

THE MINISTRIES

INTER-MINISTERIAL

THE MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT AND THE MINISTRY OF CONSTRUCTION

JOINT CIRCULAR No. 01/2001/TTLT-BKHCNMT-BXD OF JANUARY 18, 2001 GUIDING THE REGULATIONS ON ENVIRONMENTAL PROTECTION FOR THE SELECTION OF LOCATION FOR, THE CONSTRUCTION AND OPERATION OF, SOLID WASTE BURIAL SITES

In implementation of the functions and tasks of the Ministry of Science, Technology and Environment defined in the Government's Decree No. 22/CP of May 22, 1993 on the tasks, powers and organizational structure of the Ministry of Science, Technology and Environment, and of the Ministry of Construction in the Government's Decree No. 15/CP of March 4, 1994 on the functions, tasks, powers and organizational structure of the Ministry of Construction;

In order to meet the current urgent demand for the burial of urban and industrial zone solid wastes, to control pollution and protect environment,

The Ministry of Science, Technology and Environment and the Ministry of Construction hereby jointly guide the regulations on environmental protection regarding the selection of location for, the construction and operation of solid waste burial sites as follows:

I. GENERAL PROVISIONS

1. Regulation scope and application objects:

1.1. Regulation scope:

This Circular guides the implementation of the regulations on environmental protection in selecting locations for, building and operating solid waste burial sites.

1.2. The solid wastes not covered by this Circular shall include the solid wastes on the list of hazardous wastes specified in the Regulation on management of hazardous wastes, promulgated together with Decision No. 155/1999/QĐ-TTg of July 16, 1999 of the Prime Minister and other kinds of hazardous solid waste decided by competent State

bodies according to the provisions of the Regulation on management of hazardous wastes.

1.3. Application objects:

This Circular shall apply to agencies exercising the State management over investment and construction; agencies exercising the State management over environmental protection; domestic and foreign organizations and individuals providing services on environment, construction and operation of solid waste burial sites (including solid waste burial sites managed by production establishments themselves).

2. Term interpretation:

In this Circular, the following terms shall be construed as follows:

2.1. Solid waste burial site (hereinafter abbreviated to BS) means a land area or plot, which has already been planned, selected, designed and constructed for burial of solid wastes in order to minimize the negative impacts of BS on the environment.

A BS is composed of waste burial squares, buffer zone and other support works such as waste water and/or gas treatment stations, power and water supply stations, the executive office.

2.2. Solid wastes (hereinafter abbreviated to SW) mean the solid wastes arising from daily-life activities in urban areas and industrial zones, which include wastes from population quarters, wastes from trade activities, urban services, hospitals, industrial wastes, wastes from construction activities.

2.3. Garbage water means that coming from the process of natural disintegration of SW and containing polluting substances.

2.4. Gas discharged from waste burial squares means the gaseous mixture generated from waste burial squares due to the process of natural disintegration of SW.

2.5. The buffer zone means a stretch of land surrounding a BS for the purpose of preventing and minimizing the adverse impact of the BS on the environment.

2.6. Lining layers mean layers of materials spread on the entire bottom areas and surrounding walls of the waste burial squares in order to prevent and minimize the penetration of garbage water into underground water streams.

2.7. Covering layers mean layers of materials that cover the entire BSs while operating and closing the BSs with a view to preventing and minimizing the impacts from the burial squares on the surrounding environment and from the outside on the BS squares.

2.8. Waste gas collecting system means a system of works and equipment for gathering waste gases generated from the BSs in order to prevent, minimize air pollution as well as

fire and explosion dangers.

2.9. Garbage water-collecting system means a system of works including gathering layers, conduits, canals to gather garbage water into concentrated holes or treatment stations.

2.10. Protecting fences mean a system of walls, shielding fences, green belts or barriers with given heights, which surround BSs with a view to limiting the impacts of the solid waste burial activities on the surrounding environment.

2.11. The operation duration of a BS means the entire duration from the time the SW burial starts to the time the BS is closed.

2.12. BS closure means the complete cessation of SW burial activities at the BS.

2.13. Surface water and rain water drainage systems mean the systems to gather and conduct surface and rain water to designated places in order to prevent the outside surface water from penetrating into burial squares.

2.14. BS investors mean Vietnamese or foreign organizations and/or individuals that have the responsibility to manage/ provide investment capital for the construction of BSs.

2.15. BS operators mean Vietnamese or foreign organizations and/or individuals that take responsibility before the investors for the management of operation and use of BSs.

2.16. Specialized BS inspection organizations are those with the legal person status, which supervise, inspect, sample and analyze items and indexes related to the operation of BSs.

II. LOCATION SELECTION, INVESTMENT AND CONSTRUCTION OF SOLID WASTE BURIAL SITES

1. General principles:

The work of investment preparation and execution as well as BS construction must comply with the Government's Decree No. 52/1999/ND-CP of July 8, 1999, promulgating the Regulation on investment and construction management (called Decree 52/CP for short), Decree No. 12/2000/ND-CP of May 5, 2000 amending a number of articles of Decree 52/CP (called Decree 12/CP for short), with the provisions of this Circular and legal documents on investment and construction.

When an investment project for BS is approved, there must be the approval of the report on assessment of environmental impacts (according to Appendix II, to Circular 490/1998/TT-BKHCMNT of April 29, 1998 of the Ministry of Science, Technology and Environment guiding the making and evaluation of environmental impact assessment reports for investment projects).

