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Environmental impact analysis of Yen My cotton factory expansion

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ABSTRACT

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Eight March Textile Company Limited wished to increase the cotton production yield so they proposed a project plan to expand the current Yen My cotton factory with the construction of the new factory next to it. The objective of this thesis is to predict and evaluate possible environmental impacts, to support the development of the environmental impact assessment of the project.

There are four steps to predict and evaluate the impacts. Firstly, an environmental baseline study was conducted to understand the current physical, biological, and social environment quality before the construction begins. In addition, the value of the receptor environmental component is evaluated based on their importance and their reversibility. Data for this study were collected with the help of the Institute of Environmental Technology. Secondly, impact identification was done using a matrix method to list the possible impacts from the construction activities. Then, the impacts were predicted their magnitude with the quantitative method (calculation of the amount of wastewater content, emissions, and noise level) and qualitative method (rating of impacts based on a set of criteria). Finally, the impact magnitude was cross-referenced with the value of the receptor environmental component to evaluate the significance as “major”, “moderate” or “minor” and conclude whether they need further mitigation measures.

The results suggest that the impact from activities such as transportation and construction work to the air environment and surface water environment are evaluated of moderate to major significance, which means it is required to have further mitigation measures to reduce the impact further or alternative proposal to cause less impact. Other impacts on noise level, soil environment, biological environment, and social environment of the area have minor significance, indicating the planned mitigation measures are sufficient to reduce the impacts to a safe level. Most of the analysis was done with qualitative methods, which can be very subjective, however, considering the lack of resources and data, it is an acceptable method. Therefore, this assessment can be used as a broad overview of the impacts to support the development of the environmental impact assessment for the project in later stages.

Key words: impact analysis, impact prediction, impact evaluation

CONTENTS

ABBREVIATIONS AND TERMS

EIA	Environmental Impact Assessment
TSP	Total Suspended Particulate
WHO	World Health Organization

1 INTRODUCTION

Environmental impact assessment (EIA) has always been an important process of any project before it can begin. The main purpose of the environmental impact assessment process is to inform decision-makers and the public of the environmental consequences of implementing a proposed project (Environmental Law Alliance Worldwide 2018) In a developing country with vast industrial development like Vietnam, the importance of environmental impact assessment is further highlighted. Eight March Textile Company limited planned to construct a new factory near the existing factory in Yen My, Vietnam. According to the Vietnamese Environmental Protection Law (55/2014/QH13), every construction project with a possible impact on the environment is required to make an environmental impact assessment in order before the work can begin.

The objective of this thesis is to analyze the possible impacts of the environmental impact assessment of the construction phase of the project based on the requirements. Appendix 2.3 of circulars 27/2015/TT-BTNMT states that the evaluation and prediction of the environmental impact from the construction phase must be done for these three activities of the project: exploitation of construction material for the project, transportation of construction materials and construction activities of project items impacts on the receptor objects such as natural environmental components, biodiversity and human health. In which, the extent, magnitude and duration of impact must be assessed. According to this, the source of impact to be assessed includes solid waste, emission, and wastewater, noise. This type of source requires the calculation of the amount and concentration and comparing to the national standard if possible. Finally, decide whether further mitigation measures are required (Circulars 27/2015/TT-BTNMT.)

The purpose of the expansion of Yen My cotton factory is firstly to increase the yield of Siro 100% carded cotton which is a high-quality product and suitable for export. Also, this expansion would increase cotton material yield for the company or other stakeholders. Furthermore, this provides the materials for the regional

textile industry and provides occupation for approximately 230 workers in the region. From that, these workers will be trained to understand cotton spinning management, as a basis for the further expansion of the company in the future.

The location of this project was placed in a construction site with an area of 14000 m^2 near Yen My town, Hung Yen province. This land area was rented to another factory that had been dismantled before lending to this project. Therefore, the area is a flat terrain with mostly open space with some small trees and bushes around. So, this area only requires some land clearance work. The location is described in picture 1.

PICTURE 1. Map of the construction area

The intended construction area is located near Yen My town, Hung Yen province. To the north of the area is road 39A, to the south is the crops area, the east is Tan A Dai Thanh factory. The traffic system around this area is quite favorable. The construction site is right next to route 39A and 5A, which is very convenient for the transportation of fuel, materials to the construction site as well as transportation and distribution of products to other cities. There are several streams and small rivers near the area, with Nghia Tru river being the largest which is part of the water gathering point. Currently, this area is not nature preserve and did not have any important cultural structure such as pagodas, churches, historical

monuments. As the area is about 600 meters away from the residents of Yen My town, air pollution and health effects should be carefully considered before the construction begins.

For the convenience of the new building construction, the intended buildings have been estimated properly for the total area and its structure to have proper preparation for the construction. Understanding the type of building and its material can give an insight into the possible environmental impact. The list of the intended building is presented in the table below.

TABLE 1. Intended buildings and their area in the facility

Buildings	Area (m^2)
Main building	6540
Assistant area	1253
Other multipurpose room (maintenance, laboratory, air compression, power room, locker room)	250
Restrooms	93
Road	3000

Overall, the construction work of this project involves simple and basic material. The main material are concrete of various types with only difference in their content and mixing, and some types of steel and metal suitable for the integrity of the building.

TABLE 2. List of construction materials

Construction material	Amount
Hollow block 220 mm	1750 tons
Galvanized iron	19.6 tons
Cement	3924 tons
Sand	1765.8 m^3
Macadam	3139.2 m^3
Reinforced Steel	52.3 tons
Paint	650 L

Even though the amount of construction material has been estimated properly by the experts in construction, however, there are possibility of residual construction waste during construction work. This source of pollutant may have negative effects on environment

TABLE 3. Vehicles to be used in the construction

Construction vehicle	Pieces
Trucks	5
Bulldozers 160 CV	2
Hydraulic excavator 1.5 m^3	2
Rollers (10 tons)	2
Graders (160 CV)	2
Cranes (16 tons)	1
Concrete batching plant	1
Pile drilling machine	1

The vehicle used for construction work has been limited to work at the best efficiency for the project. However, this could be a source of several types of pollution. The emission from the diesel combustion of these vehicles may release harmful gases for both the environment and human health. In addition, the noise from these vehicles may cause some annoyance to citizens in Yen My town.

2 THEORETICAL BACKGROUND

2.1 Environmental impact assessment and impact analysis

Environmental Impact Assessment (EIA) is a process of evaluating both beneficial and adverse possible impacts of a project or development on environmental components such as physical, biological, and social environment (Convention on Biological Diversity 2010). It is an environmental decision support tool for decision-makers to decide whether the project should be allowed as it provides information on possible impacts of development projects (SOAS University of London n.d.). The purpose of environmental impact assessment is to identify, predict, and analyze possible impacts on the environment, social, and health (Environmental Law Alliance Worldwide 2010, 19).

The environmental impact assessment process is different for each country, depends on their regulation, however, there is a graph that describes a generalized EIA process in EIA Training Resource Manual from United Nations Environmental Programme. The generalized EIA flowchart consists of different stages of EIA, which are screening, scoping, impact analysis, mitigation and impact management, reporting, reviewing, decision-making, implementation, and follow up, in that order.

Screening is the very first step of any EIA, it is done to determine whether the project is required an EIA. If the project needs an EIA, the scoping of EIA is conducted to identify the issues and impacts that can happen in the project. In detail, scoping is used to identify the important issues to be considered in an EIA, the time boundaries of the EIA, information required for decision making, and significant effects and factors to be studied in detail (Raymond Sumo University 2006a). After that, the crucial environmental impacts are assessed in the impact analysis step. This step focuses on to identify and predict possible environmental and social impacts of the proposal and evaluate their significance. Mitigation and impact management is where the solutions to avoid or mitigate the discussed impacts are presented. After that, all of the information above is collected to an EIA report, usually standardized for decision-makers to review. Finally, the EIA

report can either be approved or rejected to decide if the project can proceed (United Nations Environmental Programme 2012, 254).

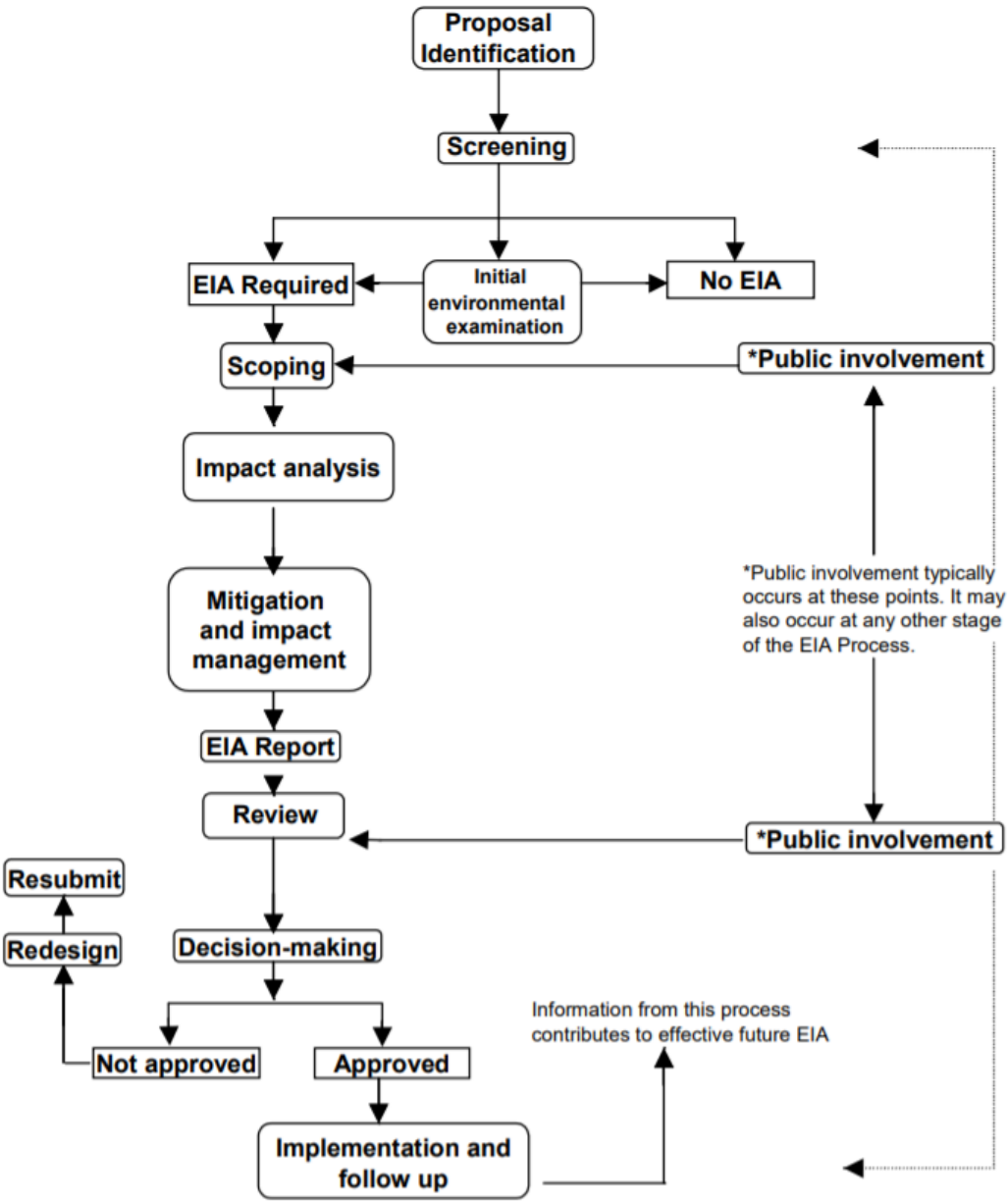


FIGURE 1. Generalized EIA flowchart (United Nations Environmental Programme 2012, 253).

