



Land Based Fuel Spills in The Bahamas

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Types of oil spills in The Bahamas and their causes

Road accidents - includes vehicle crashes and turned over tankers etc.

Leaking storage tanks - Buried and surface tanks.

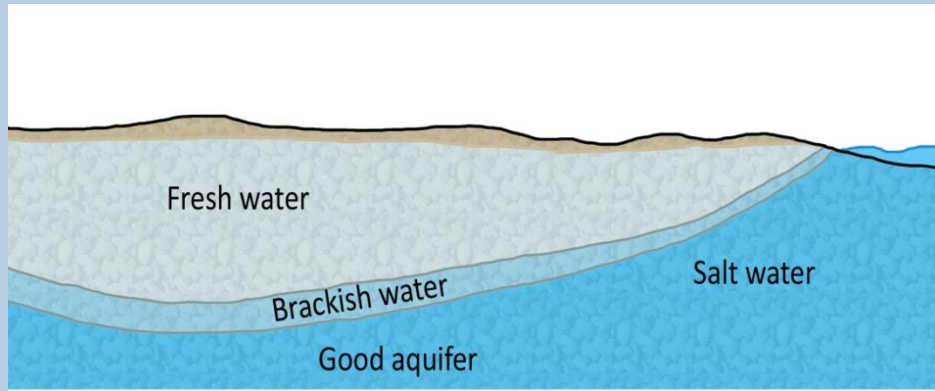
Leaking pipelines

Collapsed facilities

Discarded wastes and dumping

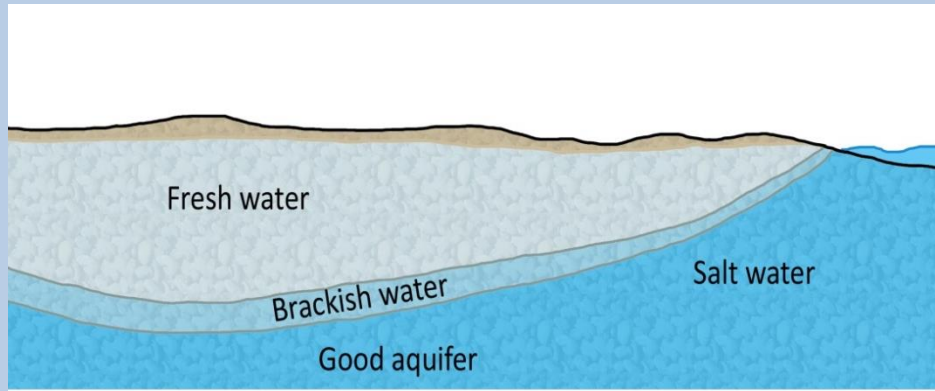
Other possibilities - can include sabotage, theft, spills and negligence, aircraft crashes, and possible damage caused by severe weather events.

Bahamian hydrogeology and its influence on oil spills



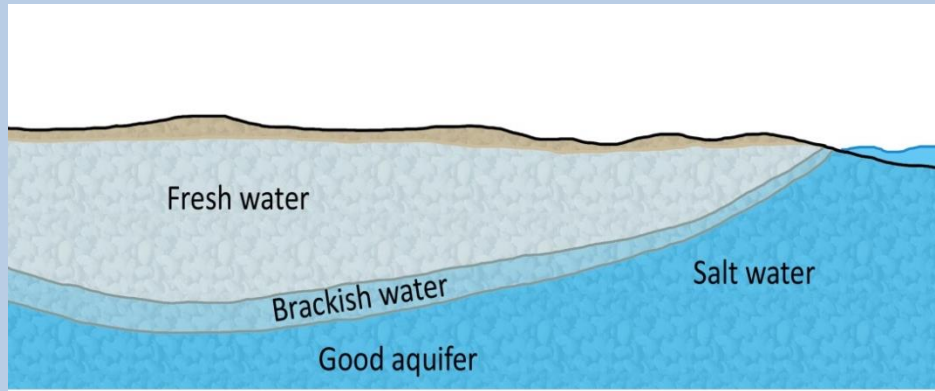
- **Land surface geology** - Naturally this is always a carbonate formation with internal drainage which is controlled by the degree of karst development. Main exceptions are the various man-made impervious surfaces, particularly in urban areas.

