

**Application of GIS in the selection of a suitable site for a Hazardous
Waste landfills**

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CRP 514: Introduction to GIS

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Outlines

- Introduction
- Criteria's for Hazardous Waste site selection
- Objectives
- Study Area
- Methodology of study
- GIS TECHNIQUES
- Discussion and Conclusion

□ Introduction

- o What is hazardous waste?
- o Hazardous solid waste management is considered as one of the most serious environmental problems confronting municipal authorities in developing countries.
- o Hazardous waste has high ability of threatening and degrading environmental resources.
- o Fore example polluting air through noxious smell, polluting surface and underground water through seepage of deposited and decomposed wastes if not properly managed

❑ **Site Selection** for disposal of hazardous waste requires consideration of numerous geographic factors.

❑ Use of a Geographic Information System (GIS) can facilitate examination of interaction between site-related factors to determine the best location of hazardous wastes to be land filled

❑ By applying GIS techniques it possible to find a suitable Landfill site for the disposal of Hazardous waste generated from Qazvin province (Iran)

❑ Criteria's for Hazardous Waste site selection

An ideal hazardous waste site should meet the following requirements

- ❖ Confirming with the land use planning and zoning of the local area.

- ❖ Easily accessible in all weather conditions to the type of transportation that will be used during the operation.

- ❖ Having secured safeguards against any potential air, surface water and ground water pollution.

- ❖ Acceptability with respect to the sensitivities of the residents

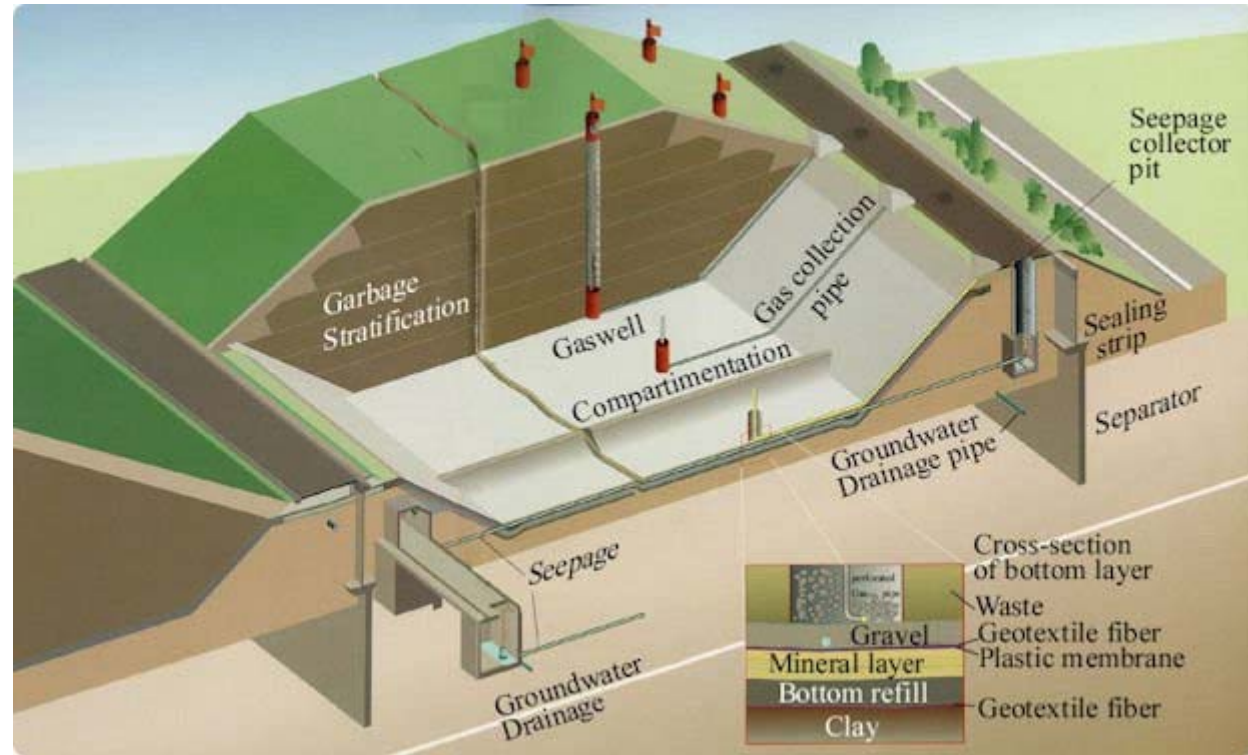
❑ Criteria's for Hazardous Waste site selection

❖ Cost-effective and economically profitable, while complying with applicable rules and regulations.sss

❖ Located where the operation is not likely to induce adverse impact on the environmentally sensitive resources.

