**DEPARTMENT OF BUILDING**

**UNIVERSITI TEKNOLOGI MARA**

**(PERAK)**

# CONSTRUCTION METHOD OF LEACHATE WATER COLLECTION DRAIN

**Prepared by:**

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**UNIVERSITI TEKNOLOGI MARA**

**(PERAK)**

**DECEMBER 2019**

It is recommended that the report of this practical training provided

**By**

**Nur Najwa Natasya Binti Muhamad Nasri**

**2017213456**

**entitled**

**Construction Method of Leachate Water Collection Drain**

be accepted in partial fulfillment of the requirement for obtaining the Diploma In Building.

| | | |
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**DECEMBER 2019**

## STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at Jauhari Permai Resources Sdn Bhd for a duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Date : 20 DECEMBER 2019

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I would also like to thank ALL the UiTM lecturers that have taught and nurtured me in becoming a better student and person. I would also like to extend my deepest appreciation to the lecturers who are directly involved during my training stint. To Cik Nor Azizah Talkis, Supervising Lecturer, Dr Mohd Rofdzi bin Abdullah, Evaluating Lecturer, En Muhammad Naim bin Mahyuddin, Practical Training Coordinator and Dr. Dzulkarnaen bin Ismail, Programme Coordinator, I value the time, effort, encouragement and ideas that they have contributed towards the successful completion of my training, this report and the valuable knowledge that have been shared over the last few semesters.

Last but not least, my special thanks to my beloved parents for their sacrifices over the years.

Thank you so much.

## ABSTRACT

Leachate Water Collection Drain is a new system introduced in Lynas Advanced Material Plant (LAMP) and the most crucial part in Lynas Malaysia Sdn Bhd residue waste management, thus this report was mainly to discuss how this collection drain functioning based on engineering design and theory. The aim of this report was to monitor the construction of this waste pond for waste residue dumping area in Lynas' waste management process stage. The objective of this report is to explain the method of construction of Leachate Water Collection Drain as the correct erection will give the efficient functioning to the collection drain system and good accommodation for the tons of loaded waste. In addition, to identify the benefits of Leachate Water Collection Drain especially to the environment prevented wastewater absorption into the underground soil. This report had been done through interviews to collect varieties of information from the experienced party along with observations recorded and photographs as evidence. From this report, we will find out the sequence of work needed to successfully construct the Leachate Water Collection Drain.

**CONTENTS** **PAGE NO**

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF APPENDIXES

# CHAPTER 1.0

# INTRODUCTION

## 1.1 Background and Scope of Study

The industrial training involves project organization and planning, site supervision, working on official documentation, project management, safety, and health supervision also maintenance monitoring. This report will focus on the construction of the Water Leachate Water Collection Drain NUF dumping area in Lynas Advance Material Plant (LAMP) or a system of waste containment.

A correct waste containment philosophy consists of optimization of the landfill location, construction of high-performance lining and capping systems, optimization of waste storage, short-term and long-term careful monitoring, and a convenient re-use of the landfill area after closure. The geotechnical engineer must has strong skills about all the aforementioned topics but in particular can effectively deal with the design, construction quality control and monitoring of the lining and cover system, the waste storage and compaction procedure, and the foundation and improving treatments for construction above waste deposits (Manassero et al., 2015). The purpose of this report is to ensure the correct work done during Leachate Water Collection Drain construction phase for the system working and functioning well by the end of this report.

In the narrow environmental context leachate is any liquid material that drains from land or stockpiled material and contains significantly elevated concentrations of undesirable material derived from the material that it has passed through (Leachate, 2019). In this project, it functioned for collecting leachate water from Neutralization Underflow Residue (NUF) stockpile.

The amount of residual waste from the Lynas industrial production increasing to 1100 tonnes of Neutralization Underflow Residue (NUF) and 800 tonnes Water Leachate Purification Residue (WLP) on average per day. These wastes must be avoided by making contact with the underground soil to prevent its contaminated water from these residues being absorbed into the underground and subsequently pollute the natural environment. That is mainly as WLP is a slightly radioactive waste with normally 0.01 millisieverts (mSv) and NUF is a Magnesium Rich Gypsum and has been proven to be non-toxic, non-carcinogenic, non-ecotoxic and non-radioactive yet still a contaminated slurry. Furthermore, the purpose of dumping these residues is mainly to dry them and Leachate Water Collection Drain is an idea for a new system to be implemented for dumping NUF residue in Lynas Advanced Material Plant (LAMP) waste management like a few other plant and processing factory. This system will guarantee to ensure a faster drying process for better management. It is a priority to construct Leachate Water Collection Drain for all the above purposes.

This project includes culvert welding, piping work, leveling, solving problems also handover process by parts to fit the production timing of NUF residue. The construction of this Leachate Water Collection Drain like a filtration system to ensure water from NUF residue flow in its corrective ways to the sump pit according to the applicable regulations and client's requirement.

This report will present the construction of Leachate Water Collection Drain from start to finish which was expected to be done within 45 days from 11$^{th}$ of September 2019 until the 25$^{th}$ of October 2019 including all hot work and cold work activities. However, this project was dragged until day 60 which on the 9$^{th}$ of November 2019 due to a few technical problems like late material supply and weather factors that had changed the actual schedule. Besides that, this report will determine benefits or how this system working for Lynas' residue waste management.

## 1.2 Objectives

1. To describe the safety features adopted in leachate water collection drain.
2. To explain the method construction of leachate water collection drain.
3. To determine the problems, occur during Leachate Water Collection Drain project and their solutions.

## 1.3 Method of study

### 1.3.1 Primary Data

**a. Observation**

Observation is divided into two ways which are observing directly (direct observation) and observation through participation (participant-observation). The overall methodology of this report is based on observations conducted during the industrial training. Observations made were recorded and photographed as evidence of the report. The observation enables the author to gain real practical experience and effective knowledge. Any information can be gain accurately from this method.

**b. Interview**

The interview gives the author time to mingle with the respondent. Interviews are the best method for open questions and get detailed information from respondents. The interview is done with the involved or experienced party for the author to have information from their knowledge and experiences. The data collected from the interview session is recorded and it can be used as a guideline in writing this report. The parties who have been interviewed are mostly the project engineer who mainly handled the project from this company, and some are from management team. This method is a direct method to collect data verbally.

### 1.3.2 Secondary Data

**a. Book**

This way can make author's training easier in order to find any related contents to the report study topic. This method is very efficient and from trusted sources to be used. This methodology is also the main sources and preferable in collecting data for this report.

**b. Internet**

Web Site is one of the faster and easiest ways in collecting data. This study method can be used to do some research on the title of the report. This method required less energy and saved time. This method is also use wisely in collecting data for this report.

# CHAPTER 2.0

# COMPANY BACKGROUND

## 2.1 Introduction of Company

Jauhari Permai Resources Sdn Bhd, (JPRSB) was established on the 6th of July 2004 from its former name Inspect Marine Sdn Bhd. The company's name was changing a few times from the 18th of August 2005 until 10th February 2017 by the services provided. JPRSB is also one of the subsidiary companies under Gateway Group of Companies apart from other 5 companies plus this company based as an in-house contractor since the establishment of Lynas Malaysia Sdn Bhd (LAMP).