Impact analysis is the main stage of EIA as it predicts the main characteristics of the potential impacts. The objectives of impact analysis are predicting and evaluating the potential impacts which cover the objectives of this thesis. There are three steps in this stage: Impact identification, impact prediction, and impact evaluation. Impact identification is specifying all possible impacts from activities of different phases of the project. Impact prediction is the process of characterizing

the identified impacts, environmental baseline study is also done to refer for comparison to clearly identify the impacts. Finally, impact evaluation is determining the significance of the impacts based on the magnitude of the impact and the value of the environmental component receptor (United Nations Environmental Programme 2012, 255.)

2.2 Environmental Baseline Study

Environmental Baseline Study is the study and data collection of relevant physical, biological, and socio-economic aspects. It is done to determine the present quality of environmental components within the area of influence before the project begins (Environmental Protection Agency Guyana 2000, 4). The purpose of this action is to provide a reference against which the characteristics and parameters of the impacts related changes are analyzed and evaluated (United Nations Environmental Programme 2012, 263.) In most cases, the baseline condition still exists when the project is implemented (United Nations Environmental Programme 2012, 264). In this thesis, the estimated construction time is about 9 months, which is quite short, therefore the current environment condition is enough to describe the environmental baseline of the construction site.

The baseline data should describe the current condition of the environment. According to the requirements in chapter 2 of appendix 2.3 of circular 27/2015/TT-BTNMT, the environmental baseline study of the physical environment is done with sampling and measurements of environmental components that are directly affected by the project. The sampling and measurement techniques followed the requirements in the National Technical Regulations. The measurement, sampling, and analysis must comply with the environmental monitoring and analysis process and rules and must be conducted by a competent functional unit recognized by a competent authority. The results must be compared with national standards and technical regulations to conclude about the environment quality. According to the Environmental Protection Law 55/2014/QH13, National Technical Regulation in the environmental field is the limit of parameters of surrounding environment quality, the content of pollutants contained in waste, technical and management requirements approved by competent state agencies. In addition, that law also defines environmental pollution

is a change of environmental components that do not comply with environmental technical regulations and environmental standards that adversely affect humans and organisms. Therefore, it can be considered that if the environment quality parameter is over the limit value, the environmental component can be considered harmful for human health and the environment.

In the baseline study, the National Technical Regulations will be used as a reference to assess the quality of environmental components. The following National Technical Regulations to be used are

- National Technical Regulations on Ambient Air Quality QCVN 05 MT:2015/BTNMT
- National Technical Regulation on Surface Water Quality QCVN 08-MT:2015/BTNMT
- National Technical Regulation on Noise QCVN 26:2010/BTNMT
- National Technical Regulation on Allowable Limits of Heavy Metals In The Soils QCVN 03-MT:2015/BTNMT

In each of these National Technical Regulation, there is a set of National Standards that instructs on how the sampling and measurement of environmental components should be done. For example, in National Technical Regulation on Surface Water Quality, the sampling of surface water sample follows National Standard TCVN 6663-1:2011, which is Technical Method for Sampling, the pH measurement follows TCVN 6492:2011 and so on. Usually, as a rule, the competent function unit working on the analysis of the samples shall follow these National Standards.

The biological and social environment around the site, observation, and references to the study of the place are used to determine the condition of these types of environment. The IUCN Red List of Threatened Species from International Union for Conservation of Nature and Nature Resources (IUCN) will be used to determine the conservation status of the species found at the construction site. The list was published in 1954 and it is a worldwide comprehensive information on global conservation status of fauna and flora species (International Union for Conservation of Nature and Nature Resources 2020a). Hungyen statistical yearbook 2018 was published in 2019, containing the summarized information of the socio-economic situation of Hungyen province,

which includes Yen My district (Hungyen Statistical Office 2019, 4). It is used to study the social environment of the area.

2.3 Impact identification

Impact identification is the first step of impact analysis. The purpose of this step is to identify environmental impacts from project activities. It is also used to classify the environmental impacts for further assessment (Raymond Sumo University 2006b).

Through time, many impact identification methods and tools have been designed for EIA. In practice, relatively simple methods are used to identify the impacts comparing to other complex methods that require more data to perform since it saves time and cost for the identification. The common methods used for impact identification are checklists, matrices, networks, overlay, and geographic information systems (United Nations Environmental Programme 2012, 267.)

Matrix is one of the common and simple methods to use for impact identification. It is a grid-like table with the project activities presented on one axis while the environmental elements are presented on the other axis. The purpose of the table is to display the interaction between the project activities and the environmental objects they might affect with noting on the intersecting points of the grid with x symbol (United Nations Environmental Programme 2012, 258.)

Overall, there are several benefits of using the matrix method for impact identification that suits the objectives of this thesis. First of all, the presentation of the matrix would show a comprehensive summary of primary impacts as it links action to impact (Modak & Biswas 1999, 90). The requirements for the EIA according to appendix 2.3 in Circular 27/2015/TT-BTNMT also require the prediction of environmental impacts of construction activities and their effects on the environmental components, therefore, the matrix method can clearly present which construction activities can affect each environmental components. In addition, the matrix method has low resource requirements (Modak & Biswas 1999, 90), which is suitable for this work because there are little data collected for the assessment.

On the other hand, there are several limitations to this method. For example, this method gives little opportunity for quantification. However, the quantification of the impacts is done separately in another part of the thesis so this disadvantage does not concern the work. Next, the impact identification is mostly subjective predictions (Modak & Biswas 1999, 90). Considering the project is still in a very early stage of development where it has not even begun, this is the limitation that must be accepted. In conclusion, considering the state of the project and the requirement of the regulations and the available resources, the matrix method is an acceptable method for impact identification for this project.

2.4 Impact prediction

Once the important impacts are clarified, their potential size and characteristics can be predicted. This is a technical process that involves physical, biological, socio-economic, and cultural data to estimate the characteristics of the impacts. Impact prediction also considers any planned mitigation method, this is done to check if the mitigation measures are enough or additional mitigation is required to reduce impact further (WYG 2018, 2-3).

Impacts should be predicted quantitatively where possible, this means using numbers to indicate the impact as this can make comparison with baseline data easier. Quantitative mathematical model is the most sophisticated method for quantitative impact prediction as it involves the selection and uses for predicting pollutant transport and fate. It can also model the biological and social environment (Canter & Sadler 1997, 48.) For example, air dispersion models can be used to predict the emission concentration and spread from a power plant, the hydrological model can predict flow regimes resulting from the construction of reservoir (United Nations Environmental Programme 2012, 267.) The result from quantification may give the impression of accuracy, as in, they might either be entirely correct or at least as accurate as possible. If quantification is difficult, other methods relating to estimation and comparison can be used. For example, rating techniques and assigning values can be used to assist impact prediction (United Nations Environmental Programme 2012, 262).

The purpose of impact prediction is to describe the characteristics of the impacts. The characteristics of the impact may vary, they are categorized as elements such as nature, magnitude, extent, timing, duration, reversibility (United Nations Environmental Programme 2012, 264). These parameters are considered in impact prediction and decision-making. Nature is the first parameter of the characteristics of the impact. The nature of the impact is determined whether the impact is beneficial or adverse to the impacted objects.

Impact magnitude is the most important characteristic to be predicted in this stage. Typically, it is expressed as relative severity of values such as high, moderate and low (United Nation Environmental Programme 2012, 265.) However, in practice, impact magnitude comprises other characteristics such as extent, severity, duration, reversibility and they are optional to include. For example, the Department of Environmental Conservation of New York States (2012) guides that the magnitude of the impact depends on its extent, duration, and severity. Another example is the EIA report of the project of construction of Nord Stream gas pipeline shows the magnitude of the impact is assessed by the extent, duration, and intensity of the impact (Nord Stream 2009, 439).

Since the term “magnitude” is used to describe the overall character of the impact, therefore, “severity” will be used to describe how intense the impacts on environmental components are. In this thesis, quantification is used to identify this characteristic. However, due to lack of resources and data, the severity of the impact is assessed with calculation of pollutants’ amount (if possible) using simple math instead of any mathematical model so the quantification, in this case, can only determine the amount of possible pollutants, not their extent. Then it is compared to the environment baseline to define its severity, whether it is high, moderate, or low. These terms are also subjective based on the calculation result, comparison with the baseline data, and professional judgment. In this study, low severity means the additional impact on the environmental component does not cause the value of any parameters to exceed the limits in National Technical Regulation. Moderate severity means the additional impact may cause the value of some parameters to exceed the limit. High severity means the impact may cause the value of most parameters to exceed the limits.

Duration defines how long the impact is going to last in the environment. It is usually categorized as short-term and long-term and the definition of these terms are relative to the project length. For example, the project of Nord Stream gas pipeline that reaches transboundary between Finland and Russia, the total time for all phases from construction to decommissioning reaches 50 years. Thus, their definition for short-term is impacts that last for some years while long-term impacts are those lasts up to 50 years (Nord Stream 2009, 439.) According to the Department of Environment Conservation of New York State (2012), the short-term impacts to last for weeks, medium-term impact last for several months, long-term impacts last for several years. In this case, considering the construction time is relatively short (9 months) the terms from the guidelines of Department of Environment Conservation of New York State should suits the project better. The construction duration is 9 months, so the medium-term should describe impacts with a duration of several months, the short-term impact would be intermittent and last for weeks and long-term impacts are considered to be impacts that last for years.

Extent of the impact refers to the area that is influenced by the impact. Depending on the scale of the project, the variation in the extent of the impact should be estimated (United Nations Environmental Programme 2012, 265.) In this thesis, the important area that might be influenced by the potential impacts are the construction site, the fields beyond the construction site, and the nearby town of Yen My. Short extent refers to the impact can only reach within the construction site, medium extent means the impact reach beyond the construction site while large extent means the impact may reach Yen My town which is residential area of about 600 m away from the construction site

Since the impact characteristics are varied and distinct, they are usually taken together to assign a value to the magnitude of impact (Therivel & Wood 2000). The Department of Environmental Conservation of New York State (2012) has a guideline of the criteria of magnitude for environmental impacts. The criteria for the magnitude is the extent of the pollutant, the severity, and the duration of the project. For example, small impacts are defined to have low severity and minor effects on environmental components, it is also limited in a small, isolated area

and intermittent or short duration (days or weeks). Moderate impacts are moderate in severity to environmental components, they also cover a large area of the site and even small area outside the site and last for several weeks or months. Finally, large impacts have severe effects on environmental components, cover a large area of neighbourhood or communities, and last for a long time from months to years. The descriptions of small, moderate, and large impacts are not always definite. For example, an impact of small extent, short-term duration but with high severity can be considered as moderate or high magnitude (Department of Environmental Conservation of New York State 2012.)

Following that guideline, the impact magnitude criteria for impacts on the physical, biological, and social environment are constructed based on the severity, extent, and duration of the impacts. The criteria are also taken reference from Nord Stream with some modifications to fit with the thesis.

TABLE 4. Impact magnitude on physical environment (Nord Stream 2009, 440, modified)

Impact magnitude	Definition
Low	A temporary or short-term impact with low severity on a physical environmental component inside the construction site.
Moderate	A medium-term impact with medium severity on a physical environmental component that may extend beyond the construction site.
High	A long-term impact with high severity that may cause irreversible effects on a physical environmental component that extend beyond the site to the nearby towns. The impact that persists after construction finished is also considered high magnitude.

