

Preliminary site suitability screening for a potential radioactive waste facility in the Philippines

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ABSTRACT

The Philippines is advancing its Nuclear Energy Program to meet future energy demand, targeting an operational nuclear power plant (NPP) by 2032. This will require the country to have a radioactive waste management system to handle the low-level waste (LLW), intermediate-level waste (ILW), and high-level waste (HLW) generated by an active NPP. However, the country currently has insufficient facilities to manage future waste, especially HLW. This study localized the criteria developed by Japan's Ministry of Economy, Trade, and Industry (METI) to provide a preliminary nationwide screening map of scientific features relevant for deep geological repository (DGR) in the Philippines, given the geological similarities between Japan and the Philippines as tectonically active, archipelagic countries along the Pacific Ring of Fire. Using Geographic Information System (GIS), the localized criteria for relevant features such as volcanism, active faults, geothermal activity, uplift and erosion, unconsolidated sediments, coastal proximity and mineral resources were spatially analyzed to delineate the unfavorable and favorable areas for the DGR siting. Following a rule-based (unweighted) overlay classification, areas were classified based on the presence of relevant geological features which rendered an area unfavorable, preferred, and favorable. Areas with identified mineral resources were classified as unfavorable from the viewpoint of future human intrusion, whereas the presence of identified geological features such as volcanism, active faults, geothermal activity, uplift and erosion, and unconsolidated sediments has rendered an area unfavorable from the viewpoint of long-term stability. Additionally, areas within 20 km of the coast are identified as preferred from the viewpoint of safe waste transportation. Lastly, all the remaining areas are classified as favorable by the absence of the identified geological features. The resulting nationwide screening map shows that a substantial area of the country is affected by geological conditions that pose potential challenges for deep geological

repository, while also identifying areas that may warrant further investigation. The resulting map is a preliminary, unvalidated, first-stage desktop screening intended to narrow down the suitable area for further studies and the next stage of the siting process. The map is also intended to support the objectives of the Nuclear Energy Program-Inter-Agency Committee (NEP-IAC) Subcommittee 6 (SC6) and future policy development for the sustainable implementation of the Nuclear Energy Program in the country.

INTRODUCTION

Global energy demand is expected to grow substantially over the coming decade, with the demand projected to increase by more than 3.5% annually through 2030, driven by rapid population growth, industrialization, and technological developments; consequently, there is an urgent need to transition toward low-carbon energy systems to meet future demand while reducing greenhouse gas emissions (IEA 2026). Renewable energy sources such as solar and wind have been popular alternatives in many countries; however, nuclear energy has re-emerged as a strategic option for the energy transition, offering a high capacity factor, low operational carbon emissions, and the ability to provide a stable baseload power (Bautista and Cervera 2025; Erdogdu 2025).

In the Philippines, the continued reliance on imported fossil fuels to meet current energy needs and anticipated future demand underscores the need to diversify the energy sector and enhance long-term energy security. In response to these challenges, the Philippines, through Executive Order No. 164 has adopted a national position for the advancement of the Nuclear Energy Program (NEP) and established an interagency framework to prepare for its implementation. The main highlight of this program is the deployment of operational Nuclear Power Plants (NPPs) with phased entry into the energy mix of 1,200 MW by 2032, another 1,200 MW by 2035, and at least 2,400 MW by 2040 and beyond (DOE 2025). This initiative aligns with the Philippine Energy Plan

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(PEP) 2023-2050, which aims to integrate nuclear energy into the country's energy mix to enhance energy security, improve supply reliability, and reduce carbon emissions (DOE 2024). The planned deployment of NPPs, however, necessitates the development of a comprehensive radioactive waste management system, including facilities for interim storage, treatment, and final disposal of radioactive waste during reactor operation and decommissioning (Lim et al. 2026).

