

Appendix 4.1 Risk Assessment Worksheets of Risk Assessment for Microbial Emissions from Dewatered Sewage Sludge

Sludge Collection								
Item No.	Hazard	Consequence	Safeguard	Freq.	Conq.	Risk	Mitigation Measures	Remarks
1	Sludge overfills the skip/container of transport vehicle	Sludge spills inside the facility, contaminated vehicle and its tyres may contaminate the roads offsite; potential disease-causing microbes exposure of on-site worker, driver and public	- General good practice and supervision of operation by workers and drivers	L	3	M		
2	Driver drives the transport vehicle away while sludge is being loaded	Sludge spills inside the facility; potential disease-causing microbes exposure of on-site worker and driver	- General good practice and supervision of operation by workers and drivers	L	3	M		
3	Leakage of skip/container of transport vehicle	Sludge spills inside the facility, contaminated vehicle and its tyres may contaminate the roads offsite; potential disease-causing microbes exposure of on-site worker, driver and public		L	3	M		
4	Sludge is being loaded but skip/container of transport vehicle is not at the loading location	Sludge spills inside the facility; potential disease-causing microbes exposure of on-site worker	- General good practice and supervision of operation by workers	L	3	M		
Sludge Transport								
5i	Road accident involving sludge transport vehicle	Sludge spills on road; potential disease-causing microbes exposure of public		L	3	M		
5ii	Road accident involving sludge transport vehicle	Sludge spills on road; potential disease-causing microbes exposure of workers handling the spillage	- Personal protective equipment for staff	L	3	M		
6i	Accident involving sludge transport barge	Sludge spills at sea; potential disease-causing microbes exposure of public		L	3	M		
6ii	Accident involving sludge transport barge	Sludge spills at sea; potential disease-causing microbes exposure of staff responding to the spillage	- Personal protective equipment for staff	L	3	M		
7	Sludge transport vehicle/barge on fire	Incomplete combustion of sludge and/or contamination of storm water by firefighting run-off water; potential disease-causing microbes exposure of public		L	3	M		

Sludge Reception and Handling at STF									
Item No.	Hazard	Consequence	Safeguard	Freq.	Conq.	Risk	Mitigation Measures	Remarks	
8	Minor error of sludge unloading operation from transport vehicle to temporary storage tank	Not all the content in the container is unloaded to temporary storage tank; the spilled sludge contaminates reception hall and delivery bay of STF; potential disease-causing microbes exposure of on-site cleaning workers	<ul style="list-style-type: none"> - Signage assists drivers to stop at appropriate unloading position - Training to driver - Personal protective equipment for cleaning workers 	L	3	M			
9	Minor error of sludge unloading operation from transport vehicle to temporary storage tank	Not all the content in the container is unloaded to temporary storage tank; contaminated vehicle and its tyres may contaminate the roads offsite; potential disease-causing microbes exposure of drivers and public	<ul style="list-style-type: none"> - Vehicle cleaning system to clean vehicles before they leave STF 	L	3	M			
10i	Vehicle crashes inside the reception hall/delivery bay of STF	Spilled sludge contaminates reception hall/delivery bay; potential disease-causing microbes exposure of drivers	<ul style="list-style-type: none"> - Training to driver - Monitoring and control the traffic flow inside the reception hall - Signage for clear indication of traveling route 	L	3	M			
10ii	Vehicle crashes inside the reception hall/delivery bay of STF	Spilled sludge contaminates reception hall/delivery bay; potential disease-causing microbes exposure of on-site cleaning workers	<ul style="list-style-type: none"> - Training to driver - Monitoring and control the traffic flow inside the reception hall - Signage for clear indication of traveling route - Personal protective equipment for workers involved in manual unloading 	L	3	M			
11	Failure of transport vehicle equipment, unable to unload sludge	Manual unloading of sludge is necessary; potential disease-causing microbes exposure of workers involved in the manual unloading	<ul style="list-style-type: none"> - Personal protective equipment for workers involved in manual unloading 	L	3	M			

Sludge Reception and Handling at STF									
Item No.	Hazard	Consequence	Safeguard	Freq.	Conq.	Risk	Mitigation Measures		
12i	Leakage of skip/container of transport vehicle	Sludge spills inside the STF, the spilled sludge contaminates reception hall and delivery bay of STF; potential disease-causing microbes exposure of on-site cleaning workers	- Personal protective equipment for workers	L	3	M			
12ii	Leakage of skip/container of transport vehicle	Spilled sludge contaminates vehicles and their tyres, may contaminate the roads offsite; potential disease-causing microbes exposure of drivers and public	- Vehicle cleaning system to clean vehicles before they leave STF	L	3	M			
Temporary Sludge Storage at STF									
13	Overfilling of sludge temporary storage tank	Spilled sludge contaminates the reception hall and delivery bay of STF; potential disease-causing microbes exposure of on-site cleaning workers	- Detection device/alarm to prevent overfilling of tank - Monitoring and control of the unloading process - Personal protective equipment for workers	L	3	M			
14	Capacity of STF is exceeded	Improper sludge storage at STF; potential disease-causing microbes exposure of on-site workers	- A safety margin is considered for the design capacity - Emergency plan to be established to handle the situation of incinerator units being down – sludge will be delivered to landfill/sewage treatment works for disposal/treatment rather than delivered to STF	L	3	M			
15	Temporary storage tank failure	Spilled sludge contaminates the STF; potential disease-causing microbes exposure of on-site workers		L	3	M			

Sludge Conveyance from Temporary Storage to Incinerator at STF							
Item No.	Hazard	Consequence	Safeguard	Freq.	Conq.	Risk	Mitigation Measures
16	Leakage of conveyance pipe	Spilled sludge contaminates the STF, potential disease-causing microbes exposure of on-site workers		L	3	M	
Sludge Incineration at STF							
17	Incomplete combustion of sludge	Potential disease-causing microbes may exist in bottom ash and exposure of on-site workers and drivers	- Monitoring and control system to monitor and control the performance of incineration process	L	3	M	
18	Failure of incinerator	On-site workers need to handle incomplete combusted sludge inside the incinerator	- Personal protective equipment for workers	L	3	M	
Wash Down Facilities at STF							
19	Presence of disease-causing microbes in wastewater	Potential disease-causing microbes exposure of on-site cleaning workers	- Personal protective equipment for workers	M	3	M	The likelihood of presence of disease-causing microbes in wastewater is high but the likelihood of disease-causing microbes exposure of cleaning workers is medium due to the protection provided by PPE
20	Blockage of drainage	Wastewater contaminates areas in STF; potential disease-causing microbes exposure to on-site workers	- Frequent maintenance - Multiple outlets in drainage system to reduce the likelihood of blockage of drainage	M	3	M	
Maintenance and Repairing at STF							
21	Workers undergo maintenance and repairing process may contact with sludge	Potential disease-causing microbes exposure of maintenance workers	- Personal protective equipment for workers	M	3	M	The likelihood of maintenance and repairing of STF equipment is high but the likelihood of disease-causing microbes exposure of maintenance workers is medium due to the protection provided by PPE