❖ Large enough to accept and process hazardous wastes during the life of the operation.

IDEAL HAZARDOUS WASTE LANDFILL

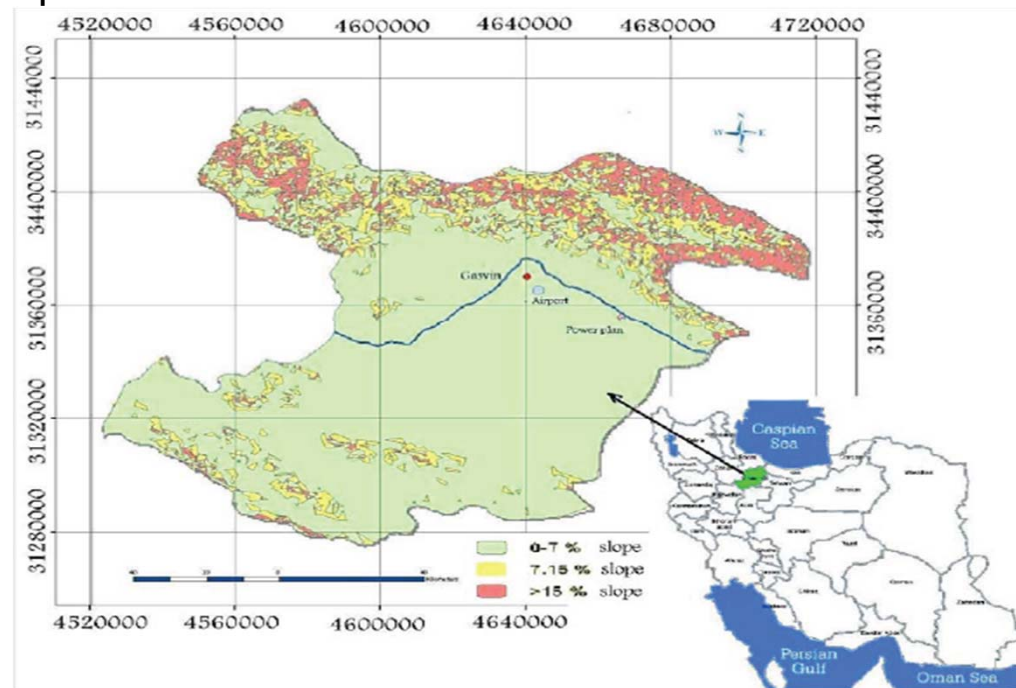


❑ Objectives

- ✓ Understanding the usage of GIS to find and select the suitable site of Hazardous waste landfills
- ✓ Extrapolation of the findings to the current situation in Hazardous waste management in Saudi Arabia
- ✓ To recommend suitable practice for regulation purposes.

□ Study Area

- This study was conducted for Shahid Rajaee power plant which is located at western central part of Iran 100 km off Tehran
- Location of Qazvin province



□ Methodology of study

- Utilized GIS to create the digital geo database as a spatial clustering process and easily understood way for landfill sitting in Qazvin plant, Iran.
- The methodology utilizes GIS to evaluate the entire region, based on certain evaluation criteria for the
- Physical Criteria Topography Soil and geology characteristics Climate Environmental Criteria
- Vegetation maps surface and ground water characteristics specific environmental zone Residential zones social-economical Criteria
- Accessibility distance to residential areas distance to water resources Technical Criteria applicability Waste transport

☐ Methodology of study

1. Physical Criteria	<ul style="list-style-type: none">• Topography• Soil and geology characteristics• Climate
2.Environmental Criteria	<ul style="list-style-type: none">• Vegetation maps• surface and ground water characteristics• specific environmental zone• Residential zones
3.social-economical Criteria	<ul style="list-style-type: none">• Accessibility• distance to residential areas• distance to water resources
4.Technical Criteria	<ul style="list-style-type: none">• Applicability• Waste transport

□ GIS TECHNIQUES

- The final site selection map is prepared by using over layer technique based on the selected criteria and sub-criteria.
- This technique is an approach that includes various features of the study region (Geology, Topography, Soil, Climate, Etc.) that makes joint comparison possible through GIS software.
- For developing of the digital GIS database, large varieties of maps in two scales were used as separated information layers.
- The methodology consists of the following steps:
 - (a) Development of a digital GIS database, includes all information layers in 1:250,000-scale maps
 - (b) Development of a digital GIS database includes detail information layer of some zones in 1:25,000-scale maps.