JPRSB mainly controlling the waste dumping job scope in LAMP situated in Gebeng, Kuantan, Pahang industrial area besides conducting businesses as a contractor in various services including construction works for the non-government company such Lynas Corporation Sdn Bhd and Venator Corporation.

Jauhari Permai Resources Sdn Bhd is a hundred percent belongs to bumiputra and in continued progress to expand their business activities with the potential and tendencies open in the civil construction profession. It is coinciding with JPRSB's vision and mission to utilize all the experiences and their perfect existing conveniences to extend this company further into civil works in this nearest period.

## 2.2 Company Profile

### 2.2.1 Company Details

Table 2.1: Company details

| About | Details |
|---|---|
| Company's Name | Jauhari Permai Resources Sdn Bhd |
| Registration No. | 658575-A |
| Date of Incorporation | 6th of July 2004 |
| Address | B2, 1ST Floor, Jalan Gebeng 2/6, Gebeng Industrial Estate, 26080 Kuantan, Pahang |
| Board of Directors | Rishinsa bin Yusoff<br>Che Razimi Che Ibrahim |
| Nature of Business | Civil Engineering Contractor |
| Paid Up Capital | RM 1 000 000.00 |
| CIDB Registered no. | 0120140519-PH156958 |
| CIDB Grade | G5 -<br>Building Services (B)- B04 B21<br>Civil Engineering (CE)- CE21 CE29<br>Mechanical Engineering (ME)- M15 |
| Tel No. | |
| Fax No. | |
| Email | jauharipermairesources@gmail.com |

Sources: Jauhari Permai Resources Sdn Bhd

### 2.2.2 Vision and Mission

**Vision**

To be the most preferred contractor of choice, providing the best civil construction service for our clients via cost effectiveness and fulfilling the designated time frame.

**Mission**

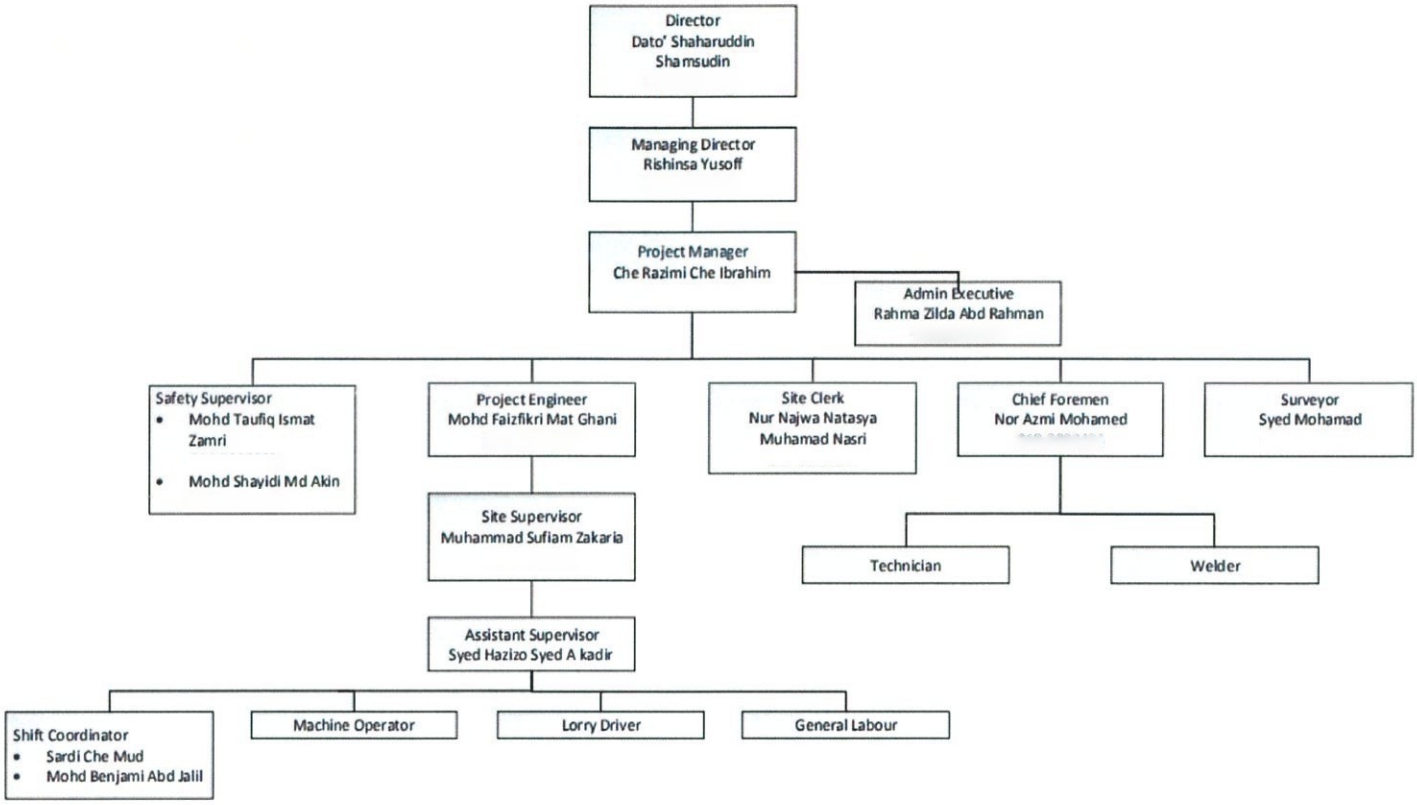
Strategically planning and monitoring all aspects to ensure that we always surpass our client expectations and set benchmark for our competitors.

**Motto**

I. to emphasize on civil construction quality service,
II. to create real value for customers,
III. Safety as a Lifestyle,
IV. to build solid teamwork through continuous training; and
V. to be technologically innovated throughout the organization.

## 2.3 Organization Chart

Table 2.2: Organization Chart of Jauhari Permai Resources Sdn Bhd




Sources: Jauhari Permai Resources Sdn Bhd

## 2.4 List of Project

### 2.4.1 Completed Project

Table 2.3: List of Completed Project

| No. | Project Description | Contract Value (RM) | Completion Date |
|---|---|---|---|
| 1. | Leachate Water Collection Drain NUF Project DSF 2 | 551,439.00 | 9th of November 2019 |
| 2. | Preparation NUF Residue Dumping Area at DSF 1 and Cell Geotube FGD | 271,933.68 | 25th of September 2019 |
| 3. | Rental Road Sweeper and Water Jetter | 24,000.00 | 5th of September 2019 |
| 4. | Road Renovation at Geotube Area | 2,444,634.40 | 20th of May 2019 |
| 5. | Prepare Access for at DSF 1 | 17,922.00 | 29th of April 2019 |
| 6. | Supply Coconut Trunk and Access at DSF 1 | 32,000.00 | 14th of April 2019 |
| 7. | Transfer Excess WLP Residue from Bay to WLP 5 | 58,500.00 | 8th of January 2019 |
| 8. | Install Reflector Tape at WLP and NUF RSF | 10,000.00 | 4th of September 2018 |
| 9. | Road Repair at DSF Area | 26,563.00 | 16th of June 2018 |
| 10. | Cut and Remove Geotube FGD Cell | 40,816.00 | 3rd of April 2018 |
| 11. | Sludge Removal RSF 1 for Project RSF 5B | 23,260.20 | 17th of July 2018 |
| 12. | Levelling Geotube | 47,328.12 | 11th of June 2018 |
| 13. | Charges for Portable Pump at Geotube | 11,300.00 | 2nd of March 2018 |
| 14. | Supply Manpower Materials and Tools to Repair Football Field at SK Balok | 23,500.00 | 27th of December 2017 |
| 15. | Construction of Yard for Gateway Shipping Sdn Bhd | 738,405.38 | 15th of December 2017 |

