



GIS bring us together



**Early Warning Case Study for
Al-Qurain Landfill Area Fires
in Kuwait
Through Using Geographic
Information
System Technology**

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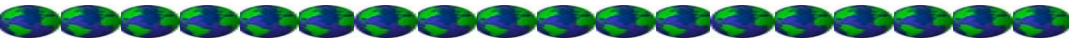
Fax : 965 - 4820579

**Disaster Relief and Management
Alexandria (Egypt), 14-17 April 2007**

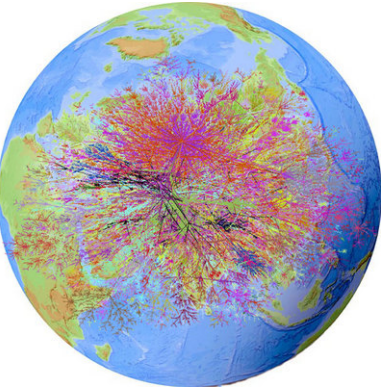


2007

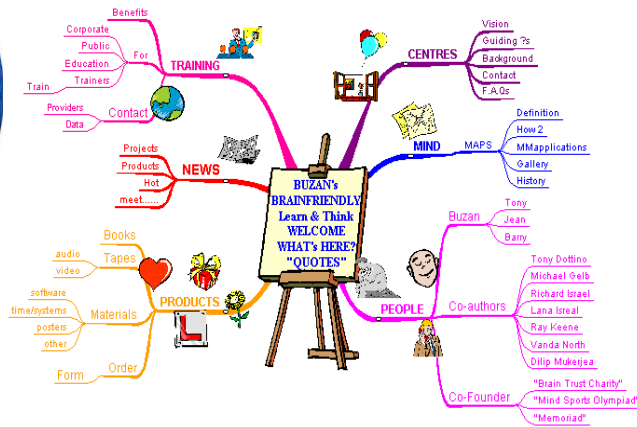
Types of Maps



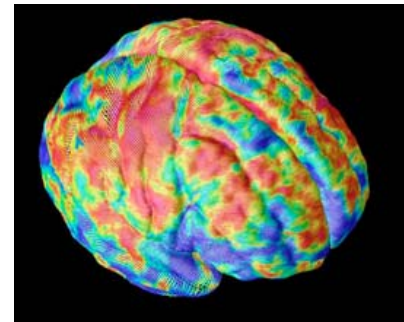
Internet Map



Mind Map



Brain Map



Heart Map



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But we are using another kind of Maps

Computerize maps

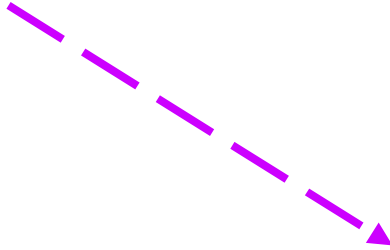
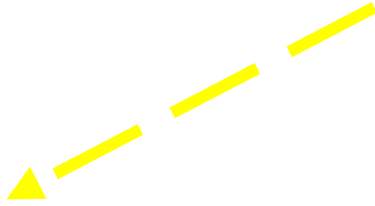


- The State of Kuwait occupy the Northeastern part of Arabian Peninsula Bounded on the north & west by Iraq & on the west & south by Saudi Arabia
- It has approximately 500km of coast line
- Has surface area of ~ 18,000 Km²
- Total population of Kuwait ~ 2.5 million in 2003, where the Kuwaiti nationality is ~ 1million





The Problem



During the 1970's with the absence of regulations and legislations to organize the dumping of domestic waste, Kuwait Municipality was Casting quantities of municipal and construction wastes without planning.

Community Complains ...



Citizens are the affected Party

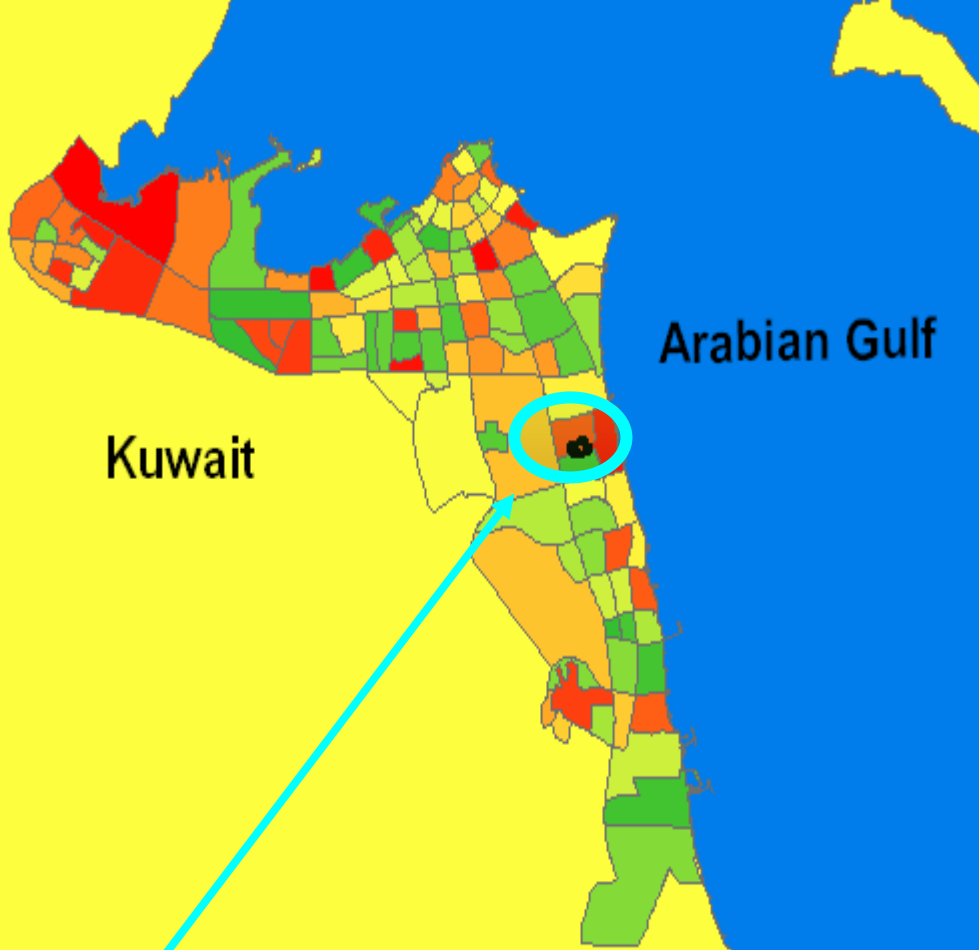


The Establishment of Environment Public Authority has big rule in stopping the old and primitive ways to manage the waste, and substituted with new Criteria and scientific systems for protecting the environment & eliminate the damage from the existing landfills .



Where is the Landfill?