Impact on biodiversity of the area focuses on the duration of the impacts, the extent refers more to the number of populations affected and the number of species affected. The low magnitude of impact on the biological environment means that the impact does not harm the population of most species. Moderate impact means some part of the population is affected but does not lead to long-term

impacts. The high magnitude of impact on the biological environment means the impacts, in this case, affect most species and their numbers and could cause permanent damage to the ecology of the area.

TABLE 5. Impact magnitude on biological environment (Nord Stream 2009, 440, modified)

Impact magnitude	Definition
Low	Impact on the biodiversity of the construction site in a short period but does not affect the population of most species
Moderate	Impact on the biodiversity of the construction site or surrounding areas that affect a portion of the population of some species found on site but does not threaten the long-term integrity of the population.
High	Impact on the biodiversity of a large area around the construction site that affects the entire population of any species

Impact magnitude on the social environment also focuses on the extent, duration, and magnitude of the impact.

TABLE 6. Impact magnitude on social environment (Nord Stream 2009, 441, modified)

Impact magnitude	Definition
Low	Impact on nearby town or communities in a short period but does not lead to any widespread or permanent damage to people or social resources
Moderate	Impact on nearby towns or communities in a medium period (months) on social assets that causes some temporary change but does not affect the stability of these communities
High	Impact on nearby towns or communities in a long period (years) on social assets that cause long-term or permanent change in status.

2.5 Impact evaluation

After the impacts are predicted, their significance is evaluated based on their magnitude and the value of the receptor environment component. Evaluation of significance should be based on a set of criteria that may be defined in EIA legislation and procedures (United Nations Environmental Programme 2012, 274). However, there are not any detailed guidelines or instructions for impact evaluation in Vietnam's law and regulations, so a framework of criteria for impact evaluation is built based on external sources.

The value of the receptor refers to its importance (WYG 2018, 2-3). This may include a feature's level of statutory designation, for example, if the receptor area is nature reserve according to the Ministry of Natural Resources and Environment, it certainly has higher importance compared to other areas. However, according to Nord Stream (2009, 442) the value of the physical environment also includes its reversibility, which is the capability of the environment component to revert to its previous status naturally or artificially. Tables 7, 8, and 9 presents the criteria of value for physical, biological, social environment respectively, the information in the table is also modified to fit with the context of this project.

TABLE 7. Criteria of value for physical environmental components (Nord Stream 2009, 442, modified)

Value	Definition
Low	The receptor environmental component is not important to the wider ecosystem. The environmental component can revert to pre-impact status naturally once the impact is stopped.
Moderate	The receptor environmental component is important to the function of the wider ecosystem. can be actively restored to pre-impact status, or will revert naturally over time
High	The receptor environmental component is important to the function of the wider ecosystem, however, it cannot revert to pre-impact status by any means.

The value of biological environment mostly depends on the conservation status of the species spotted on the site.

TABLE 8. Criteria of value for biological environmental components (Nord Stream 2009, 442, modified)

Value	Definition
Low	The impacted species are not protected, is the least concern in the IUCN Red List of Threatened Species. It is also common or abundant in the area and not critical to ecosystem functions.
Moderate	The impacted species are not protected, are at least vulnerable in the IUCN Red List of Threatened Species. It is also common or abundant in the area and important to ecosystem functions.
High	The impacted species is protected, is rare, threatened, or endangered in the IUCN Red List of Threatened Species. It is also important to ecosystem functions.

The value of social environment mostly focuses on the importance of the social assets to the scale of local or national. Low and Moderate impacts refer more to local importance while high impacts refer to the national scale.

TABLE 9. Criteria of value for social environment (Nord Stream 2009, 442, modified)

Value	Definition
Low	The receptor social assets are not important to the culture or social life of the local
Moderate	The receptor social assets affected are important to the local scale of the area.
High	The receptor social assets are protected by the national policy and legislation, has a national scale. For example, historical site or nature reserve area.

After the impact magnitude and the value of the receptor environment are determined based on the criteria, the significance of those impacts can be determined.

There are no statutory definitions for impact significance, it is unlikely that universally agreeable definition can be found (Marttunen, Vienonen, Koivisto & Ikaheimo 2013, 3). According to Marttunen et al. (2013, 4), Duinker and Beanlands (1986) defines impact significance as relativistic and always need to be in a context. As discussed in the introduction, the objective of this thesis for the evaluation is to decide whether the impact is acceptable or require other alternatives to mitigate the impact further. ”Significance determination in EIA practice makes judgments about what is important, desirable, or acceptable. It also interprets degrees of importance.” (Lawrence 2007, 757). This term fits the objectives of this thesis most so it will be used.

In this research, the impact significance is done with Type 1 approach. Wood (2007, 26) suggests type 1 approach considers the different levels of magnitude and varying degrees of receptor value. These criteria are then brought together in a simple matrix to identify relative degrees of impact significance that are summarised using single language terms (e.g. “Major”, “Moderate”, “Minor”) with no further detail provided.

The benefit of this approach is that it is relatively simple, however, the terms of impact significance are ambiguous which somewhat lack transparency (Wood 2007, 26.) Therefore, in this thesis, these terms are defined according to the objective of the thesis, which is whether the significance of the impact is large enough to require other alternatives to reduce the impacts further.

TABLE 10. Impact significance matrix of Type 1 approach (Wood 2007, 26)

	Low magnitude impact	Medium magnitude impact	High magnitude impact
Low value	Minor	Minor	Medium
Medium value	Minor	Medium	Major
High value	Medium	Major	Major

In which, minor significance impacts indicate that the impact is at an agreeable level and does not need further mitigation or alternatives, medium significance impact indicates that the impact is at a neutral level, recommended to have further

mitigation or alternatives and high significance impact requires most attention with mandatory alternatives or mitigation measures (South Stream 2014, 3-13).

3 METHODS

3.1 Environmental baseline study

The method for environmental baseline study of the physical environment is done accordingly to the requirements in appendix 2.3 of circular 27/2015/TT-BTNMT. The environmental component chosen for environmental baseline study includes air, noise, surface water, and soils. The selected competent authority for the sampling and measurement of environmental components is the Institute of Environmental Technology.

The air quality and sound pressure level of the construction area was measured using four different measurement points. The position of each measurement point was marked on the VN2000 coordinate system with a description in table 11.

TABLE 11. Measurement points position and coordinates

Name	Description	Coordinates	
KXQ1	50 m to the southwest of the factory	208866N	1060466E
KXQ2	5 m to the southeast of the factory	208781N	1060391E
KXQ3	5m to the northwest of the factory	208786N	1060395E
KXQ4	100 m to the Northeast of the factory	208868N	1060516E

The measurement point was properly surrounded in all directions of the intended construction area. This gave high accuracy in air quality measurement. After that, the result was compared to National Technical Regulation on Ambient Air Quality QCVN 05:2013/BTNMT and National Technical Regulation on Noise QCVN 26:2010/BTNMT to give a conclusion about the environment quality.

Next, the water quality was also assessed on the same date by the Institute of Environmental Technology. The location where the water sample was taken is from Nghia Tru river where the wastewater would discharge to. There was only one water sample needed for the work and the water quality assessment was based on National Technical Regulations on surface water quality QCVN08-

MT:2015/BTNMT. The assessed parameter of the water quality includes chemical oxygen demand (COD), biochemical oxygen demand (BOD), suspended solids (SS) heavy metals (As, Cd, Fe, Cu, Ni, etc.) oil traces and coliforms. The results of the measurement were compared to National Technical Regulations on surface water quality QCVN08-MT:2015/BTNMT. Because the nearby water was also used for agriculture in this rural area so the column B1 in the regulation was used as a comparison.

A soil sample from the intended construction site was collected for soil quality assessment, the purpose of this assessment was to check for any soil contamination before the construction. The standard used for this work was National technical regulation on the allowable limits of heavy metals in the soils QCVN 03-MT:2015/BTNMT.

There were much less available data and resource to check the biological and social environment around the construction site. The biological environment baseline study would study the species that are observed in the area. The conservation status of these species was determined with the IUCN Red List of Threatened Species. The social environment condition was studied with the Hungyen Statistical Yearbook which contains information about Yen My district and other reports on the social development of the Yen My district.

The baseline study was done also to determine the value of the environmental component. The value of physical, biological, and social environmental components is decided based on the criteria in table 7, 8, 9 respectively in chapter 2.5.

3.2 Impact analysis

In order to predict the environmental impact based on impact magnitude criteria, characteristics such as severity, duration, and extent of the impacts must be identified. The severity of impacts was assessed with quantification of environmental impact sources which are the number of emissions released by construction vehicles or the amount of different content in domestic wastewater. At the very early stage of the project where it has not started yet, it is very difficult to assess the

environmental impacts accurately. Besides, there was currently no official document on the pollution of these sources from the authorities. As discussed above, the environmental impact should be predicted quantitatively, which means using numbers to indicate the impact. Based on the sources of impacts, prediction of impact sources and their amount could be estimated quantitatively using references from Rapid Inventory Techniques in Environmental Pollution of the World Health Organization (WHO). The rapid assessment procedure was most useful in making an initial appraisal of the sources and levels of emissions. It had been found particularly useful in developing countries in the design of environmental control strategies and policies using relatively modest resources (World Health Organization 1993, ii.) Then, the results are compared to the environmental baseline data to determine the severity. Therefore, this document had been utilized to assess the severity of air and water pollutants quantitatively. The duration and extent of impact could be determined clearly, however, they were decided quite subjectively based on the criteria in chapter 2.4.

After the characteristics of the impacts were identified, the impact magnitude for physical, biological, and social environment could be rated as low, moderate, or high like in table 4, 5, 6 respectively. After that, based on the impact magnitude and the known value of the environment component determined in the baseline study in chapter 4.1. The impact significance was assessed using the matrix in table 10, where the impact significance was rated as minor, moderate, major.

4 RESULTS

4.1 Environmental baseline study

4.1.1 Physical environment

Before working on the environmental impact assessment of the project to the natural environment in the surrounding area, the air, water, and soil environment must be measured to understand the possible existing pollution and whether the construction work might cause the pollution to go over national standards. The measurement was done in association with the Institute of Environmental Technology.

Table 12 shows the result of four measurement points, including the national standard value from the National Technical Regulation on Ambient Air Quality QCVN 05:2013/BTNMT and National Technical Regulation on Noise QCVN 26:2010/BTNMT. In general, all four measurement points gave close values to each other. The highest value for TSP, SO_2, NO_2, CO are 93.6; 78.0; 79 and 3450 $\mu g/m^3$ respectively, and all of them were much lower compared to national values, suggesting the air quality in this area is good. On the other hand, the sound pressure level was close to the standard value.

