

Number: 047 A /UN7.F3.6.8.TL/DL/IX/2025

048 A /UN7.F3.6.8.TL/DL/IX/2025

UNDERGRADUATE THESIS

**DESIGN AND PLANNING OF A 3R WASTE PROCESSING SITE (3RWPS)
FOR SUSTAINABLE WASTE MANAGEMENT IN WEST SEMARANG
SUB-DISTRICT**



Arranged by:

Inas Haida Yusfi

21080122130073

Muhammad Miqdad Husaini

21080122140153

**DEPARTMENT OF ENVIRONMENTAL ENGINEERING
FACULTY OF ENGINEERING
DIPONEGORO UNIVERSITY**

2025

HALAMAN PENGESAHAN

Skripsi ini diajukan oleh :
NAMA : Inas Haida Yusfi
NIM : 21080122130073
Jurusan/Departemen : Teknik Lingkungan Fakultas Teknik Undip
Judul Skripsi : Design and Planning of A 3R Waste Processing Site (3RWPS)
for Sustainable Waste Management in West Semarang Sub-District

Telah berhasil dipertahankan di hadapan Tim Penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar Sarjana pada Departemen Teknik Lingkungan, Fakultas Teknik, Universitas Diponegoro.

Pembimbing I:

Prof. Ir. Mochamad Arief Budihardjo, S.T., M.Eng.Sc, Env.Eng,
Ph.D., IPU., ASEAN Eng.
197409302001121002



Pembimbing II:

Dr.Eng. Ir. Bimastyaji Surya Ramadan, S.T., M.T. IPM
199203242019031016



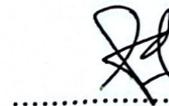
Ketua Penguji:

Ir. Pertiwi Andarani, S.T., M.T., M.Eng., Ph.D., IPM
198704202014012001



Anggota Penguji:

Ir. Ganjar Samudro, S.T., M.T., Ph.D., IPM
198201202008011005



Semarang, 17 Desember 2025
Program Studi Teknik Lingkungan
Fakultas Teknik Undip
Ketua



Prof. Dr. Ir. Badri Zaman, S.T., M.T., IPM., ASEAN Eng.
NIP. 197208302008011001

HALAMAN PENGESAHAN

Skripsi ini diajukan oleh :

NAMA : Muhammad Miqdad Husaini
NIM : 21080122140153
Jurusan/Departemen : Teknik Lingkungan Fakultas Teknik Undip
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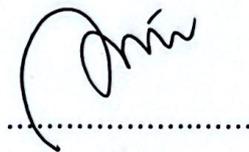
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199203242019031016



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Prof. Ir. Mochamad Arief Budihardjo, S.T., M.Eng.Sc, Env.Eng,
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198704202014012001



Semarang, 17 Desember 2025
Program Studi Teknik Lingkungan
Fakultas Teknik Undip
Ketua



Prof. Dr. Ir. Badriyanto, S.T., M.T., IPM., ASEAN Eng.
NIP. 197208302000031001

ABSTRACT

West Semarang sub-district currently lacks adequate waste processing facilities, with Temporary Waste Collection (*TPS*) serving only as initial collection points before waste is transported to the final disposal site (*TPA*). This final project aims to analyze the existing waste management conditions in West Semarang sub-district as a basis for planning a 3RWPS, which is expected to improve community waste management. The methods used include sampling based on SNI 3964:2025 and the Waste Wise Cities Tools Guidebook, Material Flow Analysis, and Simple Additive Weighting (SAW) for determining organic waste treatment. The planned 3RWPS is designed to process organic waste through composting and fermentation, and inorganic waste through a pyrolysis machine, with a capacity of 19.4 tons/day, resulting in only 10.47% of the total waste ending up in the landfill. The required investment is IDR 6,752,239,600, and management is planned to be carried out by the Karang Taruna of West Semarang sub-district, particularly in Tambakharjo Village. The proposed plan is expected to serve as an initial step toward more sustainable waste management in this sub-district.

Keywords: Waste Treatment; 3R Waste Processing Site; Bamboo Aerator;
Pyrolysis

CHAPTER I

INTRODUCTION

1.1 Background

Waste management constitutes one of the most critical urban challenges in Indonesia, as inadequate systems not only undermine environmental sustainability but also directly endanger public health and urban livability. According to the Indonesian National Standard (SNI 13-1990-F), urban waste is defined as non-hazardous solid residues generated from urban activities. However, the persistence of environmentally detrimental “open dumping” practices reflects a significant discrepancy between regulatory frameworks and actual implementation. Despite governmental interventions, such as Presidential Regulation No. 97 of 2017 which mandates waste processing before final disposal and promotes the establishment of 3R (Reduce, Reuse, Recycle) facilities, the rate of adoption remains limited, thereby constraining the policy’s intended outcomes in extending landfill lifespan and fostering behavioral change towards sustainable waste management (Mela, et al., 2024).