What size ?
one square km



Kuwait

Arabian Gulf

Located 15 km
south
of Kuwait city



Site Description



Occupied
approx
1km²

Contains ~ 5
million
Cubic Meters of
solid waste

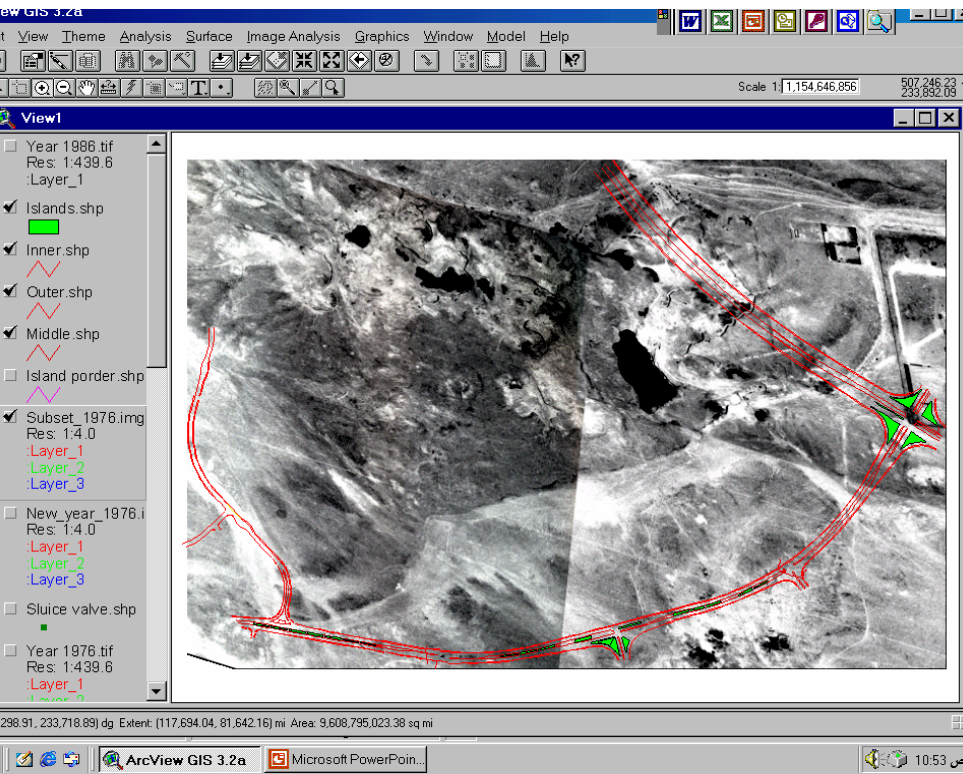


The site was
Utilized As a
sanitary solid waste
disposal site from
1975-1985

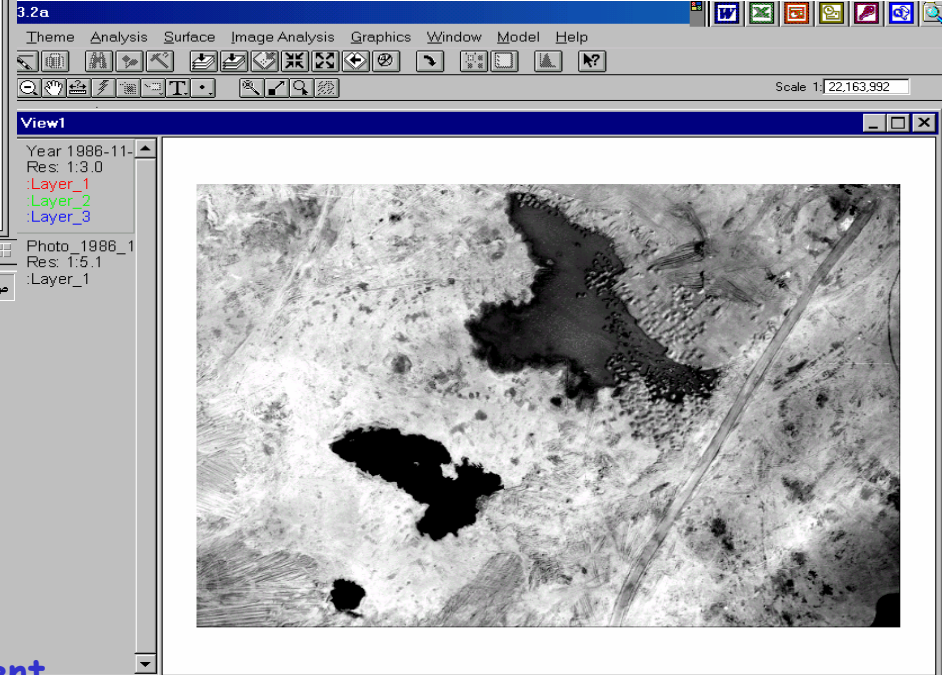
Wastes Are Primarily
Domestic Garbage,
Construction &
Industrial

Waste varies in
Depth from 6m
On the edge to
24 m in the
center

Aerial photography of the area in 1976

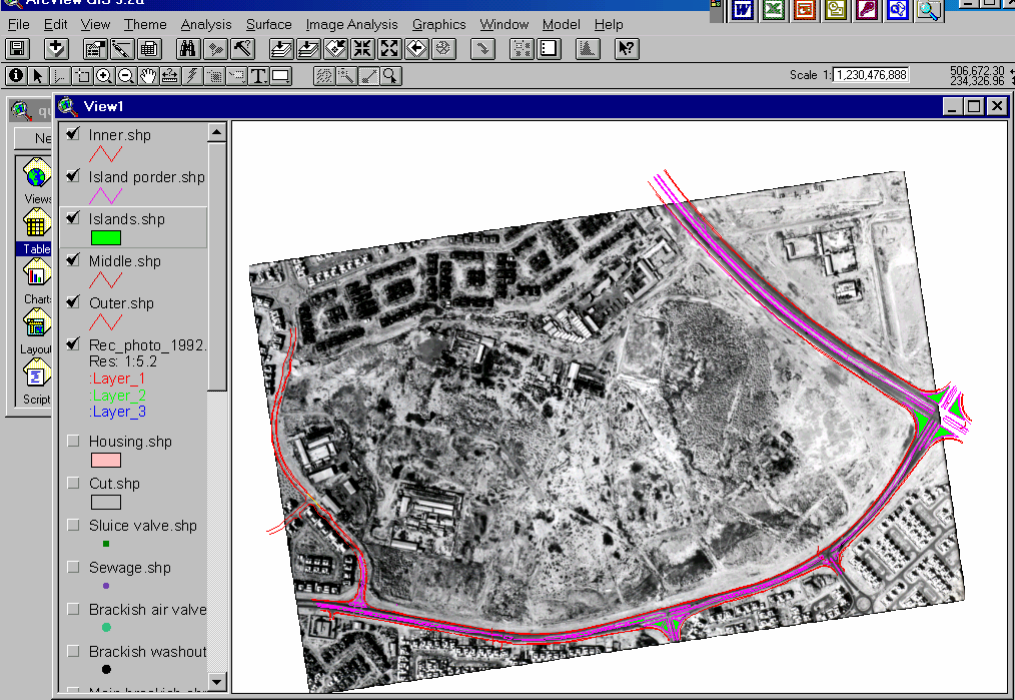


In the Past : It was an Open area, any one can cast waste in this area .



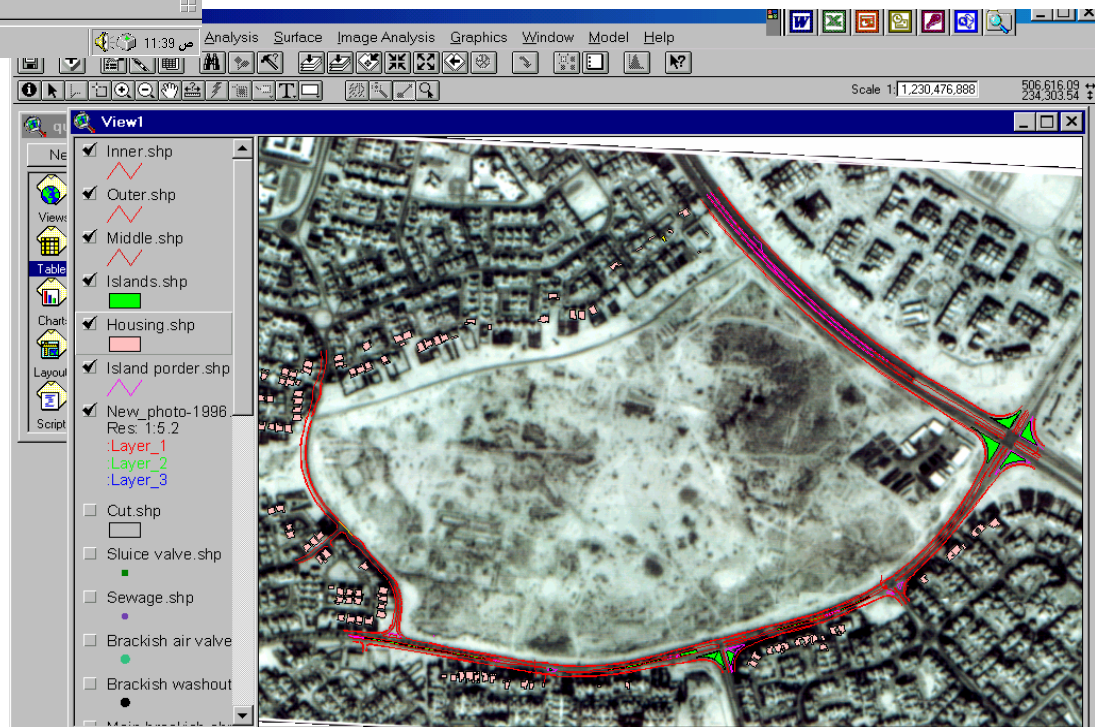
Aerial photography in The Beginning of 80's ...

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Aerial photography for
year 92

Start ArcView GIS 3.2a Microsoft PowerPoin...



Aerial photography for
year 96

With the fast urban development and expanding of Kuwait society, one of these dumping areas been designated as a residential area



When Environment Public Authority been established on 1996 to carry out all activities and functions to ensure the protection of the environment in the state ,,

It considered the Qurain Landfill area one of its priorities to clean and rehabilitate for the sake of health & safety of the inhabitants.