Sources: Jauhari Permai Resources Sdn Bhd

### 2.4.2 Ongoing Project

Table 2.4: List of Ongoing Project

| No. | Project Description | Contract Value (RM) | Start Date |
|---|---|---|---|
| 1. | Handling NUF residue DSF | 360,000.00 | 25th of November 2019 |
| 2. | PE Tank- Waste Water Management | 18,000.00 | 1st of November 2019 |
| 3. | Site Road and Fencing Replacement Work in Venator Asia Sdn Bhd | 378,756.52 | 11th of October 2019 |

Source: Jauhari Permai Resources Sdn Bhd

# CHAPTER 3.0

## Construction Method of Leachate Water Collection Drain

### 3.1 Introduction to Leachate Water Collection Drain

Leachate Water Collection Drain has been chosen as the topic for this report as to gain a deeper understanding about any potential problems that could occur during its construction and their solutions, benefits of Leachate Water Collection Drain construction to waste management process in Lynas, safety features adopted during the construction process and how to construct Leachate Water Collection Drain from start to finish. This report explained in detail the study which has been carried out by referring to the person in charge on-site and off-site apart from directly involved in this project. Thus, the contains of this report was elaborated carefully and easier understanding can be obtained. Leachate Water Collection drain is a newly introduced system named DSF 2 in Lynas Advanced Material Plant (LAMP) this year and this is its very first implementation to see how it works for their better waste management.

As all know, LAMP does have few controversial issues ever since this plant started running here in Malaysia thus required them to detail considered all the aspects in their processes to maintain their best presentation of fulfilling all Malaysia Department of Environment (DOE) criteria's or requirements and regulations. Unlike other few material plants from author visit and observation, Lynas was one of the best and proper managing waste material as their well-constructed and innovative dumping area along with proper scheduled waste management. The existed dumping place were ponds with water flows from the highest level into the collection area. The tipper lorry dumped their collected residue there followed by staked and leveled work. However, this old system causes the water gathered at the bottom of the stack which was causing movement and the upper stack to collapse. This Leachate Water Collection Drain promised to improve the residue structure to be less fragile by time and set on place through faster dry.

The overall cost for this project tendering by Jauhari Permai Resources Sdn Bhd is 551,439.00 MYR and Lynas Malaysia Sdn Bhd as the client. This Project was expected to be completed by 9th of November 2019 due to schedule changed. The site project located at B2, 1st Floor, Jalan Gebeng 2/6, Gebeng Industrial Estate, 26080 Kuantan, Pahang in Residue Storage Facility (RSF) area LAMP shown in figure 3.1 labelled as DSF 2 in yellow color constructed for dumping Neutralization Underflow Residue (NUF). It also an early preparation to accommodate the upcoming NUF residue as the existing dumping pond were expected to be full by the end of this year. The Leachate Water Collection Drain proposed site was surrounded by existing Water Leachate Purification (WLP) and NUF residue dumping ponds also residue's water collection pond and near to Lynas' rare earth separation process plant. The process in these ponds ran 24 hours every day so that this project must follow the rules and working requirement.


Figure 3.1: Location plan of Leachate Water Collection Drain project

Source: Jauhari Permai Resources Sdn Bhd

Generally, this pond construction consisted of numbers of layers as according to (Appendix A) drawing no. N201 on item Notes 2. Schematic arrangement of geofabric materials. The layers under HDPE Liner which were Geosynthetic Clay Liner (GCL), PET 400/50 which was a high strength geotextile, 300mm thickness of the sand layer, Drainage Geonet and Compacted Subgrade or layer of compacted aggregate already had been constructed by the previous tendered contractor which was HULS Engineering Sdn Bhd during phase 1. Jauhari Permai Resources Sdn Bhd scope of work were consisted of laying and Welding HDPE liner followed by lapping Cushion Geotextile, Jointed HDPE Pipe as shown in (Appendix B) drawing no. N202 section A-A and finally leveled 300mm thickness of drainage material during phase 2. The area of gabion cage as the proposed intake pump protection and screens where the process of flocculation happens was constructed simultaneously by HULS Engineering Sdn Bhd.

## 3.2 Method of Construction of Leachate Water Collection Drain Phase 2

The construction procedure was based on the method statement prepared by Jauhari Permai Resources Sdn Bhd as this project main contractor based with accordance with the client requirement. It shows a roughly or highlighted phase should have been done as well as it simultaneously updated progress. These were methods in Phase 2-layer construction:

### 1) Laid and weld HDPE liner geomembrane

Textured HDPE liner geomembrane of 2mm thickness laid overlapped for 100 mm onto each other all over the proposed pond. The liner then welds with meticulous care in order to prevent leakage as shown in figure 3.2 using the Hot wedge double fusion welding machine. It was a primary type of welding equipment used nowadays for welding of polyethylene sheet. It provides an excellent welding consistency in reduce human error and error cause by fatigue as it ran horizontally and automatically by itself when set.

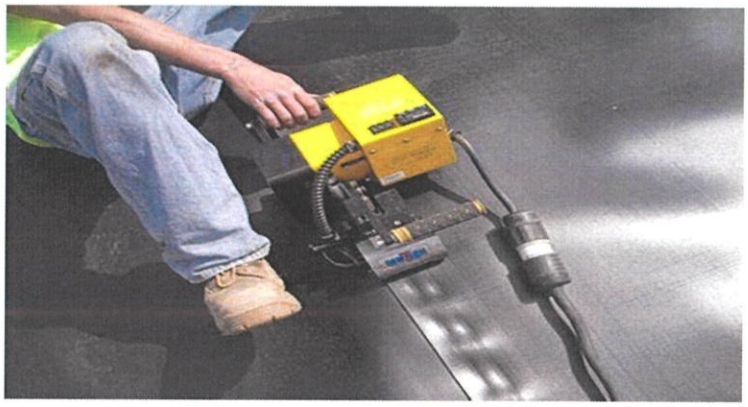


Figure 3.2: Weld HDPE Liner

This system was preferred to be use in this project liner apart from extrusion welding as it functioned to weld long continuous seams liner and can travel at speeds of 4 meter per minute. This welding machine came with a high temperature split wedge which melted the plastic along the direction of weld lines on the overlapped sheets as shown in figure 3.3 illustration. The liner sheets were then squeezed together by pressure rollers so that the two sheets fused together. The pressure applied by the drive rollers as they pressed the two sheets together determines how much plastic squeezed out of the weld area and effected the structure of the weld.

