and pollute the underground water.
- *Living solid waste*: caused by people's daily living activities, according to the report of Da Nang department of environment and resources in 2005, the estimated volume of solid waste per person was about 0,86kg/person/day.

Objectives and scale of impacts

- People living in re-settlement areas are affected
- Resettlement area management unit and ward's authorities.

Assessing the impact

- *Exhaust fume and smell*: causing bad smell to people in re-settlement areas, especially in dry season. Toxic gas agglomerated in the sewerage system can directly affect the dredging workers. The main source of impact in resettlement area executing process is the smell and toxic gas from closed sewerage system and this impact is bigger in dry season than in rainy one. Dredged mud can affect the air and the underground water at the mud throwing site.
- *Waste water*: stagnant waste water in the sewerage will cause bad smell, waste water from leaks in sewerage and gas hole systems can infiltrate to the land and pollute the underground water.
- *Living solid waste*: volume of waste is not big and will be daily collected then the impact is not remarkable.
- *Impact in terms of society:*

Environmental pollution from surrounding areas:

Re-settlement areas are one of the city's residential areas, surrounded by blank land with no industrial place. Re-settlement areas are not affected by industrial polluted sources in the operating process.

Conclusion: during the process of executing re-settlement areas, the air will be polluted mainly by dust and noise. Suitable traffic flow distribution is needed to prevent traffic jams. Impacts during the operating process of re-settlement areas are maily positive. Negative ones occur when dredging and maintaining water drainage system, collecting and treating living waste. Yet these impacts are not remarkable and can be controlled.

APPENDIX .3 LABORATORY WASTE MINIMISING

Waste Avoidance and Waste Minimising	Strategies for avoiding and minimising production of chemical waste in laboratories: - replace hazardous compounds with less hazardous compounds - minimise the quantity of hazardous materials used e.g. reduce testing procedures to semi micro or micro scale - recycle hazardous compounds (either within the laboratory or by external contractors) - pretreat wastes to remove hazardous materials prior to discharge of waste to the sink by chemical destruction, precipitation, solvent extraction or ion exchange.
Classification dangerous goods and substances	- Class 1 Explosives - Class 2 Gases - Class 3 Flammable liquids - Class 4 Flammable solids - Class 5 Oxidizing substances and organic peroxides - Class 6 Toxic and infectious substances - Class 7 Radioactive Substances - Class 8 Corrosives - Class 9 Other miscellaneous substances
Label	Label all containers with the group name from the chemical waste category and an itemized list of the contents. For example, do not label a container simply `Corrosive Liquids'. List each chemical in the container, including all solvents used. List by full name only. Abbreviations, initials or chemical formulas are not acceptable labels. Liquid dumps are intended for liquids only. Do not place glass or plastic items, such as tubes or pipettes, into solution dumps. If these items require disposal, package them separately. (Keep plastic and glass waste separate.) Any waste containing PCB's must not be placed in waste dumps. Special procedures are in place for disposal of PCB's and it is important to keep the volumes small. Packaging and containers: All waste must be appropriately packaged for the waste category. *For example:* corrosive waste should be stored in non-metallic containers. All liquid waste must be stored in leakproof containers with a screw- top or other secure lid. Snap caps, mis-sized caps, parafilm and other loose fitting lids are not acceptable. Solid debris must be placed in plastic bags. Do not place chemical or other non-biohazardous material in a biohazard bag. Biohazard bags are for biohazardous material only. Any waste disposed of in these bags will be treated as such. For the disposal of vials containing liquid scintillation fluid, place plastic and glass scintillation vials in *separate* boxes. Plastic vials can be placed loose in a cardboard box lined with a garbage bag. Glass vials should be placed in trays, then placed in a box. Attach a *completed* "Waste Scintillation Fluid" label (include all requested information). Please do not "hide" items for disposal in the boxes; the boxes are opened for final disposal and unexpected items can create a safety hazard to personnel. Sharps (needles) must be well packaged to avoid any possibility of puncturing

	personnel. Used needles should be disposed of in a commercial sharps container or other suitable heavy plastic container. With the lids secured, place the containers into a cardboard box and seal with tape. Label "Sharps for disposal". Importance of segregating waste It is very important that hazardous materials are segregated into the proper categories. Different hazardous waste has different disposal methods. These disposal methods are also reflective in the cost of disposal. For example, waste which has the potential for reuse or recycling, such as non-halogenated organic waste is less expensive to dispose of than waste which is destroyed in a chemical incinerator, such as halogenated organic waste. There is also a tremendous environmental advantage to reusing and recycling chemical waste. When categories are mixed, the disposal method is always for the "more hazardous" chemical. To use the above examples, when a few litres of a halogenated solvent is mixed with a drum of non-halogenated solvent, the entire volume must be considered halogenated waste. The contents of the drum, including the recyclable waste, will be destroyed in an incinerator. Importance of proper labelling Waste that is picked up from a lab is not sent to the final waste disposal facility in the original container. *For example*, a 4L bottle of waste lead solution is bulked into a 205L drum with lead solution from other labs. This is either done on-site at our campus transfer station or, in the case of larger volumes, at a waste brokers transfer station. Little on site testing is done before bulking. We depend on the labels you place on the containers. If a container is mis-labelled or incompletely labelled, that is, all the contents are not listed; we may inadvertently place the waste in the wrong bulking drum. With the many hazardous combinations of chemical incompatibility possible, this could have serious implications. The result could be the release of noxious, formation of more hazardous compounds, fire or fumes even explosion. It is also important when shipping hazardous waste to the disposal companies that the exact contents of the containers are known. Transportation of Dangerous Goods regulations require that the transport of hazardous materials include detailed shipping documents. Also, although we do not test the container's contents, the waste disposal companies do extensive testing of all waste to determine the proper waste disposal method. Surprises in the containers will result in a surcharge levied onto the cost of disposal. Besides the unnecessary cost expenditure, this can also result in an embarrassing situation when it appears that we are hiding "more hazardous" waste in with other materials. Chemical Waste Categories (see flowchart): AVOID MIXING WITHIN, AS WELL AS, BETWEEN CATEGORIES. SEGREGATE WASTE WHEREVER POSSIBLE.

APPENDIX 4 – MANAGEMENT OF LABORATORY WASTE

Table (i) – The general laboratory methods management

Management stages	Methods of Management
1) Characterization of waste	
Characterization of what constitutes waste	- It must be know what type of waste in includes - What type of danger or hazard does it cause - Does it react with other agents - Pack all waste in drums provided by contractors - Ensure glass bottles are prevented from breaking by adding vermiculite - All drums must be properly classified and labelled as HAZARDOUS WASTE
2) Packaging	
Collecting of Hazardous Wastes	– Hazardous wastes are collected in special containers observing the statutory regulations (e.g.,"Ordinance on the Hazardous Substances"; refer also to: "Legal Conditions for the Handling of Hazardous Substances" and "Technical Guidelines on Safety in Chemical Laboratory Courses"). – Different types of wastes should not be mixed together. For each type of waste special containers should be used for collection which are provided by the university. These containers will be given back to the waste repository, whereby the containers should not be filled above 90% (to avoid spillage during transportation). – The containers must be sealed and labelled correctly. Otherwise disposal companies are not allowed to accept them. – Containers being damaged, leaking, or contaminated with hazardous substances on the outside will also not be accepted. – The general rule for the handling of hazardous waste is to avoid any risk of endangering people and the environment during storage, transportation, and disposal of these materials. – Is the waste properly package – if not , it can lead to spills and explosions.
Packaging of chemical waste	- Place hazardous waste in sealable containers - Enviroserv supply different plastic and metal containers sized from 25L to 200L, plastic or metal. - Containers must be kept closed. - Do not leave a hazardous waste container with a funnel in it. - Glass bottles with waste must be packed with vermiculite into bigger containers. - The container should not react with the waste being stored (e.g. NO hydrofluoric acid in glass) - Similar wastes may be mixed if they are compatible - Wastes from incompatible hazard classes should not be mixed (e.g. organic solvents with oxides) - Be aware that certain metals also cause disposal problems when mixed with flammable liquid or other organic liquids.
3) Storage	
Use containers	- Select the correct container (glass / polyethylene) for storage - Use original containers if possible - Use appropriate sized container - Do not make containers too heavy to lift by the contractors - Containers must be tightly sealed and not leak