A deep geological repository (DGR) is one of the scientifically and internationally recognized approaches to the management of high-level radioactive waste (Unoki et al. 2025). DGRs are facilities designed to contain radioactive waste in stable underground geological sites several hundred meters below the surface, thereby preventing potential exposure to humans and the environment (McCartin et al. 2020). Countries such as Canada, Finland, and Sweden have developed advanced deep geological repository programs (Bharath Kumar and Lingaraju 2019), whereas Japan continues to develop long-term disposal strategies (Fujiyama and Kaku 2023). In the Philippines, the Philippine Nuclear Research Institute (PNRI) is the sole agency mandated to operate the national Radioactive Waste Management Facility, which provides collection, treatment, conditioning, and interim storage services for institutional radioactive wastes (DENR 1992; PNRI 2016). However, this facility is designed only for low- and intermediate-level waste from non-power applications, such as medicine, industry, agriculture, research, and education; it is not designed to accommodate the large volume and hazard level of spent nuclear fuel and high-level radioactive waste generated by an operational NPP (Panloui et al. 2021). Therefore, one prerequisite for deploying NPPs in the Philippines is identifying suitable geological sites for radioactive waste facilities capable of handling the expected wastes.

A notable example of a nationwide-scale site screening approach is the methodology developed by Japan's Ministry of Economy, Trade, and Industry (METI) for the Nationwide Map of Scientific Features Relevant for Geological Disposal. Published in 2017, this methodology provides a scientific screening framework to identify areas with relatively favorable and unfavorable characteristics for long-term geological disposal in Japan. The framework utilizes nationwide spatial analysis of scientific features, including active faults, volcanism, geothermal systems, mineral resources, uplift, and erosion (METI 2017).

Given the geological similarities between Japan and the Philippines as tectonically active, island-arc, archipelagic countries along the Pacific Ring of Fire (Zhang et al. 2022; Ansari et al. 2024), the METI framework provides a useful basis for preliminary screening of geological disposal in the Philippine context. However, it is worth noting that this study does not propose a new site-selection methodology but rather a systematic localization of an existing internationally referenced screening approach. Through substitution of Japan-specific datasets with the equivalent Philippine national datasets, a preliminary, desktop-level nationwide screening was applied.

This study aims to localize the METI scientific feature screening criteria using Philippine geological and environmental datasets and to apply this localized framework through rule-based GIS overlay analysis to produce a nationwide preliminary screening map.

MATERIALS AND METHODS

Considerations for the screening criteria

The safe disposal of high-level radioactive waste (HLW) generated from NPP operations is a critical stage to ensure the long-term

sustainability of the nuclear energy program and the protection of humans and the environment. Therefore, the appropriate design of the disposal facility is important to ensure the proper handling of waste (IAEA 2024). International practices have shown that the designs behind DGRs are based on the site-specific characteristics of the host geological environment such as host rock type, hydrogeological setting, geochemical conditions, and geothermal properties (IAEA 2011; IAEA 2020). Among the ongoing studies on DGR design concepts, four (4) have gained scientific and international recognition: crystalline rock, salt formations, volcanic tuff, and clay/shale repositories. These design concepts were created in relation to their host rock formation with each design concept having their own structural advantages, containment mechanism, and associated challenges (Unoki et al. 2025).

IAEA guidance describes the siting of radioactive waste disposal facilities as an iterative, staged progression that begins with assessment of broad or large areas, towards increasingly detailed, site-specific investigation. In the IAEA Nuclear Energy Series Technical Reports No. NW-T-1.40 "Management of Site Investigations for Radioactive Waste Disposal Facilities", the siting process is shown to consist of four (4) main stages: (1) conceptual planning stage, (2) area survey stage, (3) site investigation stage, and (4) detailed site characterization stage. The conceptual planning stage involves identifying potential suitable disposal concepts and the establishment of the initial site selection criteria that includes exclusionary criteria that will screen out areas from receiving further investigation. The area survey stage involves a review of large regions within a country that would be determined on the basis of desk-based studies that will result in some regions being screened out as unsuitable to host repository, while a smaller number of areas would proceed to the next stage as potential suitable area for radioactive waste repositories. The third stage, which is the site investigation stage is the start of ground surveys and limited borehole investigations to further narrow down the list of suitable sites, preferably one to three candidate sites. Lastly, the detailed site characterization stage is the final stage of the siting process which involves the remaining candidate sites being intensively investigated through surface based and underground surveys to come up with the final site choice for the radioactive waste repository (IAEA 2024).