Bahamian hydrogeology and its influence on oil spills



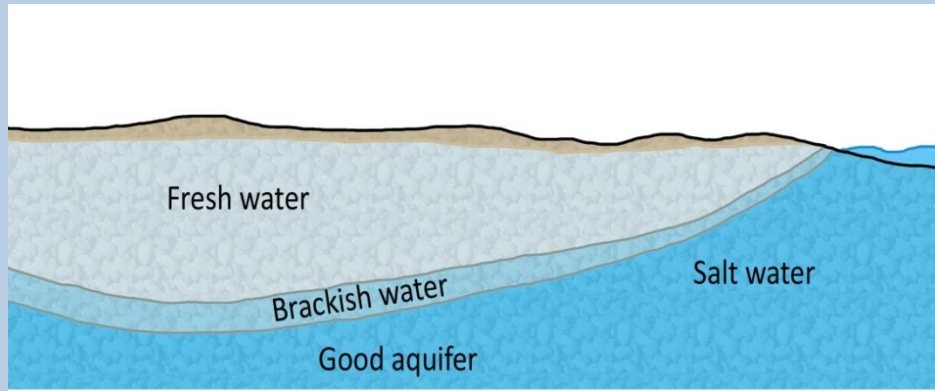
- **Shallow subsurface geology** - Most commonly this horizon is represented by the shallow marine carbonate formations of the Sangamon Interglacial. Infiltration of liquids dominated by degree of diagenesis and development of solution features, the presence of sedimentary structures, burrows, and other organic features like root casts.

Bahamian hydrogeology and its influence on oil spills



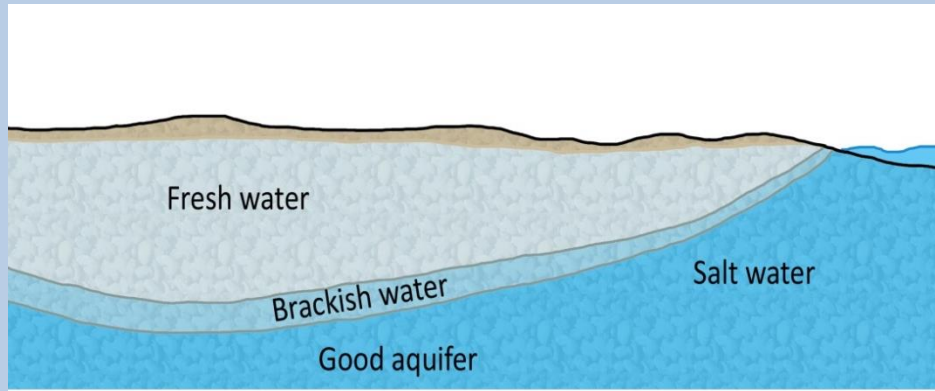
- **Water table geology** - Same as above though exceptions would be where Aeolian or littoral formations occur. The first subsurface change in geology is usually at about 15 ft. below the water table where there is often a disconformity and the older formation below has a better developed solution system.

Bahamian hydrogeology and its influence on oil spills



- **Hydrology** - Typical of a limestone ocean-island wherein rainfall infiltrates down to the water table and where freshwater lenses can often develop overlying the saline water below.