2. Requirements on selection of BS location.

2.1. The BS locations must be determined on the basis of construction planning already approved by the competent State management bodies.

2.2. The distance from the constructed BS to population quarters, urban centers is stipulated in Appendix 1 to this Circular.

2.3. The location selection must be based on the natural, economic and social factors as well as the technical infrastructure systems in the areas planned for the BS construction (stipulated in Appendix 2 to this Circular).

3. Selection of BS models

Depending on the characteristics of each kind of waste to be buried and the topographic characteristics of each region, the following BS models can be selected: dry burial site, wet burial site, dry-wet mixed burial site, above-ground burial site, underground burial site, above-ground- cum underground burial site and mountain-creek burial site (specified in Appendix No.3).

4. BS sizes:

4.1. The BS sizes are determined on the basis of:

a/ Population and current waste volume, the rates of population growth and waste volume increase throughout the operation duration of the BS.

b/ The economic growth possibility and urban development orientations.

4.2. The BS design must ensure that the total depth of the site from its bottom to its top may reach between 15 m to 25m, depending on the BS type and the conditions of the landscapes surrounding the BS.

4.3. The area for the construction of support works: roads, embankment, water drainage and conducting systems, warehouses, yards, workshops, garbage water deposit reservoir, water treatment reservoir, green tree fence systems and other support works in a BS accounts for about 20% of the total area of the site.

Based on the above characteristics, the BS sizes shall be determined according to Table 2 in Appendix 4 to this Circular.

5. The BS selection process:

The selection of BS location is carried out through 4 steps:

- *Step 1:* Gathering materials related to the BS's requirements, the volume of SW to be buried and future projection. The stipulations on investigation extent upon the elaboration of BS construction projects are prescribed in Appendix 5 to this Circular.

- *Step 2:* Determining the plan on possible locations for BS construction. These locations may be considered and proposed on the basis of studying and analyzing the

topographical, geological, hydro-geological maps, the maps on the current state of available land use, current population distribution state. Conducting field surveys.

- *Step 3:* Comparing and selecting plans with the BS norms and dropping a number of planned locations. Making official selection. At this step, comparison and evaluation of details of the remaining locations shall be made on the basis of analyzing and evaluating the technical, economic and social norms, the optimum option, applying methods of grafting maps and giving points to norms. To carry out this step, there must be enough materials on the investigation of the current environmental state, natural, economic and social characteristics of all planned locations; thereby to give points to each factor for each location and select the most appropriate location.

- *Step 4:* Outlining and reproducing selected location plan.

The BS's capital construction works are prescribed in Appendix 6 to this Circular.

III. OPERATING SOLID WASTE BURIAL SITES

1. The stage of operation of BSs.

1.1. Wastes transported to the BSs must be checked and classified (through weighing stations) and buried immediately within 24 hours. Wastes must be buried strictly according to squares prescribed for each type of corresponding waste. For BSs receiving more than 20,000 tons (or 50,000 m³) of wastes per year, they must be equipped with electronic weighing systems in order to control waste quantity.

1.2. The operators of BSs must determine correctly types of waste permitted for burial when admitting them into the BSs and open books for annual monitoring with the following subjects:

a/ Names of drivers of waste carrying trucks.

b/ The nature of waste, if it is thick mud, the sediment content must be clearly inscribed.

c/ Waste volume.

d/ Time (day, month, year) of transporting the waste.

e/ Sources of waste; if it is industrial waste, the names of factories or enterprises must be clearly inscribed.

The recording books and relevant documents must be kept and preserved at the BS Management Boards during the operation and for at least 5 years after the closure of the BSs.

1.3. Wastes must be buried in layers separated from each other with layers of soil.

a/ Wastes, after being admitted for burial, must be leveled out and carefully stamped (with mechanical stamper 6 ÷ 8 times) into layers of the maximum thickness of 60 cm.

ensuring the minimum percentage of stamped wastes of 0.52 ton ÷ 0.8 t/m³.

b/ Intermediary soil layer must be covered on garbage surface after the garbage was tightly stamped (into layers) with the maximum height of 2.0m - 2.2m. The thickness of the covering soil layer must reach 20 cm. The covering soil layer makes up about 10% ÷ 15% of the total garbage and soil coverage volume.

c/ The covering soil must contain > 30% clay grain, being wet enough for easy stamping. The covering soil layer must be evenly and fully spread over the waste layer and, after being carefully stamped and pressed, have the thickness of about 15 cm ÷ 20 cm.

1.4. Besides covering soil, materials which satisfy the following conditions may also be used as intermediary covering materials between waste layers:

a/ Having the permeability of $\leq 1 \times 10^{-4}$ cm/s and at least 20% of the volume sized ≤ 0.08 mm.

b/ Having the characteristics of:

- Being capable of preventing odors.
- Not causing fire, explosion.
- Being capable of preventing assorted insects, burrowers.
- Being capable of preventing the dispersal of wastes being light materials.

1.5. The SW of thermo-power plants shall be buried under the specialized technical guidance.

1.6. The burial squares must be sprayed with insecticides (not in solution form). The number of sprays shall depend on the level of development of assorted insects so as to make appropriate number of spray aiming to limit to the utmost the development of insects.

1.7. SW transport means, after dumping wastes into the BSs, must be cleaned before moving out of the BS areas.

1.8. The waste water-gathering and-treating systems must operate regularly and be periodically inspected, maintained, repaired and cleaned in order to ensure their designed capacities. The sediment holes must be dredged and the mud therefrom must be carried to appropriate treatment areas.