Land Sat Images

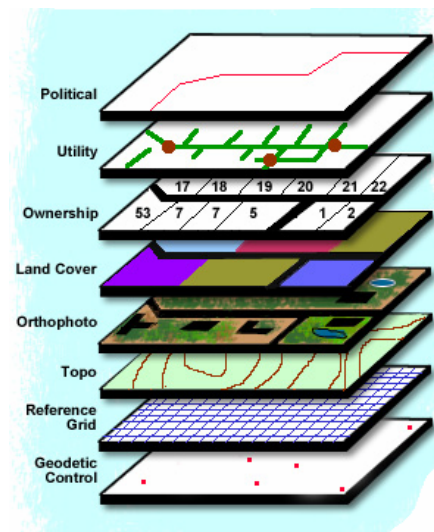


Main Objectives



- Build up a complete Spatial database for the Landfill area .

• Create hazard zones maps that integrate different data layers With population information.



Also, to present the information in a way that a non-technical staff can understand

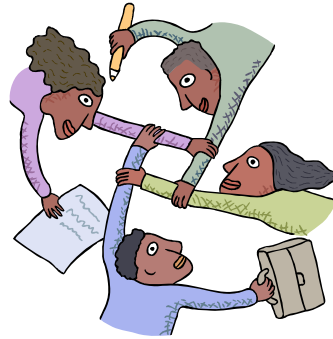


Qurain Community under Threat



The dumping area is threat to the community,

major health & safety and to Environment



Due to :

Biodegradation
Of organic
Matter &
bad odors
releases

Huge pressure
from generated
gases mainly
Methane CH₄
which can
lead to
Fire hazards

Pollution to
air ,
Water
&
land

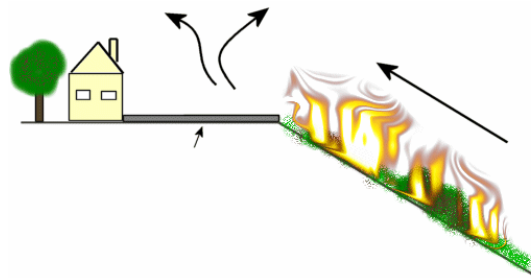
Note

Since it's an ignored site with piles of waste without any control, the area become suitable for illegal activities

When Fire Occurs



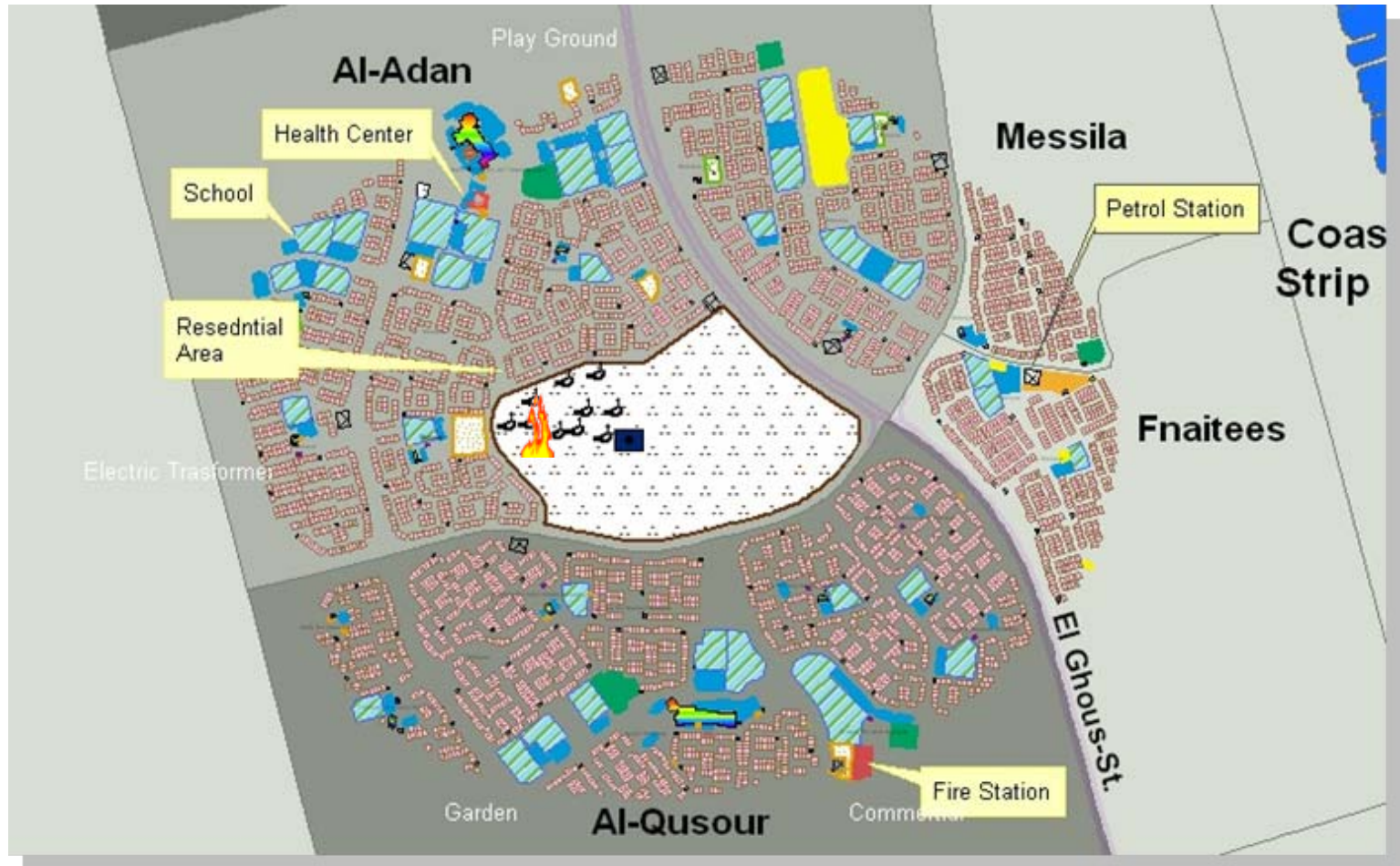
Usually a fire incident can occur when children playing in the landfill site throwing some matches on these cracks for fun.



In case of fire breaks out, EPA will contact the fire department who is already familiar with this case as EPA meets on a regular basis and discuss these matters with the fire department.



Fire Locations



Once the flame stops, it eventually causes odors to arise, and the cracks been covered by soil

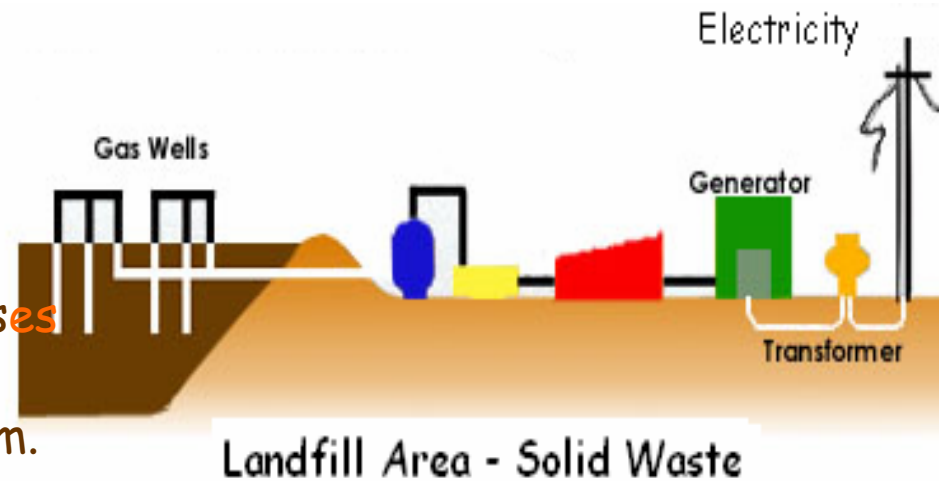
The project been implemented in 2 directions: Field work & Office work

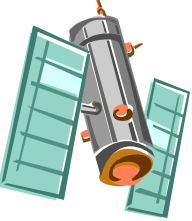


Field work

EPA action plan - Rehabilitation :

- 1- Removing the surface waste
- 2- Drill ~ 300 wells (boreholes) in Al-Qurain area & near the residential houses
- 3- Accumulate the gases by network system.
- 4- Establishing the complete gas network to use the flow of gases in producing electricity by the generator system





Office work:



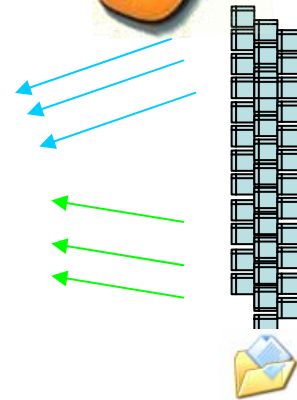
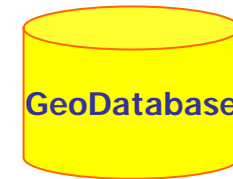
Gather data

- The data been collected on site by mobile lab recording the gases emission such as, Methane, Carbon Dioxide and Flow rate, Ethane, Ethylene, Propane.
- Also, measurement of soil capacity & underground soil characterization
- Using GPS points to locate the bore holes



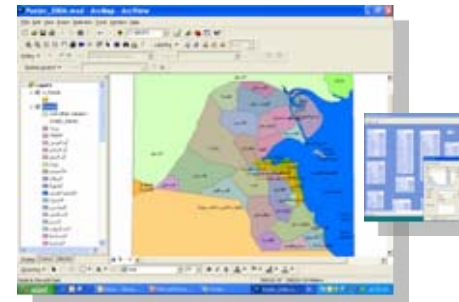
Analyze data

- The Data are stored in simple geo-database
- Using GIS-System to evaluate the situation & create different scenarios to reach best decision.