The IAEA technical report also discussed two strategies for siting: (1) a site screening starting from a national map, and (2) siting approach with preferred site or list of sites with a priori favorable characteristics. The first approach as described in the technical report comprises initial desk-based studies to identify if large regions (countrywide) have the potential to host a repository. Through a series of desk-based screening strategies using exclusionary criteria the national map will be narrowed down to prospective areas that will be the subject of further studies and possibly limited field surveys. This approach follows the four (4) stages in the siting process for radioactive waste repository from conceptual planning stage to the detailed site characterization stage. The second approach involves one or a short list of sites with a priori favorable characteristics identified from previous investigations. This approach allows one to move past the four (4) stages in the siting process and proceed directly to the detailed site characterization stage (IAEA 2024).

The present study follows the first approach and corresponds to the conceptual planning stage and area survey stage of the siting process; the screening criteria were applied on a nationwide level and conceptualized without a priori identification of candidate sites or disposal facility design, using a desk-based approach grounded in international methodologies and guidelines.

This study localized the METI (2017) framework within the Philippine setting, anchored on IAEA SSG-23 ("The Safety Case and Safety Assessment for the Disposal of Radioactive Waste"), IAEA-TECDOC-563 ("Siting, Design and Construction of a Deep Geological Repository for the Disposal of High Level and Alpha Bearing Wastes"), and IAEA NW-T-1.27 ("Design Principles and Approaches for Radioactive Waste Repositories") (IAEA 2012; IAEA 1990; IAEA 2020). Features associated with geological instability, geothermal activity, groundwater movement, and potential future human intrusion were treated as unfavorable for geological disposal.

Methodological Framework

Figure 1 presents the methodological flowchart followed in this study, starting with the adoption of the METI criteria (Step 1), followed by localization to Philippine setting by collecting datasets that corresponds to the identified criteria (Step 2), GIS data processing (Step 3), rule-based overlay classification (Step 4), and production of the nationwide screening map (Step 5).

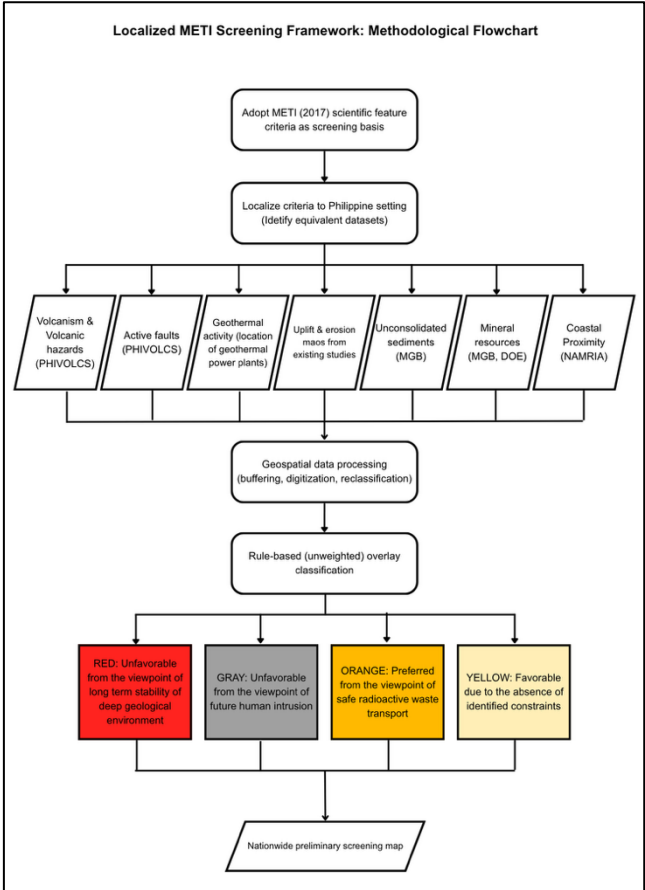


Figure 1: Methodological Flowchart of the Study

Data Collection

Spatial datasets were collected from various Philippine government agencies, such as DOST-PHIVOLCS and DENR-MGB. These datasets include information related to active faults, volcanic systems, geothermal areas, mineral resources, topography, and geomorphological conditions. Some datasets were requested directly from the relevant agencies, while others were obtained from publicly available geodatabases. In some cases where digital spatial datasets were unavailable, the relevant features were digitized from existing scientific studies, maps, and published figures. Digitization of features involved georeferencing scanned maps and manually extracting the features relevant to the study. Table 1 summarizes the localized criteria, the Philippine dataset, and the corresponding data sources.