The garbage water must not be discharged directly into the environment if the percentage of polluting substances exceeds the prescribed standards (Vietnamese standards).

1.9. Pure garbage water from the gathering systems of BSs or thick mud from the garbage water treatment systems are allowed to be used for watering on BSs in order to accelerate the process of waste disintegration under the following conditions:

a/ The thickness of the being buried-garbage layer must exceed 4 m.

b/ The technique of watering evenly on the surface must

be applied.

c/ This shall not apply to areas of the burial squares, which have been covered with the final layer.

2. The stage of BS closure

2.1. The BS closure shall be effected when:

a/ The volume of waste buried in the BS has reached the largest capacity according to the technical design.

b/ The operator of the BS is incapable of continuing to operate the BS.

c/ The BS is close for other reasons.

In all circumstances, the BS operators must send official dispatches to the State management bodies in charge of environment, informing the latter of the time to close the BS.

2.2. The BS closure order:

a/ The top covering soil layer contains the clay percentage of >30%, ensures the standard humidity and is stamped and pressed carefully, has the thickness of over or equal to 60 cm. The slanting degree from the foot to the peak of a dump rises gradually from 3 ÷ 5%, always ensuring good water drainage, non-slide and non-sink. It should be then:

- Covered with a soil buffer layer containing commonly sand of from 50cm ÷ 60 cm thick.

- Covered with a layer of cultivation soil (edaphic soil layer) of from 20 cm ÷ 30 cm thick.

- Planted with grass and green trees.

b/ In big BSs, their operations must be carried out simultaneously with the construction of new burial squares and the closure of filled-up squares. Therefore, the regulations for each of the above stage must be strictly complied with.

2.3. Within 6 months after the BS closure, the BS operators shall have to report to the State management bodies in charge of environmental protection on the present situation of the BSs. Such a report must be made by an independent specialized environment agency, including the following contents:

a/ The situation of operation, efficiency and possible operation of all works in the BS, including the anti-penetration system of the BS, the garbage water-gathering and-treating systems, the surface water and/or underground water management systems, the waste gases-gathering systems as well as the entire system for supervising underground water quality, etc.

b/ The observation of the quality of water discharged from the BSs into the environment, the situation on the quality of underground water as well as on the emission of waste gases.

c/ The compliance with the current provisions of this Circular as well as the restoration and improvement of the

landscapes in the BS areas. The report must clearly point to cases of non-compliance with the provisions of this Circular and propose remedial measures.

2.4. After the BS closure, people and animals are still not allowed to freely enter the BS, particularly the peak of the sites where gas is concentrated. There must be safety signs and instructions in the BSs.

3. Observation of the BS environment

3.1. General provisions:

Any BS, big or small, in delta or mountainous region, must be observed in term of environment and organize the monitoring of environmental changes.

a/ The environment observation covers the observation of the air environment, water environment, land environment and ecological system, labor environment, the health of people in nearby communities

b/ The observation posts must be placed at typical points where the environmental changes due to the impacts of the burial sites can be determined

c/ For BSs, the automatic observation posts must be arranged.

3.2. Water environment observation posts

a/ Surface water:

- In each BS, there must be at least two observation posts for monitoring surface water on the flows receiving waste water of the BS.

+ The first post is situated 15 m ÷ 20 m upstream the waste water discharge sluice-gate of the BS.

+ The second is situated 15 m ÷ 20 m downstream the waste water discharge sluice-gate of the BS.

- If there exist within a parameter of 1000m water reservoirs, one more post should be arranged at the water reservoirs.

b/ Underground water:

- The underground water observation post is arranged along the flow direction from upstream to downstream of the BS, needing at least 4 observation bores (one bore on the upstream and three on the downstream). Observation is conducted even in atmospheric zone and water saturation zone.

- For each population spot around the BS, at least one observation post (a deep well or a bore) should be arranged.

c/ Waste water:

Observation posts shall be arranged for the comprehensive observation of the quality of the input and output waste water of the treating areas. Concretely:

- One post is situated before the entrance to the treating system.

- One post is situated after the treatment, before being discharged into the surrounding environment.

3.5. Observation cycle: For automatic posts, the observation and data updating must be made daily. When the automatic observation posts are not available, depending on the period of operation or closure of the burial sites, the observation location and frequency must be designed in a rational manner, ensuring the full observation of environmental developments due to the operation of the BS; concretely as follows:

a/ For the period of operation, the following should be observed:

- Flow (surface water, waste water): Once every two months.

- Chemical component: Once every four months.

b/ For the period of closure of the BS:

- In the first year: Once every three months

- In subsequent years: 2 m ÷ 3 m times/year.

When taking samples at underground water observation bores, water must be pumped in flows for at least 30 minutes.

c/ Indexes for chemical composition analysis and comparison:

According to the Vietnamese standards on environment.

d/ Each year at the beginning of the rainy season, rain water can be sampled and analyzed.

3.4. Air environment observation posts

a/ Location of observation posts:

Air environment monitoring posts are arranged as follows: Inside the works and working offices within the BSs, a network of at least 4 posts should be arranged to supervise the air outside such works and working offices within the BS areas.

b/ Observation regime (when the automatic observation post is yet available): Once every three months.

c/ Measuring parameters: dust, noise, temperature, emitted gas according to the Vietnamese standards.

3.5. Monitoring employees' health:

Officials and workers working at the BSs must have their health monitored and checked periodically at least once every six months.