Present results

Create information products as Maps ,Tabular Data & Reports.

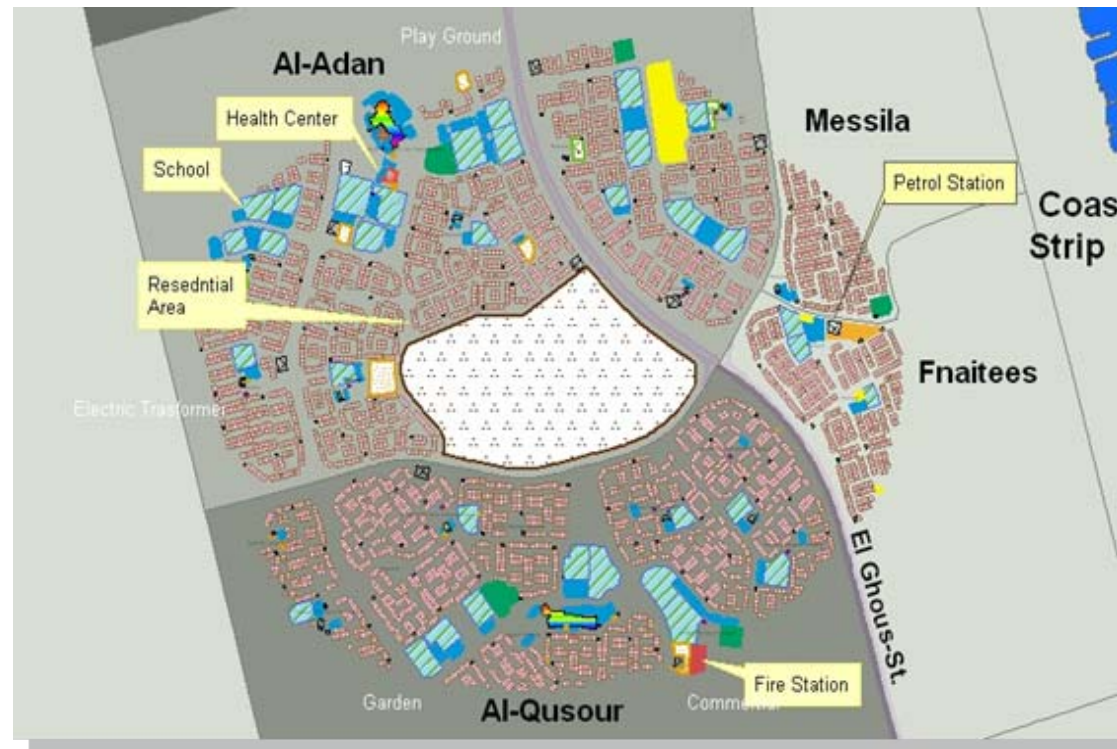


Map Layers:



-Infrastructure :

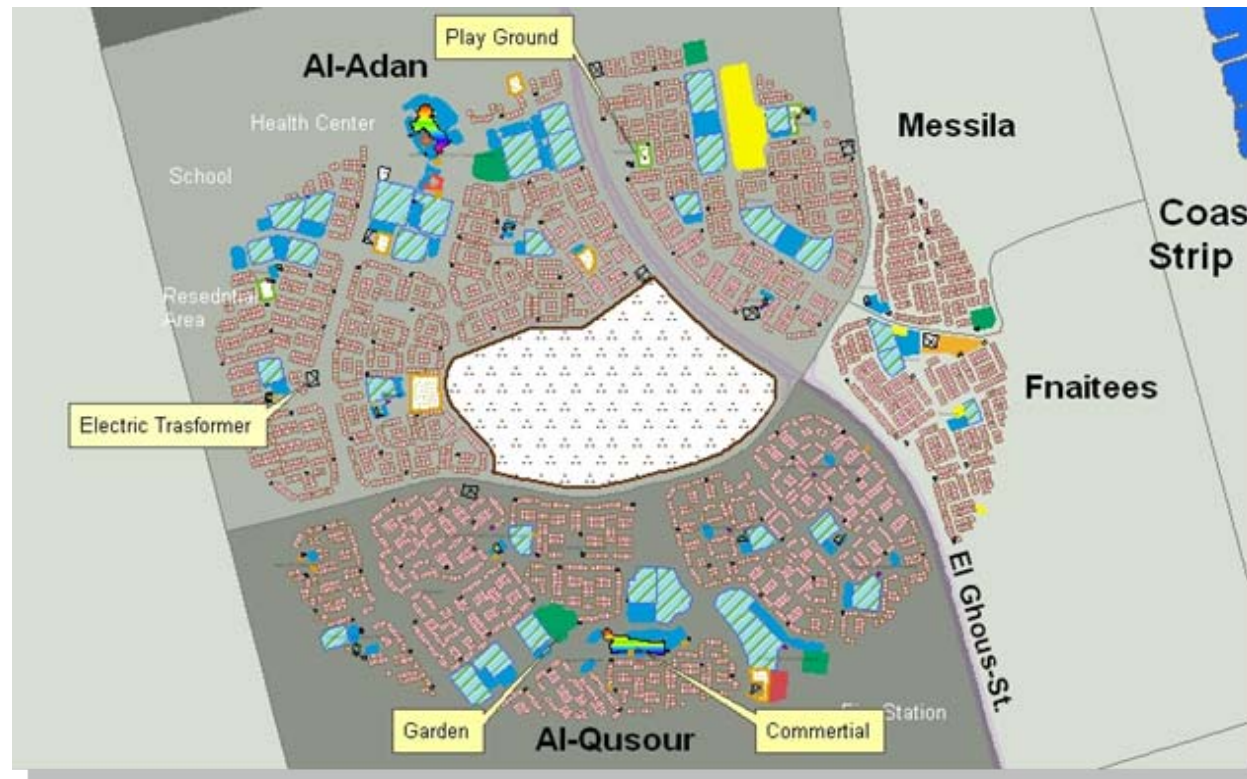
- Schools
- Fire stations
- Health Centers
- Petrol stations
- Residential Areas





-Facilities :