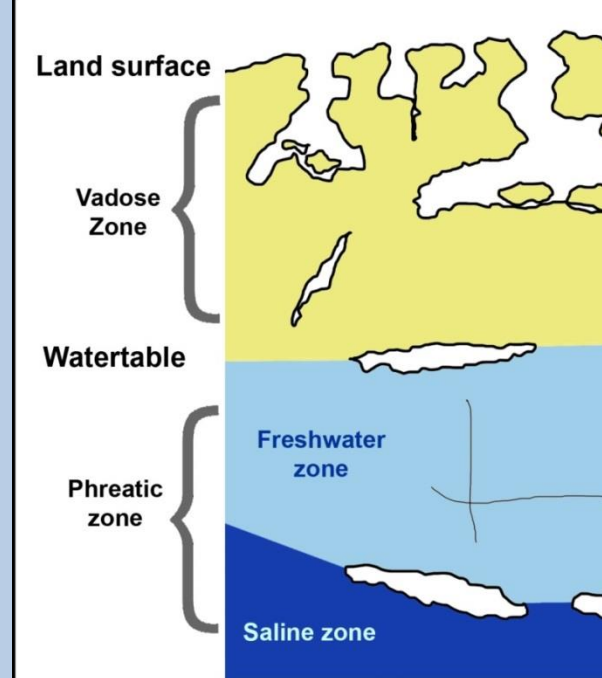
Bahamian hydrogeology and its influence on oil spills



- **Groundwater flows -** Water table elevations are controlled by the thickness of freshwater lenses and flows will be away from the thicker lens locations. Flows are also impacted by tidal effects, pumping sites, and flows towards areas of higher evapotranspiration like ponds and marshes. Compared to continental land masses Bahamian water tables are very flat. The highest is just 3.5 ft. above mean sea level.

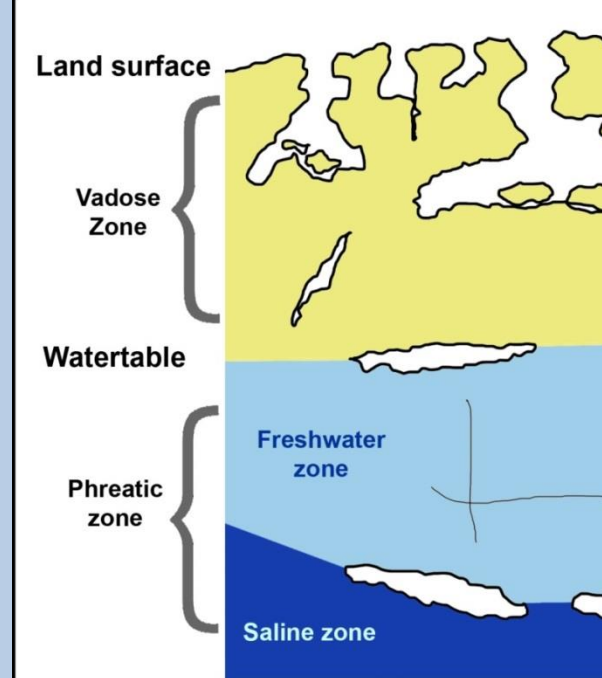
Spill behaviour

- **At the surface** - Infiltration controlled by local permeabilities.



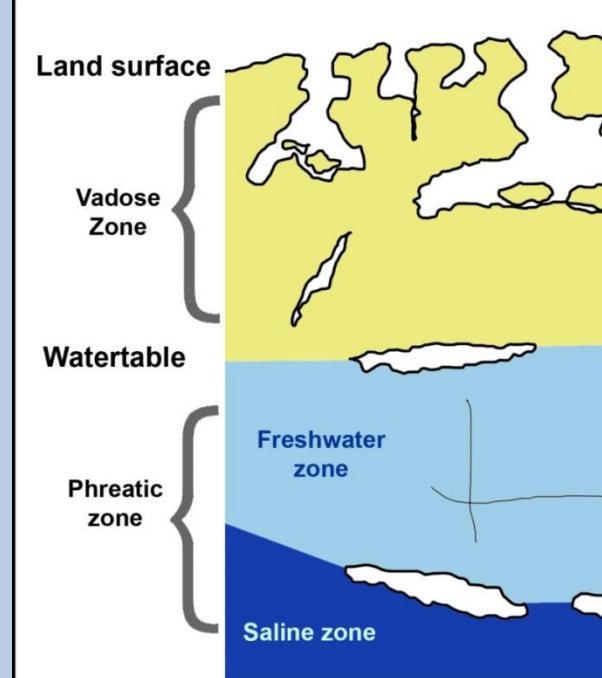
Spill behaviour

- **In the vadose Zone** - Vertical movement downwards unless influenced by sedimentary structures, and similar features. Heavier oils will be more “sticky” and retained in the vadose zone though downward migration will be influenced and increased by heavy rainfall.