3.6. Measuring locations (posts): The measuring locations (posts) must be fixed, preferably with markers. For underground water observation posts, there must be detailed design, which can be referred to diagram (see drawing in Appendix 7).

3.7. Observation to inspect the slanting degree, the sinking degree of the covering layer and floral cover: When the automatic observation posts are yet available: Twice a year. If problems arise, adjustment should be made immediately.

3.8. Reporting regime: Annually, the BS-managing units must report on the present environment of the sites to the State management bodies in charge of environmental

protection.

3.9. Reporting documents: Apart from documents on measuring, observation results, there must be reports on hydrologic geology, project geology, detailed explanation of operation of systems gathering water, garbage, gas, slope, etc.

3.10. Expenses: Expenses for the construction, the environment observation network may be calculated into the costs of construction and operation of the BSs.

3.11. Operation duration: The operation duration of an observation network commences from the time of starting the operation to the time of closing a BS. After the BS closure, the sampling for analysis must continue for 5 years; if the quality of the analytical samples is below the Vietnamese standards, the sampling for analysis shall terminate and the operation of the observation post shall cease.

3.12. Measuring equipment and methods:

The measuring equipment and methods must be uniform; depending on the scientific and technical progress, the measuring stations can be automated and hooked up with the general control room of the site.

4. Examining the project quality regarding the environment

4.1. The work of examining the environment in the construction, operation and closure of BSs must be conducted regularly.

4.2. Among items which must be environmentally qualitatively checked, special attention should be paid to examining the anti-penetration system, garbage water-gathering and-treating systems, biogas-gathering, -evaluating and -disposing systems as well as underground water observation well systems, surface water observation posts. The examination must be carried out both in the field and in the laboratory, for the right items and in conformity with each necessary period of time in order to ensure that the materials and equipment being used in the BSs meet the Vietnamese standards on environment.

4.3. All materials and equipment used in the construction of BSs to combat penetration or to install systems mentioned in Part II must be objectively inspected by professional officials in order to meet the requirements on environment.

4.4. Professional officials in charge of environment quality inspection and supervision must submit reports on the results thereof after each period, each construction investment item stated in Part II to the State management bodies in charge of environment in order to detect in time cases of violation of the environment standards in designing, constructing and operating BSs and propose remedial measures.

4.5. Equipment used for inspection of environment quality must satisfy the national and international standards.

5. Reusing BS areas

5.1. When planning the use and design of BSs, the possibility of reusing the burial grounds after the closure of BSs for such purposes as keeping the status quo of the BSs, for construction of parks, entertainment centers, stadiums, parking lots, or tree planting, shall be taken into account.

5.2. In case of a need to reuse BSs, the survey and evaluation of relevant environmental elements must be conducted: only if the prescribed conditions are met can the reuse be made.

5.3. Pending the reuse of the BSs, the treatment of garbage water and gas must continue as usual.

5.4. After the BS closure, the monitoring of environmental changes must be carried on at the observation posts.

5.5. After the BS closure, the topographical maps of the BS areas must be re-drawn.

5.6. After the BS closure, there must be full reports on the BSs' operation process, and active measures must be proposed for environment control in subsequent years.

5.7. Carrying out procedures for handing over the BS grounds to the competent agencies and units for continued management and reuse thereof.

5.8. When reusing BSs, the gas gathering bores must be closely examined. Only when the pressure of the gas bores no longer differs from the atmospheric pressure and the gas concentration is not higher than 5% can the leveling be permitted.

IV. ORGANIZATION OF IMPLEMENTATION

1. The Ministry of Science, Technology and Environment:

1.1. To assume the prime responsibility and coordinate with the Ministry of Construction and the People's Committees of the provinces and centrally-run cities in disseminating, guiding and inspecting the implementation of this Circular.

1.2. To direct the provincial/municipal Services of Science, Technology and Environment to do the following:

a/ Organizing surveys of conditions on hydrologic geology, project geology and environment of the planned areas, which shall serve as basis for designing and constructing BSs; monitoring and urging the construction investors to make reports on the assessment of the BSs' environmental impacts and submit them to the State management bodies in charge of environment for approval.

b/ Coordinating with the provincial/municipal Services of Construction as well as of Communications and Public Works in guiding the implementation of Vietnam's current regulations and standards on environment in designing, constructing and operating BSs.

2. The Ministry of Construction:

2.1. To assume the prime responsibility and coordinate with the Ministry of Science, Technology and Environment and the People's Committees of the provinces and centrally-run cities in guiding the planning of locations for construction of BSs in localities, the elaboration and promulgation of standards for BS design and construction, which ensure the environmental hygiene.

2.2. To direct the provincial/municipal Services of Construction as well as of Communications and Public Works to coordinate with the provincial/municipal Services of Science, Technology and Environment in guiding the implementation of Vietnam's current regulations and standards on environment in selecting locations, designing, constructing and operating the BSs.

3. The People's Committees of the provinces and centrally-run cities

According to their respective functions and powers, to direct the implementation of the provisions of this Circular in their respective localities.

This Circular takes effect 15 days after its signing.

If difficulties and problems arise in the course of implementing this Circular, the localities, organizations and individuals shall reflect them in time to the Ministry of Science, Technology and Environment and the Ministry of Construction for study and appropriate amendments and supplements.