TABLE 12. Air quality measurement result

Parameter	Standard	KXQ1	KXQ2	KXQ3	KXQ4
TSP ($\mu g/m^3$)	300	80.5	63.0	77.5	93.6
SO_2 ($\mu g/m^3$)	350	71.2	78.0	55.1	66.8
NO_2 ($\mu g/m^3$)	200	79	55	73	70
CO ($\mu g/m^3$)	30000	3450	2520	2850	3350
LeqA (dB)	70	66,9	64.5	70.1	65.4

Overall, the air environment is essential to the ecosystem of the area which includes both humans and the environment, as air pollution causes adverse health effects and environmental damage. For example, air pollutions such as sulfur may lead to acid rain, nitrogen in the atmosphere can affect aquatic life when it

is deposited into the surface water (United States Environmental Protection Agency 2016). It can also cause short-term and long-term health effects on sensitive people such as those with heart or lung conditions (Oxfordshire Air Quality n.d.). Therefore, maintaining air quality is important to avoid these problems. The air quality can recover gradually over time after the impact. For example, recently, the Coronavirus pandemic has caused restrictions on travel in many parts of the world and this has improved the air quality. Emissions such as nitrogen dioxide, particulate matter has shown a reduction of about 35% and 60% respectively in Western Europe and the U.S (American Geophysical Union 2020). Therefore, the air quality will improve once the construction is finished as the operation of the vehicles is ceased, so the air quality can be reverted to the pre-impact state naturally. In conclusion, the value of the air environment of the area is moderate.

Noise level is also an important environmental component to the ecosystem. Sound is certainly a key element to the animals as their many activities depend on it such as finding habitats, avoiding predators, protecting their offspring, expanding their territory (National Park Service 2018a). Also, loud noise also disrupt human health as it causes stress, poor productivity, and concentration in people (Australian Academy of Science 2017). However, a high noise level can immediately disappear once the sources of the noises are stopped, therefore, the value of the noise level in the environment, in this case, is low.

Next, the water quality was also assessed on the same date by the Institute of Environmental Technology. The location where the water sample was taken was from Nghia Tru river where the wastewater would discharge to. There was only one water sample needed for the work and the water quality assessment was based on National Technical Regulations on surface water quality (National Technical Regulations QCVN08-MT:2015/BTNMT). Because the nearby water was also used for agriculture in this rural area so the column B1 in the regulation was used as a comparison.

Table 13. Surface water quality result

Parameter	Data	QCVN08-MT:2015 /BTNMT
pH	7.5	5.5-9
BOD_5 (mgO_2/L)	21	15
COD (mgO_2/L)	35	30

Parameter	Data	QCVN08-MT:2015 /BTNMT
SS (mg/L)	42	50
As (mg/L)	0.03	0.05
Cd (mg/L)	0.005	0.01
Pb (mg/L)	0.02	0.05
Cr (VI) (mg/L)	0.02	0.05
Cr (III) (mg/L)	0.2	0.5
Cu (mg/L)	0.4	0.5
Zn (mg/L)	0.7	1.5
Fe (mg/L)	0.8	1.5
Hg (mg/L)	0	0,001
NH_4^+ (mg/L)	0.05	0.5
F^- (mg/L)	0.8	1.5
NO_3^- (mg/L)	7.8	10
NO_2^- (mg/L)	0.03	0.04
CN^- (mg/L)	0	0.02
Phenol (mg/L)	0	0.01
Oil (mg/L)	0.02	0.1
Total coliform (MPN/100ml)	6000	7500
E. coli (MPN/100ml)	240	100

In general, most components found in water, especially harmful metal and anions were below the maximum value based on the standard. The number for BOD, COD, and E.coli was slightly higher than the standard. The surface water of the area shows mild signs of heavy metal pollution. The main wastewater source will be from the hygiene and basic needs of the workers in the factory, this could be a significant source of BOD, COD and other coliforms which requires a proper wastewater treatment plant later to mitigate the impact.

Water environment is also important to the ecosystem of the area. It is a habitat of many aquatic species such as fishes, crabs. The water at Nghia Tru river is the water supply source for Yen My town for their domestic use or irrigation of the fields. In case of contamination, the water can be treated with several processes such as chemical disinfection to remove the bacteria, coagulation, and flocculation for removal of suspended solids and colloid matter (PSC Engineering n.d.). Based on the criteria in table 7, the water environment is important to the ecosystem while in case of contamination, it can be actively treated, as a result, the value of the water environment to the area is considered moderate.

Finally, a soil sample from the intended construction site was collected for soil quality assessment, the purpose of this assessment is to check for any soil contamination before the construction. The standard used for this work is National technical regulation on the allowable limits of heavy metals in the soils QCVN 03-MT:2015/BTNMT. The result is presented in the table below.

TABLE 14. Soil quality of the construction site

Soil component	Data	QCVN 03-MT:2015/BTNMT
Cu (mg/kg soil)	0,51	300
Zn (mg/kg soil)	1,62	300
Cd (mg/kg soil)	0,05	10
Pb (mg/kg soil)	4,42	300
As (mg/kg soil)	0,6	25
Cr (mg/kg soil)	1	250

The soil quality of the construction is very good considering all the heavy metal concentrations are insignificant compared to the standard values. Therefore, there are no signs of soil contamination in the construction site.

Soil provides ecosystem services critical for life: soil acts as a water filter and a growing medium; provides habitat for billions of organisms, contributing to biodiversity; and supplies most of the antibiotics used to fight diseases (Soil Science Society of America 2013). For Yen My town, soil also plays an important role in the agriculture of the area. Therefore, the soil is important for the ecosystem of the area. In the case of soil contamination, there are several artificial remediation techniques available such as thermal soil remediation, encapsulation, air sparging, and bioremediation (Spokane Environmental Solutions 2020). Based on the criteria of Table 7, the value of the soil environment is moderate.

4.1.2 Biological environment

The observation at the site shows that there are no rare flora or fauna species around the construction area. Most of the ecosystem in this area was artificial. There are a lot of cattle and poultry that belong to local farmers freely roam the

fields. There were several wild bird species around the area such as house sparrows (Passer domesticus), little egret (Egretta garzetta) mountain tailorbird (Phyllergates cucullatus), red-whiskered bulbul (Pycnonotus jocosus) which were all least concern on conservation status (International Union for Conservation of Nature and Natural Resources 2020b,c,d,e). In general, based on the value criteria of the biological environment in table 8, since most of the species found in this area are the least concern in conservation status, the value of the biological environment of the area was low.

4.1.3 Social environment

According to Hungyen statistical yearbook in 2018, Yen My district had a population of 143145 people. The citizen in this area was well-equipped with adequate health and education system. This district concerned to provide occupation for 3000 people (Hungyen Statistical Office 2019, 55.)

The occupation of the people at Yen My town was mostly agriculture. In the first six months of 2018, the town showed a significant growth in both agriculture and silviculture as in an increase of production yield by 2 to 3 % while the number of cattle and poultry increaseed by up to 10% compared to last year. The town also showed sign of growth in industrial activities as production value from all industrial project is 12.5% compared to last year (Yen My People's Committee 2018, 1-2)

The value of social assets, in this case, were the traffic, wellbeing, and livelihood of the people. These values were only at local importance so they are all set at moderate importance.

4.2 Impact identification

The matrix used for identifying the environmental impacts of this project was designed simple and meet the requirements of appendix 2.3. First of all, the requirement needs the impact sources from activities such as exploitation of construction material, transportation of construction materials, and construction activities of project items. In this project, the construction material was going to be bought

from other companies so the project does not involve in the exploitation of materials. Therefore, this activity can be skipped from the assessment. The impact of construction activities and transportations of materials must be analyzed with their effects on natural components, biological environment, and socio-economic environment.

The construction activities were divided into two main categories which are construction work and workers' activities. The construction work mostly focused on the operation of the construction vehicles, the workers' activities. Based on experts' judgement the identified impacts are presented in table 15.

TABLE 15. Impact identification matrix

Environmental component		Transportation	Construction work	Workers' activity
Physical	Air	x	x	
	Water		x	x
	Noise		x	
	Soil		x	
Biological	Biodiversity		x	
Social	Traffic	x		
	Livelihood		x	
	Wellbeing			x

The different activities of the construction phase had several impacts on all physical, biological, and socio-economical environment. The air environment of the areas around the construction site might be affected by both transportation activity and construction work. According to the project plan, there were five trucks to be used to deliver the materials used for the construction. As these trucks ran on diesel fuel, they might emit several types of harmful gases to the environment such as TSP, SO_2, VOC, NO_x, and CO during their travel. This also applied for heavy-duty construction vehicles that will be used for the construction work as they also require diesel fuel to operate (World Health Organization 1993, 3-53.) Similar to the transport trucks, the operation of the construction vehicle may also release the same types of emissions, in addition to loud noise to the surrounding environment, which includes Yen My town where there is a significant number of

populations there. Currently, there were two types of wastewater of the construction, one being the wastewater from washing and mixing construction materials and cleaning equipment which contains cement, lime, grout, etc. while the other type is domestic wastewater from the workers at the site, which contains a high concentration of BOD, COD, N, P, suspended solids and E.coli. Next, the construction work would take quite a large area which possibly be the habitat for some flora and fauna species. The loss of their habitat must be assessed to check whether there would be any significant damage. Finally, the social environment might be impacted by several activities of this project. For example, the transportation of construction materials using large trucks daily might cause a traffic jam, the concentration of workers may cause disturbance to the locals. The magnitude of these impacts on the environment would be predicted in the next chapter.

4.3 Impact prediction and evaluation

4.3.1 Impact on the physical environment

In this section, the impacts from the activities from the construction phase to the physical environmental components which is air, noise, soil, surface water will be predicted based on the criteria in table 4.

The main sources of air pollution to the construction area are the emission from the transportation vehicles, construction vehicles, and welding tools. Since the construction work had not started, the impact was predicted and evaluated based on Rapid Inventory Techniques in Environmental Pollution of the World Health Organization in 1993. The document contained the estimated data kilograms of emission per tons of fuel consumed.

The main content of emission coming from the transporting vehicle for the construction work was total suspended particles (TSP), SO_2, CO, NO_x, and volatile organic compounds (VOC). These harmful gases are the product of gasoline and diesel combustion from the engines. Because there was not any specific model of each vehicle used, the transportation vehicle in this construction work was generalized based on Rapid Inventory Techniques in Environmental Pollution of the World Health Organization in 1993. Based on the construction plan of the

company, there would be on average 5 heavy-duty diesel-powered trucks of over 16 tons every day in the duration of the project. The travel distance for one truck between the material warehouses and the construction site was 20 km on average. Therefore, the total travel distance of one truck in a day was 40 km, while the total travel distance of all trucks was

$$5\ \text{truck} * 40\ \text{km/truck} = 200\ \text{km}$$

The diesel consumption of heavy-duty trucks of more than 16 tons is roughly estimated to be 17 liters per 100 km. Therefore, the consumption of all trucks were

$$17\ \text{L}/100\text{km} * 200\ \text{km} = 34\ \text{L}$$

According to the World Health Organization Europe (2011, 6), the density of diesel is estimated at 0.832 kg/L. Since the WHO guideline values were measured in tons of fuel, the total mass of the diesel used in a day was calculated as

$$34\text{L}/(0.832\ \text{kg/L}) = 28.29\ \text{kg} = 0.02829\ \text{tons}$$

From here, the potential pollutant concentration that might be released to the environment can be calculated following the estimated amount in table 16.

TABLE 16. Emission rate of heavy-duty diesel-powered vehicles (World Health Organization 1993, 3-53)

Heavy duty diesel powered vehicles > 16 tons	TSP (kg/tons of fuel)	SO_2 (kg/tons of fuel)	NO_x (kg/tons of fuel)	CO (kg/tons of fuel)	VOC (kg/tons of fuel)
Emission rate	4.3	20S	65	10	8

(Note: S is the percentage content of sulphur in the fuel, in this case, the fuel contains 1 % of sulphur, so the total SO_2 emission is 20 kg/tons of fuel)

From here, the total mass of the pollutants released was calculated by multiplying the total amount of fuel used with how much pollutants per kg of fuel used. For example, the total TSP release in one day would be

$$4.3\frac{\text{kg}}{\text{tons}} * 0.02829\ \text{tons} = 0.121647\ \text{kg}$$

Calculate the same for other pollutants, the amount of pollutants released for this amount of diesel consumed is presented in table 17.