Table 1: Summary of Localized Criteria Used in the Study (modified from METI, 2017)

Relevant Events identified by METI	Philippine Dataset	Source of Data	Localized Criteria
Criteria to identify unfavorable features			
Volcanic Activity	Active and Potentially Active Volcanoes	Philippine Institute of Volcanology and Seismology (PHIVOLCS)	Vicinity of active and potentially active volcanoes: Areas within the 15 km buffer from the center of active and potentially active volcanoes in the Philippines
Fault Activity	Active Fault System	PHIVOLCS	Vicinity of active faults: Areas within the crush zone around the active fault, which is a buffer of about 1/100 of the fault length
Uplift/Erosion	Ground Deformation Maps, Uplifted Holocene Marine Terraces Map	Published Studies (Ramos and Tsutsumi 2010; Shyu et al. 2025; Ramos et al. 2012; Sulapas et al. 2024)	Presence of uplift/erosion: Areas within identified areas of significant uplift and ground subsidence
Geothermal Activity	Location of Geothermal Power Plants (GPP)	Department of Energy (DOE)	Presence of geothermal activity: Areas within the 10 km buffer from the identified

Volcanic Fluids and Deep-Seated Fluids				coordinates of geothermal power plants in the Philippines
Unconsolidated Sediments	Quaternary Sediments from Philippine Geology	Mines and Geosciences Bureau (MGB)		Presence of unconsolidated sediments: Areas situated on the Quaternary sediments
Pyroclastic flows, etc.	Historical record of Volcanic-Induced Events	PHIVOLCS		Presence of volcanic-induced hazards: Areas with a historical record of volcanic-induced hazards
Mineral Resources	Map of Mineral Resources	DOE, MGB		Existence of mineral resources: Areas with known metallic minerals, coal fields, oil, and gas
Criteria to identify preferred features				
Transportation	Philippine Administrative Boundary	National Mapping and Resource Information Authority (NAMRIA)		Relatively short distance from the coastline: Areas within the 20 km buffer from the coastline

Vicinity of Active and Potentially Active Volcanoes/Presence of Volcanic-Induced Hazards

The distance to potential deep geological disposal sites from active or potentially active volcanoes significantly affects the long-term stability of the underground environment. Additionally, known volcanic-induced events such as pyroclastic flows and lahars may indicate the movement of these hazards; therefore, they must be excluded to ensure the facility's safety during construction and operation. Spatial data on active and potentially active volcanoes, as well as historical data on volcanic-induced events, were acquired from PHIVOLCS.

In the Philippines, PHIVOLCS has identified Permanent Danger Zones (PDZs) ranging from 4 km to 6 km around the volcanoes; these areas are strictly off-limits to the public due to the risks of explosions, lahars, rockfalls, and pyroclastic density currents (PHIVOLCS 2018). Additionally, the majority of quaternary volcanoes and lateral volcanoes have vents within a 15 km radius from the center; these vents serve as pathways for magma intrusions (METI 2017). For this study, a 15 km buffer around the centers of active and potentially active volcanoes was established to define unfavorable areas.

Vicinity of Active Faults

The deep geological disposal facility must not be located near an active fault, as tectonic activities could compromise the stability of the underground environment and the facility's long-term safety. Spatial data on active faults were obtained from PHIVOLCS. Following METI, buffer zones equivalent to 1/100 of the length of behavioral segments or seismogenic faults were delineated. The buffer zones are areas along active fault lines where rocks are fractured by seismic activity and are therefore considered unfavorable for geological disposal.

Presence of Uplift and Erosion

The presence of uplift or erosion indicates unstable ground; therefore, it is identified as an unfavorable area for the disposal facility. Due to the unavailability of digital spatial data on uplift and erosion, the relevant features were digitized from existing studies. A study by Ramos and Tsutsumi (2010) shows uplifted Holocene marine terraces in Pangasinan Province. Three (3) Holocene terrace steps were recognized, with maximum elevation measured at 11 m above mean sea level (amsl). Similarly, uplifted Holocene marine terraces in Davao Oriental Province were identified, comprising four (4) terraces with a maximum elevation of 12 m amsl (Ramos et al. 2012). Additionally, uplifted late Quaternary marine terraces were mapped along the southern coast of Bohol Island, with a calculated uplift rate of 0.1-0.4 mm/yr (Shyu et al. 2025). Lastly, Sulapas et al. (2024) have identified ground subsidence in major Philippine metropolitan cities from

2014 to 2020, with results showing a subsidence rate of 109 mm/yr in Bulacan Province; 11 mm/yr in Metro Cebu; 38 mm/yr in Metro Davao; 9 mm/yr in Metro Iloilo; and 29 mm/yr in Legazpi City.