	- Containers correctly labelled - Container compatible with chemical being stored -separate containers for each type of waste - Do not store longer than 90 days
Segregate wastes	- Keep hazardous waste separate from non-hazardous waste. - Keep organic waste separate from inorganic waste. - Keep different groups of solvent separate (e.g., halogenated vs. non-halogenated solvents). - Keep incompatible materials separated (ignitable and oxidizers; acids and bases; oxidizers and reducers, etc.).
4) Label	
Labelling -is the labelling effective	- Must be labelled as HAZARDOUS WASTE - Should be accurate, legible and fully explained - Contain name of the department, lab group name, contact person details, content and concentration, hazard class, date - Use Enviroserv /Sanumed self adhesive labels or your own. - Waste vs. used - No old labels
5) A proper procedure/ protocol in place in collecting the waste and remove it.	
Class. different type of waste	- Non-hazardous waste,-normal Municipal waste-paper, drink bottles of which can be recycle - Broken Glass can be recycled but if it is contaminated it is handled as chemical waste. - Hazardous waste which include dangerous Chemicals, biological waste ,sharps , radioactive and electronics/ computers - I will only talk about chemical, biological and sharp waste
In laboratory treatment of waste	- neutralization - separation - fixation - oxidation - precipitation - degradation - ion exchange
Cleaning of Laboratory Equipment	Cleaning of laboratory equipment after their use in chemical experiments can also be a source for hazardous wastes which have to be disposed of according to the regulations. *It is forbidden to use extremely flammable, very toxic, carcinogenic, teratogenic, or mutagenic chemicals for cleaning purposes.*

Table (ii) – Some main methods of biological waste management

Ways to minimize waste	- Good housekeeping - Document Procedures - Maintain Chemical inventory - Centralize purchasing - Spill Preparedness - Neutralize corrosives - Minimize use of solvents - Use alternative products
Packaging Biological Waste for Disposal	Where possible, biological waste should be decontaminated prior to disposal. Methods of decontamination include autoclaving and bleaching. All biological

	waste collected for disposal will be placed in a rigid container (e.g. a box, pail, or stand) that is double-lined with two regulation biohazard plastic bags. The plastic bags must be of sufficient strength to prevent ripping or tearing (3-millimeter equivalent) and must be marked according to federal, state and local regulations (i.e., red in color and/or with biohazard symbol on the outside). When the biological waste container is full, or the maximum weight limit of the container is reached, the following procedures must be followed: − Ensure that the packaged waste is within the required weight limits as indicated on the container provided; − Seal or tie each bag; − Label the outer bag with the College's identification labels − Securely close each container with 3 strips of tape on top, bottom and side seams
Animal Bedding waste	- Bagged – not be mixed with other waste - Labeled as animal bedding waste - Are to be autoclaved before being placed in medical waste boxes – disposed in the medical waste stream
Animal carcasses	- Are kept frozen - Get an order number from Elmarie King –USBD (ek2@sun.ac.za) - Department took the carcasses themselves to the Western Province Veterinary lab , Stb for incineration
Containers –Biological	
Biohazard/medical waste boxes	- Disposal of non-sharp bio hazardous waste - Cardboard box lined with a red 45 micron plastic bag - Two sizes 50 and 142 litter-max 15kg - Seal bag with cable tie, seal box with biohaz .tape - Sanumed destruct it by high temp. incineration
Biohazard Sharp containers	- Disposal sharp bio-hazardous waste - 100% puncture proof - Available in 4, 7.6, 10, 15 and 25 *l* - Destruction by high temp
Specimen bins	- For safe human and animal tissue disposal. - Ideal for wet waste - Available in 2.5, 5 and 10 *l* bin - Destruction by high temp
Bio-hazardous waste Pick-up Procedures	- Seal red bags when ¾ full with cable ties provided by contractor - Seal Biohazard/Medical waste boxes with biohazard tape - Complete chemical/biological waste pick-up request form - USBD will arrange for contractor to pick up waste and replace containers as needed - Double-lined red biohazard bags - In rigid containers - Within weight limits - Double tape bags when full - Label with college label obtained from Coordinating Dept - Close container and triple tape seams - Notify Coord. Dpt for pickup at Sharps
Points to remember	- No bio-hazardous waste shall be stored for longer than 24 hours without being decontaminated - Decontaminated bio-hazardous waste stored up to 30 days - No storage public areas

	- Store under refrigeration if necessary to prevent odors - Sharps containers treated as regular bio-hazardous waste

How to handle chemical waste

Workers must be aware of which class the reagents belongs to.

When it known what class type be worked with, it must be must be segregated properly.

Proper segregation of Lab waste is essential to good chemical hygiene and a safe workplace environment.

Proper segregation of wastes involves making sure that wastes within a bottle are compatible, and that the following types of waste must be NEVER be stored near each other

- Acids and bases
- Organics and acids
- Powdered or reactive metals and combustible materials
- Cyanide, sulfide or arsenic compounds and acids
- Mercury or silver and ammonium containing compounds
- Do not mix solids and liquids
- Halogenated with non-halogenated chemicals

If incompatible waste must be stored in same area, it must be separated with a second container.

Container must be **compatible** with the waste for instance:

- Mineral acids - plastic
- Bases -Plastic
- Oxidizers - Glass
- Organics (including Acetic acid) - Glass

Special care must be taken when working with:

- Nitric acid – it can reacts with organics which will cause heat and gas
- Make sure that the container is rinsed thoroughly
- Another danger is Perchloric acid and organic peroxides, as it is highly reactive with organics and organic material such as wood, it may also react with metals.
- hydrofluoric acid dissolves glass containers.

Place hazardous waste in sealable containers

- Waste firms supply different plastic and metal containers Sized from 25L to 200L in plastic or metal.
- Containers must be kept closed at all times.
- hazardous waste container must not be left with a funnel in it.
- Glass bottles with waste must be packed with vermiculite into bigger containers

Example of improper storage:

- Storage of waste in a fume hood where reactions are being carried out.
- Leaving waste bottles in or near hoods where reactions are being performed.
- Using metal cans for waste
- Storing flammable waste containers on a bench or floor.
- Storing waste bottles in or near a sink or floor drain.
- Only small amount of waste is allowed in the lab.
- Extra waste has been in a ventilated store room, preferably far from the labs, on the ground floor.

The container should not react with the waste being stored (e.g. NO hydrofluoric acid in glass). Similar wastes may be mixed if they are compatible. Wastes from incompatible hazard classes should not be mixed (e.g. organic solvents with oxides). Certain metals also cause disposal problems when mixed with flammable liquid or other organic liquids.

It is very important to label everything used and more important for waste.