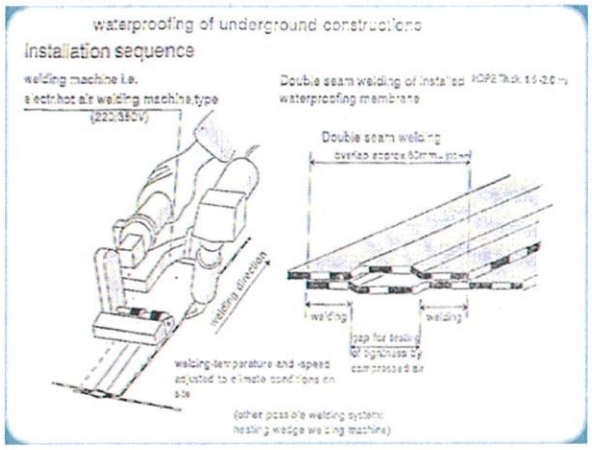



Figure 3.3: Double fusion welding illustration

Source: https://www.sciencedirect.com/science/article/abs/pii/026611449090020D

In order to weld a good seam, few aspects were taken into consideration which ensured the edge of track not cut the liner, the both areas of fused material avoided of any seam lines, confirmed the air liner was cleared, the track width were all equal and the squeezed part barely visible. The liner jointed by competent welders at its every 100 mm lapping and onto the boundary existed bunds which already been laid with smooth HDPE liner.

The specification of the HDPE liner was specifically followed the technical data sheet as in Appendix C. This liner was puncture resistance, impact resistance and tear resistance in characteristics supplied by SOLMAX company with 1000-meter per roll as shown in figure 3.4. HDPE liner geomembrane plays the most important part to the main function of this pond construction as it was water-resistance and able to avoid water from residue to absorb into the underground soil or layer beneath.

Figure 3.4: Stock pile of 2mm thick HDPE Liner Geomembrane in rolls

**2) Lapped cushion geotextile**

There were few steps taken before laid cushion geotextile or which specifically known as polyester needle punched non-woven geotextile were measured the proposed pond as shown in figure 3.5 using Distance Wheel Roller. The limit of cushion geotextile level was also marked to 400mm height using dumpy level by surveyor team as shown in figure 3.6. The geotextile laid work were done by area which was started from point A to point B and finally point C. This was purposely to allow the next arrangement and weld of delivered HDPE pipe on cushion geotextile layer as per as built-drawing specification ran simultaneously. Workers measured one point upon first delivery to the next delivery in order to fix the width and length of geotextile rolls thus the lap could be adjusted.

Figure 3.5: Measured area of DSF 2 Cell

Figure 3.6: Marked cushion geotextile limit

The Cushion geotextile were then laid by general workers and lapped not less than 500 mm onto one another as shown in figure 3.7. Cushion geotextile is a non-woven membrane delivered in 1200-meter square per roll with 6 mm thick as in Appendix D and punctures resistance texture which purposely laid as a separator to protect liner geomembrane from drainage material. Its tensile strength of 20 N/$m^2$ was proved long-lasting used in similar industry and flexible enough to support the load above including drainage materials and upcoming NUF residue.

Figure 3.7: General Workers laid Cushion Geotextile on HDPE liner

### 3) Jointed perforated HDPE pipe

HDPE pipe that had been used were 8 inches diameter for the main pipe and 6 inches diameter for radial pipe perforated with 12mm diameter holes at every 50mm measured illustrated in Appendix A on drilled pipe details and as shown in figure 3.8 below. The pipe should be strong enough to withstand the enormous pressure and weight from above.

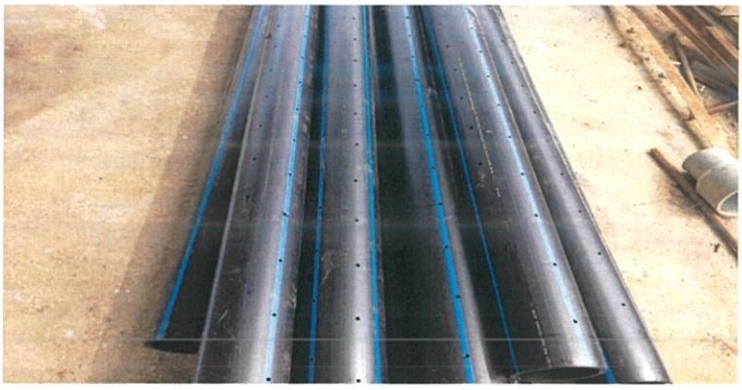


Figure 3.8: Fabricated Perforated Pipe

There were 789 meters HDPE pipe firstly laid on cushion geotextile as drawn in pink in Appendix A on the proposed leachate collection pipes layout. Afterward, the pipes were clamped end to end and jointed using HDPE Pipe Butt Fusion Machine which so-called butt fusion method as shown in figure 3.9 by a competent welder. The turning parts were jointed with fabricated pipe fittings like tee and elbow as shown in figure 3.10 and the end of every unconnected pipe installed with end cap as in figure 3.11. This method took up about 30 minutes for every fusion to completely jointed together which required about 170 hours with not less than 132 units of perforated HDPE pipe to be jointed.

Figure 3.9: Welders weld pipe using butt fusion method

Figure 3.10: Pipe fittings

Figure 3.11: Install End Cap at every end of HDPE Pipe

These perforated HDPE pipes were then wrapped with separator geotextile and secured with cable ties as shown in figure 3.12 which intentionally to obstruct sand particle from entered the pipe and cause a blockage. In the actual state, only leachate water drains from above through the drainage particle will passes into the pipe. The water will then flow through the pipeline follow the gravity. This was the reason why the pond structured like slope to be high from point A and the level lowered to the end of point C which the bund pump intake and screen is located to be the lowest part as in Appendix A. The leachate water inside the sump pit will then be remove or pump up to the treatment pond.

Figure 3.12: Pipe wrapped with geotextile and secured with cable ties

**4) Levelled drainage material**

Drainage material was coarse sand as details on item 3.2 sub-surface drainage sand shown in Appendix A. Coarse sand provide high surface area for rapid filtration rate thus effectively functioned to self-filter water from NUF residue before entering perforated HDPE pipe. Sand level were marked for 300 mm height to be filled up the pond using the dumpy level as shown in figure 3.13.

Figure 3.13: Sand level marked by survey team

Excavator spread sand as drainage material on geotextile upon material delivery by supplier as in figure 3.14 and figure 3.15 were general workers continued to level sand more precisely follow the marked level on the bund. This step was run concurrently with the HDPE pipe joint which required them to leave a 2-meter gap at proposed pipeline placement.

Figure 3.14: Coarse sand as drainage material

Figure 3.15: Sand manually levelled by general workers

The sand was compacted by roller compactor as in Figure 3.16 as to level the laid sand approximately 300 mm height and as proper view before handover process. When there were decreases at any part, the additional drainage material top up to reach the standardized level.