TABLE 17. Total calculated emission of the transportation activities in one day

Heavy duty diesel powered vehicles > 16 tons	TSP (kg)	SO_2 (kg)	NO_x (kg)	CO (kg)	VOC (kg)
Total mass	0.12	0.57	1.84	0.29	0.23

Each of these emission types has its negative effects on both human health and the environment, which is the entire ecosystem of the area. For example, total suspended particulates mean the total concentration of particulate matter of all sizes. This type of pollutant may cause several health effects such as decreased lung function, aggravated asthma, irregular heartbeat, heart attacks, and environmental effects such as damaging sensitive forests and farm crops, depleting the nutrients in the soil (United States Environmental Protection Agency 2020.)

Sulphur dioxide (SO_2) is harmful to both the environment and human health. It can combine with water and air to form sulphuric acid, which is acid rain that causes deforestation, acidify water bodies, and building corrosion (Queensland Government 2017). Inflammation and irritation of the respiratory system are the common health effects of exposure to SO_2 which leads to coughing and throat irritation. In addition, it can worsen existing respiratory problems for sensitive groups (National Park Service 2018b).

Nitrogen oxide gases also have severe effects on human health and the environment. This gas may cause vegetation to be more susceptible to disease. In addition, it may form ozone with other pollutants which also damages the vegetation (Icopal N.d.) It can cause several health problems to human health such as breathing difficulties, headaches, eye irritation (Science X Network 2015).

Volatile organic compound may react with NO_2 from vehicle emissions to form particulate matter, which then form smog with ozone and other gases cause eye, nose, throat irritation, worsen heart problems (Environmental Protection Department of Hong Kong 2019).

Carbon monoxide can harm both the environment and human health. The increase of carbon monoxide, which is also a greenhouse gas, is one of the main culprits of global warming. As a result, it causes changes in the ecosystem, increases storm activity, and other extreme weather events (National Pollution

Inventory 2009). This gas can cause several health effects such as dizziness, vomiting, headache, and nausea (Centers for Disease Control and Prevention 2016)

Overall, the result of total emission from the transportation of materials was large in amount as it may reach several hundred of grams per day. Even though the air quality of the area was in good condition, this additional amount when the transportation work begins would cause the parameters to exceed the limit values. Meanwhile, the adverse health and environmental effects are vast as discussed above. As a result, the severity of the impact was considered as high. The travel distance between the construction site and the material place is 20 km so the emissions were expected to spread along the road, with the possible wind, the emissions would be spread on a large extent. The impact is short-term considering it only occurs for a few hours of traveling of the trucks every day. With all these characteristics, the impact magnitude was rated as moderate. The value of the air environment was considered to be moderate; therefore, the significance of this impact was also moderate.

Moreover, there would be some construction vehicles to be used for construction work. This equipment is known to consume a large amount of diesel fuel and release some emissions as a result. Therefore, the amount of emission that might be released must be estimated as an assessment of environmental impact. In this project, heavy-duty construction vehicles such as bulldozers, rollers, cranes, etc. are used. Their emission release is estimated by fuel consumption per day in table 18.

TABLE 18. List of construction vehicle and their fuel consumption

Construction vehicle	Pieces	Total fuel consumption (kg/day)
Bulldozers 160 CV	2	110
Hydraulic excavator 1.5 m^3	2	180
Rollers (10 tons)	2	65
Graders (160 CV)	2	86
Cranes (16 tons)	1	65
Concrete batching plant	1	168
Pile drilling machine	1	48

The fuel used for construction vehicles is the source of harmful emissions such as sulphur dioxide, noxious gases, carbon monoxide, and volatile organic compounds. The construction vehicles were considered heavy-duty diesel-powered vehicles of 3.5 to 16 tons.

TABLE 19. Amount of pollutant released from diesel construction vehicle (World Health Organization 1993, 3-53)

Heavy duty diesel powered vehicles 3.5 -16 tons	TSP (g/ kg of fuel)	SO_2 (g/ kg of fuel)	NO_x (g/ kg of fuel)	CO (g/ kg of fuel)	VOC (g/ kg of fuel)
Emission rate	4.3	20S	70	14	4

(Note: S is the percentage content of sulphur in the fuel, in this case, the fuel contains 0.25 %, therefore, the total SO_2 emission is 20 x 0.25 = 5 (g/kg of fuel)

With the known amount of fuel used for construction vehicles and the amount of harmful emissions released per kilograms of fuel, the amount of emissions released per working shift could be calculated with a simple multiplication. For example, the amount of NO_x gas released by the bulldozers in one working day is

$$110\frac{\text{kg}}{\text{day}} * 70\frac{\text{g}}{\text{kg}} = 7700\ \text{g/day}$$

Following the same methods, the results were presented in table 20. Overall, the total mass of TSP, SO_2, NO_x, CO and VOC all reach several hundreds of grams per day.

TABLE 20. Total calculated emission

Construction vehicle	TSP (g/day)	SO_2 (g/day)	NO_x (g/day)	CO (g/day)	VOC (g/day)
Bulldozers 160 CV	473	550	7700	1540	440
Hydraulic excavator 1.5 m3	774	900	12600	2520	720
Rollers (10 tons)	279.5	325	4550	910	260
Graders (160 CV)	369.8	430	6020	1204	344
Cranes (16 tons)	279.5	325	4550	910	260
Concrete batching plant	722.4	840	11760	2352	672
Pile drilling machine	206.4	240	3360	672	192

In general, the amount of emission is proportionate to the fuel consumption of the vehicles. Equipment such as the excavators and bulldozers consume the most amount of fuel which leads to most emissions. The emissions from the burning of the fuel in the engines of the construction vehicle are noxious gases while releasing the least amount of SO_2 due to low levels of sulphur in the fuel.

Based on the calculation result, the amount of emissions released from the operation of the construction was a few hundred grams per day, which is a lot. Even though the air quality at the site was still at a safe level, this huge additional amount of emissions every day might cause the concentration of the pollutants to be higher than the national technical regulation value which can be harmful to both human health and environment. Therefore, the impact on the air quality of the area was considered to have a high severity. Although the construction vehicles only operate within the site, under a weather condition where it is windy, the emissions may spread to other parts beyond the construction site to the residence, so the extent of the impact is considered to be large. The duration of the impact is considered medium-term as the construction vehicles should operate for several months. In total, the impact has a large extent, medium duration, in addition to high severity, the magnitude of the impact is considered moderate. The magnitude of the impact source is high while the value of the air environment is moderate. Therefore, the significance of this type of impact was major.

Large heavy equipment used in this construction project was also predicted to cause a lot of noise to the environment. The sound pressure level of the noise from the construction vehicle is estimated based on an article of Electronic Library of Construction Occupational Safety & Health in 2003. In this paper, the sound pressure level of some types of equipment are estimated at 15 meters away, the results are presented in table 21.

TABLE 21. The sound pressure level of some construction vehicle (Electronic Library of Construction Occupational Safety & Health 2003)

Heavy equipment	Sound pressure level at 15 m distance (dbA)
Bulldozer	93 - 96
Pile drilling machine	82 - 96
Roller	91 - 104
Excavator	72 - 92
Grader	80 - 92
Concrete Mixer	74 - 85
Crane	93 - 101

The nearest town, which is Yen My town is estimated to be 600 m away from the construction site. With the assumed sound pressure level from the drill at 15 m distance, the sound pressure level from the drill at Yen My town at 600 m would be

$$P_{600} = P_{15} - 20\log\left(\frac{d_{600}}{d_{15}}\right) = 96 - 20\log\left(\frac{600\ \text{m}}{15\ \text{m}}\right) = 64\ dB$$

TABLE 22. Predicted sound pressure level at Yen My town

Heavy equipment	Sound pressure level at Yen My town (dbA)
Bulldozer	61 - 64
Pile drilling machine	50 - 64
Roller	59 - 72
Excavator	40 - 60
Grader	48 - 60
Concrete Mixer	42 - 53
Crane	61 - 69

According to National Technical Regulations on Noise (QCVN 26:2010/BTNMT), the maximum allowed sound pressure level from construction sites to Yen My town (which is a normal area) is 70 dBA. The sound pressure level from these construction vehicles would be much lower than this value. Most of this equipment should have a sound pressure level of about 60 to 70 dB, which is as loud as a normal conversation (Dangerous Decibels n.d.). Therefore, this should pose no adverse hearing effects for the citizen at Yen My town. However, the baseline study of the site showed that the noise level in the area nearly reached the national standard. If this noise level persisted, in addition to the noise level from the construction work as predicted, the noise level at Yen My town might exceed the National Technical Regulation on Noise values, result in possible annoyance and adverse health effects on the locals. So the severity of the impact is estimated to be moderate. The extent of the exceeding noise level may reach some parts of Yen My town, therefore, the extent of the impact is considered to be large. Finally, the duration of the construction is 9 months, which can be sorted as medium-term effects. Overall, the impact has moderate severity, moderate extent, and medium duration, result in the magnitude of the impact is moderate. Obviously, after the construction is finished, the operation of the construction vehicles are stopped, therefore, the noise level of the area will immediately revert back to before the construction starts. Therefore, the value of the noise level in the area is low. As a result, the impact significance of this impact source is minor.

Currently, there is no national technical regulation on the sound pressure level for the construction area. The sound pressure level of the construction vehicle can reach up to 100 dB, which may cause permanent hearing loss for workers who contact that every day without protection (National Center for Biotechnology Information 2017). The risk with sound pressure level at construction area for the workers can be mitigated by avoiding using older machines, using administrative controls to let workers switch between noisy and quiet works and providing hearing protectors such as earmuffs and earplugs to reduce noise exposure (WorkSafe Victoria 2020). Assuming there is enough hearing protection gear for the workers and they oblige to the occupational health and safety rules properly, the noise level that the worker receives may reduce to safe levels. So the impact on the workers will be low in severity as it may not cause any harm. Also, not all the construction vehicles will operate all the time during 9 months of construction,

therefore, the impact is intermittent and classified as short-term. As a result, the impact magnitude of noise to the workers is low. In addition to the fact that the value of the noise level in the environment is low. This type of impact has minor significance.

The water consumption from construction activities would be insignificant, the total wastewater was estimated to be about 2 to 3 m^3 per day. Water would be taken from the nearby lakes and rivers just for washing and mixing construction materials and cleaning equipment. Therefore, the main contents of the wastewater are mainly construction materials such as soil, sand, lime, and grout. If discharged to the nearby rivers, it might be harmful to the aquatic ecosystem as the wastewater contains lime and cement which significantly increases the pH of the water. The wastewater of this type would not be large in volume so the wastewater will be collected in a drainage system and then collected and transported to other wastewater treatment plants. Overall, the environmental impact of this wastewater type is certainly manageable.

The volume of this type of wastewater would be small and its contents might contain only a small amount of residual construction materials. The current surface water quality is in good condition, so the severity of this impact source was determined to be low. Furthermore, this type of wastewater would cease once the construction phase was over. Even though the wastewater was directed to the drainage system at the site, however, in case it is released into the Nghia Tru river, it may reach larger parts of the river which leads to the nearby crops. However, the probability of the contamination breach would be very low considering the drainage system is in good condition. The duration of this impact would be short and intermittent as this type of wastewater does not occur every day. In general, the impact on the water environment, in this case, would have a low magnitude.