- Waste must be labelled as Hazardous waste
- The labels must be accurate, legible and full explained
- Smaller waste bottles must contain name, content, concentration and the date.
- Storage waste containers must contain name of the department, contact person, content, type of hazard, date.
- Enviroserv supply self adhesive labels that can be put on the bigger waste containers.
- If something isn't really waste, don't put the word waste on the bottle, but label it as "used".
- Do not leave old labels on the bottles- this can cause confusion.

Enviroserv has also a waste classification system for each department/ building. This is an example:

- Numbers are allocated to departments and a code letter is used to describe what hazard type the waste is.
- These codes must be put on the labels of the containers that Enviroserv picks up.
- Another codes letter sis used for the method of destruction by Envirnoserv.

How To Segregate Waste In The Laboratory

The guidelines for temporary storage of chemical wastes in the laboratory are the same as those used for the storage of usual lab chemicals. The most important rule is to make sure that any chemicals or wastes that stored together are compatible with each other! Therefore, proper segregation of wastes involves making sure that wastes within a bottle are compatible, but it also means that you should NEVER store the following types of wastes near each other (a list of incompatible chemicals is above):

Select the correct container for storage

- Use original containers if possible
- Container must be compatible with chemical being stored
- Use appropriate sized container
- Do not make containers too heavy to lift by the contractors
- All containers must be tightly sealed and not leak
- All containers must be correctly labelled
- Use separate containers for each type of waste
- Avoid combining chemicals
- Do not store longer than 90 days
- Always remove waste bottles from hoods where reaction are being performed
- Store flammable waste containers in a cabinet, preferably an –explosion resistant solvent cabinet
- Do not store waste bottles in or near a sink or floor drain.
- Pack all waste in drums provided by the contractors
- Ensure glass bottles are prevented from breaking by adding vermiculite
- All drums must be properly classified and labelled as HAZARDOUS WASTE
- A copy of the form that must be fill in it is available on USRPS website. The form includes the contact details of the appointed departmental waste officer, what waste must be picked up and what empty containers must be delivered.

Please **DO NOT**

- Pour unknown chemicals down the drain
- Mix unknown chemicals with any other chemicals
- Bring unknown chemicals to a regular waste pick up

Abandon unknown chemicals in the work area.

Selected Remarks on the Disposal of Chemical Wastes from Laboratory

It is recommended to detoxify small amounts of hazardous chemical wastes in the laboratory by qualified staff. Detailed information on the procedure to be applied is contained in the mode of operation. Hazardous wastes routinely occur in laboratory work. Therefore, it is recommended that the following information is used to treat and to clear them of:

Chemical Remainders:

For chemical remainders only those materials can be disposed of, which

- constituents are known
- are not classified as explosives, and
- are not radioactive.

They must not contain highly toxic constituents like polychlorinated dibenzodioxins and furans, (PCDD/F), polychlorinated biphenyls (PCB), or warfare agents. Waste containers must be labeled properly even small vessels. Small vessels and product vials from lab courses can be collected together in containers for solid materials and declared, e.g., as

"syntheses products from inorganic chemical lab course in vials." In case of unknown chemicals (e.g. in unlabelled vessels) it is recommended to elucidate the type of the compound. Chemicals classified in certain waste groups have to be disposed of according to these groups. Hydrochloric acid should be explained as an example. It is assigned to the waste group "Inorganic Acids, Acid Mixtures, and Mordants". That means, HCl must not be disposed of as chemical remainder. Old chemicals in properly closed vessels should be offered to other groups or institutes for further use. They should be only disposed of if nobody is interested in having these substances within a time limit set.

Inorganic Acids, Acid Mixtures, and Mordants

The pH values of these solutions are below 6. They are aqueous acidic solutions which must be free of

- cyanides (otherwise hydrogen cyanide will be formed!)
- ammonium ions (max. 0.1 mol/L is allowed), and
- any type of organic substances (e.g., solvents, fats and oils).

Spent acids containing nitric acid (e.g., nitrating acid mixtures) have to be neutralized and then disposed of as "Rinsing and Washing Water". Acidic solutions which do not contain heavy metals or other hazardous substances can be neutralized with sodium hydroxide or sodium hydrogen carbonate in equimolar amounts and then poured out into laboratory wastewater.

Bases, Alkaline Mixtures, and Mordants

This waste category comprises liquid wastes with a pH above 8. They are aqueous alkaline hydroxide solutions which must be free of

- cyanides
- ammonium ions (max. 0.1 mol/L, otherwise emission of ammonia!), and
- any type of organic substances (e.g., solvents, fats and oils).

Alkaline solutions which do not contain heavy metals or other hazardous substances can be neutralized with equimolar amounts of hydrochloric acid and then poured out into laboratory wastewater.

Rinsing and Washing Waters, containing metal salts

This waste category comprises aqueous solutions of metal salts which must be free of

- cyanides,
- ammonium ions (max. 0.1 mol/L is allowed!), and
- any type of organic substances (e.g., solvents, fats and oils).

In case of these aqueous solutions it is possible to reach a significant volume reduction by applying concentration measures.

Remainders of Alkaline Metals

During drying of organic solvents remainders of alkaline metals are obtained. This sodium or potassium remainders are reacted by drop wise addition of ethanol or iso-

propanol. Finally, these solutions are neutralized and disposed of as halogen-free solvents.

Heavy Metals
Heavy metals in aqueous solutions can be precipitated as sulphides or carbonates. The precipitates are then filtered, dried, and disposed of as solid wastes.

Mercury containing Wastes (elementary Hg)
This waste category comprises elementary mercury (e.g., broken thermometers and manometers, mercury containing switch modules, mercury vapor UV lamps, mercury from diffusion pumps) which are collected separately. The collected spent mercury will be worked up and gained back in a special factory. Mercury compounds do not belong to this category of waste, but they will be disposed of as “fine chemicals”.

Silver containing Solutions and Wastes
For these substances it is recommended to collect them separately in order to work them up.

Hydrocyanic Acid and Cyanides
Highly toxic chemicals like hydrocyanic acid and its salts (cyanides) must not be poured out into wastewater. They have to be detoxified by oxidation. At laboratory scale oxidation of these substances with sodium hypochlorite solutions is an appropriate method. Only harmless substances like nitrogen, carbon dioxide, and chloride ions are formed via the intermediate cyanate. An alternative method is the oxidation of cyanide under alkaline conditions (pH 10- 11) to nitrogen and carbon dioxide. It can be checked with Merckoquant Cyanide Testkit whether the oxidation was completed.
Note: The disposal of cyanides should not be performed by the students in the basic lab course by themselves. They should be supervised by an expert person (e.g., course assistant). It is possible to form hydrogen cyanide and dicyane while improper operation.

Solvents, halogen free
All organic compounds can be disposed of as halogen free solvents if they meet following conditions:

- The elements C, H, N, Na, O, P, and S may be contained.
- There must be no halogens, even inorganic halogen compounds like salts).
- These solutions must be liquid at room temperature.
- If they are solids they should be dissolved in a suitable solvent.

The pH value must be adjusted to 6-9 by neutralization if necessary. Halogen free organic solvents should be recycled as much as possible.

Solvents, containing halogens

Halogenated solvents must be collected separately and be worked up or be provided to special companies. These solvents are forbidden to be mixed with others. As halogenated solvents organic compounds can be disposed of which

- may contain the elements C, H, N, O, P, S, F, Cl, Br, and I,
- are liquid at room temperature,
- are dissolved in a suitable solvents if they are solids.

The pH value must be adjusted to 6-9 by neutralization if necessary. Halogen free organic solvents should be recycled as much as possible.