Figure 3.16: Sand compacted by Roller compactor

### 5) Lapped Separator Geotextile

Separator Geotextile laid onto drainage materials as in figure 3.17 before it was fully prepared for the dumping process. Separator geotextile thickness was less than Cushion Geotextile thickness which was 1.3 mm as shown in Appendix E simultaneously with its function as a separator between drainage material and NUF residue that will be dump onto it. NUF residue cannot be directly dumped on the sand as the particles between sand and NUF product along with water will cause these particles to attach among each other and clotted. This separator geotextile only allowed water to pass through and dried NUF residue remains in its layer which also prevents water clogged. By referring to the test result, the separator geotextile used can withstand 17.01 kN/m load which proved that it was strong enough to support tons of NUF residue dump onto it even with 1.3 mm thickness.

Figure 3.17: Laid separator geotextile

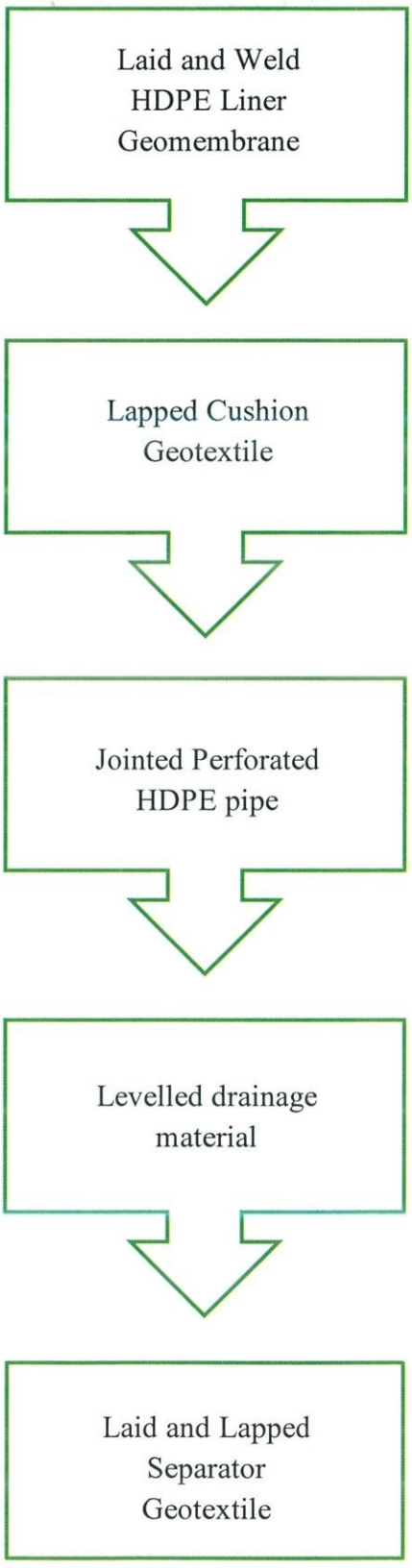



Figure 18: Step by step collection drain layering work

## 3.3 Safety features adopted in Leachate Water Collection Drain construction

1) Installation reflector lifeline along access ramp to proposed DSF 2 cell due to narrow space for machinery move in and out of the cell as in figure 3.19. It acts as an alert to the drivers of the ramp boundary. The proposed ramp at both point A and new ramp at point B were just next to dumping work machinery route thus, the ramp's width cannot be more than 6 meters due to the limited existing space.

Figure 3.19: Reflector installed along access ramp

2) Wearing additional personal protective equipment (PPE) with the requirement to wear yellow safety boots such as figure 3.20 due to soil settlement and watery site. It helps from the slippery incident and contaminated water entered the boots which might be caused by itchiness or any unwanted diseases. In additional, Leather gloves as in figure 3.21 were used specifically for workers who were in hot work scope such as HDPE pipe handling butt fusion machine. This was to avoid abrasion with the thermal issue from the high-temperature machine directly or indirectly contact the worker's hands.

Figure 3.20: Yellow safety boots

Figure 3.21: Leather gloves

3) Radiation badge or personnel dosimetry as in figure 3.22 provided by LAMP Safety and Health personnel to whoever exposed with radiation work or worked in the radiation area as Leachate Water Collection Drain project was near to Water Leachate Purification (WLP) dumping area and monitoring pond. These workers were likely to risk received slightly ionizing radiation recorded by the badge. It shows the quantity of dose both internally, due to inhaled radioactive substances and externally due to irradiation the workers took-up from measurement with a variety of indicators in their laboratory. However, the radiation level recorded for these workers per month were roughly not more than 0.08 millisievert (mSv).


Figure 3.22: Radiation badge

4) Before started working inside Lynas' plant, a person either working for Lynas or under contractor must went for an induction session with Lynas safety personnel to get an excess pass. They were exposed to what to do and not to do once entering the plant with all the requirements restricted to follow especially on personal protective equipment. They were warned with a penalty for whoever disobey the rules enshrined. The construction team were having toolbox every morning as in photo 3.23 before started working accordingly to remind all the workers to work safely with the scope of work and any related issue to be discussed. The toolbox was also a medium for safety pass to highlight any important issue to be taken as a good example or to be corrected.

Photo 3.23: Morning Toolbox

5) Permit to Work system (PTW) for both hot work and cool work was an approval pass to show that any work ran in the project were approved as per completed Job Hazard Analysis (JHA) submitted. PTW is a system used in LAMP as an approvement that particular scope of work was permitted to be done in the plant area. It needs to be renewed by safety personnel as in Figure 3.24 every 12 hours before start working which means to be at 7 in the morning and 7 at night. There were few divisions in LAMP and this proposed project was under Outside Utility Room (OUR) as an owner area. To request the PTW, JPR safety personnel need to prepare a complete JHA which were then revised and reviewed by OUR Lynas supervisor to be approved by their superintendent. JHA contains all the work steps, hazards expected to occur accordingly and safety measures to be taken as prevention. The approved JHA will entitle the contractor to apply a Master Permit to Work due to our scope of work as in Figure 3.25. Work can then be done with briefing the JHA on-site before starting work.

Figure 3.24: Renewed permit

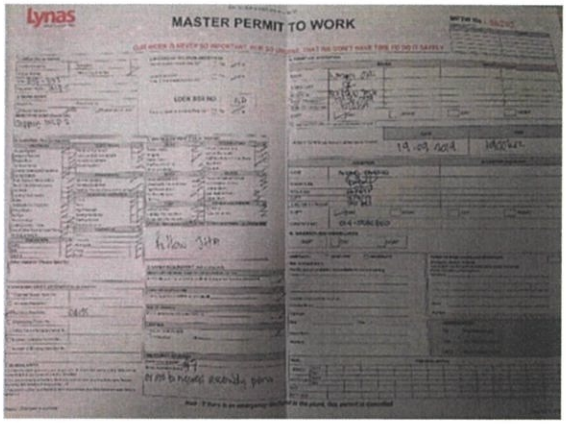



Figure 3.25: Master PTW

6) Signage set up where required in the proposed site to alert everyone passed by of the ongoing construction as in figure 3.26 below.


