CHAPTER 4

PROJECT OPTIONS

4.0 Introduction

This chapter presents the projection options of the proposed development of new clinical waste thermal treatment plant at Tanjung Langsat, Johor by Southern Medi One Sdn. Bhd. (SMOSB). Project options include the advantages and disadvantages of the proposed project from the perspective of technical, economical and operational point of view. In this chapter, various projects options including site option, technology option, waste management option and no project option are further examined.

4.1 Project Options

This section outlines the available project options to address issues on the increasing trend in the generation of clinical wastes. Then, justifications for selecting the proposed project as the most suitable project option are presented. The various project options being considered and evaluated were as follows:

Option 1: Site Option
Option 2: Technology Option
Option 3: No Project Option

4.1.1 Option 1: Site Option

The project site is currently a cleared land. If no development is undertaken, the existing cleared land will be maintained. With development, the proposed project site will be converted into a well – planned industrial area.

The project site is zoned as industrial area under Johor Bahru and Kulai District Local Plan, 2025. In terms of the planning aspect, the proposed development of clinical waste thermal treatment plant is not contradicted with development planning zone by the Pasir Gudang Municipal Council and the State of Johor.

Based on the studies carried out by the project proponent, it was deducted that the proposed project is compatible with its surrounding land use and as such can be successfully integrated into the existing surrounding land use. The factors in favour of the proposed site and development from a commercial and planning perspective are as follows:-

In general, the site location usually takes into account the followings:

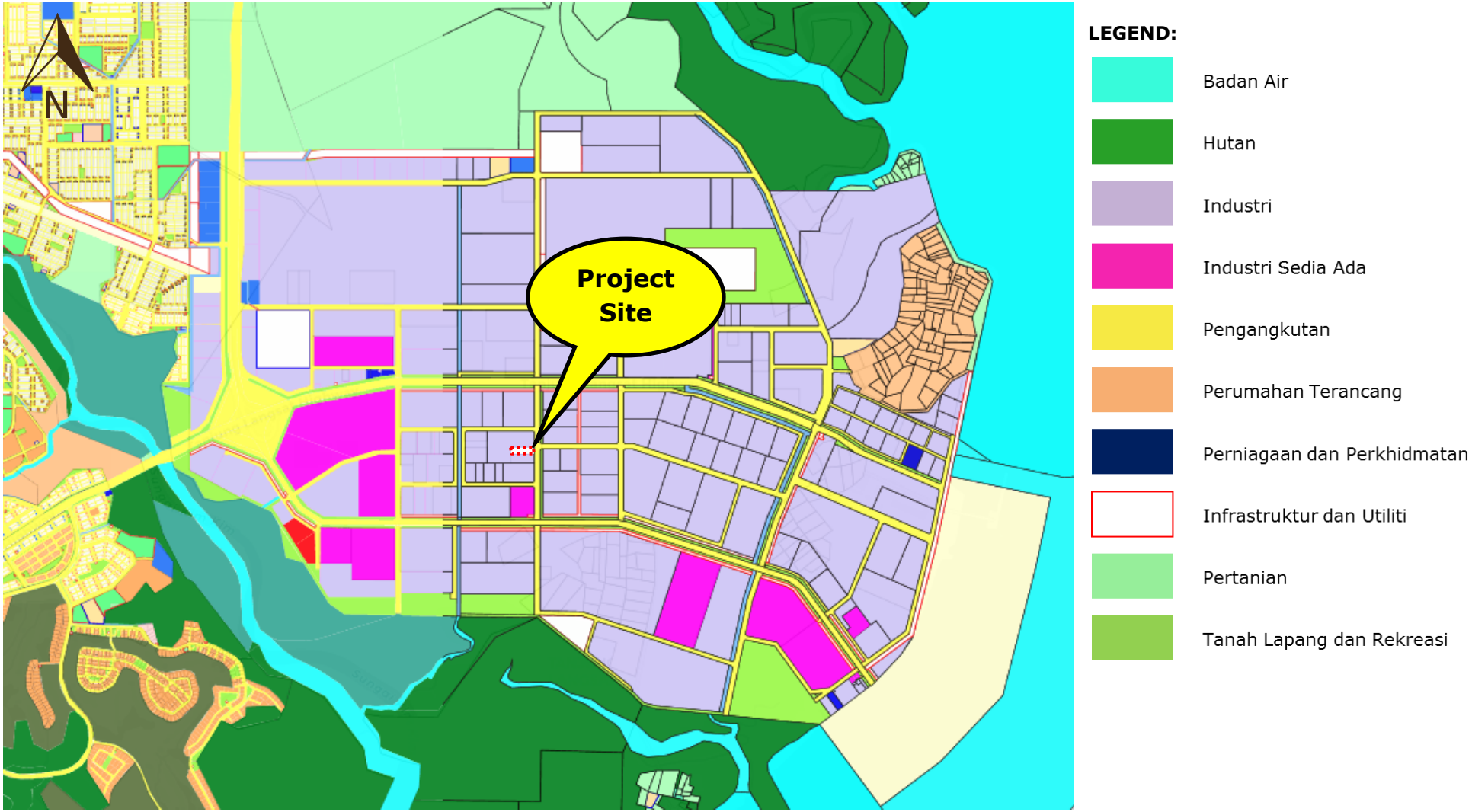
i. Availability of land, its size and location suitability for the proposed project development; and
ii. Policy of the state on supporting the development (i.e. infrastructure, tax structure, land ownership and acquisition process and etc.)