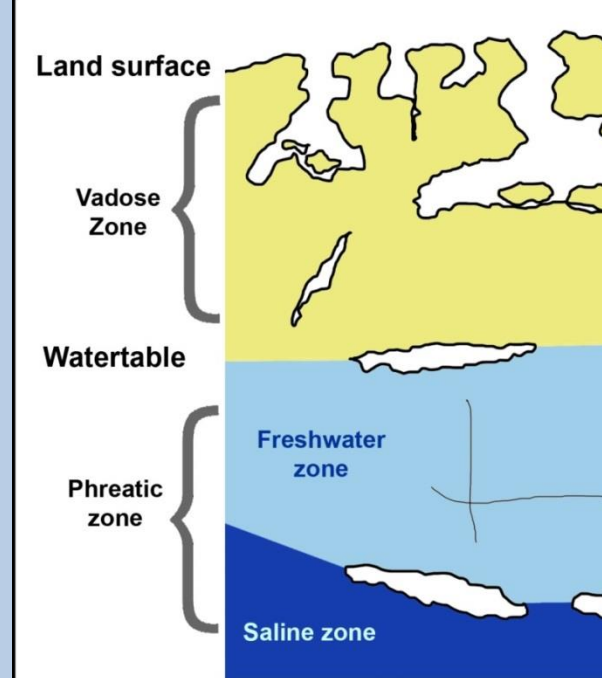
Spill behaviour

- **At the water table** - Hydrocarbons will accumulate and spread out at the water table. Plumes develop much like the freshwater lenses spreading outwards from the centre point except if influenced by impermeable barriers, pumping or abstraction.



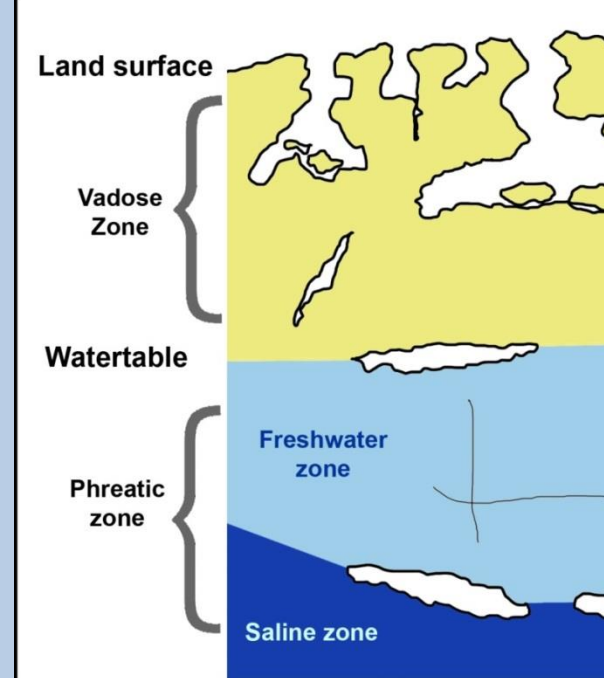
Spill behaviour

- **In the meteoric zone** - Hydrocarbon “lenses” can thicken pushing down the water interface. Soluble components can penetrate into the lower aquifer. Monitor wells often act as traps and can contain thicker volumes of the spill than the surrounding formation.