Presence of Geothermal Activity

In the METI framework, geothermal activity refers to areas with significant underground heat, specifically those with geothermal gradients greater than 15 °C/100 m, which can raise underground temperatures. Additionally, volcanic hydrothermal fluids and deep-seated fluids refer to the movement of hot fluids with unfavorable chemistry, particularly in groundwater areas where pH is less than 4.8. All of these processes indicate a thermally active subsurface, which can affect the underground environment and therefore must be excluded.

The present study uses a buffer of 10 km around the locations of geothermal power plants as an alternative data source because no data are publicly available on geothermal gradients, hydrothermal fluids, or deep-seated fluids in the Philippines. The presence of geothermal power plants is an indicator of active geothermal activity, a hydrothermal system, and deep-seated fluid movement underground (Siler and Pepin 2021; Munawar et al. 2022).

Presence of Unconsolidated Sediments

Quaternary sediments are geologically young deposits formed during the Quaternary period, spanning from ~2.6 million years ago to the present (Elias 2013). In the Philippines, these sediments are characterized as unconsolidated to weakly consolidated and formed by recent tectonic and volcanic activity; they commonly consist of sand, gravel, silt, clay, alluvium, pyroclastic materials, and coral limestone deposits (King and McKee 1949). In this study, geospatial data on Quaternary sediments were extracted from the MGB geological map of the Philippines.

Existence of Mineral Resources

Areas with economically valuable mineral resources were identified as unfavorable for geological disposal due to the potential for future human intrusion associated with exploration and extraction activities. In this study, geospatial data on delineated metallic and non-metallic mining tenements from the MGB were used. These tenement maps include the approved agreements and contracts for exploration, permits, applications, and small-scale mining. Moreover, data on coal and petroleum resources were extracted by digitizing the DOE Coal Operating Contract (COC) map and the Pre-Determined Areas (PDAs) for Petroleum Development and Production map.

Relatively Short Distance from the Coastline

To protect the public from potential radiation exposure and to ensure nuclear security, Japan preferred marine transport for its

radioactive waste (METI 2017). Therefore, areas closer to the coastline were preferred for geological disposal. For the Philippines, no decision on transport strategies has been made to date; however, following the METI framework, this study delineated a 20-km-wide area along the coastline as the preferred site for geological disposal.

Classification of criteria/Assignment of screening categories
Following the METI framework, the identified local scientific features were classified based on their potential influence on repository performance. Features associated with geological instability, geothermal activity, groundwater movement, and possible future human intrusion were considered unfavorable for geological disposal. Localized datasets equivalent to those used in the METI study were collected, processed, and analyzed using Geographic Information System (GIS) techniques. Figure 2 shows the framework used in this study to classify areas. Consequently, a rule-based classification was performed in this study such that four (4) map categories were assigned reflecting the classification of features – Red for unfavorable areas due to geological instability, Gray for unfavorable areas due to possible future human intrusion,

Orange for preferred areas due to safe radioactive waste transport, and Yellow for favorable areas due to absence of any geological constraints. This level of classification is consistent with the exclusionary logic of the METI framework, as well as the recommended screening methodology of IAEA (2011) for the conceptual planning stage and area survey stage of the siting process. Table 2 shows the summary of assignment of screening map categories.

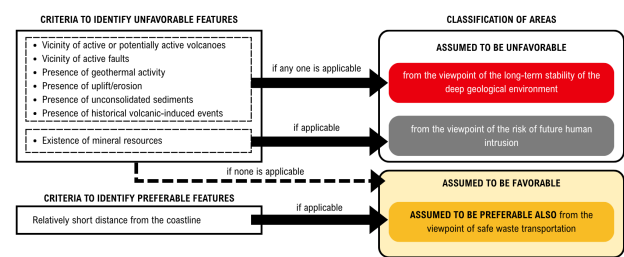


Figure 2: Classification of Areas in Terms of Scientific Features (modified from METI, 2017)