*For the Minister of
Science, Technology and Environment
Vice Minister
PHAM KHOI NGUYEN*

*For the Minister of Construction
Vice Minister
NGUYEN VAN LIEN*

Appendix 1

Table 1. APPROPRIATE DISTANCES WHEN SELECTING LOCATIONS FOR BURIAL SITES

Works	Works' features and sizes	Minimum distance from the works' belt to burial sites (m)		
		Small and medium burial sites	Large burial sites	Very large burial sites
Urban regions	Cities, provincial towns, district capitals, townships...	3,000 - 5,000	5,000 - 15,000	15,000 - 30,000
Airports, industrial zones, seaports	From small to large size	1,000 - 2,000	2,000 - 3,000	3,000 - 5,000
Delta and midland population clusters	≥ 5 households at the end of principal wind direction	≥ 1,000	≥ 300	≥ 1,000
	Other directions	≥ 300	≥ 1,000	≥ 300
Mountainous population clusters	Along mountain creeks (with down-running current).	3,000 - 5,000	> 5,000	> 5,000
	Not in the same creek	Not prescribed	Not prescribed	Not prescribed
Underground water exploiting works	Capacity < 100 m ³ /day	50 - 100	> 100	> 500
	Q < 10,000 m ³ /day	> 100	> 500	> 1,000
	Q > 10,000 m ³ /day	> 500	> 1,000	> 5,000

Note: BSs should not be planned on areas with large deposits of underground water, regardless of whether the underground water lies shallow or deep, areas with lime stone (Karst). However, if there is no other alternatives, the burial sites must ensure that all the dump squares, waste water storing and treating lakes, waste water conducting canals (both their beds and banks) must be constructed with anti-penetration layers, or the bottoms of the above works must be reinforced to reach the penetration coefficient of lower than or equal to 1×10^{-7} cm/s with the thickness of not lower than 1m, and there must be systems to gather and treat garbage water and waste water.

Appendix 2

SELECTION OF LOCATIONS FOR SOLID WASTE BURIAL SITES

Upon the selection of locations for the construction of BSs, the overall planning of each region, province or city must serve as the basis therefor, the sustainable development must be ensured and the following factors must be taken into full account:

1. Natural factors (natural environment):

- Terrain.
- Climate.
- Hydrology.
- Geological elements.
- Hydrologic geology.
- Project geology.
- Natural resources, minerals.
- Ecological landscapes.

2. Socio-economic factors:

- The population distribution of the region.
- The current economic situation and the possibility of economic growth.
- The administrative management system.
- Historical relics.
- Security and defense.

3. Infrastructure factors:

- Communications and other services.
- Current land use situation.
- Distribution of industrial production establishments, mining establishments at present and in the future.
- Water supply system and electricity networks.

4. Appropriate distances when selecting locations for burial sites:

When selecting locations for BSs, the following should be clearly determined:

- The distance from the BS to urban centers.

- The distance from the BS to population quarters.
- The distance from the BS to airports.
- The distance from the BS to cultural works, tourist sites.
- The distance from the BS to underground water exploiting works.
- The distance from the edge of the BS to the main traffic roads.

These distances are specified in Table 1 of Appendix 1 to this Circular.

Appendix 3

COMMONLY USED WASTE BURIAL SITE MODELS

1. Dry burial sites are burial sites for common waste (daily-life garbage, street garbage and industrial garbage).

2. Wet burial sites are those used for burial of waste in form of thick mud.

3. Dry-cum-wet burial sites are places for burial of common waste and thick mud too. For squares reserved for wet and mixed burial, it is compulsory to increase the garbage water-gathering system's capacity to absorb garbage water, without letting the garbage water penetrate into the underground water.

4. Aboveground burial sites are those built on the land surface in areas with flat terrain or slightly slanting (hilly regions). Wastes are piled up into heaps of 15m high. In this case, the sites must be surrounded with non-penetration dykes in order to prevent contact between garbage water and surrounding surface water.

5. Underground burial sites are those lying under the land surface or built through making full use of natural holes, former mining pits, ditches, canals.

6. Underground-cum-aboveground burial sites are those built with half underground and half aboveground. Wastes are not only filled up the underground half but also heaped up above the ground.

7. Mountain creek burial sites are those formulated by way of making full use of mountain creeks in high-mountain and hilly regions.

Appendix 4

Table 2- CLASSIFICATION OF SOLID WASTE BURIAL SITE SIZES

Ordinal number	Site type	Current urban population	Garbage volume	Site area
1	Small	≤ 100,000	20,000 tons/year	≤ 10 ha
2	Medium	100,000-300,000	65,000 tons/year	10-30 ha
3	Large	300,000-1,000,000	200,000 tons/year	30-50 ha
4	Very large	≥ 1,000,000	> 200,000 tons/year	≥ 50 ha

Note: The operation duration of a BS shall be at least 5 years. It is most efficient if such duration is 25 years or more.

Appendix 5

REGULATIONS ON SURVEY (SURVEY EXTENT)

1. Topographical survey:

For all BSs, topographical measuring must be carried out with scales of 1:5,000 and 1:2,000, in addition to regional topographical maps of scale $\geq 1:25,000$ for the delta and $\geq 1:50,000$ for midland and mountainous regions. All points of physio-geological measuring, hydro-geological boring and project-geological boring must be determined with coordinates and heights and put on topographical maps.

2. Weather and climatic survey:

To gather climatic materials at the nearest meteorological stations, factors to be gathered include:

- a/ Average rainfall of the months in a year, the maximum daily rainfall, the minimum daily rainfall.
- b/ The average and maximum evaporation degree in the month.
- c/ The wind direction and wind speed in the year.
- d/ The average, highest and lowest temperatures in the month, etc.