In this construction project, there would be in total of 40 workers that will work in a period of 9 months. These workers would use water for their own hygiene and basic needs that might be a significant source of wastewater. This type of wastewater should mostly contain suspended solids, BOD, COD, N, P (World

Health Organization 1993, 4-39). The total amount per person in a day was estimated from Rapid Inventory Techniques in Environmental Pollution of World Health Organization. The results are presented in table 23.

TABLE 23. Content of domestic wastewater in a day of one person (World Health Organization 1993, 4-39)

Parameter	Amount
BOD_5 (g)	45 - 54
COD (g)	72 - 102
Suspended solids (g)	70 - 145
Total N (g)	6 -12
Total P (g)	0,6 - 4,5
Total Coliforms (CFU/100mL)	10^6 - 10^9

It is estimated that the wastewater from one person in a day is 0.2 m^3. Therefore, the concentration of BOD can be calculated

$$\frac{45\frac{g}{person}}{\frac{0.2m^3}{person}} = 225\frac{g}{m^3} = 225\ mg/L$$

Following the same calculation, the concentration of other pollutants can be found in table 24.

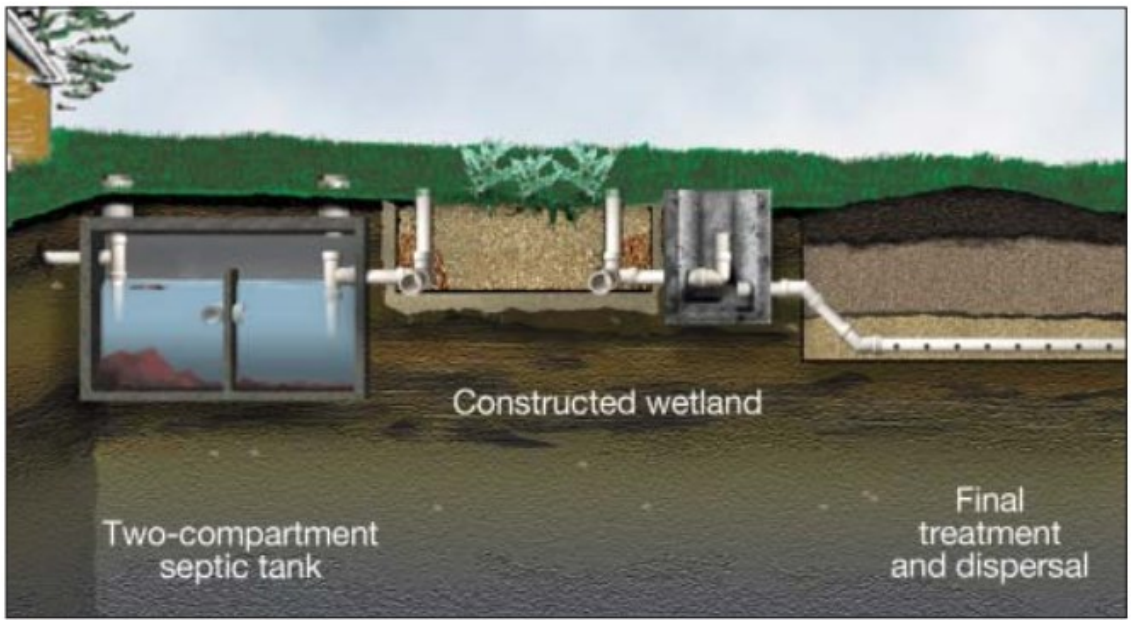
TABLE 24. Total concentration of pollutant found in domestic wastewater

Parameter	Amount in one day	QCVN14-MT: 2015/BTNMT
BOD_5 (mg/L)	225 – 270	100
COD (mg/L)	360 - 510	250
Suspended solids (mg/L)	350– 725	200
Total Nitrogen (mg/L)	30 - 60	80
Total P (mg/L)	3 – 22.5	15
Total Coliforms (CFU/100mL)	10^6 - 10^9	10^4

The total discharge of wastewater from this activity would be quite low, however, comparing to national technical regulation in domestic wastewater quality QCVN14-MT: 2015/BTNMT, the concentration of the components found in this wastewater might be harmful for both environment and human health. For example, decaying organic matter can take dissolved oxygen from the lake which can suffocate the aquatic life, excessive nitrogen and phosphorous entering the water bodies can lead to eutrophication, over-fertilization that can alter the

habitat, leading to reduction of some species (U.S. Geological Survey 2018). The possible health effects of coliforms found in this water if ingested are gastrointestinal upset and general flu-like symptoms such as fever, abdominal cramps, and diarrhea (Pennsylvania State University 2016).

The wastewater would be discharged to septic tanks of the construction site so these compounds are reduced to the level of little impacts. Taking the advantage of nearby wetland, the septic tanks would be connected to the constructed wetland to optimize wastewater treatment.



PICTURE 1. Intended septic system at the construction site (Lesikar 2018)

The septic tank would be a buried, watertight tank receiving the wastewater from the toilets and drains for treatment. Heavy solids settle to the bottom while grease and lighter solids float to the top of the tank (Environmental Protection Agency 2018) The vertical flow constructed wasteland is a planted bed that is drained at the bottom. Once the wastewater is poured into it, the water flows vertically down through the filter matrix to the bottom of the basin where it is collected in a drainage pipe (Sustainable Sanitation and Water Management Toolbox n.d.). Finally, the wastewater will be led to the centralized wastewater treatment plant of the factory.

There was a research in the removal efficiency of wastewater treatment using this same septic system by Nguyen, Pham, Nguyen, Morel, and Tonderski in 2007. The efficiency of the conventional system is presented in table 25.

TABLE 25. Removal efficiency of septic tank effluent treatment in vertical flow constructed wetland (Nguyen et al. 2007, 12)

Parameter	Removal rate (%)
BOD_5	80 - 90
COD	73.0 - 92.6
Suspended solids (SS)	84.4 – 88.9
Total Nitrogen	53.2 - 60.4
Total P	28.4 – 58.5
Total Coliform	90 - 96

To calculate the minimum concentration of the wastewater after treatment, the lowest concentration was multiplied with the highest removal rate. For example, the minimum remaining concentration of BOD_5 would be

$$225\frac{\text{mg}}{\text{L}} - 225\frac{\text{mg}}{\text{L}} * 90\% = 22.5\ \text{mg/L}$$

Meanwhile, the maximum possible concentration of the wastewater after treatment was calculated by multiplying the highest concentration with the lowest removal efficiency.

$$270\frac{\text{mg}}{\text{L}} - 270\frac{\text{mg}}{\text{L}} * 80\% = 54\ \text{mg/L}$$

Following the same calculation, the remaining concentration of other key components in wastewater are listed in the table below with the comparison with national technical regulation in domestic wastewater quality QCVN 14-MT: 2015/BTNMT. In addition to the total wastewater volume reaching 8 m^3 which is between 5 to 50 m^3 so column B4 of the standard has been used for this assessment.

TABLE 26. Remaining concentration of the main component in domestic wastewater

Parameter	Concentration	QCVN14-MT: 2015/BTNMT
BOD (mg/L)	22.5 - 54	100
COD (mg/L)	26.64 – 137.7	250
Suspended solids (mg/L)	38.85 – 113.1	200
Total N (mg/L)	11.88 – 28.08	80
Total P (mg/L)	1.25 – 16.11	15
Total Coliform (CFU/100 mL)	4×10^4 - 10^8	10^4

Using this septic system, the contents of the wastewater would be removed to reach national standard, except for coliforms, which could be treated with disinfection at the central wastewater treatment plant. The surface water quality of Nghia Tru river where the wastewater could be discharged into showed some sign of BOD and COD exceeding the limits value. Even though the value may not be fixed until the project begins, the additional BOD and COD released from this type of wastewater may cause these value to exceed the limits by a small amount. Therefore, this impact was considered to have a moderate severity. Nghia Tru river does not cover many areas aorund Yen My town so the extent of the impact could be considered as moderate. The duration of the construction phase is 9 months which is also the duration of the workers staying and working here, so the duration of the impact is medium. Overall, the magnitude of this impact is considered to be moderate. As discussed in chapter 4.1, the surface water has moderate value. Therefore, the significance of this impact is moderate.

In the construction process, there are also other hazardous waste that may occur, the estimated amount of waste might be generated are the oil stains of 3 kg/month, paint cannisters 6 kg/month, oil waste of 20 L/month. This type of waste may come from spilling and leaking from construction vehicles which can cause soil contamination. Therefore, in such case, the company planned to work on soil remediation using soil washing and thermal treatment which use water or heat to separate or remove contaminants (Enva n.d.) In addition, to mitigate this impact, the hazardous waste is collected at a sheltered area where workers will not cross regularly. This type of waste is little in amount and collected at a safe area so it is collected monthly to transport to waste handling sites.

The amount of hazardous waste is low in general, even though they are the potential of severely contaminate the soil environment at the construction site and probably spread to other areas where the crops are planted around the construction site. This problem may lead to long-term contamination if left unchecked. With all these characteristics, the impact magnitude should be rated high, however, there are waste collection measures and soil treatment measures planned, so the chance of contamination is low. Therefore, the magnitude of the impact is low. The value of the soil environment in the area is moderate. Based on table 10, the impact significance of the impact is minor.

4.3.2 Impact on the biological environment

Typically, construction work will lead to habitat destruction which plant and sessile animals in these areas are directly impacted resulting in alteration or reduction in biodiversity (Notice Nature 2007). Fortunately, the construction site was open land with some small trees and bushes, in addition to some free-roaming cattle and poultry which belonged to the farmers nearby so it was speculated that there would not be any significant impact on the ecosystem of the area. The fauna species of the area included common cattle species such as cows, bulls, buffalos, and poultry species of chicken and ducks which are common and easy to relocate to other parts of the open fields around the farm so these species should not be harmed much. There were several bird species around the area such as house sparrows (Passer domesticus), little egret (Egret ta garzetta) mountain tailorbird (Phyllergates cucullatus), red-whiskered bulbul (Pycnonotus jocosus) which are all least concern on conservation status (IUCN 2020). These birds did not have nests in the area, so they only came here to find food. With the construction underway, they might not come to this site, however, there are still plenty of other open spaces around so this construction should not put them at risk. Overall, the impact has a low severity as there should not be any casualties of any species, a small extent as only the construction site is occupied so the impact magnitude is considered as low. The value of both the species and habitat at the site has been discussed as low value. Therefore, the impact significance of this impact is ranked as minor significance.

4.3.3 Impacts on the social environment

Besides the health effects discussed in other parts above, the impacts on the social environment are the traffic jam causing by the transportation of materials, the disturbance due to the concentration of workers, and occupational opportunities for the locals. The traffic near the entrance of the town is national routes 5A, 39A, which is very convenient for the transportation of fuel, materials to the construction site as well as trade routes of the town to other parts of the country. There were estimated 5 heavy-duty trucks of more than 16 tons, which might take some space of the routes during their travel. This might result in a traffic jam on the routes for some short time in rush hours and might not leave any significant long-lasting damage. Therefore, according to table 6, the magnitude of this impact was low. The routes that might be affected due to the transportation of materials are important for the travel of the locals, therefore, the value of this social asset is moderate. With the low magnitude of moderate value social asset, the impact significance of the transportation to the social environment is minor.