GIS TECHNIQUES

- The methodology consists of the following steps:
 - (a) Development of a digital GIS database, includes all information layers in 1:250,000-scale maps
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□ ***Priority Processing***

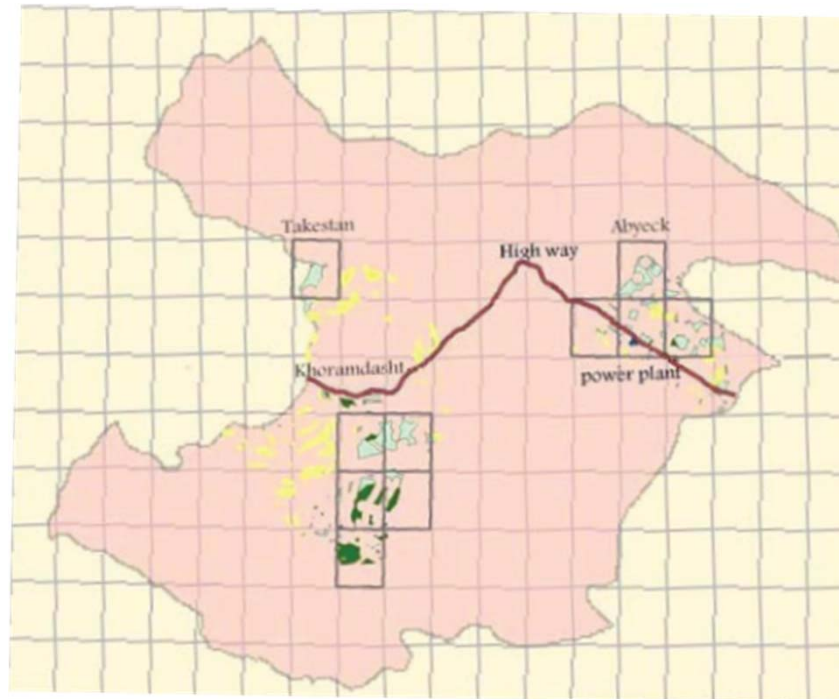
❖ The most important factor in selecting proper site for land filling for Hazardous materials is the vulnerability of these sites to contaminate groundwater.

❖ DRASTIC is an empirical method that was developed by the US Environmental Protection Agency (US EPA) for evaluating the pollution potential of groundwater systems on a