Table 2: Basis for Assignment of Screening Map Categories

Category	Assignment Rule	Rationale
Red – Unfavorable from the viewpoint of the long-term stability of the deep geological environment	Assigned wherever the area intersects any one or more of the following geological features: - Buffer of active and potentially active volcanoes - Buffer of active faults - Buffer of geothermal power plants - Uplift/erosion - Unconsolidated sediments - Historical record of Volcanic-Induced Events (pyroclastic flows, lahars, etc.)	The features in these areas may undermine the long-term stability of the deep geological environment and the safety of the facility.
Gray – Unfavorable from the viewpoint of the risk of future human intrusions	Assigned wherever the area intersects any one or more of the following geological features: - Delineated mineral tenements - Coal operating contract areas, - Petroleum pre-determined areas.	These areas have potential for future human intrusions due to the presence of mineral resources, and are therefore unsuitable for long-term operation of a deep geological repository.
Orange – Preferred from the viewpoint of safe radioactive waste transport	Assigned to areas within the 20 km coastal buffer that are not already classified Red or Gray.	These areas are preferred due to the proximity to the coast and marine transportation which is the preference for radioactive waste to limit the risk of public exposure during transport.
Yellow – Favorable due to absence of geological constraints	All remaining areas not classified Red, Gray, or Orange.	These areas are favorable due to the absence of unfavorable geological constraints.

GIS-Based Spatial Analysis

The collected thematic datasets, representing individual layers, were standardized and integrated into a GIS environment using QGIS software. GIS techniques were applied to each layer to meet the criteria for identifying unfavorable features, and georeferenced layers were then projected into a common coordinate reference system. Rule-based overlay analysis was performed to identify areas where unfavorable scientific features overlap and delineate areas assumed to be favorable. Figure 3 shows the collection of geospatial layers used in the study.