Pressure Cylinders

Pressure cylinders must be controlled in fixed periods of time according to the gas type they contain. Any cylinder not in use must be given back to an expert company (usually the deliverer) 6 weeks before the control date (imprinted on the cylinder shoulder). If the control date already run out and the cylinder is still under pressure special transportation regulations have to be followed. Such a pressure cylinder is only disposed of or reutilized by a special company at high cost. Spray cans can be disposed of in special recycling container after being empty completely.

In laboratory treatment of waste

Neutralization of acids and bases is probably the most commonly used treatment method in educational institutions. Neutralization reduces a material's corrosivity (acid or caustic properties) by raising or lowering the pH to a neutral range, between 6 and 9.
Examples of some laboratory wastes amenable to treatment or neutralization are:

- phenol – with hydrogen peroxide and iron catalyst
- acid halides and anhydride – by hydrolyzing using sodium hydroxide solution
- hydroperoxide – by addition to acidified ferrous sulfate solution
- metal hydride – through gradual addition of methanol, ethanol, or N-butyl alcohol
- soluble metal fluoride – by treating aqueous metal solutions with calcium chloride solution
- finely divided metal – by oxidation with water
- aqueous solutions containing toxic metal ions, precipitate as insoluble sulfides using sodium sulfide in neutral solution
- oxidizing agents (e.g., hypochlorite or chromate) – by reduction using sodium bisulfite
- Again, before you implement any treatment methods outside of the experimental process, you should discuss your plans with state or local regulatory agencies.

Table (iii) - **Consult With Safety And Environmental Services Before Mixing Waste.**

Organic waste	
Phenol	Any waste generated which contains phenol or phenol mixtures, including phenol-acid mixtures and phenol-chloroform mixtures.
Halogenated	Any halogenated organic waste or any mixtures containing halogenated organic waste, except those containing phenol. Including chlorinated oils such as cutting oil. Examples: chloroform, 1,1,1-trichloroethane, methylene chloride
Corrosive	Non-halogenated solvent-acid mixtures, non-halogenated organic acids such as acetic acid, trichloroacetate, acetic anhydride.
Non-halogenated plus water	Non-halogenated solvent-water mixtures or non-halogenated solvents with greater than 20% water such as 80% ethanol.
Non-halogenated	Acetone, toluene, acetonitrile, ethyl acetate, heptane, hexane, alcohol with less than 20% water.
Corrosive waste	
Acid	Hydrochloric acid, sulphuric acid, nitric acid, chromic acid, hydrofluoric acid.
Inorganic/acid mixture	Iron III chloride, aluminium trichloride, mercury compounds dissolved in acid, other inorganic compounds dissolved in acid.

Alkali	Hydroxides, phosphates, ammonia.
Alkali mixture	Compounds dissolved in hydroxides, phosphates, ammonia.
Waste Oil	Used pump oil, crankcase oil, hydraulic oil. Excluding halogenated oils such as cutting oils.
Reactive waste	Air and water sensitive materials such as Grignard reagent, alkaline metals, reactive halides.
Waste oxidizers	All nitrates, potassium dichromate, metal peroxides such as chromium dioxide.
Inorganic waste	Heavy metal compounds and solutions such as those of mercury, lead, copper and zinc (except those dissolved in acid), other inorganic compounds not covered by another category.
Hazardous waste - Other	Waste not covered by any other category. All waste in this category must be segregated. No mixtures. Does not include radioactive waste, biohazardous waste, highly hazardous waste, explosive waste or surplus chemicals.
Radioactive waste	Follow procedures in place for the disposal of radioactive waste.
Biohazardous waste	Follow procedures in place for the disposal of biohazardous waste.
PCB waste Includes any waste containing or suspected of containing PCB's.	Follow procedures in place for the disposal of PCB's.
Explosive or other highly hazardous materials	Peroxide formers such as aged ether, di and tri -nitro compounds, old flares, azides. These materials require special disposal. Consult the safety office for arrangements.
Surplus chemicals	Any chemical which is no longer used or needed but which is still in good, usable condition. Consult the safety office for an assessment.

Table (iv) - Example In laboratory treatment of waste

Chemical	In laboratory treatment of waste
Nitrating Acid & Ice Water	After extraction of the product and separation of the organic phase an aqueous solution is obtained which is strongly acidic (pH 1) due to the content on mineral acid (nitric acid, sulfuric acid). These nitric acid containing wastes will be neutralized and disposed of as hazardous waste under the category “Rinsing and Washing Water”. Neutralization can be performed by adding equimolar amounts of sodium hydroxide or sodium hydrogen carbonate (be careful: foam formation due to carbon dioxide).
Sodium hydrogen carbonate solution & water from neutral washing	This alkaline phase can be used to neutralize the above mentioned acidic solutions and then be disposed of as hazardous waste under the category “Rinsing and Washing Water”. *Spent drying agent (sodium sulfate)* Sodium sulfate used to dry the organic phase will be collected in a vessel for spent drying agents after filtration and removal of the organic solvent (e.g., by evaporation). Later they can be disposed of as inorganic solids.
Distilled off cyclohexane from rotary evaporator	Separately collected spent solvents will be worked up from time to time by distillation.
Mother liquor from recrystallization	The residues of mother liquors containing methanol resp. ethanol can be disposed of as halogen free organic solvents. If there is a large volume of mother liquor collected that can be distilled in order to recover methanol resp. ethanol.
Distillation residues in the vessels	Distillation residues in the flasks and further organic residues will be dissolved, for instance, in acetone. These solutions can be disposed of as halogen free spent solvents. Liquid wastes will

	be incinerated in a high temperature waste incineration plant. The off-gas treatment systems of these plants prevent to emit hazardous pollutants into the environment. Pumpable inorganic wastes are treated in a stirred-tank reactor in several steps with suitable reactants. Some of the hazardous constituents (e.g., heavy metals) are precipitated as solids and then separated from the liquid phase by a chamber filter press. The sludge obtained will be disposed of in a hazardous waste landfill or in an underground disposal site. The filtrate of chamber filter press will be neutralized and then given into wastewater treatment facility. For quality assurance purposes and to control meeting the limit values an analytical monitoring is needed. Following, some treatment measures are given for pumpable inorganic wastes as example: o Cyanide is oxidized in strong alkaline medium (pH > 12) with sodium hypochlorite over cyanate to carbon dioxide and nitrogen. It is also possible to oxidize cyanides at technical scale by ozone. o Nitrite is oxidized by hydrogen peroxide in weak acidic medium to nitrate (pH 3.5-4.5). o Chromium(VI) (chromate) is reduced to chromium(III) by sodium disulphide in strong acidic medium (pH 2). o Fluoride is precipitated as poorly soluble calcium fluoride by the addition of lime milk. o Heavy metals are precipitated as hydroxides in alkaline medium or as sulphides in acidic medium.
Disposal of Peroxides	
Liquids	Dilution and Incineration. For small quantities of both refrigerated and ambient storage organic peroxides. Dilute peroxide to 1 % active oxygen or less than 10 % by weight (whichever is lower) in common hydrocarbons which are readily soluble with organic peroxides. The hydrocarbon solvent should be the same temperature as the peroxide being diluted, so that the heat contribution from the peroxide will be negligible. The mixture is then incinerated in a chemical incinerator. Note : This procedure is NOT recommended for solid peroxides.
Solids	Solids are disposed of 'as is' or as water wet mixtures. *MEKP :* Disposal of Methyl Ethyl Ketone Peroxide (MEKP) : 1.Harden with polyester resin, and dispose in landfill. 2.Hydrolysis : Incremental addition of MEKP to a rapidly stirred, cold 5 - 10 % sodium hydroxide solution. Reaction requires adequate agitation and temperature control between 30 to 40 °C. Note : NEVER add the caustic to the MEKP. This procedure converts the MEKP to water soluble salts which can be disposed of as non hazardous waste.
Decontamination and Destruction of Aflatoxins in Laboratory Wastes	Two methods for the treatment of laboratory wastes contaminated with aflatoxins : 1. Treatment with sodium hypochlorite, NaOCl, Technical grade, 12% w/w or 48% w/v 2. Treatment with conc, H_2SO_4 and a saturated solution of Potassium permanganate, $KMnO_4$.(about 0.4M soln. at room temp.) *Notes :* 1. Wastes present in organic solvents are first evaporated to dryness under vacuum with rotary evaporator. 2. Wastes present in oils are first extracted with 1:2 methanol water and the methanol evaporated to dryness under vacuum using rotary evaporator. 3. 3. Wastes present in water solutions are treated directly.
Disposal of used drying agent	
Disposal of sodium/sodium wire :	Ethanol is added slowly to react with the drying agent. There may be a delay in hydrogen evolution whilst surface contamination of the drying agent is dissolved. It is important to swirl the flask during the addition to ensure adequate mixing. When the evolution of hydrogen has ceased, a small amount (ca .15 cm3) of a 1:1 ethanol/water mixture is cautiously added. If no