3. Hydrological survey:

Apart from gathering materials on regional hydrology (river and stream networks, value of the average, maximum and minimum water levels, average, maximum and minimum water flows at the nearest hydrologic stations, the tidal regimes for regions under the tidal impacts), field surveys must be carried out and the following fundamental issues must be clarified:

- a/ The region's river and stream networks, particularly

currents running through BS areas (constant flows or temporary flows for seasonable flows).

- b/ Scales of currents: width, depth, flowing direction...
- c/ Current basin: area, slope, water gathering capacity.
- d/ Current flow, with special attention being paid to flood flow.
- e/ The maximum, minimum water levels of currents.
- f/ Water quality.
- g/ The current water use situation.
- h/ Ponds and lakes, their sizes, quality and current use.
- i/ Fluctuation of water levels in lakes.
- j/ The distances from BSs to lakes, water flows.
- k/ Results of analyzing a number of water samples

The longer duration for which the update of the above data is made, the higher the value of such data, but the minimum duration shall not be shorter than 5 years.

4. Geological, hydro-geological and project-geological surveys:

4.1. The survey must answer the following basic questions:

- a/ The distribution of soil and rock layers in the BS regions, the area, thickness and depth of such layers.
- b/ The petrographic composition of layers.
- c/ The absorbent coefficients of layers.
- d/ The chemical composition of water, the physio-mechanical properties of soil layers, the grain composition.
- e/ The water levels of layers.
- f/ Are there broken and discontinuous stretches running through the site construction regions? The scale and nature of such breaks and discontinuity.

5	Surface flow drainage and checking system	x	x	x	x	x	x	x	x	x
6	Fence system	x	x	x	x	x	x	x	x	x
7	Canopy tree belt	x	x	x	x	x	x	x	x	x
8	Signboard system	x	x	x	x	x	x	x	x	x
9	Environment observation system	x	x	x	x	x	x	x	x	x
10	Power-and water-supply systems		x	x		x	x		x	x
11	Weighing station		x	x		x	x		x	x
12	SW inspection station		x	x		x	x		x	x
13	Vehicle, machinery cleaning station		x	x		x	x		x	x
14	Control system		x	x		x	x		x	x
15	Working office		x	x		x	x		x	x
16	Covering substance-storage	x	x	x		x	x		x	x
17	Recovered discarded materials storage	x	x	x	x	x	x	x	x	x
18	Insecticide warehouses		x	x		x	x		x	x
19	Repair, maintenance station		x	x	x	x	x	x	x	x
20	Vehicle, machinery shed	x	x	x	x	x	x	x	x	x
21	Experimenting station		x	x			x			x

MAJOR CAPITAL CONSTRUCTION WORKS IN BURIAL SITES

1. The burial squares include a number of following types:

1.1. Common SW burial squares:

a/ Burial squares are places where wastes are stored and buried. For large and very large BSs, they can be divided into common SW burial squares and a number of squares for burial of hazardous wastes when so permitted by the State management bodies in charge of environmental protection. Each BS is often designed with a number of burial squares in conformity with the BS's capacity and practical conditions of each locality.

b/ Burial squares should be designed in a way with sizes that each square must be closed after no more than 3 years' operation and a new burial square shall be used.

c/ Squares should be separated from each other with dykes on which green trees are planted to limit pollution and create environmental landscapes.

d/ The burial squares' foundations and walls must have

low absorbent coefficients and great loading capacity, which are either natural or man-made. The natural foundations and walls of burial squares must be lined with soil layers with the absorbent coefficient of $\leq 1 \times 10^{-7}$ cm/s and the thickness of over 1m. If the natural soil layers have the absorbent coefficient of $> 1 \times 10^{-7}$ cm/s, the anti-penetration layers with the absorbent coefficient of $\leq 1 \times 10^{-7}$ cm/s and the thickness of not lower than 60 cm must be built. The foundations and walls of the squares in burial sites must be lined with anti-penetration layers made of synthetic membrane of at least 1.5 mm thick. The top of partitioning walls must be at least ground-high and their bases must pierce into the clay layer of the sites for at least 60 cm.

e/ The beds of burial squares must have the loading capacity of >1 kg/cm² to facilitate the mechanized construction. The slope of the burial square is not lower than 2%, which shall be not lower than 5% at places near the garbage water gathering ditches.

f/ The burial squares' beds must be constructed with garbage water gathering systems.

1.2. Squares for burial of wastes in form of mud: The

requirements thereon are similar to those on squares for burial of common wastes but the squares for burial of wastes in mud form should be solidified with concrete and thoroughly lined with cement layers or structured with double beds with two layers plus one anti-penetration synthetic membrane of HDPE (or materials of equivalent properties and quality) of at least 1.5 mm thick for absolute non-penetration and convenient mechanized construction. The distance between ditches and garbage water-gathering holes must ensure the full recovery of garbage water in squares. Before being put into burial squares, mud must be sun-dried and pressed.

1.3. When rock or ore mining pits or mines (already used) are reused as burial sites, the following conditions must be satisfied:

a/ Where mining pits' or mines' beds are situated higher than the underground water level, if the daily average flow of infiltrating water (calculated according to the average of a continuous observation year) is lower than $1.5 \times 10^{-3} \text{ m}^3$ of water/m², it is not necessary to apply the anti-penetration measures for beds and walls of the burial squares. If the daily average flow of infiltrating water is higher than $1.5 \times 10^{-3} \text{ m}^3$ of water/m², the anti-penetration measures must be applied as provided for in this Appendix.

b/ Where the pits' or mines' beds are situated lower than the underground water level, the anti-penetration measures must be applied as provided for in this Appendix.