Figure 3.26: General worker set up signage at workplace

These were type of signages set up onsite:

## REFERENCES

**Web Site:**

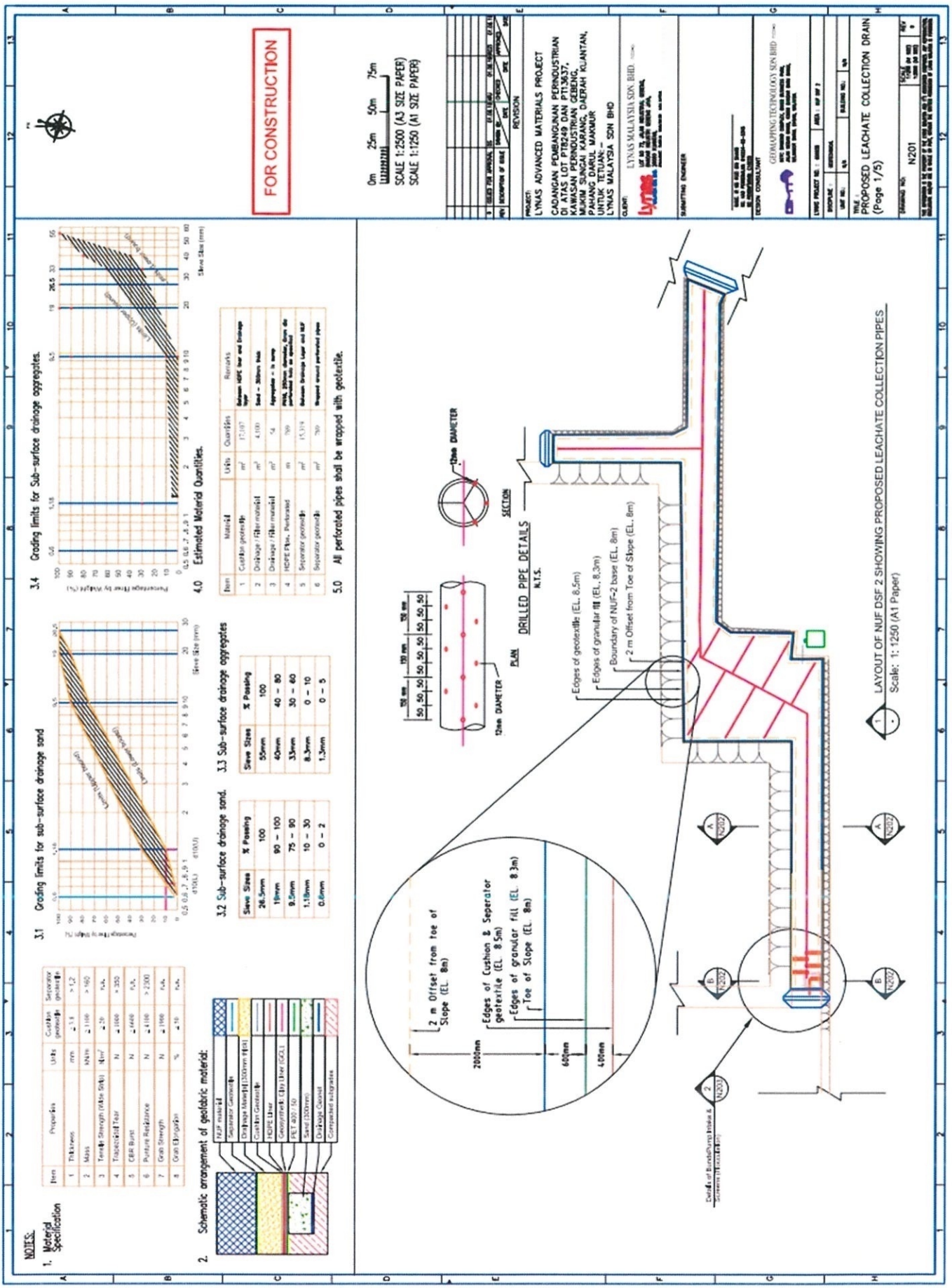
Leachate. (2019, November 18). In *Wikipedia, The Free Encyclopedia*. Retrieved 04:21, November 26, 2019, from https://en.wikipedia.org/w/index.php?title=Leachate&oldid=926761893

Manassero, M, Benson, C.H, Bouazza, A. (2015, August) "SOLID WASTE CONTAINMENT SYSTEMS". Retrived from https://www.researchgate.net/publication/265432087_Solid_waste_containment_system

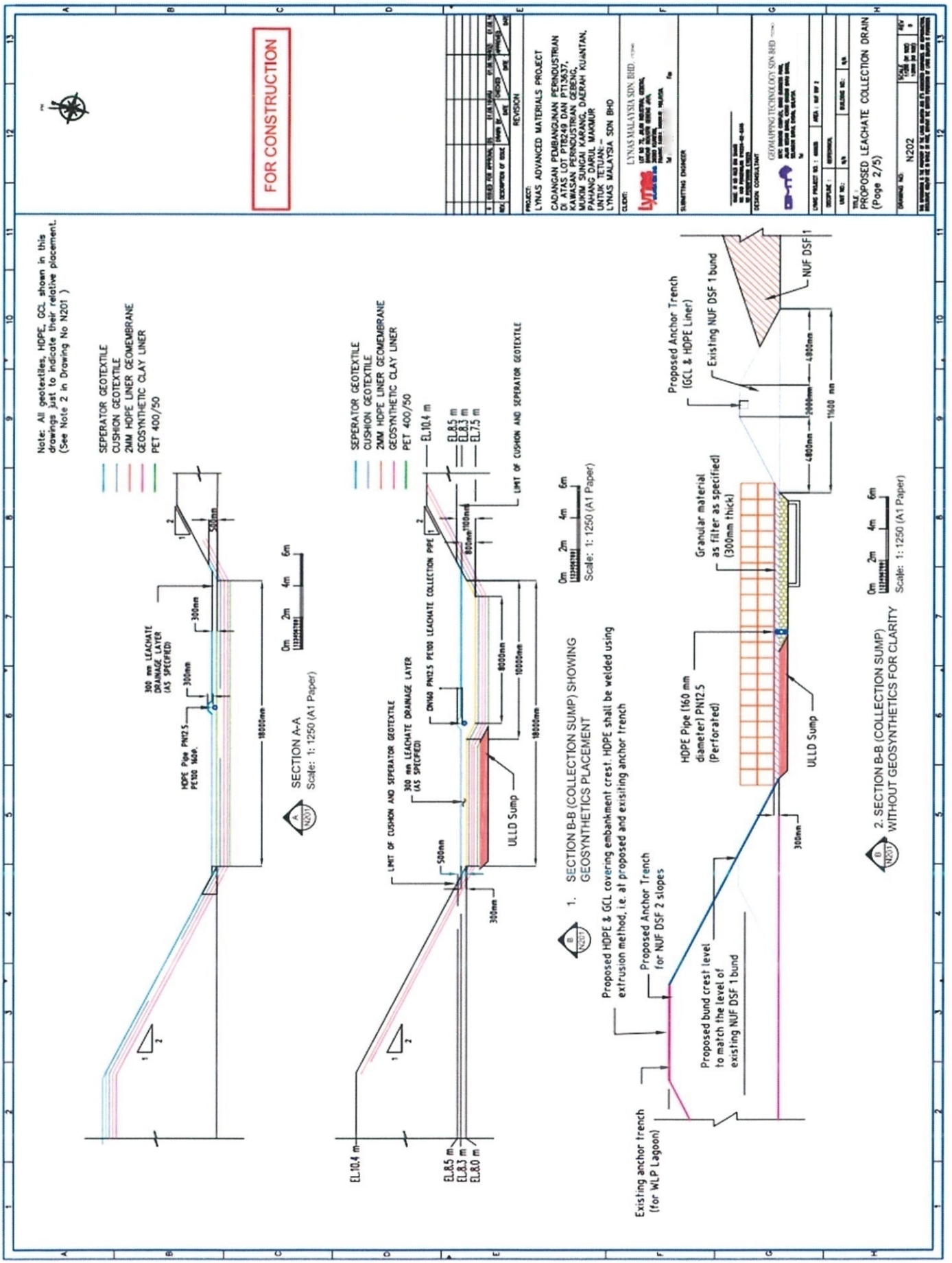
Kolbasuk, G.M. (2016, October) "Hot wedge fusion welding of HDPE geomembranes". Retrived from https://www.sciencedirect.com/science/article/abs/pii/026611449090020D