- Gardens
- Play ground
- Electric Transformer
- Commercial



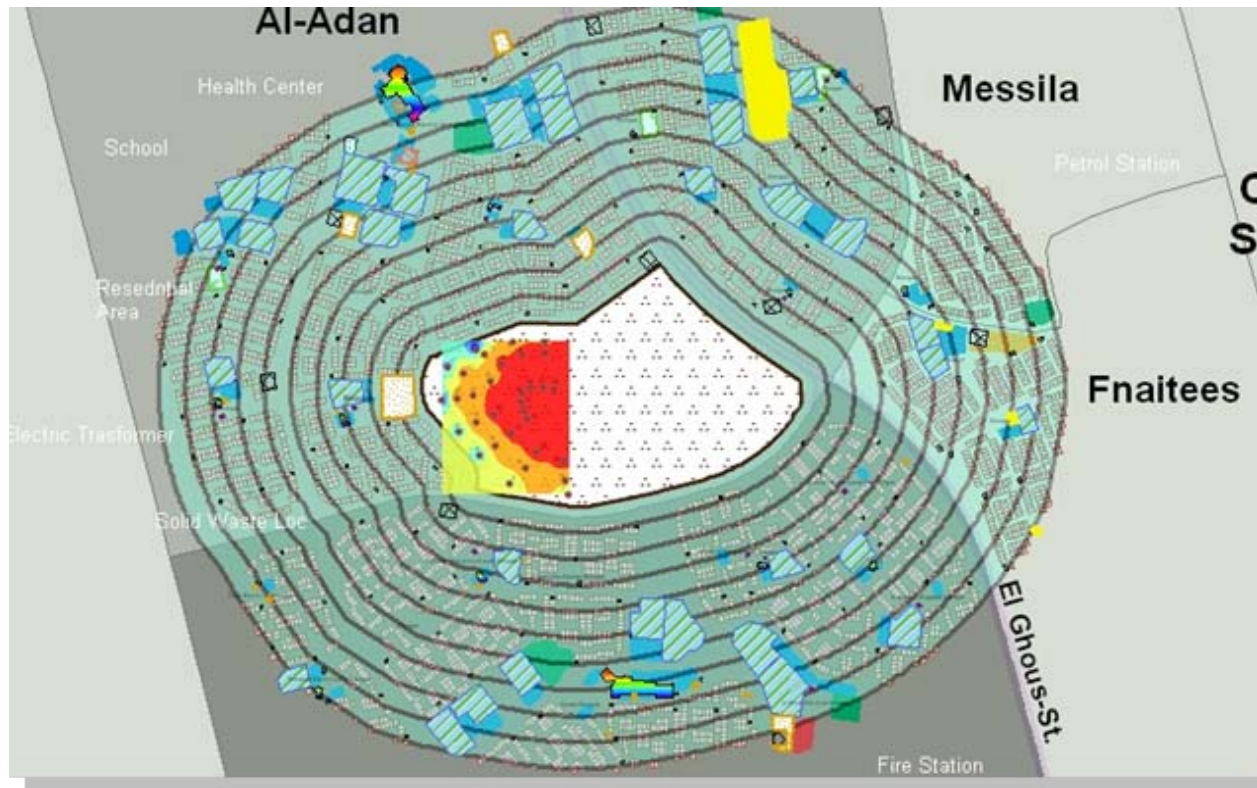
Demographics :

- **Boreholes :**
 - Sand properties
 - Solid waste Locations



- ✕ No Waste
- ✕ Solid Waste
- ✕ Construction Debris

& Population of the area



Population of El Aadan
Area: 17772 Inhabitants
They are ~ 0.6 % of Kuwait
Population ~ 2.5 Million

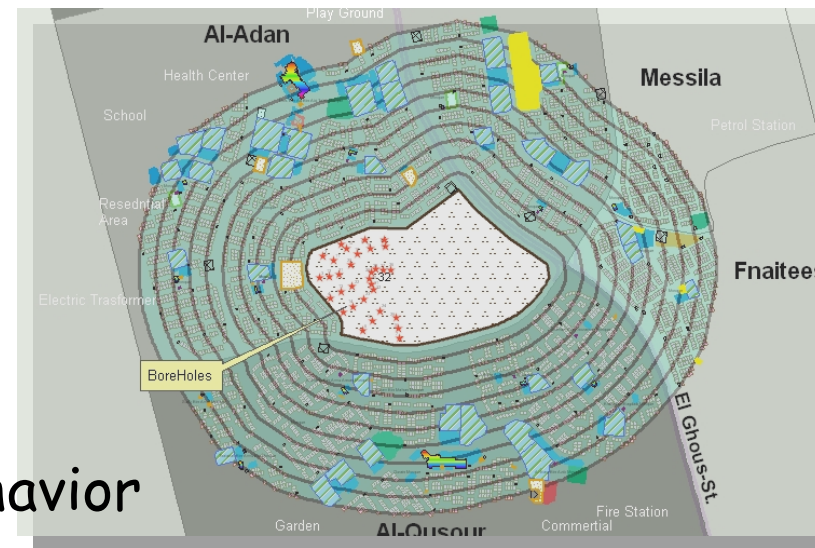
Utilizing GIS System



We used GIS to serve as a tool for :

Managing the Landfill site, through Visualizing the Spatial Relationships between various Features As :

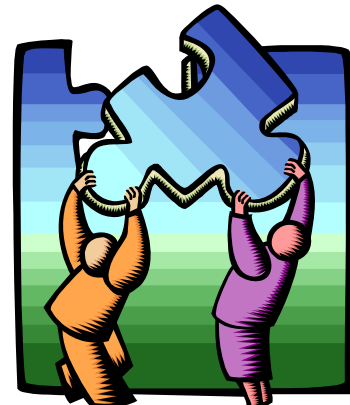
- Parcels & buildings around the dumping area.
- Soil Type & soil Bearing Capacity
- Gas distribution & gas migration behavior
- Impact of landfill fires & the bad odors to the surroundings.
- Using Census Data to evaluate inhabitants who are potential risk .





Results





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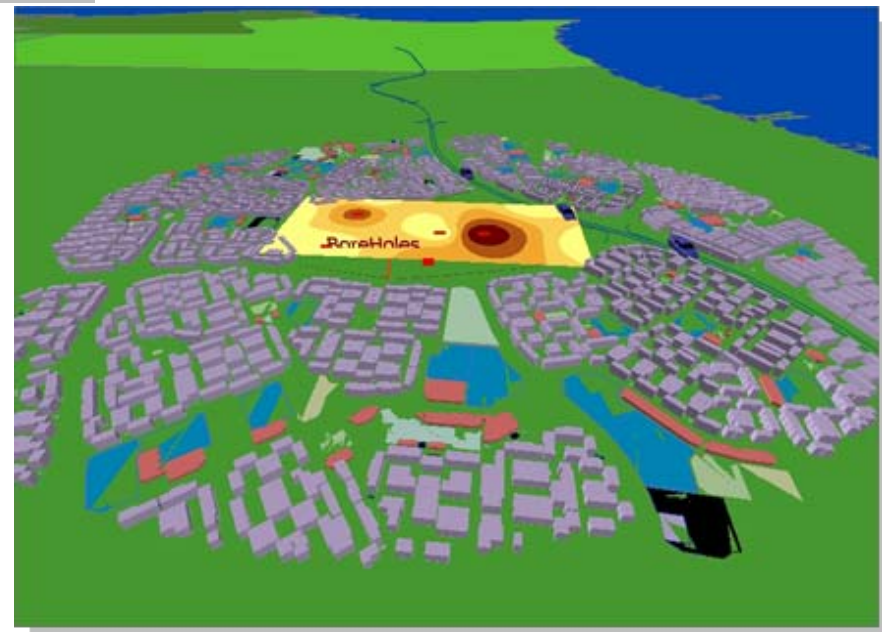




CH4 – Buffer
1989

5 Bore Holes been made

-  0 - 10.1 % lowest
-  10.1 - 19.7 % Moderate
-  19.7 - 32.9 % High
-  32.9 - 51.82 % Highest

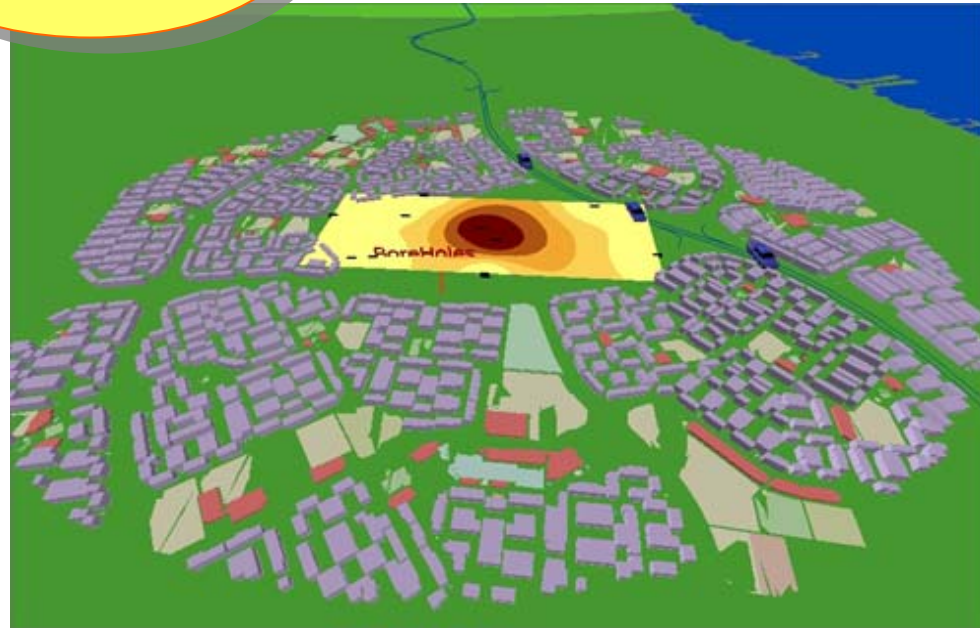
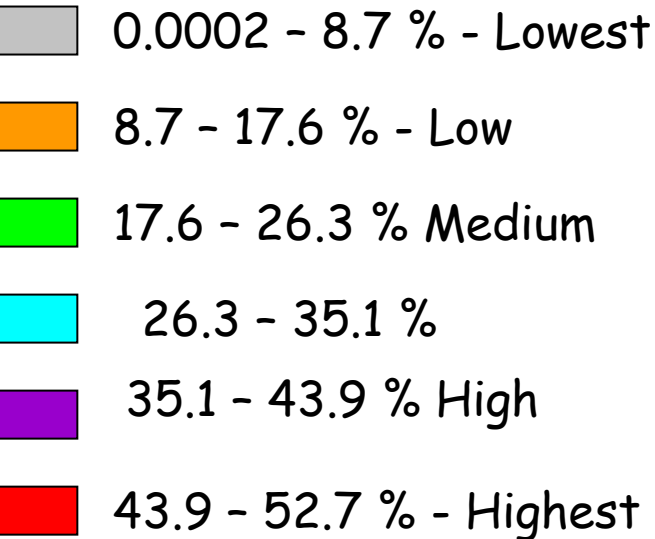