2. Garbage water, waste water- gathering and treating systems of BSs:

2.1. All BSs must gather garbage water and waste water (from daily-life activities, water from cleaning transport means, water discharged from testing and experiment and other kinds of waste water). Garbage water and waste water, after being treated, must reach the Vietnamese standards on environment.

2.2. The garbage water and/or waste water-gathering system is composed of ditches, conducting pipes and garbage water- and waste water-gathering holes, which are rationally arranged in order to fully gather the garbage water, waste water into the treating stations. This gathering system is composed of:

a/ The garbage water-gathering layer is placed at the bed and walls of a burial square and above the anti-penetration layer of the burial square's beds or above the anti-penetration synthetic membrane, depending on each specific case. It must be at least 50 cm thick and have the following properties:

- Having at least 5% of volume of grains sized $\leq 0.075 \text{ mm}$
- Having the minimum absorbent coefficient of 1×10^{-2}

cm/s.

b/ The network of garbage water-gathering pipes is placed inside the garbage water gathering layer (as described above), fully covering the burial square's bed. These garbage water gathering pipes must satisfy the following requirements:

- The inner walls are smooth and their minimum diameter is 150 mm.

- The minimum slope is 1%.

c/ The layer enclosing the garbage water and/or waste water-gathering pipes is composed of a layer of soil with grain of at least 5% of the volume of grains with the diameter of 0.075 mm or a synthetic filtering membrane of equivalent filtering efficiency in order to prevent the movement of too smooth grains into the gathering system so that the garbage water automatically runs into the gathering system.

2.3. The garbage water and/or waste water-gathering systems must be designed and installed in a way so as to minimize the accumulation of garbage water at the beds of the burial squares. Materials selected for the construction of garbage water gathering system must ensure their chemical and mechanical durability throughout the duration of operating and using the BSs.

2.4. The garbage water and/or waste water-gathering and treating systems must be constructed with anti-penetration beds and walls to prevent the infiltration of garbage water and waste water into underground water and surface water.

2.5. The garbage water- and waste water-treating methods and technologies shall be properly applied according to the practical conditions of each BS and the requirement that the garbage water and waste water, after being treated and discharged into the surrounding environment, must reach the Vietnamese standards on environment.

3. Waste gas gathering and treatment

3.1. To ensure safety and environmental hygiene, all BSs must have the waste gas-gathering and- treating system. Depending on the volume of generated gas, the gas may be used for welfare purpose or destroyed by method of burning, without letting the gas leak into the surrounding environment.

3.2. Gas is usually gathered by passive gas releasing systems (for small BSs) or active gas releasing systems with vertical drilling wells (for medium and large BSs).

3.3. The positions of drilling wells should be placed atop the waste mounds

The bores must reach deep into the waste layer (under

the site covering layers) for at least 1 m - 1.5m. The distance between gas gathering bores is usually 50m - 70m and such bores are arranged in equilateral triangles.

The gas gathering bores must be fully wedged around with ductile clay and cement.

3.6. The gas-gathering and- treating areas must be surrounded with fences or signboards "For staff only".

4. Surface water and rain water drainage systems

The surface water and rain water drainage systems vary according to the BSs' terrain.

4.1. For BSs constructed in mountainous and midland regions, canals must be used to gather water, prevent water from pouring down from slopes into BSs. These canals shall function to drain rain water in the BSs.

The canals are designed with sizes based on the capacity of water pouring from nearly slopes into BSs and running out from the sites. Places where strong flood currents run must be embanked with rocks so as to prevent water on the canal banks from pouring into the BSs.

4.2. In delta regions, the BSs may be surrounded with (non-penetration) dyke systems in order to separate the BSs from surrounding areas. The dykes must be 2m - 3m higher than the flood water level, the dyke surface is 3m - 4m wide, planted with fences and trees. There must be separate systems to gather and discharge rain water into rain water drainage canals of the regions.

5. Fence and green- tree belts: The BSs must be surrounded by fences.

5.1. At the initial stage, the fences must be made of barbed wires in combination with the planting of thriving and polyrhizous plants (acanthus is a good choice) or construction of walls.

5.1. At the initial stage, the fences should be made of barbed wires in combination with the planting of green trees of polyrhizal roots, which grow quick (better the acanthi), or brick walls.

5.2. Planting green trees around BSs.

a/ Better to select trees of with large canopy, without leave fall and green all year round. The minimum height of the trees is usually equal to the height of the BSs.

b/ Green trees should be planted in land areas left unused and unoccupied land around warehouses and support works.

c/ Green trees shall also be planted along the passages from the main traffic roads leading into the BSs.

6. Communications system: The communications

system must satisfy the requirement of facilitating the operation of assorted vehicles and machinery throughout the process of operating the BSs.

6.1. Roads leading into the BSs:

a/ The roads shall be designed and constructed with grades based on the calculation of vehicle flow, tonnage and speeds according to the road designing norms set by the Ministry of Communications and Transport; the road surfaces must be wide enough with two lanes for vehicles running at the speed of 60 - 80 km/h, the top dressing must be well made for the intensity of 5 - 7 kg/cm² and well drained.

b/ Being painted with separating lines for vehicles, passers-by, rudimentary means;

c/ Built with water drainage ditches (for mountainous and midland regions).

d/ Houses are not allowed to be constructed along both sides of the roads.

e/ The roads are planted with trees on both sides.