Spill behaviour

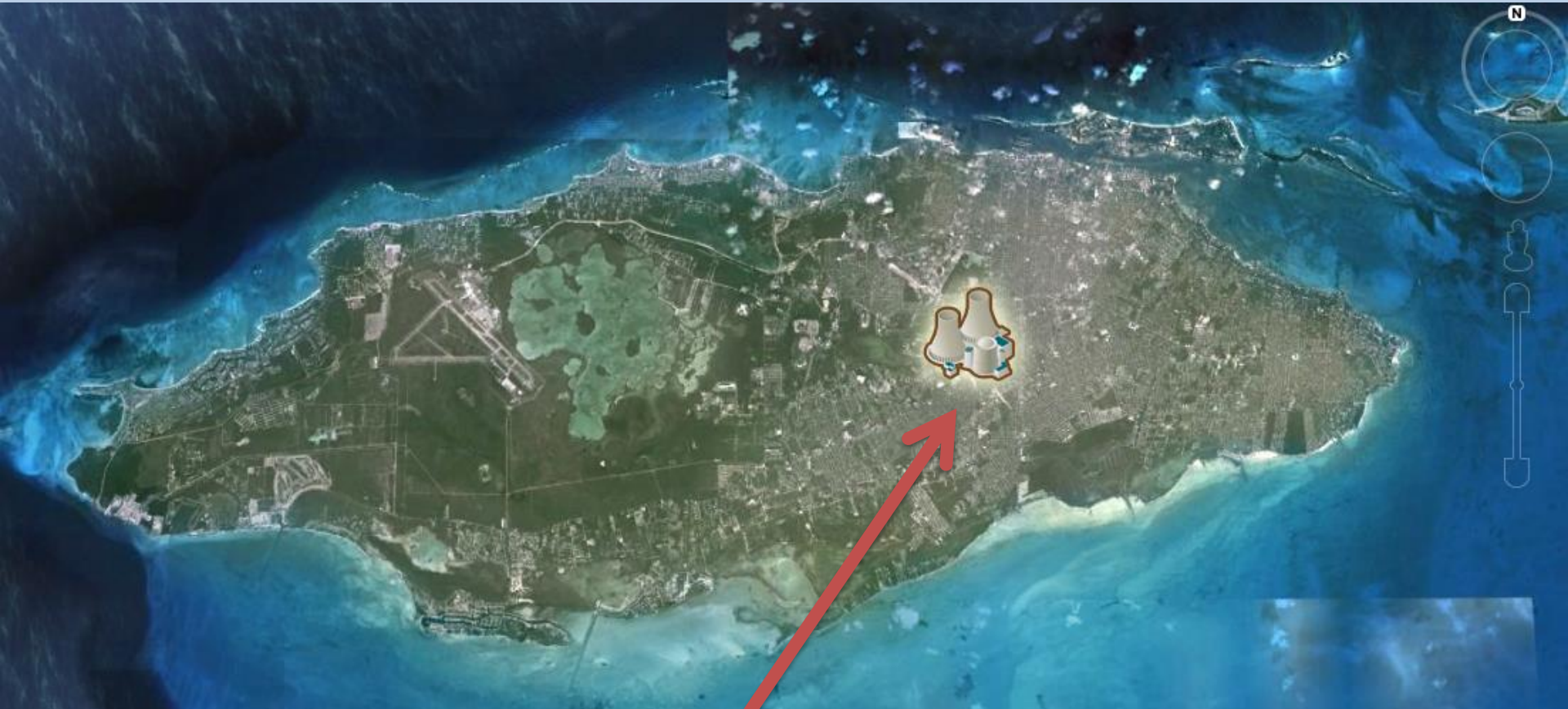
- **At deeper horizons** - Unless the spill is injected to deeper levels by use of disposal wells only soluble components will penetrate down into the aquifer.