The concentration of workers at the site may cause disturbance to the locals near the construction area. However, according to the experts', this type of impact would have a small magnitude since the workers also have to follow a set of rules while living at the construction site so they would less likely to cause troubles to the locals. This also makes this impact significance considered to be minor.

On the other hand, the construction provides occupation for the locals, which is beneficial for the livelihood of the citizen. Furthermore, once the construction is completed, there are more career opportunities for the locals to work in the factory. Therefore, the construction brings benefits to the livelihood of the area.

4.3.4 Summary

This chapter is the summary of the possible environmental impacts that are predicted and evaluated in previous chapters. Overall, the magnitude of impact from transportation of materials on the air quality, impact on noise level from construction work and impact on the surface water quality from the domestic wastewater of the workers at the site were all moderate. The greatest impact magnitude was

impact on air quality from construction vehicles. Other impacts were at low magnitude. On the other hand, the construction work had benefits to the livelihood of the area as it provides occupation for the locals.

TABLE 24. Impact magnitude results

Environment component		Transportation	Construction work	Workers' activity
Physical	Air	Moderate	High	
	Water		Low	Moderate
	Noise		Moderate	
	Soil		Low	
Biological	Biodiversity		Low	
Social	Traffic	Low		
	Livelihood		Positive	
	Wellbeing			Low

Table 25 presents the summary of impact evaluation. The impact of construction vehicles on the air quality of the area is evaluated to be major significance. The impact of transportation vehicles on the air quality and impact of wastewater from workers' basic needs on the surface water of the area are both evaluated to be moderate significance. Other impacts on noise level, soil, the biological and social environment of the area are all minor significance.

TABLE 25. Impact evaluation results

Environmental component		Transportation	Construction work	Workers' activity
Physical	Air	Moderate	Major	
	Water		Minor	Moderate
	Noise		Minor	
	Soil		Minor	
Biological	Biodiversity		Minor	
Social	Traffic	Minor		
	Livelihood		Beneficial	
	Wellbeing			Minor

5 DISCUSSIONS AND CONCLUSIONS

In this assessment, based on the calculation of amount and concentration of pollutants, the severity of the impacts is determined, in addition to the subjectively decided extent and duration of the impacts, the impact magnitude is decided as a step to determine impact significance. Notable impact with moderate to high magnitude of impacts on air quality from both material transportation and construction activities, impact on surface water from domestic wastewater, and impact on the noise level from construction activities. These impacts all have moderate severity due to their high amount of calculated content or the baseline data is already close to limit values. The extent of these impacts is all beyond the construction site and possibly reaching Yen My town in the case of emissions. The duration of these impacts is all for the entire construction duration of 9 months. On the other hand, the impact on the social environment has low magnitude because the construction site is in its own open area that there is less contact with the social assets and the impact on the biological environment has low magnitude because the construction area is not home to any of the species spotted on the site.

The impact on air quality of the environment from construction work has major significance, which means it is mandatory to take mitigation measures or alternatives to the plan to reduce the impacts. The impact on the air environment by the transportation of materials is at moderate significance which is recommended to have mitigation measures. The possible recommended solutions are using hybrid technology for some construction vehicles such as the excavator to reduce the emission, use low sulphur fuel for the vehicles and install particulate filters and catalyst converters on the equipment to reduce the emission (Guzder 2019). The impact on surface water at Nghia Tru river by the domestic wastewater from the workers has moderate significance mostly because the current BOD and COD concentration of Nghia Tru river is already over the limit values, while the calculated concentration of wastewater content in chapter 4.3.1 should be within limit values. Therefore, the solution for this problem is river remediation techniques such as aeration, water diversion, sediment dredging to reduce the contaminant

in a safe way (Wang, Liu & Lu 2012, 1857-1858). That way, the additional domestic wastewater from the construction site would not cause further problems. Other impacts on noise, soil, biodiversity, social environment are all minor impacts as the receptor can recover quickly in the case of noise level or the magnitude of the impacts are low, in the case of soil contamination, the chance of contamination leach is low, or biodiversity where there is no impact on the wild or domestic animals in the area. These minor impacts are at an agreeable level of impact that does not need further attention.

There are several limitations to the assessment in this thesis mostly due to the lack of resources and data. The environmental baseline study which includes many sampling and measurements was done by the Institute of Environmental Technology, therefore, it should have high accuracy. However, due to limited funds and existing data, the number of samples are very few and the sample was taken from just one day at the site so it makes the quality of the environmental components seems fixed, rather than a changing trend throughout the weeks which should describe the condition better because in case there were some unexpected events on the measurement date, the result of the sampling and measurement could be wrong. Next, the quantification of the impact was done with simple calculation from reference data of rate of emission from Rapid Inventory Techniques of WHO, so this may estimate the amount of the pollutants, however, it cannot describe exactly the extent that the pollutants might reach. Furthermore, the set of criteria used in the value of the receptor, impact magnitude, and other characteristics such as severity, extent, and duration are very subjective to use. Therefore, the assessment based on these criteria alone might not be accurate. It is highly recommended for the future development of the EIA of this project to gather more data on the condition of the environmental components to describe its trend. For the quantification of environmental impacts, it is recommended to use quantitative mathematical models such as air dispersion models to determine the extent and concentration of the pollutants at a specific area based on the emissions and meteorological data (United States Environmental Protection Agency 2020).

The objectives of this thesis are prediction and evaluation of impacts from construction activities to the environmental components, quantification of the impact

sources such as content of wastewater, amount of emissions, amount of hazardous waste and noise level and decision of whether the impacts require further mitigation methods or alternative proposal. In general, the objective of the thesis have been met. First of all, the impacts from construction activities which includes transportation of materials and construction activities have been identified their interaction on physical, biological, and social environment in impact identification section. The amount and concentration of emissions, noise level, wastewater have been calculated using the emission rate data from Rapid Inventory Techniques of WHO to determine the severity of the impacts. The characteristics of impact required to determine which are severity, extent, and duration have been predicted qualitatively based on the set of criteria to rate impact magnitude. The impact significance was also determined based on the magnitude of impact and the value of receptor environmental components. Noticeable impacts with moderate to high magnitude impact on air quality, the impact of domestic wastewater on surface water quality, and impact on the noise level. Meanwhile, the impact significance of impacts on air quality of the area is moderate for transportation activities and major for construction activities, indicating these impacts are recommended to have mitigation measures or alternatives proposals to reduce the impact. Impact significance of domestic wastewater from workers' activities also has a moderate significance which also recommended to have mitigation measures or alternatives proposal to reduce the impact. The results certainly covered the objectives of the thesis. Since there are several limitations to the qualitative assessment of the impacts, this thesis should only be used as an overview of the environmental impacts of the project to support the later stages of environmental impact assessment of the project.

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APPENDICES

Appendix 1. Unofficial translation of appendix 2.3 of circular 27/2015/TT-BTNMT 1(5)

PHỤ LỤC 2.3

APPENDIX 2.3

CẤU TRÚC VÀ NỘI DUNG CỦA BÁO CÁO ĐÁNH GIÁ TÁC ĐỘNG MÔI TRƯỜNG

STRUCTURE AND CONTENT OF ENVIRONMENTAL IMPACT ASSESSMENT

Chương 2

ĐIỀU KIỆN MÔI TRƯỜNG TỰ NHIÊN VÀ KINH TẾ - XÃ HỘI KHU VỰC THỰC HIỆN DỰ ÁN

ENVIRONMENTAL, ECONOMIC AND SOCIAL CONDITION OF PROJECT AREA

2.1. Điều kiện môi trường tự nhiên (Natural Environment Condition)

2.1.1. Điều kiện về địa lý, địa chất (Geology and Geometrical data)

Đề cập và mô tả những đối tượng, hiện tượng, quá trình có thể bị tác động bởi dự án (đối với dự án có làm thay đổi các yếu tố địa lý, cảnh quan; dự án khai thác khoáng sản và dự án liên quan đến các công trình ngầm thì phải mô tả một cách chi tiết).

Describe and discuss the object, events or processes that can be affected by the project (For projects that possibly change the geography, scenery; other mining project and projects relating to underground work requires detailed description)

2.1.2. Điều kiện về khí hậu, khí tượng (Meterological data)

Nêu rõ các yếu tố khí hậu, khí tượng đặc trưng với chuỗi số liệu đủ dài, phù hợp với loại hình dự án, địa điểm thực hiện dự án để làm cơ sở đầu vào tính toán, dự báo các tác động của dự án như nhiệt độ, hướng và vận tốc gió, lượng mưa, v.v... đặc biệt, chú ý làm rõ các hiện tượng bất thường.

Describe the climate of the area with chain of data suitable for every type of the project, location of the project in order to forecast the effect it may have on the project such as temperature, precipitation, humidity and so on. Notice any possible abnormally

2.1.3. Điều kiện thủy văn/hải văn (Hydrology data)

Mô tả đặc trưng thủy văn/hải văn với chuỗi số liệu đủ dài, phù hợp với loại hình dự án, địa điểm thực hiện dự án để làm cơ sở tính toán, dự báo các tác động của dự án như mực nước, lưu lượng, tốc độ dòng chảy, v.v..

2.1.4. Hiện trạng chất lượng các thành phần môi trường đất, nước, không khí (Condition of air, soil and water environment)

- Làm rõ chất lượng của các thành phần môi trường có khả năng chịu tác động trực tiếp bởi dự án như môi trường không khí tiếp nhận trực tiếp nguồn khí thải của dự án (lưu ý hơn đến các vùng bị ảnh hưởng ở cuối các hướng gió chủ đạo), nguồn nước tiếp nhận nước thải của dự án, chất lượng đất khu vực dự kiến thực hiện dự án, v.v..

- Đưa ra đánh giá, nhận xét về chất lượng môi trường so sánh với tiêu chuẩn, quy chuẩn kỹ thuật môi trường, nhận định về nguyên nhân dẫn đến ô nhiễm; thực hiện đánh giá sơ bộ về sức chịu tải của môi trường khu vực dự án trong trường hợp có đủ cơ sở dữ liệu về môi trường trên cơ sở kết quả lấy mẫu, phân tích các thành phần môi trường.

- Nêu rõ các vị trí lấy mẫu phân tích chất lượng các thành phần môi trường theo quy định hiện hành.

- Các điểm đo đạc, lấy mẫu phải có mã số, tọa độ, có chỉ dẫn về thời gian, địa điểm, đồng thời, phải được thể hiện bằng các biểu, bảng rõ ràng và được minh họa bằng sơ đồ bố trí

các điểm trên nền bản đồ khu vực thực hiện dự án. Việc đo đạc, lấy mẫu, phân tích phải tuân thủ quy trình, quy phạm về quan trắc, phân tích môi trường và phải được thực hiện bởi đơn vị chức năng được cấp có thẩm quyền công nhận đủ điều kiện.

- Đánh giá sự phù hợp của địa điểm lựa chọn thực hiện dự án với đặc điểm môi trường tự nhiên khu vực dự án.

-Clarify the quality of environmental components that are likely to be directly affected by the project such as the air environment directly receiving project emission sources (paying more attention to the affected areas at the end of the project). prevailing wind direction), water sources receiving project wastewater, land quality of the area planned for project implementation, etc.

- Making assessments and comments on environmental quality compared with environmental standards and technical regulations, comment on the causes of pollution; perform preliminary assessment of bearing capacity of the environment of the project area in case of having sufficient environmental database on the basis of results of sampling, analyzing environmental components.

- State the locations of samples for analyzing environmental components according to current regulations.