# APPENDICES

Appendix A


NOTES:
1. Material Specification
2. Schematic arrangement of geolbric material:
3.1 Grading limits for sub-surface drainage sand
3.2 Sub-surface drainage sand.
3.3 Sub-surface drainage aggregates
3.4 Grading limits for Sub-surface drainage aggregates.
4.0 Estimated Material Quantities.
5.0 All perforated pipes shall be wrapped with geotextile.
DRILLED PIPE DETAILS
N.T.S.
SECTION
PLAN
12mm DIAMETER
150 mm
50,50,50,50,50,50,50
2 m Offset from toe of Slope (EL. 8m)
Edges of Cushion & Seperator geotextile (EL. 8.5m)
Edges of granular fill (EL. 8.3m)
Toe of Slope (EL. 8m)
2000mm
650mm
450mm
Edges of geotextile (EL. 8.5m)
Edges of granular fill (EL. 8.3m)
Boundary of NUF-2 base (EL. 8m)
2 m Offset from Toe of Slope (EL. 8m)
1 LAYOUT OF NUF DSF 2 SHOWING PROPOSED LEACHATE COLLECTION PIPES
Scale: 1: 1250 (A1 Paper)
FOR CONSTRUCTION
0m 25m 50m 75m
SCALE 1:2500 (A3 SIZE PAPER)
SCALE 1:1250 (A1 SIZE PAPER)
PROJECT:
LYNAS ADVANCED MATERIALS PROJECT
CADANGAN PEMBANGUNAN PERINDUSTRIAN DI ATAS LOT PT8249 DAN PT13637, KAWASAN PERINDUSTRIAN GEBENG, PAHANG DARUL MAKMUR
UNTUK TETUAN:- LYNAS MALAYSIA SDN BHD
CLIENT:
LYNAS MALAYSIA SDN. BHD.
SUBMITTING ENGINEER
GEOMATPING TECHNOLOGY SDN BHD
TITLE:
PROPOSED LEACHATE COLLECTION DRAIN
(Page 1/5)
DRAWING NO:
N201

Appendix B


FOR CONSTRUCTION
Note: All geotextiles, HDPE, GCL shown in this drawings just to indicate their relative placement. (See Note 2 in Drawing No N201 )
SEPERATOR GEOTEXTILE
CUSHION GEOTEXTILE
2MM HDPE LINER GEOMEMBRANE
GEOSYNTHETIC CLAY LINER
PET 400/50
300 mm LEACHATE DRAINAGE LAYER (AS SPECIFIED)
HDPE Pipe PN12.5 PE100 160A.
SECTION A-A
Scale: 1: 1250 (A1 Paper)
LIMIT OF CUSHION AND SEPERATOR GEOTEXTILE
DN160 PN12.5 PE100 LEACHATE COLLECTION PIPE
EL.10.4 m
EL.8.5 m
EL.8.3 m
EL.7.5 m
EL.8.0 m
ULLD Sump
1. SECTION B-B (COLLECTION SUMP) SHOWING GEOSYNTHETICS PLACEMENT
Scale: 1: 1250 (A1 Paper)
Proposed HDPE & GCL covering embankment crest. HDPE shall be welded using extrusion method, i.e. at proposed and existing anchor trench
Proposed Anchor Trench for NUF DSF 2 slopes
Existing anchor trench (for WLP Lagoon)
Proposed bund crest level to match the level of existing NUF DSF 1 bund
Granular material as filter as specified (300mm thick)
HDPE Pipe (160 mm diameter) PN12.5 (Perforated)
Proposed Anchor Trench (GCL & HDPE Liner)
Existing NUF DSF 1 bund
NUF DSF1
2. SECTION B-B (COLLECTION SUMP) WITHOUT GEOSYNTHETICS FOR CLARITY
Scale: 1: 1250 (A1 Paper)
PROJECT:
LYNAS ADVANCED MATERIALS PROJECT
CADANGAN PEMBANGUNAN PERINDUSTRIAN DI ATAS LOT PTB249 DAN PT13637, KAWASAN PERINDUSTRIAN GEBENG, MUKIM SUNGAI KARANG, DAERAH KUANTAN, PAHANG DARUL MAKMUR
UNTUK TETUAN:-
LYNAS MALAYSIA SDN BHD
CLIENT:
LYNAS MALAYSIA SDN. BHD.
SUBMITTING ENGINEER
DESIGN CONSULTANT
GEOMAPPING TECHNOLOGY SDN BHD
TITLE:
PROPOSED LEACHATE COLLECTION DRAIN (Page 2/5)
DRAWING NO:
N202