6.2. Intra-BS roads:

a/ They must be convenient and large enough for smooth operation of vehicles and machinery.

b/ For large and very large BSs, there must be solid and semi-solid roads top-dressed with asphalt or concrete.

c/ The semi-solid roads, temporarily used as one-way run for vehicles. Vehicles enter for dumping garbage and exit on other roads, through vehicle-cleaning yards, and get out of the BSs through other entrance in order to avoid congestion and reduce dust.

d/ Temporary roads are used for entering vehicles to dump garbage; they must be built with places for easy U-turns.

7. Water supply systems: For large and very large BSs, there must be water supply systems in service of daily life of officials, employees and of production.

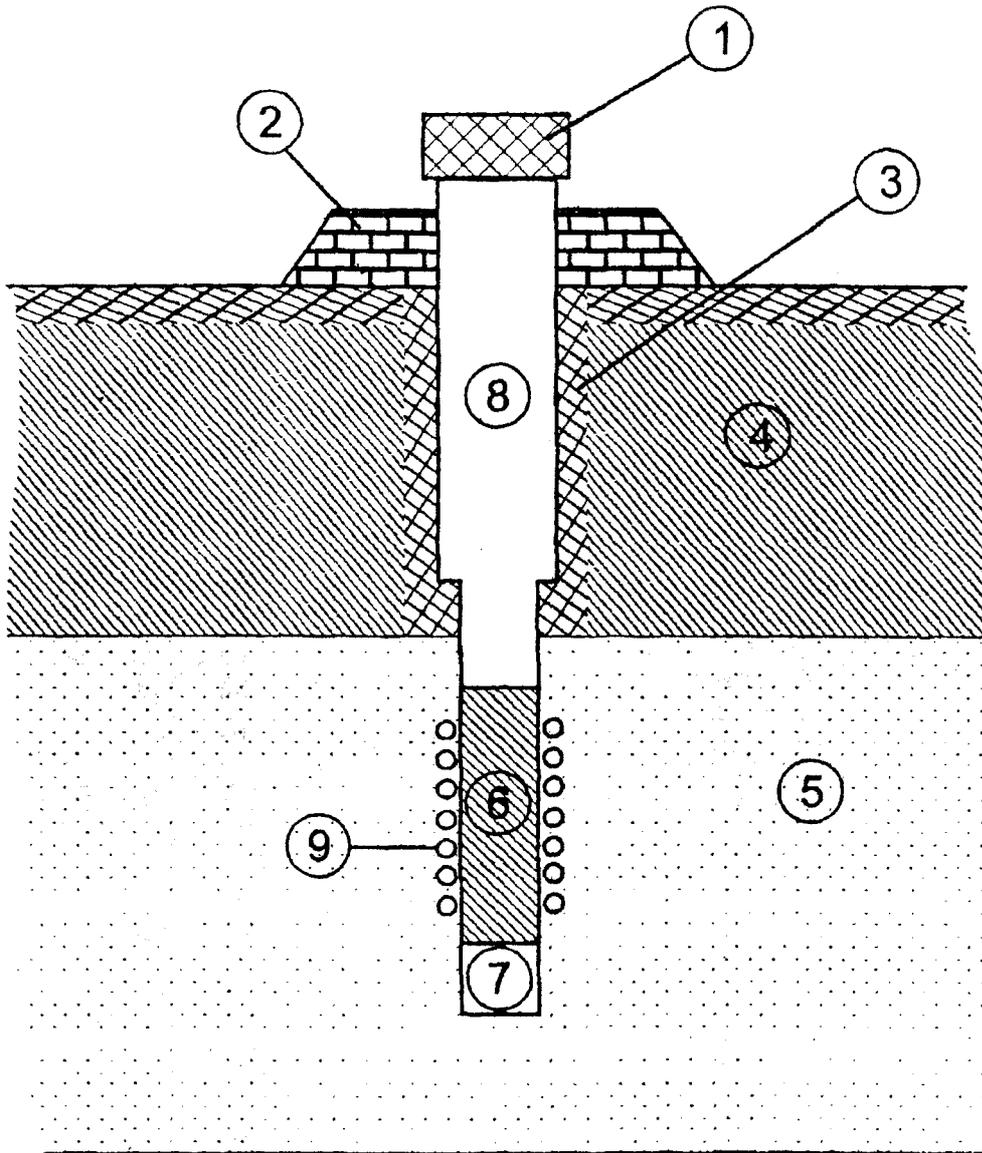
7.1. The water supply system may be constructed independently or in conjunction with the common urban water supply system.

7.2. In case of independent water supply system, it is best to use the underground water from the bores and there must be the treating system reaching the standards prescribed for the supply of water for daily life activities.

7.3. Water for production (cleaning vehicles, spraying roads, cleaning yards) are taken from the rain water drainage canals (or biological lakes after the standardized treatment); water supplied for daily life activities shall not be used for cleaning vehicles, yards. -

Appendix 7

DIAGRAM OF UNDERGROUND WATER OBSERVATION BORE



- | | |
|-------------------------|---------------------------|
| ① Protection lid | ⑥ Filtering pipe |
| ② Cement platform | ⑦ Sediment pipe |
| ③ Wedging clay | ⑧ Prop pipe |
| ④ Poorly-absorbent soil | ⑨ Reverse filtering layer |
| ⑤ Water-storing layer | |