State is the land's owner who governs the policy with regards to the use of land within the state. Thus, it is important that siting any development must be in tandem with the State's development plan in place as in the case of the proposed project.

Appendix 4.A presents the land title document of the proposed project site. Currently, the project proponent is in progress purchasing the land from the owner with the reference of agreement as attached in **Appendix 4.B**. The power of attorney is presented in **Appendix 4.C**. The existing land is been gazetted for industrial activities as shown in **Figure 4.1** for land use map. The proposed project site will be sited on 0.809 hectares (2 acres) on part of PT 4865, in Tanjung Langsat, Mukim Sungai Tiram, District of Johor bahru, Johor.

In short, Tanjung Langsat was considered to be the most suitable site for the proposed clinical waste thermal treatment plan. Several important criteria in selecting Tanjung Langsat as the site are as follows:

a) The proposed site is available for the proposed development works;
b) The location indeed is considered ad convenient and accessible for the transportation of clinical waste in southern region in Peninsular Malaysia;
c) The land use is compatible for the intended development of clinical waste thermal treatment plant since the land zoning have sufficient buffer from the nearby residential as the nearest residential areas is located more than 2 km from the project site; and
d) Installation of new clinical thermal treatment plant at Tanjung Langsat will assist the private health care services by providing a venue for the treatment and disposal of clinical waste.



Source: http://geoportal.johor.gov.my/, PLAN Malaysia@Johor

Figure 4.1: Location of Proposed Project Site (in Land Use Map)

4.1.1.1 Siting Criteria

Proper siting of thermal treatment plant as the main scheduled waste management facility will prevent negative effects on the environment as well as the risks to human health arising from treatment of scheduled waste. In addition, it is essential that standards method of operation based on the best current practices in the management of scheduled waste treatment and storage is adhered for better protection of the environment and human health.

As in the case of the proposed project, important site selection criteria have been taken into consideration in the initial screening process. Both the environmental and social or public welfare are the dominant factors in the selection process.

The details of the siting criteria for the proposed clinical waste thermal treatment plant are categorized into four (4) main aspects as below; and shown in **Table 4.1**.

i. Size, physical and land use;
ii. Environmental constraints;
iii. Economic constraints; and
iv. Social constraints.

Table 4.1: Criteria and Parameters in Site Selection

No.	Considerations	Criteria
1.	**Size, Physical and Land Use**	
	a) Size including any potential expansion area.	The total area of the proposed project is 0.809 hectares.
	b) Compatibility of land use.	The project site has been zoned as industrial by Johor Bahru and Kulai District Local Plan, 2025.
	c) Away from densely populated areas.	The nearest residential area is Kampung Perigi Acheh and Kampung Tanjung Langsat located approximately 2.8 km and 2.6 km away at the North and Northeast and Southeast of the proposed project site.
	d) Away from abstraction points in the catchment areas.	There is no water catchment area located upstream and downstream of the project site.
	e) Away from rivers and swamp.	The proposed project site is drained by a small stream to Sungai Perawan and Sungai Kopok only and directed to the sea. Potentially monsoon drain and may appear during the event of rainfall only.
2.	**Environmental Constraints**	
	a) Avoidance of unique habitat, ecological value or scenic beauty areas.	There is no environmental constrains for the proposed project since the location of the project is in industrial area.