Appendix C

SOLMAX

# TECHNICAL DATA SHEET

## HDPE Series, 2.00 mm

Conductive, Textured

Lot 28, Jalan Sungai Pinang 4/2 Taman Perindustrian Pulau Indah, Fasa 2B 42920 Pelabuhan Klang, Selangor Darul Ehsan
Tel.: Fax: www.solmax.com

| PROPERTY | TEST METHOD | FREQUENCY[1] | UNIT Metric | 5026862 |
|---|---|---|---|---|
| **SPECIFICATIONS** | | | | |
| Nominal Thickness | | - | mm | 2.00 |
| Thickness (min. avg.) | ASTM D5994 | Every roll | mm | 1.90 |
| Lowest ind. for 8 out of 10 values | | | mm | 1.80 |
| Lowest ind. for 10 out of 10 values | | | mm | 1.70 |
| Asperity Height (min. avg.) (3) | ASTM D7466 | Every roll | mm | 0.40 |
| Melt Index - 190/2.16 (max.) | ASTM D1238 | 1/Batch | g/10 min | 1.0 |
| Sheet Density (8) | ASTM D792 | Every 10 rolls | g/cc | ≥ 0.940 |
| Carbon Black Content (9) | ASTM D4218 | Every 2 rolls | % | 2.0 - 3.0 |
| Carbon Black Dispersion | ASTM D5596 | Every 10 rolls | Category | Cat. 1 / Cat. 2 |
| OIT - standard (avg.)(6) | ASTM D3895 | Per formulation | min | 100 |
| Tensile Properties (min. avg) (2) | ASTM D6693 | Every 2 rolls | | |
| Strength at Yield | | | kN/m | 31 |
| Elongation at Yield | | | % | 13 |
| Strength at Break | | | kN/m | 31 |
| Elongation at Break | | | % | 150 |
| Tear Resistance (min. avg.) | ASTM D1004 | Every 5 rolls | N | 265 |
| Puncture Resistance (min. avg.) | ASTM D4833 | Every 5 rolls | N | 675 |
| Dimensional Stability | ASTM D1204 | Certified | % | ± 2 |
| Stress Crack Resistance (SP-NCTL) | ASTM D5397 | 1/Batch | hr | 500 |
| Oven Aging - % retained after 90 days | ASTM D5721 | Per formulation | | |
| HP OIT (min. avg.) | ASTM D5885 | | % | 80 |
| UV Res. - % retained after 1600 hr | ASTM D7238 | Per formulation | | |
| HP-OIT (min. avg.) | ASTM D5885 | | % | 50 |
| Low Temperature Brittleness | ASTM D746 | Certified | °C | - 77 |
| **SUPPLY SPECIFICATIONS** (Roll dimensions may vary ±1%) | | | | |
| Roll Dimension - Width | | | m | 7.50 |
| Roll Dimension - Length | | | m | 105.0 |
| Area (Surface/Roll) | | | m² | 787.5 |
| Application (10) | | - | - | Conductive |

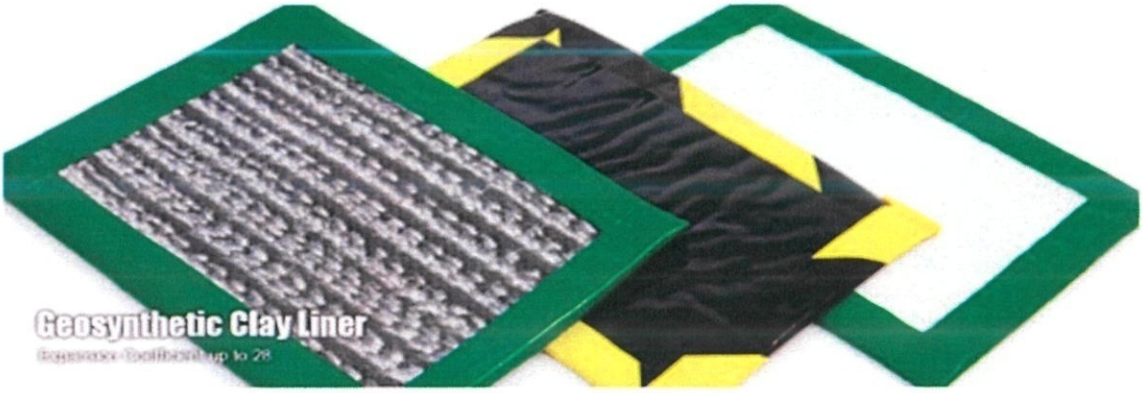
Appendix D

# fibromat®

EROSION CONTROL | GEOSYNTHETIC

Fibromat (GCL) made from two layer Geotextile with natural sodium in the centre.
Geotextile: one layer is Woven geotextile, another is Non woven geotextile.
It's Swell when meet water, long time waterproofing and friendly to environment.
Has Separation, reinforcement, protection, filtration etc function, and easy for construction.

| Item | | Unit | Value |
|---|---|---|---|
| GCL Mass / unit area | | G/M2 | ≥4000 |
| Tensile Strength | MD | KN/M | ≥10 |
| | CD | | ≥10 |
| Peel Strength | MD | N/100MM | ≥60 |
| | CD | | ≥60 |
| CBR | | KN/M | 1.3 |
| Pesistance hydraulic pressure | | M/S | $\leqslant 1.0 \times 10^{-11}$ |
| Resistance hydraulic pressure | | 0.4Mpa 1h no leakage | ≥0.6 |
| Swell Index | | ML/2G | ≥24 |
| Fluid Loss | | ML | ≤17 |
| Water absorption Rate Of Bentonite | | % | ≥600 |
| Nonwoven Geotextile Mass | | G/M2 | 200 |
| Woven Geotextile Mass | | G/M2 | 120 |
| Thickness | | mm | 6 |




**MTS FIBROMAT (M) SDN. BHD.**
(Co. No. 491502-K) SST No : W10 - 1809 - 22200051
No. 574 A, B & C, Jalan Samudra Utara 1, Taman Samudra,
68100 Batu Caves, Selangor Darul Ehsan, Malaysia.
Tel : Fax :
Email : enquiry@fibromat.com.my Web : www.fibromat.com.my

Appendix E

# R&D AND LABORATORY
# MTS FIBROMAT (M) SDN BHD

Lot 2&4, Jalan Zurah 4, Kawasan Perindustrian Zurah, Mukim Rasa,
44200 Hulu Selangor , Selangor.
Website : www.fibromat.com.my

MS ISO/IEC 17025
TESTING
SAMM NO. 904

## TEST RESULT

Part Name : MTS 200
Roll No / Batch No : -
Report No : TR-19032

Date : 11-Jul-19
Page : 2 of 2

| NO | TEST ITEM | STANDARD | UNIT | TEST RESULT | SPECIFICATION |
|---|---|---|---|---|---|
| 1 | Mass Per Unit Area | ASTM D5261 | g/m² | 215.99 | 200 |
| 2 | Thickness | ASTM D5199 | mm | 1.34 | 1.29 |
| 3 | Tensile Strength - MD | ASTM D4595 | kN/m | 15.67 | 15.1 |
| | Elongation - MD | | % | 74.97 | 64 |
| | Tensile Strength - CD | | kN/m | 17.01 | 16.3 |
| | Elongation - CD | | % | 88.08 | 80 |
| 4 | CBR Puncture Resistance | ASTM D6241 | N | 2425 | 2350 |
| 5 | Trapezoidal Tear Strength - MD | ASTM D4533 | N | 426.6 | 370 |
| | Trapezoidal Tear Strength - CD | | | 360.6 | 300 |
| 6 | Index Puncture Resistance | ASTM D4833 | N | 546.8 | 500 |
| 7 | Grab Strength - MD | ASTM D4632 | N | 873.7 | 810 |
| | Grab Strength - CD | | N | 1028.7 | 925 |
| 8 | Water Permeability - 50 WH | ASTM D4491 | l/m²/s | 71.4 | 70 |
| 9 | Apparent Opening Size $O^{95}$ | ASTM D4751 | µm | 90, 0.4% passing | 90, <5% passing |