Significant oil spill case histories in The Bahamas



BEC power plant at Blue Hills



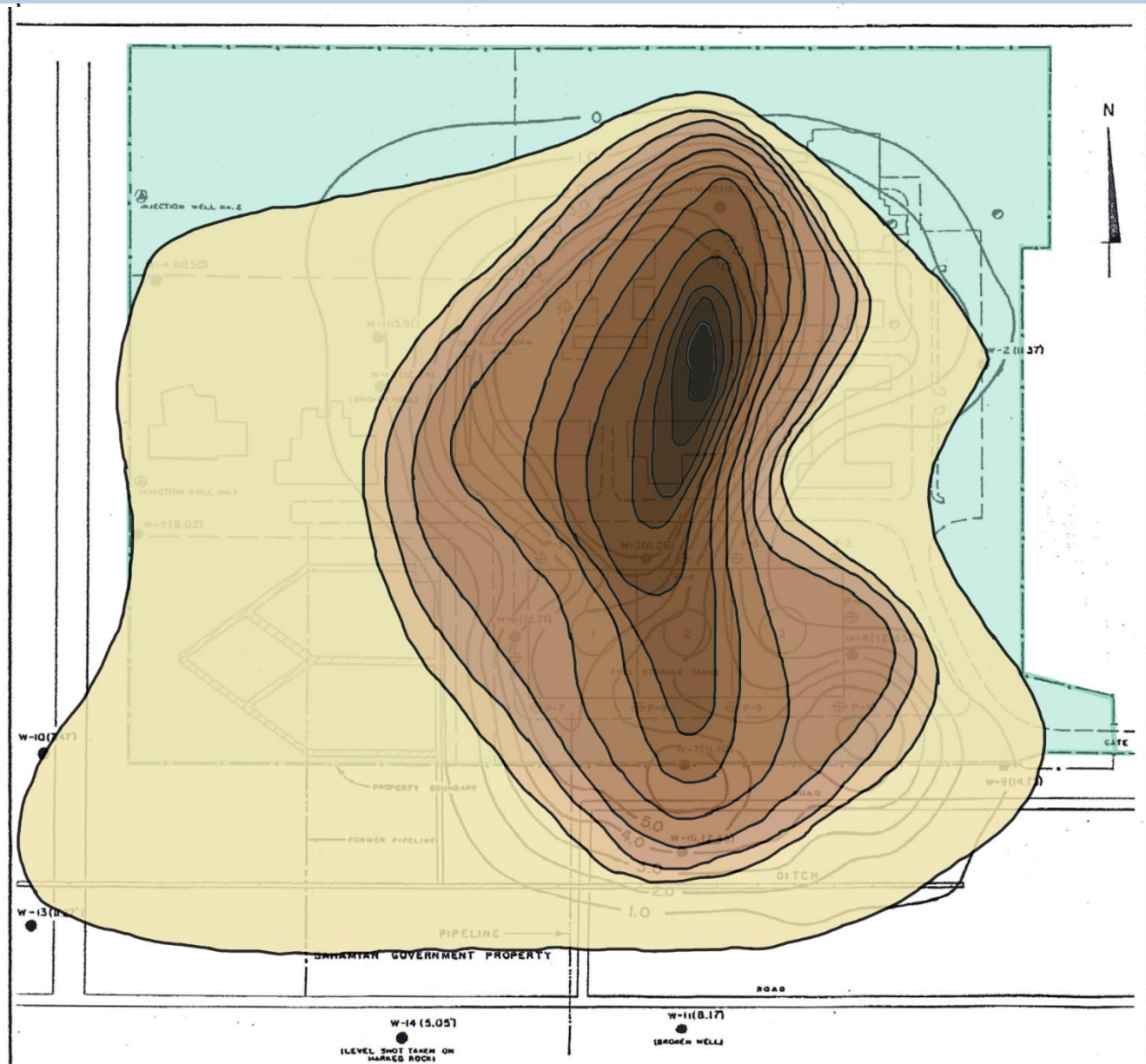
Blue Hills Power Station

BEC power plant at Blue Hills cont'd



**First noticed in 1982 when
drilling a deep disposal well.**

BEC power plant at Bluehills cont'd



1985

Bunker C Diesel.