Table 4.1: Criteria and Parameters in Site Selection

No.	Considerations	Criteria
3.	**Economic Constraints**	
	a) Distance to be less than half day travel by lorries to the site	The waste transporting would not take more than half a day since the site has a good road network.
	b) Minimal transportation costs	The transportation costs to the proposed project site should be relatively low as the routes to the sites are accessible.
4.	**Social Constraints**	
	a) Land preferably government owned	The proposed project site is under the ownership of Southern Medi One Sdn. Bhd. (SMOSB).
	b) Distance from major settlements	The residential areas are located from 2 – 3 km from the proposed project site.
	c) Distance from public facilities	The public facilities such as schools, hospitals or clinics and mosque are located within 2 – 5 km from the proposed project site.

4.1.2 Option 2: Technology Option

There are two (2) major clinical waste treatment technologies – thermal treatment and non – thermal treatment technologies. Thermal technology refers to the high temperature treatment technologies and non – thermal technology refers to the low temperature heat treatment, chemical processing technology, radiation processing technology and biological treatment technologies.

Thermal treatment technologies;

- Incineration;
- Gasification; and
- Pyrolysis.

Non-thermal treatment technologies;

- Autoclave;
- Microwaves; and
- Chemical disinfection.

All of the above options are possible solutions. However, there are differences between these treatment options in terms of three (3) main aspects i.e. technical, environmental and regulatory requirement criteria. Selecting the right option for treatment of clinical waste is governed by these main criteria.

The superiority of the thermal treatment method over all other treatment methods for the disposal of clinical waste is well documented and in most cases met the above three (3) main criteria. The thermal treatment has many advantages compared to other methods due to the:

- Fast detoxification process;
- Inert or stabilised end products;
- Tremendous mass and volume reduction; and
- Option for energy or steam recovery.

Table 4.2 shows the advantage and disadvantages of clinical waste treatment options available.

Table 4.2: Advantages and Disadvantages of Clinical Waste Treatment Options

Type of Treatment	Advantages	Disadvantages
Thermal Treatment	• Involved direct combustion thus aim at the reduction of the waste volume • Convert waste into harmless materials and the utilization of the energy that is hidden within waste as heat, steam, electrical energy or combustible material • Reducing the volume of waste into ash and the ability to dispose recognizable waste and sharps	• Largest concern is **pollution** i.e. air, water and noise pollution • **Operation cost** is at higher end since it require high temperature in order to ensure all harmful material completely destroyed and additional investment for flue gas treatment and water treatment
Autoclave	Can be used to process up to 90% of clinical waste and are easily scaled to meet the needs of any medical organization	Waste that is treated using an autoclave is still recognizable after treatment, and therefore must be shredded after treatment to allow for disposal with general waste
	Low capital cost	• Autoclaves are not recommended for the treatment of pathological waste, due to the recognisability factor after treatment, and that pathological waste may contain low levels of radioactive material or cytotoxic compounds • No volume or mass reduction in waste
Microwave Disinfection	Absence of liquid discharge	• Not suitable for all waste types • No significant volume reduction
	Rapid processing	• High investment cost • Require significant space to accommodate waste • No volume or mass reduction waste
Chemical Disinfection	Well known and widely being used	• High investment cost • Dealing with chemical, primarily chlorine products • No volume or mass reduction waste

Based on the above table, none of the non-thermal technologies i.e. autoclave, microwave and chemical disinfection is capable of providing the listed advantages above compared to those of thermal treatment option.

In order to narrow down the best available Thermal Treatment Technology to be adopted, the Best Available Techniques (BAT) Guidance Document on Waste Incinerator shown in **Table 4.2** issued by Department of Environment is used.

Table 4.3: Summary of the Current Successful Application of Thermal Treatment Techniques to the Main Waste Types at Dedicated Installations

Technique	Untreated Municipal Waste	Pre-treated MSW and RDF	Hazardous Waste	Clinical Waste
Grate - Reciprocating	Wide applied	Applied	Not normally applied	Applied
Grate - Traveling	Applied	Applied	Rarely applied	Applied
Grate - Rocking	Applied	Applied	Rarely applied	Applied
Grate - Roller	Applied	Applied	Rarely applied	Applied
Grate - Water Cooled	Applied	Applied	Rarely applied	Applied
Grate plus rotary kiln	Applied	Not normally applied	Rarely applied	Applied
Rotary kiln	Not normally applied	Applied	Widely applied	Widely applied
Rotary kiln – Water cooled	Not normally applied	Applied	Widely applied	Widely applied
Static hearth	Not normally applied	Not normally applied	Applied	Widely applied
Static furnace	Not normally applied	Not normally applied	Widely applied	Applied
Fluidised bed - bubbling	Rarely applied	Widely applied	Not normally applied	Not normally applied
Fluidised bed - circulating	Rarely applied	Widely applied	Not normally applied	Not normally applied
Fluidised bed - rotating	Applied	Applied	Not normally applied	Applied
Pyrolysis	Rarely applied	Rarely applied	Rarely applied	Rarely applied
Gasification	Applied	Rarely applied	Rarely applied	Rarely applied