	further hydrogen evolution occurs, water is cautiously added to fill the flask and it is left until no more bubbles of gas can be seen. If an aqueous and an organic layer have formed, these must be separated, the solvent put into the appropriate waste solvent bottle and the aqueous layer washed down the sink with lots of water. If the water and solvent are miscible, often the whole contents of the flask can be washed down the sink with lots of water to render the mixture non-flammable.
Disposal of magnesium or calcium hydride :	The procedure is similar to that used for sodium except that a mixture of 90% ethanol and 10% water is used in place of pure ethanol. When hydrogen evolution ceases, water may be added cautiously until no bubbles can be seen. Similarly, as for sodium, if an aqueous and an organic layer have formed, these must be separated, the solvent put into the appropriate waste solvent bottle and the aqueous layer washed down the sink with lots of water. If the water and solvent are miscible, often the whole contents of the flask can be washed down the sink with lots of water to render the mixture non-flammable.
Unidentified Chemical waste	- Should be considered unknown hazardous waste. - Unknown waste cannot be legally transported or disposed. - To dispose them safely and properly it need to be characterized by Enviroserv which is a costly affair. - Find out as much as possible about how the waste was generated. - Please **DO NOT** ▪ Pour unknown chemicals down the drain ▪ Mix unknown chemicals with any other chemicals ▪ Bring unknown chemicals to a regular waste pick up ▪ Abandon unknown chemicals in the work area.

Cleaning of Laboratory Equipment

Some chemicals are unsuitable for cleaning purposes. Tehse are: diethylether (extremely flammable), benzene (toxic, carcinogenic), and tetrachloro methane (toxic, carcinogenic). Organic residues in lab ware can be dissolved in a suitable solvent (e.g., acetone, 2-propanol, ligroin). The solutions are collected and solvents are recycled by distillation. Distillation residues can be disposed of as “halogen free solvents” (halogen content < 2%) resp. “halogen containing solvents” (> 2%). These substances must not be poured out into wastewater! Stubborn pollutions can be treated in many cases with saturated sodium permanganate solutions, which will be added in the vessel to be cleaned with the same volume of sodium hydroxide solution (20 wt.-%). The use of chromic acid cleaning mixture for this purpose is forbidden in the meantime since it is carcinogenic! (Use of carcinogenic substances should be prohibited where substitutes are available) There are further (alkaline) cleaning agents like soaps, ethanol or 2-propanol containing KOH solutions (note the fire prevention instructions!), and commercially available cleaning agents like Extrane (Merck), which often degrade organic residues in the presence of air. While using strong alkaline cleaning baths one should carry safety goggles and gloves. Any contact of these agents with the skin or eyes has to be avoided, in order to protect nails, callus, and cornea. Spent solutions of Extant Laboratory Cleaner is usually biodegradable. But if they are contaminated with chemicals hazardous for the environment during the cleaning process they have to be neutralized and disposed of as “salt containing solutions”. Inorganic residues (e.g., salts)

are dissolved in diluted acids or bases if needed. Strong oxidizing cleaning agents, like concentrated sulfuric acid, concentrated nitric acid, hydrogen peroxide may only be used when other cleaning measures remained unsuccessful.

Guidelines for disposing of items used in Laboratories

- Autoclave rooms are for laboratory waste only.
- Do not place office waste or other miscellaneous waste in these rooms.
- Do not use the autoclave rooms for storage.
- Choose autoclave pans and liner bags appropriate for the task.
- DO NOT OVERFILL pans. Lids should always fit FLUSH
- on top of the pan to facilitate safe stacking and transportation. Contact SRP at x3202 for instructions on handling items too large to fit in available discard pans.
- NEVER use hands to force overfilled bags into autoclave pans.
- Add ~250ml-500ml water to autoclave bag or discard pan prior to removal from laboratory.

Table (v) - Reusable Laboratory Items:

(DO NOT MIX REUSEABLE ITEMS WITH DISPOSABLE ONES)

Not Contaminated	Place in metal pan. Wire baskets may be used only for returning the litre glass bottles for sterile water to Glassware. Add "Building and Room Number" and "Do Not Autoclave" labels. Cover and leave in autoclave room for pick-up.
Contaminated	(Must be Autoclaved and NEVER placed in general waste) - Place in metal pan and add water to 250ml - 500ml. - Cover pan and add "Building and Room Number" label and autoclave tape on the same end of the pan. - Place in autoclave room on the appropriate rack for decontamination and pick-up.
Single-use/Disposable Laboratory Items: (Must be Autoclaved and NEVER placed in general waste)	- pipette tips *plastic-backed diapers - pipette tip boxes *aluminium foil from - all pipettes laboratory glassware - flasks, dishes, etc. *"weigh boats" - plastic tubes *tongue depressors, etc. - commercial/non-reusable- *gloves, gowns, masks, etc. - glass containers contaminated or not - Place waste in metal pans lined with an autoclave bag. (If ONLY soft items, omit pan) - Add water and fold bag loosely and cover pan. - Add "Building and Room Number" and autoclave tape. - Place in autoclave room for decontamination and pick-up.
All Sharps (Must be Autoclaved and NEVER placed in general waste) (Includes ALL disposable syringes,	- Place "sharps" and disposable syringes in approved red Sharps Container (obtained from Laboratory Services). - Add water (~20ml), "Building and Room Number" label and autoclave tape. - Place "Sharps Container" in metal pan and leave in autoclave room for decontamination and pick-up. Neither syringes nor needles may be sent to the landfill. They must be discarded in