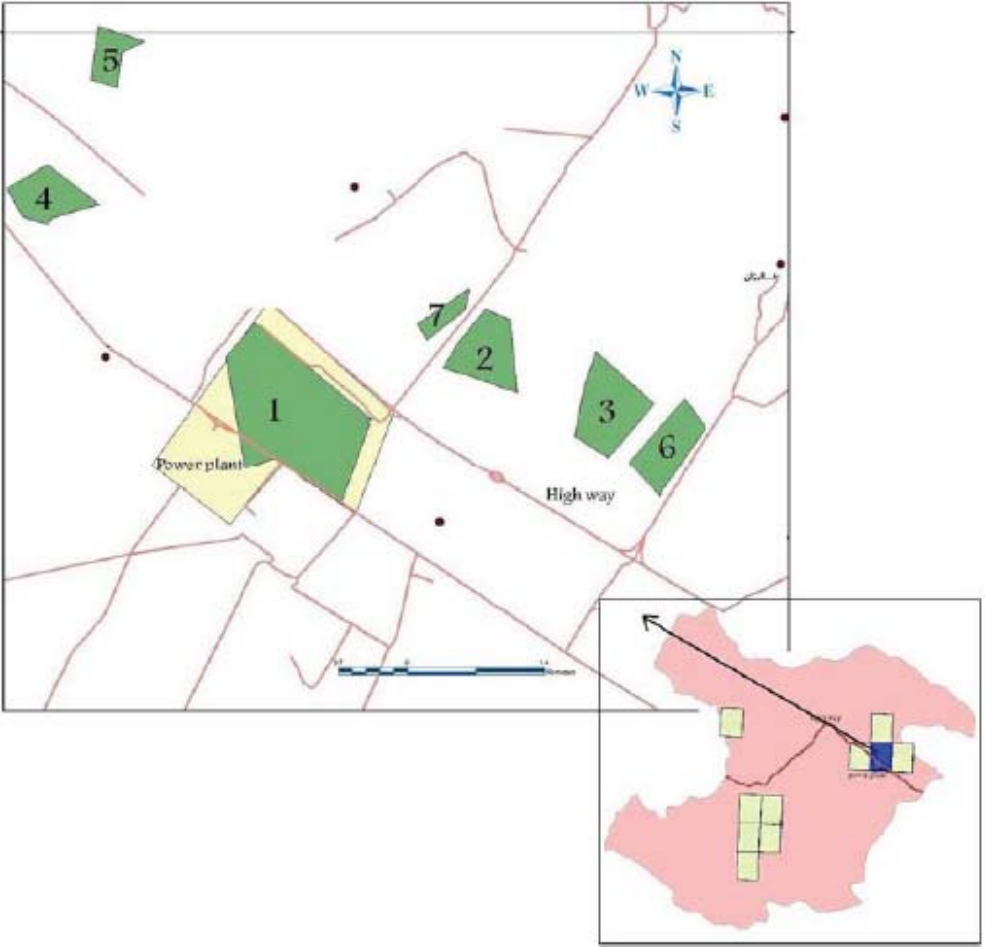
Parameters and their assigned weights in DRASTIC Method

Number	Parameters	weight
1	Depth to water table	5
2	Net recharge	4
3	Aquifer media	3
4	Type of soil	2
5	Topography	1
6	Impact of the vadose zone	5
7	Hydraulic conductivity	3