Each of the thermal treatment unit has its own specific characteristics that make it a suitable choice for a specific application. For an example, the fluidised bed type thermal treatment is utilised or considered whenever the waste material to be treated is uniform in size like sludge from wastewater treatment plant where no pre-processing of waste such as shredding of waste (high energy requirement process) into small pieces of uniform size is required in this case. This is a main drawback of a fluidised bed type thermal treatment that makes it unsuitable for the

treatment of clinical waste which is mostly in large solid form that will need additional pre-processing treatment of shredding the waste in small pieces.

Thus, there are only two (2) main types of thermal system commonly use in the thermal treatment of clinical waste i.e. Rotary Kiln and Hearth Type. Each has its own advantages and disadvantages over the other which first and foremost depending on the kind or type of waste to be treated whether it is mainly solid or a combination of both solid (usually about 70%) and liquid (usually about 30% of waste burned).

4.1.2.1 The Thermal Treatment System

A brief description of the thermal system types most commonly utilised in clinical waste thermal treatment is presented in the following section.

Rotary Kiln (RK)

Rotary Kiln is commonly used to treat a wide variety of waste. It is usually and specifically considered whenever a multiple forms or combination of waste are to be treated i.e. solid, liquid, slurry or sludge and etc. This is why RK is typically found in most of the centralised waste facility to handle various hazardous wastes from wide range of industries. In this respect, RK is commonly designed with multiple wastes feeding system to cater for these various forms of incoming waste. Solid waste is fed through a hopper while liquid or slurry ones are injected directly into the kiln, which is a slightly inclined horizontal cylinder, lined with refractory that turns about its longitudinal axis. The waste is fed at one end and the burn-out ash fall-out at the opposite end of the rotating kiln, drove by a gear.

Thus, a RK type thermal treatment apart of its capability of handling variety of waste, it is characterised having a lot of moving parts, which apparently cause a high maintenance cost compared to hearth type thermal treatment.

Hearth Type Thermal Treatment

Hearth type is another category of thermal system commonly used to treat waste usually in the form of solid waste like clinical or municipal waste. It consists of a primary chamber, which is designed with either fixed or moving hearth type bed (stepped hearth). The under-fire air is fed underneath the bed as primary air to support the combustion process and at the same time creates a turbulence effect to increase the efficiency of burning. Hearth type thermal treatment does not have rigorous moving parts as compared to RK and is typically considered to have less maintenance cost. A moveable hearth of minimal bed with superior under-fire air distribution in the primary chamber would be the best choice to be considered.

4.1.2.2 The Recommended Thermal Treatment System

The options for the thermal treatment system are either rotary kiln or hearth type thermal treatment. Each has its own uniqueness as a thermal treatment. Thus, three (3) main factors are to be given due consideration before selecting the appropriate system such as;

- Characteristics of waste;
- Easy of operation; and
- Maintenance cost.

Technically, the three (3) main criteria between rotary kiln and hearth type thermal treatment can be summarised as the following **Table 4.4**.

Table 4.4: Summary of the Three (3) Main Criteria of the Thermal Treatment System

Thermal Treatment Type	Characteristics of Waste Treated	Relative Ease of Operation	Relative Cost of Maintenance
Rotary kiln	Solid or combination of solid and liquid	Low	High
Hearth	Solid	High	Low

The hearth type thermal treatment seems to be a better position when the three (3) main criteria are to be considered in this case. Most importantly, the maintenance cost of the two (2) types of thermal treatment systems i.e. rotary kiln and hearth type.