The case of Semarang exemplifies systemic challenges in urban waste management. With a population of 1,703,833 in 2024 and an annual growth rate of 0.88% (Badan Pusat Statistik, 2025), the city’s waste generation increased from 431,534.65 tons in 2023 to 434,243.97 tons in 2024 (SIPSN, 2024). The city’s waste composition is dominated by organic waste, reaching about 61%, while the remaining 39% consists of inorganic waste (SIPSN, 2024). This composition not only reflects consumption patterns but also presents challenges for effective treatment, particularly when most of the waste ends up in a single final disposal site. Semarang City depends on the Jatibarang Landfill, which receives about 1,200 tons of waste daily. Most of this waste is disposed of using the environmentally harmful "open dumping" method, resulting in overcapacity and escalating environmental risks as the landfill has reached its maximum capacity (Ranita Ivana, 2025). Such reliance on outdated disposal practices underscores structural deficiencies in Semarang’s waste governance system.

A more localized example can be seen in West Semarang, one of the sub-districts with the highest number of villages in the city. Despite its size, the area faces pressing waste management issues, including limited WPS facilities, insufficient transport vehicles, and minimal community participation in 3R (Reduce, Reuse, Recycle) programs. The absence of an 3R Waste Processing Facility (3RWPS) in this sub-district has led to waste accumulation in several areas, thereby posing threats to both the environment and public health (Rahmawati, 2023). Consequently, waste management in the sub-district remains entirely dependent on an inefficient "collect-transport-dispose" model. With no segregation at the source, the volume of waste transported to the Jatibarang landfill is maximized. This situation highlights the urgent need for a decentralized processing facility to intercept the waste stream before it reaches the landfill.

1.2 Problem Identification

The challenges encountered in waste management in West Semarang sub-district, include:

1. The Jatibarang Landfill has exceeded its operational capacity, which significantly increasing environmental risks, such as landslides and waste contamination;
2. The absence of 3RWPS causes waste to remain unprocessed and be directly disposed of in landfills.
3. The positive correlation between population growth and waste production has not been accompanied by a high level of public awareness and participation in waste management.

1.3 Problem Limitation

The scope of this final project has been narrowed to ensure the planning remains focused on specific topics and stays within defined boundaries. The problem formulation for this planning are:

1. This planning focuses on domestic and non-domestic waste processing and the study area is limited to administrative region of West Semarang sub-district.
2. Calculation of waste generation volume and composition produced by the community, including projections of waste generation up to the year 2035, with

sampling methods conducted in accordance with SNI 3964-2025 and waste wise cities tools.

3. The data required included primary data obtained through sampling, interviews, and questionnaires, as well as secondary data obtained from government agencies in the field of waste management
4. Planning a 3R Waste Processing site (3RWPS) based on pyrolysis and composting technology.
5. Cost Budget Plan (*RAB*) starting from the construction, operation, and maintenance of 3R waste processing site

1.4 Conceptualization of Problems, Goals, and Benefits

1.4.1 Problem Conceptualization

Based on the problem identification described above, the problem conceptualization can be described as follows.

- a. How is the existing waste processing conditions in West Semarang Sub-District?
- b. What is the potential reduction in waste generation that can be achieved through the implementation of the proposed 3R Waste Processing Site?
- c. Which organic waste processing method is most suitable for the existing conditions in West Semarang Sub-district?
- d. What financial management strategies can be used to support the operational sustainability of 3RWPS?
- e. How to plan the construction and location of the 3R Waste Treatment Site using the chosen method?

1.4.2 Goals Conceptualization

Based on the problem conceptualization described above, the goals conceptualization can be described as follows.

- a. Analyzing the existing condition of domestic and non-domestic waste in West Semarang sub-district, including the characteristics, waste generation, and waste treatment.

- b. Estimating the potential reduction in waste generation resulting from the implementation of the proposed waste processing facility through Material Flow Analysis (MFA).
- c. Analyzing the most suitable treatment for organic waste in West Semarang sub-district using Simple Additive Weight (SAW).
- d. Identifying and formulating financial management strategies to support the operational sustainability of 3RWPS.
- e. Planning the construction and location of the 3R Waste Processing Site using the chosen method.

1.4.3 Benefits Conceptualization

The benefits of this planning are as follows

- a. For The Author/Planner
 - a. To expand knowledge, insight, skills, and character through an implemented study by planning and developing an 3R Waste Processing Facility (3RWPS)
 - b. Allows the author to implement concepts and theories gained by academic studies into practical planning
 - c. To fulfill the requirements of the Final Project course in The Environmental Engineering Study Program, Faculty of Engineering, Universitas Diponegoro
- b. For The Government
 - a. The results of this planning study can be used by the government or related institution consideration for building a waste processing facility, including optimization of the waste management system in West Semarang Sub-district to fix their waste problems.
- c. For The People of West Semarang Sub-district
 - a. Reduce the impact of environmental pollution caused by waste
 - b. Provide information or description about the provision of waste management facilities in an effort to handle waste within the community.

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