Potentially affected Area's



More Bore Holes been added around the location to monitor the lateral migration of gases

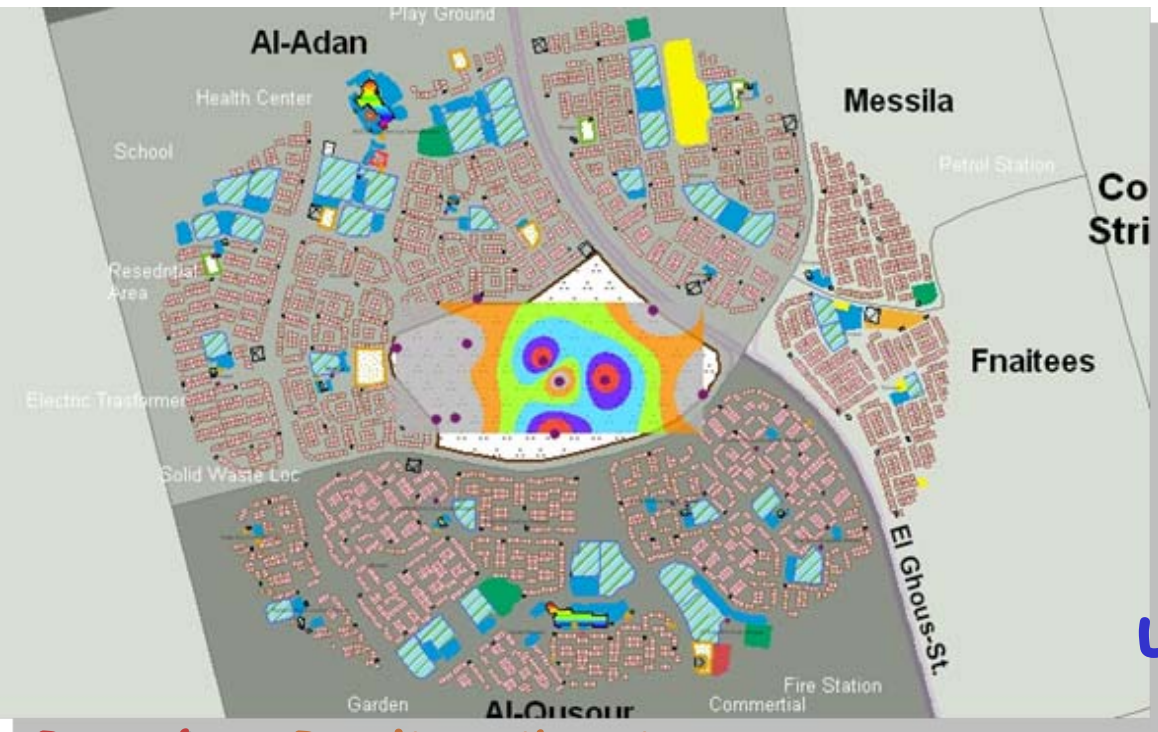
CH₄ - Buffer
1994











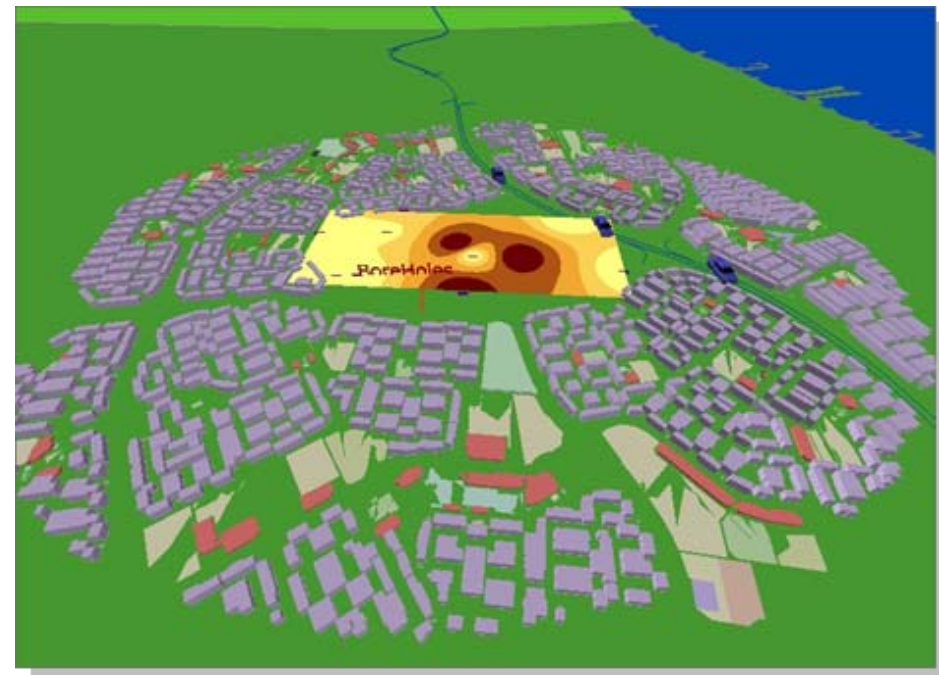
CH4 – Buffer 1997

Start removing the upper layer of waste



**Result : Redistribution
Of gases pressure in
the land fill area**

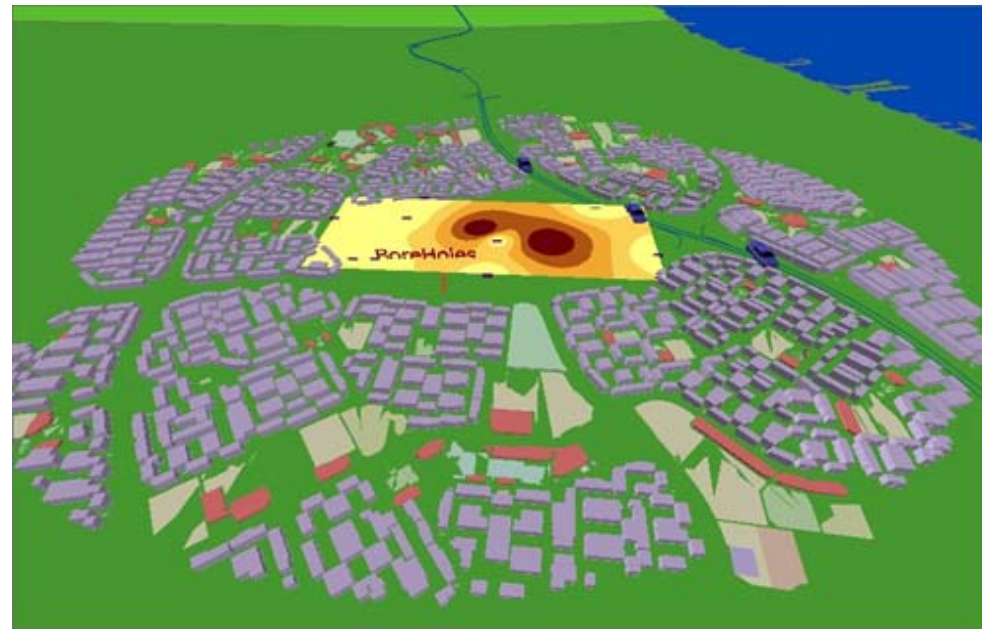