needles, scalpels, etc. and may include pipette tips, glass slides, glass vials, etc.)	"Sharps" Containers only, not in regular trash or autoclaved discard.
Broken glass (Must be Autoclaved and NEVER placed in general waste. Do not use cardboard "Broken Glass" boxes).	– Small pieces of broken glass may be disposed into the Sharps Containers. If the broken glass is contaminated, it should be treated in the same manner as any contaminated sharps item. It is prudent to wipe the top of the Sharps Containers with 10% Bleach solution or other appropriate disinfectant after inserting any contaminated item or at the completion of a task. – Large broken glass items should be placed in a discard pan lined with an with autoclave bag and labeled with" Building/Room Number" sticker. – The lid for the discard pan should be secured with several inches of autoclave tape. – The words CAUTION: BROKEN GLASS should be written on the autoclave tape along the top of the discard pan in large letters to alert the SRP staff to take extra care in handling this discard pan.
Pasteur Pipettes (Must be Autoclaved and NEVER placed in general waste).	– Short-tipped and Long-tipped Pasteur pipettes may be placed in the red Sharps Containers containing ~1" of appropriate disinfectant for decontamination and disposal. It is prudent to wipe the top of the Sharps Containers with 10% Bleach solution after inserting any contaminated item or at the completion of a task involving infectious agents. Loosely recap container when not in use. – Short-tipped and Long-tipped Pasteur pipettes may be collected into a plastic beaker containing ~1" of appropriate disinfectant. – Upon completion of the procedure, the beaker of pipettes may be carefully decanted into a discard pan lined with an autoclave bag. – Special care should be taken to avoid overfilling the discard pan. – Each user should check to assure that all pipette tips are flat in the pan and not protruding upward. – The discard pan should be labelled Caution: Pasteur Pipettes to alert Scientific Resources personnel.
Handling "Other" Waste (Examples)	
Shipping containers	– Decontaminate if necessary *i.e.*, autoclave or wipe with appropriate disinfectant. – Deface Biohazard Sticker. – Mark outer cardboard container "Trash". – Place in general waste. – Send inner decontaminated plastic container
Gloves	– All latex, vinyl and nitride laboratory gloves must be autoclaved regardless of use. – Household-type utility gloves may be discarded in general trash unless they have been used in the laboratory and are contaminated.
CHEMICAL SPILLS	
Locate spill cleanup materials. Laboratories should be equipped with spill cleanup kits. Wear the appropriate personal protective equipment (e.g., gloves, goggles) when cleaning up spills.	
Acid Spills	Apply neutralizer (or sodium bicarbonate) to perimeter of spill. Mix thoroughly until fizzing and evolution of gas ceases. NOTE: It may be necessary to add water to the mixture to complete the reaction. Neutralizer has a tendency to absorb acid before

	fully neutralizing it. Check mixture with pH indicator paper to assure that the acid has been neutralized. Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place in the fume hood. Notify supervisor.
Caustic Spills	Apply neutralizer to perimeter of spill. Mix thoroughly until fizzing and evolution of gas ceases. Check mixture with pH indicator paper to assure that the material has been completely neutralized. Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place in the fume hood. Notify supervisor.

Computer & Electronic Waste

Procedures for Recycling or Disposing of Computer and Electronic Equipment	
Step 1: Erase Data	Prior to disposing or sending for surplus, all software and data files on all computer equipment must be destroyed or sanitized. Information Technology Services (ITS) has issued information and guidelines to assist departments in accomplishing this task.
Step 2: Asset Management Surplus/Disposal Tag	After successfully destroying or sanitizing any data contained on the computer equipment, the computer equipment must be "tagged" for surplus or disposal by the department Env. Management.
Step 3: Removal for Surplus or Recycling/Disposal	Once the first two steps have been completed, the equipment is ready for removal. If the equipment is going for surplus, Asset Management will arrange the removal. If the equipment is to be sent for recycling/disposal, contact your building manager to arrange for the equipment to be removed from area. The building manager will contact Environmental Health & Safety to coordinate the recycling/disposal.
Management label prior to disposal	
Management label prior to disposal	– If glass monitor should break and the glass can contain 4-8 lbs of lead, the broken glass MUST be collected as hazardous waste – Use proper PPE (gloves, safety glasses) and with a dust pan, carefully scoop glass into a bag. – Place bag into a box or hard container and label it with a Hazardous Waste Label as “lead – broken glass from monitor”

Table (vi)– The laboratory’s safe methods

HANDLING LIQUIDS	
Obtaining the chemical	Take an appropriate container to the reagent shelf. Avoid measuring volumes of strong acids and alkaline solutions with your graduated cylinder held at eye level. Support your graduated cylinder on your bench; add hazardous liquids a little at a time, inspecting after each addition.
Reagent in a dropper bottle	If the general supply bottle is equipped with a dropper, use it, but be sure that the dropper never touches your container or the contents in it. Never put it down on the bench top, but return it immediately the right reagent bottle.
Reagent in a stopper bottle	If the general supply bottle is equipped with a stopper, the stopper should either be held during the transfer or placed on its flat top. Do not lay the stopper on its side on the bench top. Pour chemicals from the general supply bottle into your container. Be sure that the proper stopper is returned to the supply bottle; do not interchange stoppers.
Mixing	If liquid chemicals are to be mixed with water, always add the concentrated

	chemical to water rather than the other way around. This keeps the new solution dilute at all times and avoids many accidents. Usually addition should be done slowly, using small quantities. It is especially important to add acid to water because of the heat generated.
Pipetting	Liquids are drawn into the pipet by applying a slight vacuum at the top, using a small rubber suction bulb but NEVER THE MOUTH.
Heating	Liquids in beakers and flasks can be heated by placing them on a ring stand on wire gauze with the container supported by a clamp. Liquid should never be heated in a graduated cylinder or in other columetric glassware.
Disposal	Check with your laboratory instructor before disposing of any chemicals down the drain. If the liquid chemical can be disposed of in the skin, dispose of it by rinsing it down the sink with large quantities of water. Avoid unnecessary splashing during this process by pouring the chemical directly down the drain while the water is running vigorously.
HANDLING SOLIDS: THE CONTAINER	
Take an appropriate container to the reagent shelf where the general supply is kept. Solids are somewhat more difficult to transfer than are liquids, so a wide-mouthed container such as a beaker is preferable.	
The transfer	During the transfer, hold the stopper or lay it on the bench without contaminating the stopper. Solid chemicals are most easily poured by tipping the general supply bottle and slowly rotating it back and forth. Mere tipping of the bottle alone often causes large chunks to come out very suddenly which leads to spills. If you use your own spatula, be sure that it is absolutely clean. Return the proper stopper to the general supply bottle; do not interchange stoppers.
Mixing	If the solid is to be mixed with a liquid, add the solid to the liquid. Additions should be made in small quantities except in special circumstances.
Disposal	If the laboratory instructor directs you to dispose of any solid chemicals in the skin, flush it down the drain with copious amounts of running water. All other solids should be disposed of in special containers provided for this purpose.
CHEMICAL SPILLS	
Locate spill cleanup materials. Laboratories should be equipped with spill cleanup kits. Wear the appropriate personal protective equipment (e.g., gloves, goggles) when cleaning up spills.	
Acid Spills	Apply neutralizer (or sodium bicarbonate) to perimeter of spill. Mix thoroughly until fizzing and evolution of gas ceases. NOTE: It may be necessary to add water to the mixture to complete the reaction. Neutralizer has a tendency to absorb acid before fully neutralizing it. Check mixture with pH indicator paper to assure that the acid has been neutralized. Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place in the fume hood. Notify supervisor.
Caustic Spills	Apply neutralizer to perimeter of spill. Mix thoroughly until fizzing and evolution of gas ceases. Check mixture with pH indicator paper to assure that the material has been completely neutralized. Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place in the fume hood. Notify supervisor.
Solvent Spills	Apply activated charcoal to the perimeter of the spill. Mix thoroughly until material is dry and no evidence of liquid solvent remains. Transfer absorbed solvent to a plastic bag (if compatible), tie shut, fill out and attach a waste label, and place in the fume hood. Notify supervisor.
Mercury Spills	Using a mercury vacuum, vacuum all areas where mercury was spilled with