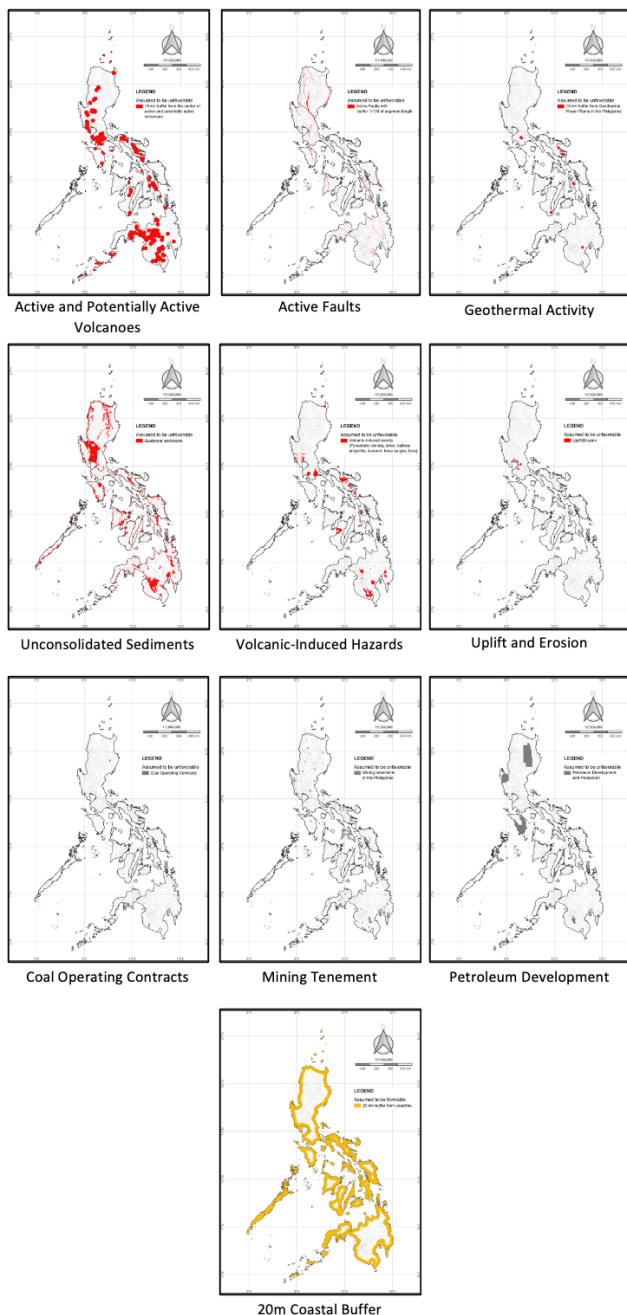


Figure 3: Collection of Geospatial Layers/Criteria Used in the Study

RESULTS AND DISCUSSION

Preliminary desktop-level screening is the recommended first step in the repository siting process, used to evaluate the potential of extensive regions such as countrywide to host a repository and to screen out unfavorable areas, prior to more extensive regional and site-specific investigation (IAEA 2024). In this assessment, a localized METI framework was used as a preliminary screening tool to produce a countrywide assessment of potential sites for radioactive waste facilities, based on geological and environmental conditions relevant to deep geologic disposal. The analysis of scientific features produced a preliminary nationwide screening map showing the favorable and unfavorable areas for siting deep geological disposal. The resulting map, shown in Figure 4, delineates areas based on the presence of relevant geological features that may affect the long-term stability and safety of a potential deep geological disposal facility (METI 2017).

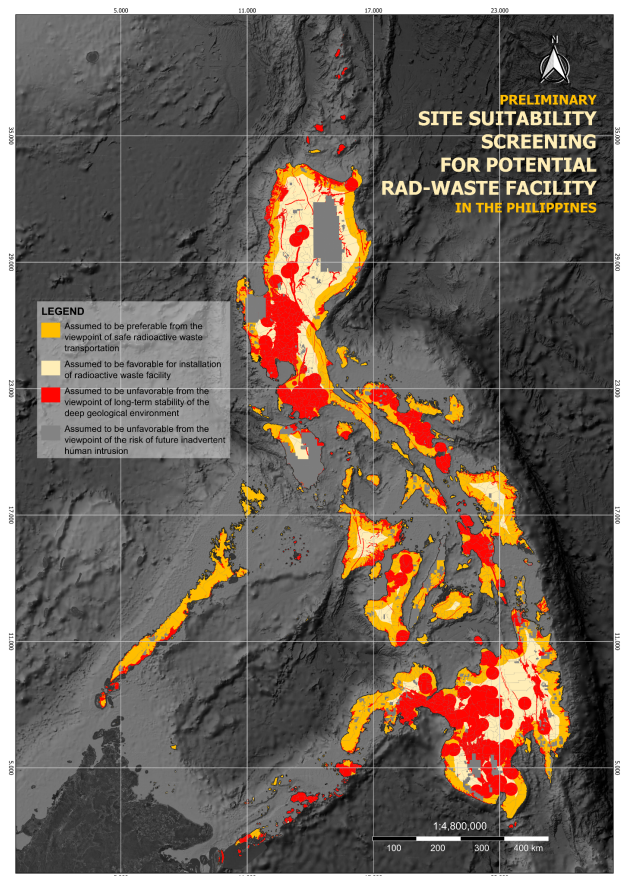


Figure 4: Map of Preliminary Site Suitability Screening for a Potential Radioactive Waste Facility in the Philippines

Areas shown in red are classified as unfavorable because they contain features that may undermine the long-term stability of the deep geological environment and the safety of the facility. These include volcanic activity, active faults, geothermal activity, uplift and erosion, and unconsolidated sediments. Volcanic processes, especially magma intrusion and eruption, can disrupt the underground environment and reduce the facility's ability to isolate waste. Volcanic hazards such as pyroclastic flows, lahars, and ballistic projectiles may also threaten safety during construction and operation (IAEA 2024; METI 2017). Active faults can cause ground rupture and seismic activity, while uplift and erosion can change repository depth, all of which may impair long-term stability and containment. While geothermal gradient datasets are not readily available, this study used geothermal power plants as proxies for geothermal activity, indicating elevated subsurface heat that may exceed disposal design limits (METI 2017). Hydrothermal systems and deep-seated fluid movement may also weaken disposal barriers and increase the potential for radionuclide transport (METI 2017; Chang et al. 2022). Unconsolidated sediments were likewise identified as unfavorable because their weak and unstable nature can compromise facility safety during construction and operation (METI 2017; Alim et al. 2026).