The advantages and disadvantages of thermal treatment systems as the superior system against others are summarized in the **Table 4.5.**

Table 4.5: The Advantages and Disadvantages of Different Types Thermal Treatment Systems

Type of Thermal Treatment	Advantages	Disadvantages
Rotary Kiln	Waste can be directly fed into the kiln without pre-treatment	High capital cost
	Enhance residue burnout after the burning process	The cooling air that enter the unit at the waste feed end will detain the temperature increase required for rapid ignition
	Wet and dry ash removal	Kiln-based thermal treatment will

Table 4.5: The Advantages and Disadvantages of Different Types Thermal Treatment Systems

Type of Thermal Treatment	Advantages	Disadvantages
Rotary Kiln	Tolerant of highly varied waste sizes and properties	cause high particulate and hydrocarbon concentrations in the flue gases entering the air pollution control system (APCS) compared to conventional hearth system.
Stepped hearth	Optimizes the movement of waste through the combustion chamber to allow more efficient and complete combustion	Thermal treatment plants must be designed to ensure that flue gases reach at least 850°C for 2 seconds
	The heat form the super heater can be transferred to steam for electricity generation in turbine	High capital and maintenance cost
		Required to be designed exclusively according to systems it needs to fit in, therefore not much of compatibility with just any system.
Fixed hearth	Mature and well proven application	Temperatures are likely not adequate to break down dioxins
	Lower capital and maintenance cost compared to other systems	Old-fashioned and unlikely compatible with modern facilities
		High capital and maintenance cost
Fluidized bed	The fluid-like state allows the mass of waste, fuel and sand to be fully circulated through the furnace	High capital and maintenance cost
	This system gives very good mixing and hence good heat and mass transfer	Required pre-processed of the waste to remove coarse dense material and reduce particle size
	Excellent residue burnout (less than 1% unburned carbon)	Complicated system of supply
	Lower combustion temperatures	Adverse impact on the fluid system if ash slagging occurs
	Lower potential of ash slagging	

In general, either rotary kiln or hearth type of thermal treatment process is suitable to be used for treatment of clinical waste. However, current perfect choice that meets all the requirements and criteria will be the hearth type thermal treatment. A stepped hearth of minimal bed movement with superior under-fire air distribution in the primary chamber would be the best choice for to be considered for a long-term reliability.

Thus, SMOSB have selected the stepped hearth type for the thermal treatment of its clinical waste due to the advantages of this technology. Furthermore, testimonial of this technology worldwide have proven to be positive for this purpose as well as to meet the emission compliance to Clean Air Regulation, 2014.

4.1.3 Option 3: 'No Project' Option

The "no – project" or "do nothing" option means that no action will be taken to address the critical issues of increasing amount of clinical wastes to be disposed or treated in Johor Bahru. This could result in serious environmental and health implications and also contradicts the Government's effort to ensure a safe handling and disposal of ever increasing clinical waste in the country.

Poor or improper clinical waste management practices will be a risk to human health and the environment. The waste generated from medical activities can be hazardous, toxic and even lethal because of their high potential for diseases transmission. The hazardous and toxic parts of waste from healthcare establishments comprising infectious, medical and radioactive material as well as sharps constitute a grave risks to mankind and the environment, if these are not properly treated, disposed or are allowed to be mixed with other municipal waste.

Clinical waste is also a source of contamination of land and water sources if not rendered harmless before its burial on land or disposal in water. Furthermore, clinical waste emits harmful gases, unpleasant smell, growth and multiplication of insects, rodents and worms if treated in a wrong way.

In developing countries such as Nigeria, hazardous and clinical wastes are still handled and disposed-off together with domestic wastes, thus increasing the risk to general workers, the public as well as the environment.

Also, the existing treatment facility will not be adequate to treat incoming amount of clinical waste generated in the country in the coming years. A quick and rapid response on disposal of within 24-h period of the incoming clinical waste is warranted as part of the Ministry of Health Malaysia (MOH) requirement in managing the waste. Furthermore, more of the private specialist hospitals are being built at present and this will certainly increase the generation of waste which needs to be treated promptly.

Thus, with the "no-project" options of clinical waste thermal treatment plant at Tanjung Langsat would mean that the disposal of clinical waste in the country will soon meet its end. A worst situation is when the disposal of clinical waste will be halted for a number of days or weeks or even months if one (1) or two (2) or even all of the concessionary incineration plants undergo forced or emergency plant shutdown due to unforeseen circumstances. This illustrates the dire need of such initiatives on the part of the project proponent, Southern Medi One Sdn. Bhd. (SMOSB) and thus the development of clinical waste thermal treatment plant is very necessary and renders the '"no project" option is irrelevant.