	particular attention to corners, cracks, depressions and creases in flooring or table tops. Place the contaminated sponge in its plastic bag, tie shut, fill out and attach a waste label, and place in the fume hood.
LARGE CHEMICAL SPILLS ON THE LABORATORY BENCH OR AREA. In all cases, immediately alert your neighbors and the laboratory instructor of the spill.	
If the material is not particularly volatile, nor toxic, and poses no fire hazard	Liquid can be cleaned up by using an absorbent material which neutralizes them, for example, sodium bicarbonate solution or powder for acids, or sodium thiosulfate solution for bromine. Rubber or plastic gloves should be worn while using absorbent materials. A dustpan and brush should be used to remove the absorbent material. Then, the contaminated area should be cleaned with soap or detergent and water; and the area mopped dry.
If the material is volatile, flammable or toxic	ALERT everyone in the laboratory to extinguish flames, disconnect spark-producing equipment, shut down all experiments, and evacuate the laboratory. The laboratory instructor will handle the clean up.
CHEMICAL SPILLS ON A PERSON.	
Over a large area	Within seconds, quickly remove all contaminated clothing while person is under safety shower. Flood the affected body area with cold water for at least fifteen minutes. If pain continues or resumes, flood with more water. Wash off chemicals with a mild detergent solution. Do not apply any materials such as neutralizing agents or salves, to the area. Obtain medial assistance immediately.
Over a small area	Immediately flush area thoroughly with cold water. Wash with a mild detergent solution. If there is no visible burn, scrub the area with warm water and soap.
In the eyes	Will need to assist the person who has chemicals spattered in the eyes. Immediately drench the eyes at the nearest emergency eyewash station. Force the eye or eyes open to get water into them. The speed of your response to this emergency is extremely important. Notify the laboratory instructor of the accident immediately.
Swallowing chemicals	The laboratory instructor should determine what specific substance ingested. The individual should be forced to drink copious amounts of water while en route to medical assistance. The Health Center or Hospital should be notified while the individual is in transit as to what chemicals are involved.
Burns	For burns by hot objects, flames or chemical, flush the affected area with cold water for several minutes. Notify the laboratory instructor of the burn and he will arrange transportation to the infirmary if necessary.
Fire	Give assistance to people first. If the person clothes are on fire, guide him/her without running to the fire blanked station or to the safety shower and drench him. Do not hesitate because of such insignificant things as shrinking sweater, ruined hairstyles, or soggy discomfort. While the victims are being cared for other available people should try to shut off or reduce the fuel supply to the fire. Get a fire extinguisher and direct its spray toward the base of the fire. If the fire is too big to extinguish, have the laboratory instructor call the fire department and sound the fire alarm. When the fire is out, be sure all extinguishers used are tagged as empty and are replaced.
Injury or illness	Render assistance if necessary. For minor cuts, wash them thoroughly, apply a good antiseptic, and a band-aid. For major cuts, severe bleeding or serious illness, send someone for help and administer first aid. Only a physician is trained to treat serious injury or illness. Notify the instructor immediately.

Table (vii)- Fires and Fire extinguishers

Extinguisher type	Class of Fire	Examples of Fire type	Distinguising Features
Water	A	Ordinary materials, paper, wood, plastics, cardboard etc...	not recommended for lab or electrical fires; water-logged debris
Water mist	A - Where potential class C hazard exists.	Hospital environments, books, clean-rooms, MRI and NMR rooms	Misting nozzle provide safety from electrical shock and reduce scattering of burning material
Dry chemical (powder) BC - Na or K carbonate ABC - ammonium phosphate	A, B, and C	Combustible liquids, laboratory solvents etc...	Overlaying powder reduces re-ignition
Dry metal powder Copper agent NaCl agent	D	Metal and lithium alloy fires (Cu) Mg, Na, K, Uranium and Al fires (NaCl)	Powder cling to vertical and 3-D surfaces (Cu). Cakes and forms crust over surface - excludes air, dissipates heat (NaCl).
Dry sand	D	Electrical etc...	Smother embers
Carbon dioxide CO_2	B and C	Flammable solvents, electrically charged equipment and appliances, tools, switches etc...	Leaves no harmful residue, but may re-ignite with class A fires
Halotron 1	B and C	As for carbon dioxide. Ideal for computer rooms, clean rooms, electronics environments etc...	No thermal or static shock,non-conducting, discharges as "clean agent" liquid and has high visibility
Hydrofluorocarbons HFC - 236fa and fe - 36TM	B and C	To replace Halotron types.	"Cleanguard" zero-ozone depleting

Table (viii) - Typical extinguishers and their uses

Water extinguishers are suitable for class A (paper, wood etc.) fires, but not for class B, C and D fires such as burning liquids, electrical fires or reactive metal fires.	In these cases, the flames will be spread or the hazard made greater!
Water mist extinguishers are suitable for class A and C;	Dry chemical extinguishers are useful for class A,B,C fires and are best all around choice. They have an advantage over CO2 extinguishers in that they leave a blanket of non-flammable material on the extinguished material which reduces the likelihood of reignition. They also make a terrible mess but if the choice is a fire or a mess, take the mess! Note that there are two kinds of dry chemical extinguishers!
Type BC fire extinguishers	contain sodium or potassium bicarbonate.
Type ABC fire extinguishers	contain ammonium phosphate. CO2 (carbon dioxide) extinguishers are for class B and C fires. They don't work very well on class A fires because the material usually reignites.
CO2 extinguishers	have an advantage over dry chemical in that they leave behind no harmful residue. That makes carbon dioxide or Halotron I; a good choice for an electrical fire involving a computer or other delicate instrument. Note that CO2 is a bad choice for a flammable metal fires such as Grignard reagents, alkyllithiums and sodium metal because CO2 reacts with these materials.
Metal/Sand Extinguishers	are for flammable metals (class D fires) and work by simply smothering the fire with powdered copper metal or sodium chloride (NaCl). You should have an approved class D unit if you are working with flammable metals. The copper extinguishing agent is preferred for fires involving lithium and lithium alloys. It is the only known lithium fire fighting agent which will cling to a vertical surface thus making it the preferred agent on three dimensional and flowing fires. Sodium chloride works well for metal fires involving magnesium, sodium (spills and in depth), potassium, sodium potassium alloys, uranium and powdered aluminum. Heat from the fire causes the agent to cake and form a crust that excludes air and dissipates heat.
Some other less-common extinguishers that are worth noting	
Halotron I extinguishers	like carbon dioxide units, are for use on class B and C fires. Halotron I is an ozone-friendly replacement for Halon 1211 (which was banned by international agreements starting in 1994). This "clean agent" discharges as a liquid, has high visibility during dischage, does not cause thermal or static shock, leaves no residue and is non-conducting. These properties make it ideal for computer rooms, clean rooms, telecommunications equipment, and electronics. The superior properties of Halotron come at a higher cost relative to carbon dioxide.
Water mist extinguishers	are ideal for Class A fires where a potential Class C hazard exists. Unlike an ordinary water extinguisher, the misting nozzle provides safety from electric shock and reduces scattering of burning materials. This is one of the best choices for protection of hospital environments, books, documents and clean room facilities. In non-magnetic versions, water mist extinguishers are the preferred choice for MRI or NMR facilities or for deployment on mine sweepers. Typical small lab fires (in a hood or on a bench) can easily be controlled by a dry chemical (ABC) or CO2 extinguisher provided that you are properly trained.