□ Candidate areas in Phase 1 site selection processes

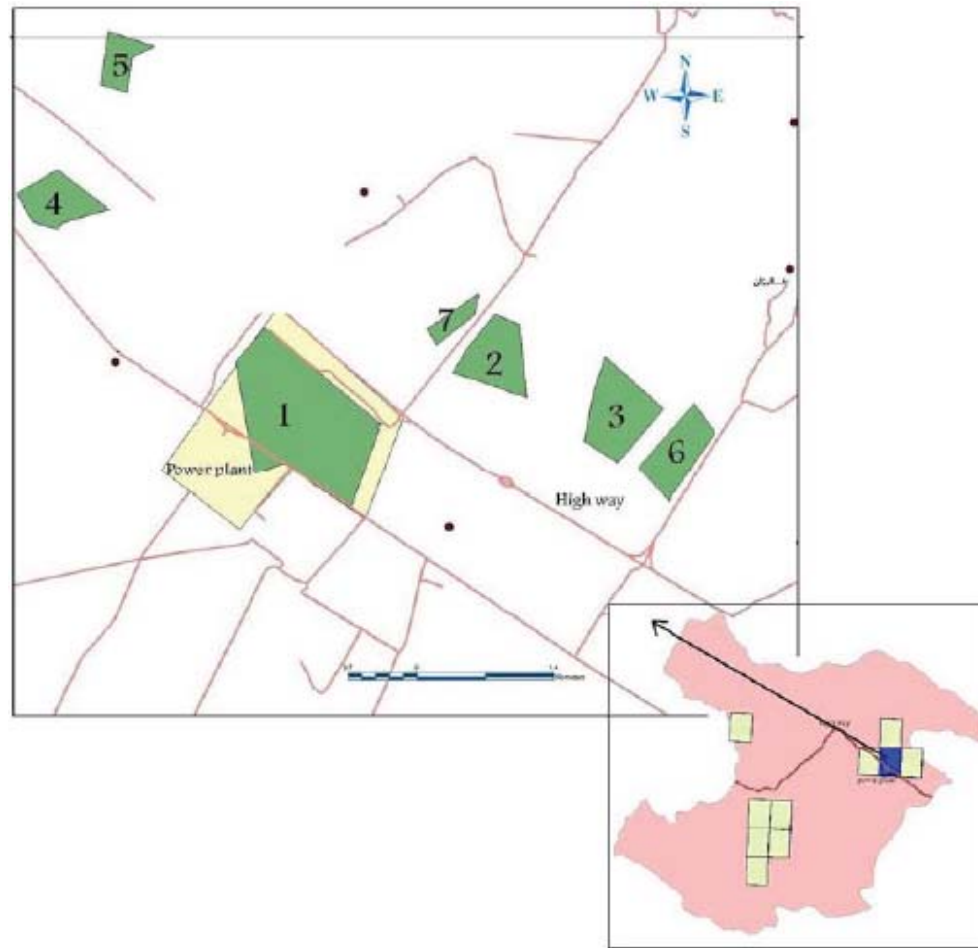


☐Candidate Landfills in Abyeck area



- ❑ Six determinative and seven conditional factors For developed method method

Number	Determinative Criteria	Conditional Criteria
1	Minimum 305 meters distance from any lake or pool	Minimum 305 meters distance from road, parks and residential area
2	Minimum 92 meters distance from any river or channel	No threat to any water resources pollution
3	Distance from area with 100 year retention period flood	Avoiding from area with high erosion and drainage
4	Avoiding from wetlands	No threat to drinking water storage
5	Do not cumulate birds in sensitive area around airport	No threat to ground water resources contamination
6	Distance from area with limestone ground and caves	Constructed with enough precaution consideration
7	-	Feasibility of monitoring and sampling of ground water



□ Social, Economic, Environmental-Technical criteria and their assigned weight in the developed method

Social-Economical criteria		
Number	Title	Weight
1	Distance from waste generation source	5
2	Easily owning	4
3	Distance from residential area	4
4	Easily access	3
Environmental - technical criteria		
Number	Title	Weight
1	Depth of ground water level	5
2	Ground water monitoring feasibility	3
3	Rain fall and run off	3
4	Soil type	4
5	Seismic activity	4
6	Distance from mines and industrial areas	3
7	Distance from sensitive environmental areas	3
8	Land Slope	3

□ Ranges and scores for the two sub criteria

Distance from waste generation source	
Distance(km)	Score
<2	10
2-5	8
5-15	6
15-30	4
30-60	2
>60	0
Slope	
Rang (%)	Score
0-3%	10
3-7%	7
7-10%	3
>10%	0

Ranges and scores for the two sub criteria

Social-Economical criteria											
Title	Site 1			Site 9			Site 14				
	weight	score	utilitarian	weight	score	utilitarian	weight	score	utilitarian		
Distance from waste generation source	5	10	50	5	0	0	5	0	0		
Easily owning	4	10	40	4	5	20	4	5	20		
Distance from residential areas	4	5	20	4	2.5	10	4	2.5	10		
Easily access	1	10	30	1	6	18	1	6	18		
Environmental -Technical criteria											
Depth of ground water level	5	10	50	5	10	50	5	7	35		
Ground water monitoring feasibility	3	10	30	3	5	15	3	0	0		
Rain fall and run off	3	3	9	3	6	18	3	6	18		
Soil type	4	10	40	4	10	40	4	5	20		
Seismic activity	4	7	21	4	10	30	4	10	30		
Distance from mines and industrial areas	3	10	30	3	0	0	3	5	15		
Distance from sensitive environmental areas	3	7	21	3	7	21	3	3	9		
Land Slop	3	10	30	3	10	30	3	7	21		
Total Score			371	Total Score			252	Total Score			196

□ Score of each site among each site.

Site	Abyeck zone							Khoramdasht zone						Takestan zone			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Score	371	324	308	288	288	294	304	186	252	242	196	205	252	196	195	174	186

□ Discussion and Conclusion

- ✓ This paper used a multidisciplinary approach based on GIS screening map and priority analysis to develop a GIS database and maps with two scales (1:250000 and 1:25000).
- ✓ Saudi Arabia due to the expansion in industrial and urbanization developments need to develop secure landfills to store all hazardous and toxic materials and utilize similar methodologies presented in this study to prevent any contamination on the much dependable groundwater.
- ✓ GIS is one of the most efficient tools that should be utilized by specialists to study and formulate appropriate landfill site selection application, which will facilitate decision makers in the technicality of landfill selection processes.

Thank You