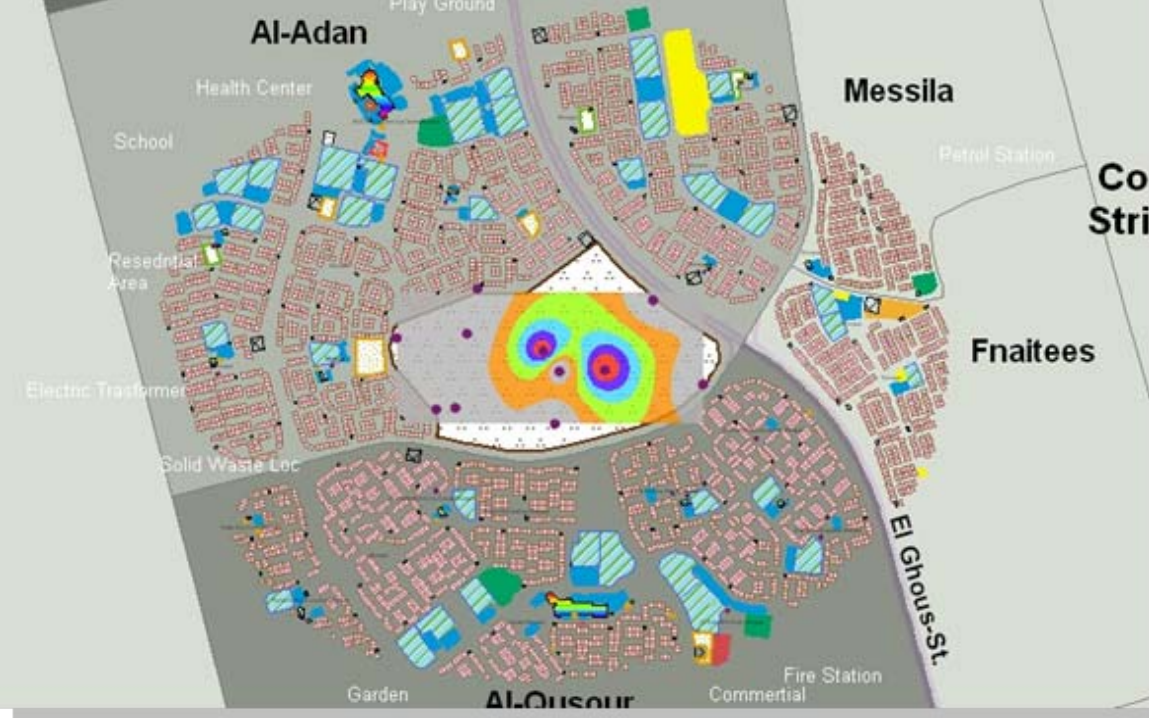
-  0.0003 - 8.4 % - Lowest
-  8.4 - 16.8 % - Low
-  16.8 - 25.3 % Medium
-  25.3 - 33.7 %
-  33.7 - 42.2 % High
-  42.2 - 50.6 % - Highest



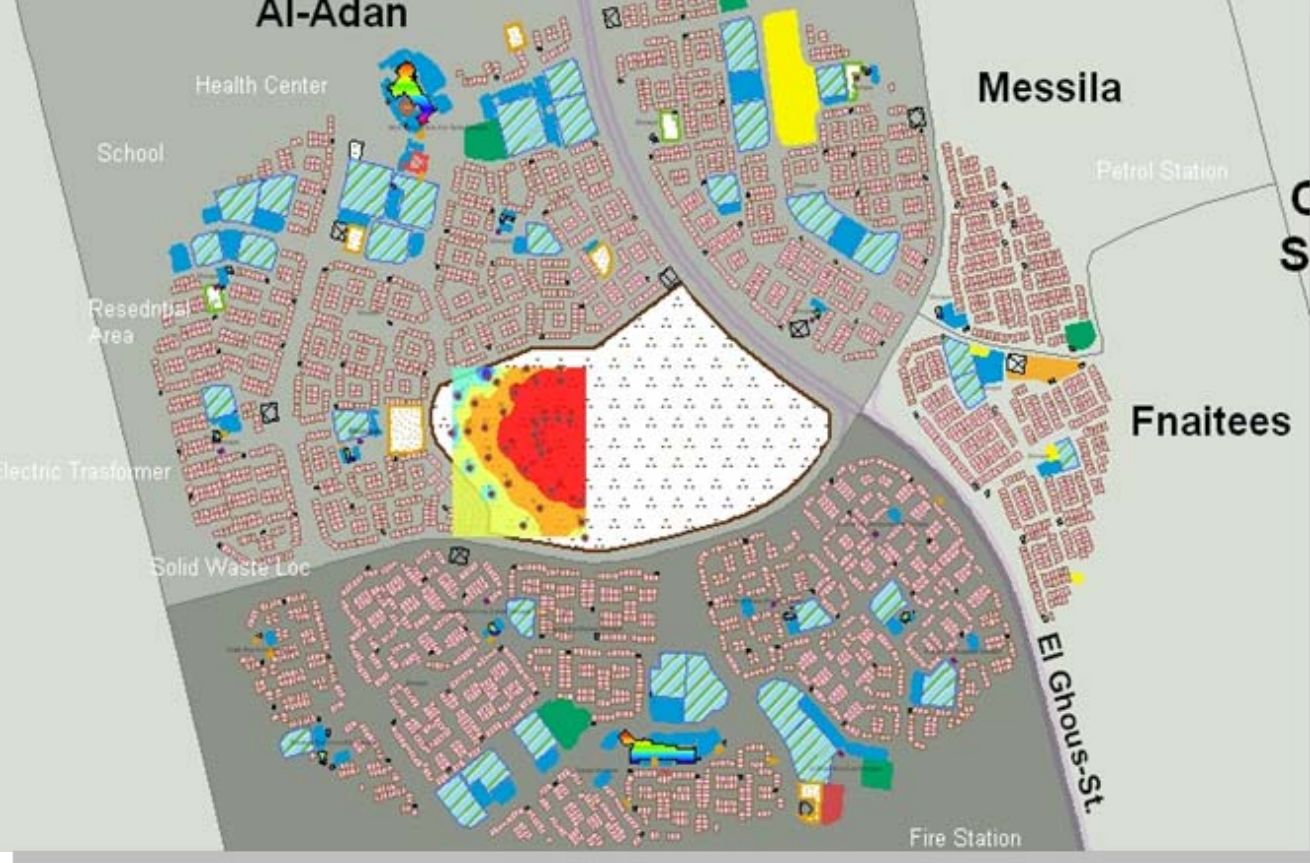


CH₄ – Buffer 2000

The Southern west of
Landfill area has been
covered with Layer
of getch



Result : Redistribution
Of gases pressure
in the dumping Area
& the concentration
decreases in the
southern west part