- The measurement and sampling points must have codes and coordinates, instructions on time and place, and must be presented in clear tables and tables and illustrated with a layout diagram of the points on the map of the project area. The measurement, sampling and analysis must comply with the environmental monitoring and analysis process and rules and must be conducted by a competent functional unit recognized by a competent authority.

- Assessing the appropriateness of the project selection location with the natural environment characteristics of the project area.

Lưu ý: Đối với dự án có liên quan đến phóng xạ, trong mục 2.1.4 cần trình bày rõ hoạt động quan trắc phóng xạ, kết quả quan trắc; đánh giá hiện trạng và sơ bộ phân tích nguyên nhân.

2.1.5. Hiện trạng tài nguyên sinh vật

Hiện trạng đa dạng sinh học của khu vực dự án và các khu vực chịu ảnh hưởng của dự án, bao gồm:

- Số liệu, thông tin về đa dạng sinh học trên cạn có thể bị tác động bởi dự án, bao gồm: nơi cư trú, các vùng sinh thái nhạy cảm (đất ngập nước nội địa, khu bảo tồn thiên nhiên, khu dự trữ sinh quyển, khu di sản thiên nhiên thế giới trong và lân cận khu vực dự án); khoảng cách từ dự án đến các vùng sinh thái nhạy cảm gần nhất; diện tích các loại rừng (nếu có); danh mục và hiện trạng các loài thực vật, động vật hoang dã, trong đó có các loài nguy cấp, quý, hiếm được ưu tiên bảo vệ, các loài đặc hữu có trong vùng có thể bị tác động do dự án;

- Số liệu, thông tin về đa dạng sinh học biển và đất ngập nước ven biển có thể bị tác động bởi dự án, bao gồm: đặc điểm hệ sinh thái biển và đất ngập nước ven biển, danh mục và hiện trạng các loài phiêu sinh, động vật đáy, cá và tài nguyên thủy, hải sản khác (nếu có).

Yêu cầu đối với mục 2.1:

- Cần có số liệu mới nhất về điều kiện môi trường tự nhiên trên cơ sở khảo sát thực tế do chủ đầu tư hoặc đơn vị tư vấn thực hiện. Nếu là số liệu của các đơn vị khác cần ghi rõ nguồn, thời gian khảo sát;

- Chỉ dẫn nguồn tài liệu, dữ liệu tham khảo, sử dụng.

Current status of biodiversity of the project area and project affected areas, including:

- Data and information on terrestrial biodiversity that may be affected by the project, including: habitats, sensitive ecological areas (inland wetlands, nature conservation zones, projected areas) biosphere reserve, world natural heritage sites in and around the project area); distance from the project to the most sensitive ecoregions; area of forest types (if any); list and current status of plant and wildlife species, including endangered precious and rare species prioritized for protection, endemic species in the region likely to be affected by the project;

- Data and information on marine biodiversity and coastal wetlands that may be affected by the project, including: characteristics of marine ecosystems and coastal wetlands, list and current status of species plankton, benthos, fish and other aquatic and marine resources (if any).

Requirements for section 2.1:

- It is necessary to have the latest data on natural environmental conditions based on the actual survey conducted by the investor or the consultancy unit. If data are from other units, specify source and time of survey;

- Indicating resources, reference data and usage.

2.2. Điều kiện kinh tế - xã hội

2.2.1. Điều kiện về kinh tế (Economic condition)

Nếu rõ các hoạt động kinh tế (công nghiệp, nông nghiệp, giao thông vận tải, khai khoáng, du lịch, thương mại, dịch vụ và các ngành khác), nghề nghiệp, thu nhập của các hộ bị ảnh hưởng do các hoạt động triển khai dự án.

State the economic activities (industry, agriculture, transportation, mining, tourism, trade, services and other industries), occupation, and income of households affected by the activities, project implementation.

2.2.2. Điều kiện về xã hội (Social condition)

- Nêu rõ đặc điểm dân số, điều kiện y tế, văn hóa, giáo dục, mức sống, tỷ lệ hộ nghèo, các công trình văn hóa, xã hội, tôn giáo, tín ngưỡng, di tích lịch sử, khu dân cư, khu đô thị và các công trình liên quan khác chịu tác động của dự án.

- Đánh giá sự phù hợp của địa điểm lựa chọn thực hiện dự án với đặc điểm kinh tế - xã hội khu vực dự án.

Yêu cầu đối với mục 2.2:

- Số liệu về kinh tế - xã hội phải được cập nhật tại thời điểm thực hiện ĐTM và được trích dẫn về nguồn gốc, thời gian, đảm bảo độ tin cậy;

- Đối với các dự án đầu tư vào khu sản xuất, kinh doanh, dịch vụ tập trung, nội dung của mục 2.2 chỉ nêu hoạt động đầu tư phát triển và hoạt động bảo vệ môi trường của khu sản xuất, kinh doanh, dịch vụ tập trung.

- Stating the characteristics of population, health conditions, culture, education, living standards, poverty rate, cultural, social, religious, belief, historic and residential relics, urban areas and other related works affected by the project.

- Assessing the appropriateness of the project location with the socio-economic characteristics of the project area.

Requirements for item 2.2:

4(5)

- Socio-economic data must be updated at the time of EIA implementation and quoted in terms of origin and time, ensuring reliability;

- For investment projects in concentrated production, business and service areas, the content of Section 2.2 only indicates development investment and environmental protection activities of production, business and service areas. concentration service.

Chương 3

ĐÁNH GIÁ, DỰ BÁO TÁC ĐỘNG MÔI TRƯỜNG CỦA DỰ ÁN

EVALUATION AND PREDICTION OF ENVIRONMENTAL IMPACTS

3.1. Đánh giá, dự báo tác động

3.1.1. Đánh giá, dự báo các tác động trong giai đoạn chuẩn bị của dự án (Preparation phase)

Việc đánh giá, dự báo tác động trong giai đoạn này cần tập trung vào các nội dung chính sau:

- Đánh giá tính phù hợp của vị trí dự án với điều kiện môi trường tự nhiên và kinh tế-xã hội khu vực thực hiện dự án;

- Đánh giá tác động của việc chiếm dụng đất, di dân, tái định cư (đặc biệt đối với các hộ dân bị mất đất ở, đất canh tác, mất việc làm);

- Đánh giá tác động của hoạt động giải phóng mặt bằng (phát quang thảm thực vật, san lấp tạo mặt bằng và hoạt động khác).

3.1.2. Đánh giá, dự báo các tác động trong giai đoạn thi công xây dựng dự án (Evaluate and predict impacts from construction phase)

Việc đánh giá, dự báo tác động trong giai đoạn này cần phải tập trung vào các nội dung chính sau:

- Đánh giá, dự báo tác động của hoạt động khai thác vật liệu xây dựng phục vụ dự án (nếu thuộc phạm vi dự án);

- Đánh giá, dự báo tác động của hoạt động vận chuyển nguyên vật liệu xây dựng, máy móc thiết bị;

- Đánh giá, dự báo tác động của hoạt động thi công các hạng mục công trình của dự án hoặc các hoạt động triển khai thực hiện dự án (đối với các dự án không có các hạng mục công trình xây dựng).

Evaluation and prediction of (environmental) impact must include the following contents:

- Evaluation and prediction of environmental impact from transportation of construction materials

- Evaluating and prediction of impacts of construction activities of project items or project implementation activities (for projects without construction works items).

3.1.3. Đánh giá, dự báo các tác động trong giai đoạn hoạt động/vận hành của dự án (Evaluate and predict impact from operation phase)

Việc đánh giá, dự báo tác động trong giai đoạn hoạt động/vận hành dự án cần phải tập trung vào các nội dung chính sau:

- Đánh giá, dự báo tác động của các nguồn phát sinh chất thải (khí, lỏng, rắn);

- Đánh giá, dự báo tác động của các nguồn không liên quan đến chất thải.

3.1.4. Đánh giá, dự báo tác động giai đoạn khác (tháo dỡ, đóng cửa, cải tạo, phục hồi môi trường và các hoạt động khác có khả năng gây tác động đến môi trường) của dự

án (nếu có). (Evaluate and predict impacts from other phases (demolition, closing, recovery, and other activities that impacts the environment) of the project (if any))

Việc đánh giá, dự báo tác động trong giai đoạn này cần tập trung dự báo các nguồn chất thải tồn lưu sau giai đoạn vận hành và những vấn đề môi trường liên quan đến hoạt động phá dỡ các công trình, phục hồi, cải tạo môi trường khu vực dự án.

Yêu cầu đối với các mục 3.1.1, 3.1.2, 3.1.3 và 3.1.4:

- Từng nguồn gây tác động phải được đánh giá tác động theo đối tượng bị tác động, phạm vi, mức độ tác động, xác suất xảy ra tác động, khả năng phục hồi của các đối tượng bị tác động;

- Cần làm rõ nguồn gây tác động liên quan đến chất: cần cụ thể hóa về thải lượng, tải lượng và nồng độ của tất cả các thông số chất thải đặc trưng cho dự án và so sánh với các tiêu chuẩn, quy chuẩn kỹ thuật hiện hành, cụ thể hóa về không gian và thời gian phát sinh chất thải;

- Cần làm rõ nguồn gây tác động không liên quan đến chất thải (tiếng ồn, độ rung, xói mòn, trượt, sụt, lở, lún đất; xói lở bờ sông, bờ suối, bờ hồ, bờ biển; bồi lắng lòng sông, lòng suối, lòng hồ, đáy biển; thay đổi mực nước mặt, nước ngầm; xâm nhập mặn; xâm nhập phèn; mất rừng, thảm thực vật, động vật hoang dã, tác động đến hệ sinh thái nhạy cảm, suy thoái các thành phần môi trường vật lý và sinh học; biến đổi đa dạng sinh học, các tác động do biến đổi khí hậu và các nguồn gây tác động không liên quan đến chất thải khác);

- Các tác động tiêu cực và tích cực quan trọng nhất cần được đánh giá, dự báo gồm: tác động đến các thành phần môi trường tự nhiên; tác động đến đa dạng sinh học; tác động đến sức khỏe cộng đồng; tác động đến biến đổi khí hậu;

- Việc đánh giá, dự báo các tác động đến sức khỏe cộng đồng phải làm rõ được mức độ của các tác động gắn với quy mô và phạm vi cộng đồng chịu tác động;

- Đối với dự án cải tạo, mở rộng, nâng cấp, nâng công suất phải đánh giá, dự báo tác động tích lũy (tổng hợp) những nguồn thải mới và nguồn phát thải ở cơ sở sản xuất, kinh doanh, dịch vụ hiện hữu.

Requirements on sections 3.1.1, 3.1.2, 3.1.3 and 3.1.4:

- Each source of impact must be assessed for impact according to the impacted object, extent, magnitude, probability of occurrence, resilience of impacted subjects;

- Clarify the source of environmental impact relating to waste; states the amount and concentration of every pollutant and comparing to national standards

-Clarify the sources of environmental impact not relating to waste (noise, vibration, erosion, slip, fall, landslide, land subsidence; erosion of river banks, stream banks, lakes and coasts; sedimentation of river beds, stream beds, lakes, seabed; changes in surface water and groundwater levels; salinization; alum intrusion; loss of forests, vegetation, wildlife, impacts on sensitive ecosystems, degradation of physical and biological environmental components; biodiversity change, impacts due to climate change and other sources of impacts not related to other waste);

- The most important negative and positive impacts to be assessed and forecasted include: impacts on natural environment components; impact on biodiversity; impact on community health;

- Assessing and forecasting impacts on public health must clarify the extent of impacts associated with the scope of affected communities