Areas shown in gray indicate unfavorable conditions due to the potential for future human intrusion and are therefore unsuitable for long-term operation of a deep geological disposal facility. These areas primarily correspond to the identified mineral and petroleum resources that may be explored and extracted in the future (Kim et al. 2023). The map also shows orange areas, which are preferred areas from the viewpoint of safe transportation of radioactive waste. These areas are relatively close to the coastline because marine transport is preferred for radioactive waste to limit the risk of public exposure (METI 2017). Lastly, the yellow areas

represent regions identified as favorable due to the absence of the identified unfavorable geological features.

Table 3. Total Area of Each Classification

Land Area	Area in km ²	Area in %
Philippines	295,856.81	100%
Unfavorable from the viewpoint of the long-term stability of the deep geological environment	102,932.90	34.79%
Unfavorable from the viewpoint of the risk of future human intrusions	31,604.45	10.68%
Preferred from the viewpoint of safe radioactive waste transport	104,830.75	35.43%
Favorable due to absence of geological constraints	56,488.71	19.09%

The nationwide screening shows that 34.79% of the Philippines are affected by geological conditions that may pose challenges for deep geological disposal, whereas 10.68% is susceptible to human intrusion. The screening also identifies 35.43% of preferred areas and 19.09% with favorable conditions that may warrant further investigation for deep geological disposal siting. In essence, the red and gray areas are screened out as unsuitable and may be excluded from the next stages of the siting process, whereas orange and yellow areas are considered suitable for further study.

CONCLUSION

The nationwide screening map produced in this study provides a preliminary scientific assessment of geological and environmental conditions relevant to deep geological disposal in the Philippines and can serve as input to identify key areas suitable for the next stages of the siting process. By localizing the METI criteria using national datasets, the study delineated areas that are favorable or unfavorable for deep geological disposal. The results show that large portions of the Philippines are affected by geological conditions that may pose challenges for deep geological disposal, as well as by areas susceptible to future human intrusion, while also identifying areas with favorable conditions that may warrant further investigation. Volcanic activity, active faults, uplift and erosion, unconsolidated sediments, geothermal activity, and mineral resources were identified as key factors affecting the stability, safety, and isolation of a disposal facility. However, the resulting map should not be interpreted as a final site suitability assessment, as the analysis was intended only as a preliminary nationwide screening to identify areas that can be subjected to future detailed site suitability assessment, investigations, and site characterization studies.

The localized and modified METI framework proves applicable as an initial step for desktop-level nationwide screening of deep geological repository facility siting in the Philippines. The substitution of most METI criteria with the localized datasets or proxies, allowed the study to accomplish the main purpose of the national screening, which is to identify key features that act as exclusionary criteria to screen out unsuitable areas, while identifying the remaining areas that are suitable for the next stages of the siting process. By employing the modified METI framework, this study narrowed down the areas that may be suitable for deep geological depository facility in the Philippines, which is important for a country that currently has no candidate sites for radioactive waste facilities.

In addition, this preliminary investigation also reveals the need for more detailed nationwide and regional-scale uplift and subsidence studies to address the limited data on uplift and the absence of erosion values for the Philippines, both of which are important inputs for the siting process. Publicly available data on geothermal gradients and delimitation of tenements for both mineral and petroleum resources would further improve the suitability map. Application of GIS-based analytical hierarchy process and multi-criteria decision analysis could further optimize the overall site selection and ranking.

Future work and the next phase of siting activities should involve comprehensive site-specific investigations, including detailed geological, hydrogeological, geophysical, geochemical, and environmental studies, as well as long-term safety assessments and public consultations. The results of this investigation may serve as a first-level scientific reference for future radioactive waste management planning and deep geological disposal research in the Philippines.

Finally, it must be emphasized that the map presented in this study has not undergone field validation and should not be interpreted as a final or validated site suitability determination. It is intended strictly as a preliminary screening tool for the conceptual planning stage and area survey stage of the siting process to identify areas for the next stages of investigation.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

CAPP: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – original draft, review & editing. **RNMQ:** Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – original draft, review & editing. **ADCP:** Conceptualization, Methodology, Writing – review & editing. **REP:** Conceptualization, Formal Analysis, Supervision, Writing - review & editing, Funding acquisition. **JOS:** Conceptualization, Formal Analysis, Writing – review & editing. **ATBVII:** Writing – review & editing, Supervision, Funding acquisition.

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