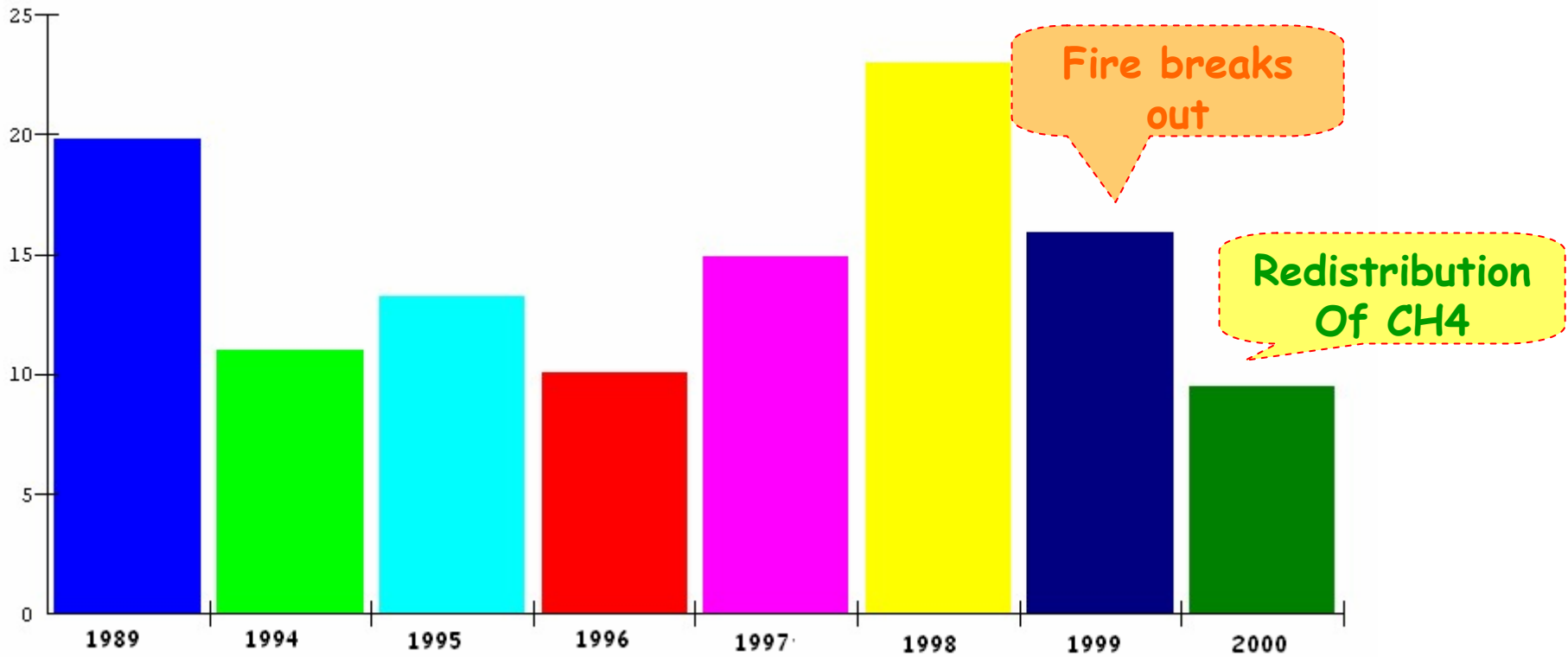


CH₄ – Buffer
2003

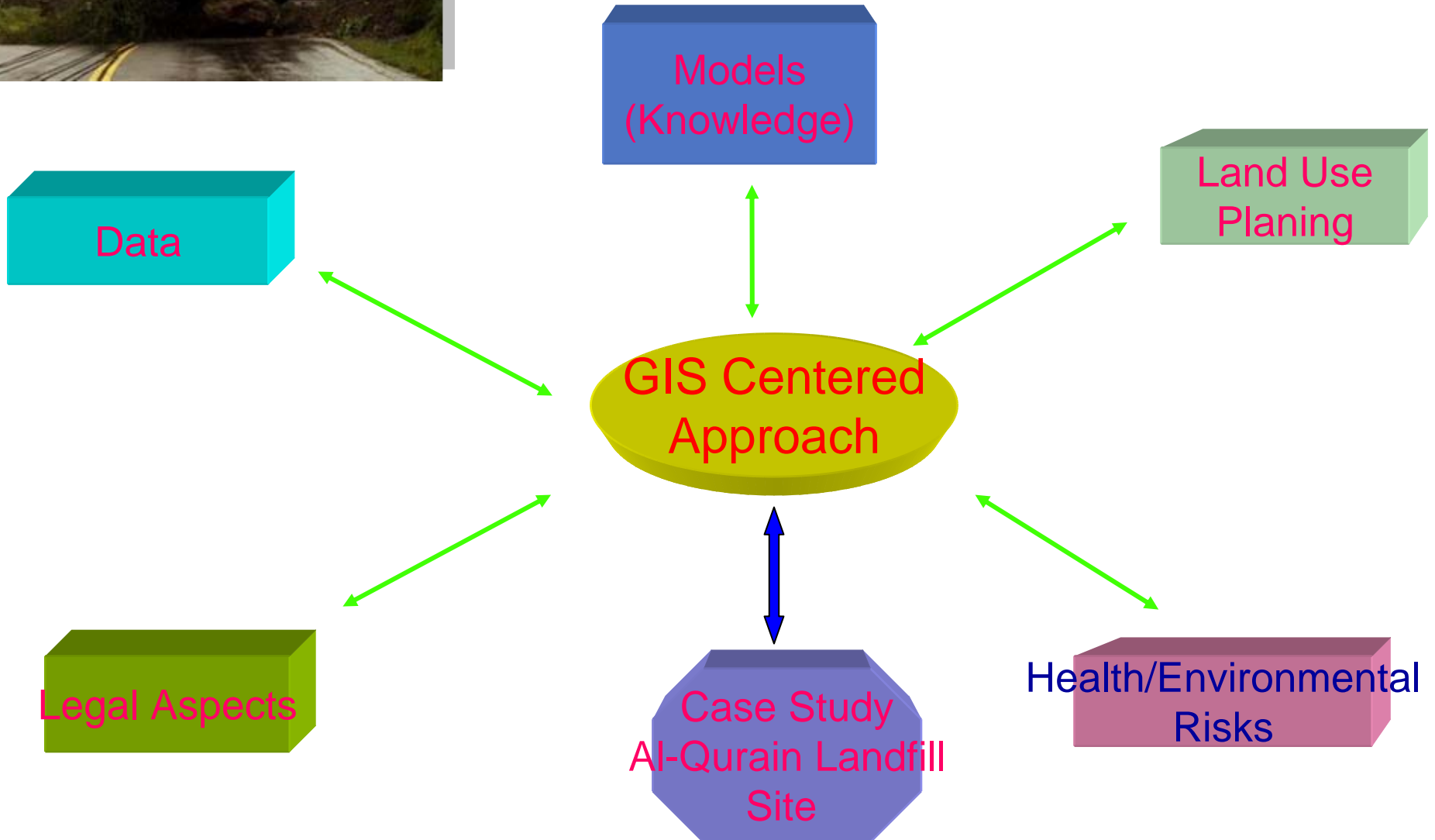
People who lives around this area are potentially at risk from emitted gases Due to *biodegradation of organic matter Which generate mainly methane CH₄ & CO₂*

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Measures of Methane from 1989 - 2000



Challenges ...



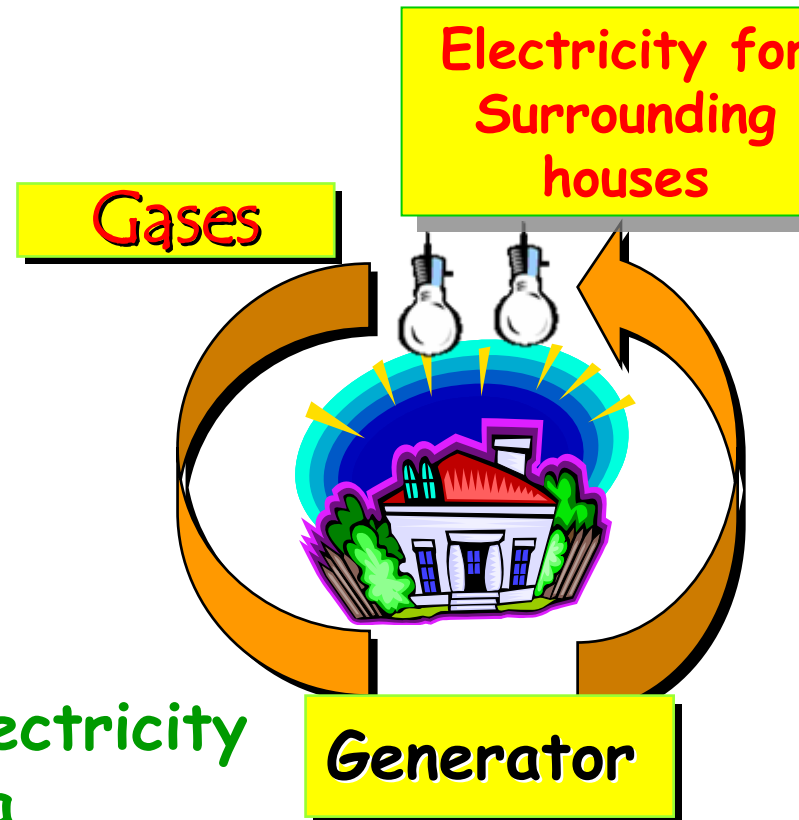
Project Progress



- Continue collecting data from the field
- Capping the landfill area
- Digging more Boreholes
- Create an integrated system to *Accumulate the gases by network system into a fire flare*

Now, the Flaring are canceled

Generator is used to supply electricity to the surrounding area



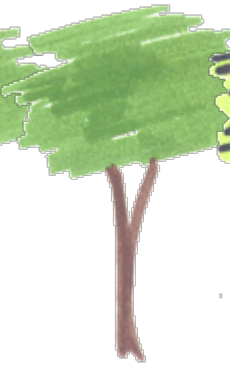
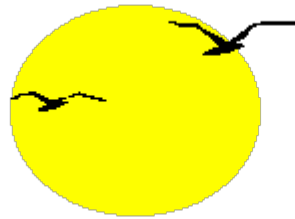
Landfill Location After Rehabilitation



End of bad odors problem

&

Become Public Park





Thank you