Personal safety equipment

The vulnerable parts of the body when working in labs/ testing rooms are eyes, skin, respiration and digestion. Therefore, it is necessary to use personal safety equipments as below:

- Eye glasses, eye protection glasses, mask or apron are to protect the eyes and face while glasses of contact lens are not recommended to use at work of labs/ testing rooms. Also, it is advised to flush the eyes with appropriate liquid cleansers once finding chemicals in eyes.
- Rubber gloves should be used when dealing with skin harming chemicals. Latex plastic gloves could be worn every day at work. If any one gets allergic to latex ones, however, polyvinyl might be used as a replacement.
- Blouses/shirts used in testing rooms/ labs must be full length, fully buttoned and made of liquid resistant or fire resistant materials, either single layer or multi layer upon demands,
- Standard boots and mask must be used at work, particularly only when dealing with biological, chemical and other poisons, the special ones to be used.
- Noted that all personal safety equipments are tidied up upon leaving testing rooms/ labs.
- All blood samples and body liquor must be collected, transported and used properly; safety equipments like gloves, blouses, masks must be used in case the chemical could be spattered. The test tube of biological sample must be closed when centrifualizing so as to prevent disease causing bacteria air cellular from spreading out in the air.

Regulations for biological labs

Treatment of disposed emissions

As part of the nature of work, staff in testing rooms/ labs always come into contact with harmful factors: power shocks, harmful smoke, compressed air, flammable liquids, radiation, corrosives substances, and poisonous agents, cancer causing substances or bacteria infection and physical injury.

Accidents occurring in Labs or Testing Rooms are caused by two reasons:

- Unsafe environment and conditions.
- Tasks and processes that are not properly done in terms of biological safety.

In labs, the decontamination of harmful charges and the removal of these agents are normal activities and responsibilities. For instruments that have contact with disease carriers need to be destroyed or disinfected by auto clave or in aspirating burners in testing rooms. They should not be removed unless it is necessary and the appropriate care is taken during removal. Checks must be done to ensure that:

- all tools fully decontaminated via standard processes
- If not , that they are carefully wrapped up to be burnt out on-site or moved to another means for burning out

- There is no any correlation between the removal of these disinfected things and other potential dangers of biology or other risks to those directly involved in the removal process or those interacting with the removed things out of the testing room.

Detoxication, decontamination:
The wet autoclave is a preferable measure for decontamination process. The tool used for disinfection must be placed in tanks like autoclave, colour plastic bags. The regulation on decontamination via autoclaving and/or burner is set out. Other alternative solutions could be applied if they could completely remove and/ or fully wipe out microorganisms.

Process of receiving and treating the instruments, materials and wastages of disease carriers
It is necessary to have specialized systems applicable for substances of disease carrier and tanks. The local and international law must be complied with following points:

- The charge without disease carrier could be re-used or recycled or disposed as normal.
- The sharp charge with disease carrier – needle, knife and broken glass must be collected and kept in perforable box with closed cover and special treatment.
- The tool with disease carriers will be disinfected by autoclave, then cleaned and reused or recycled.
- The tool with disease carrier will be decontaminated and disposed.
- The tool with disease carrier will be burnt out immediately.

Management of Sharp things:
After being used, injection needles are not to be covered by their sheaths, bent or taken out of single-use syringes. All of these must be put in sharp waste bins. Cylinders being used separately or together with injection needles must be put in sharp waste bins and steamed to sterilize before being burnt down. Bins carrying sharp waste should neither be pierced through nor fully stuffed. When being stuffed up to three fourths of its volume, the bin must be taken to disease carrier place and burnt or sterilized before being burnt if needed. These bins should never be taken to the dumping ground.

Disease carrier tools must be steamed for sterilizing and recycled. Washing is not allowed before these tools are steamed for sterilizing and recycled. Any necessary cleaning or repairing must be done after steaming and sterilizing.

Disease carrier tools for steaming, sterilizing and recycling:
Sharp parts are discarded by the above procedure; all disease carrier or possibly disease carrier substance need to be steamed and sterilizing in close bins such as

steamable ones or nylon bags in different colours which are marked before being discarded. After that, these tools could be put in bins and taken to the burning places. Medical tools must not be discarded to the dumping ground even when they are sterilized. If there is an incinerator in the testing room, then the autoclave is not needed: disease carrier waste must be put in bins with separate designs (with coded colours and bags) and moved immediately to the incinerator. Multiple use bins must have a fit and close cap and must be cleaned and sterilized before being taken back to testing room.

Disease carrier waste:

Waste bins and vases should not be breakable (made from plastic for instance) and should be put in all working place. When being sterilized, waste must be fully soaked in aseptic solution (without separating air foam) in a specific period. Waste bins must be sterilized and cleaned before being re-used.

APPENDIX 5 - ASSESSMENT ON METHODS USED

METHODS USED TO EVALUATE ENVIRONMENTAL IMPACT

Statistics

Collecting and process data on meteorology, hydrograph, socio-economy of project site:.

Onsite sampling and lab analysis

Identifying parameter of air, water, noise quality at project site and surroundings; water sampling to analyse water beings.

Quick assessment by pollution coefficient established by WHO

Estimating amount of pollutants during project construction and operation and making comparison with WHO pollution coefficient.

Comparison

Making evaluation of impacts based on comparing with current Vietnamese environmental standards.

Table and matrix preparation

This method is used to establish relation between project activities and environmental impacts caused.

Community consultation

This method is used during interview with local authority and residents at project site. This method is also proved by the fact that Project owner asking written comment from the local people's committee and the ward committee of Vietnam fatherland front.

APPENDIX 6 – DATA AND COMMENTS ON DATA

SOURCES OF DATA AND FIGURE SUPPLYING

- Set of Vietnamese environment standards, 1995.
- Set of Vietnamese environment standards, 2005.
- Project Feasibility Report (ADB TA 7105 PPTA team)
- ADB (1990). Environmental Guidelines for Selected Industrial and Power Development Projects.
- Alexander P.Economopoulos, Assessment of Sources of Air, Water, and Land Pollution, Part 2: Approaches for Consideration in formulating Environmental Control Strategies, WHO, Geneva, 1993.
- World Health Organization, Assessment of Sources of Air, Water, and Land Pollution, A guide to rapid source inventory techniques and their use in formulating Environmental Control Strategies, Geneva, 1993.

APPLIED METHODS DURING EIA PROCESS

The following methods were applied when making EIA report for the project:

- Statistical method: to collect and process figures about meteorological, hydrographic and socip economic conditions at the project area
- Site sample collecting and laboratory analyzing method: to define parameters about the current status of air and water quality and level of noise at the project area and surrounding area
- Method of quick assessment according to polluted coefficient established by World Health Organization to estimate the volume of polluting substances causing by project activities
- Comparison method: to assess the impacts based on Vietnamese environment standards
- Tabulating method and matrix method: used to establish the relationship of project activities and impacts to the environment
- Community consulting method**:** this method is used during the process of interviewing local authorities and people at the project site.

Comments About The Level Of Detailed And Reliability Of Assessments

Table below shows the level of reliability of the methods being used:

Table. Syntherized reliability level of used EIA methods

Stt	Method	Level of reliability	Causes
1	Statistical method	High	Based on official statistical figures of the city
2	Site sample collecting and laboratory analyzing method	High	Sampling and analyzing equipment have high degree of accuracy. Based on standard sampling method
3	Method of quick assessment by pollution coefficient established by WHO in 1993	Average	Based on pollution coefficient established by WHO thus not really relevant to Vietnam's conditions
4	Standard comparison method	High	Analyzing results have high reliability level
5	Tabulating method and matrix method	Average	This method only assess qualitatively or semi-quantitatively based on subjective ideas of assessors
6	Community consulting method	High	Based on the official writing ideas of the commune people's committee and the commune's fartherland front