**Piped from
Clifton to Blue
Hills.**

BEC power plant at Bluehills cont'd

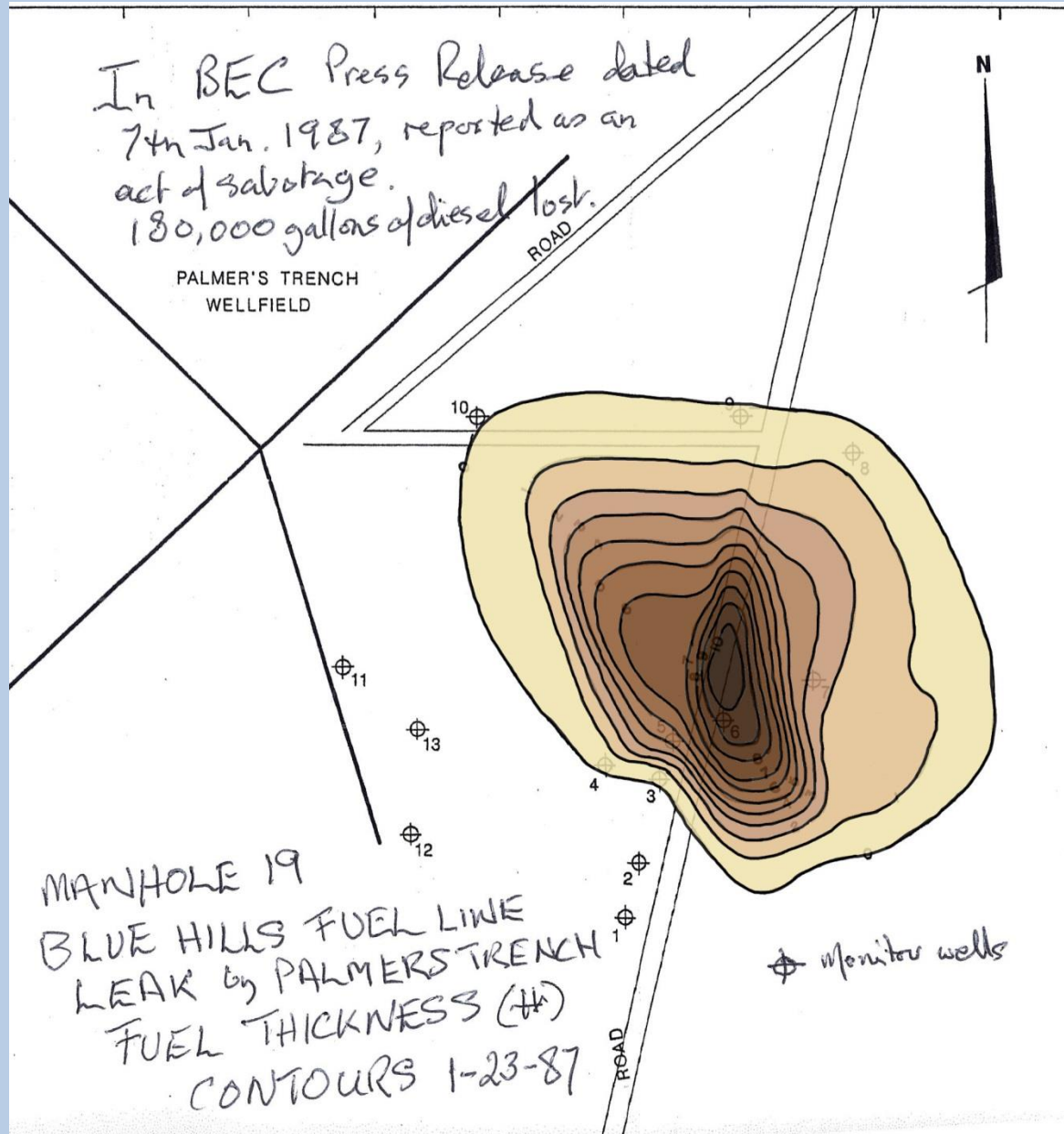


**Multiple methods of
fuel recovery applied.**

BEC power plant at Bluehills cont'd

- **Probably close to 2 million gallons involved and more than 1 million gallons recovered.**
- **Spill studied in great detail by consultants (Dames and Moore), the Ministry of Works Hydrologists, B.E.C., and an involved Insurance Company.**
- **Spill impacted Blue Hills wellfield and also private wells in Blue Hills Estate.**
- **Ignited on at least 2 occasions threatening the power plant.**

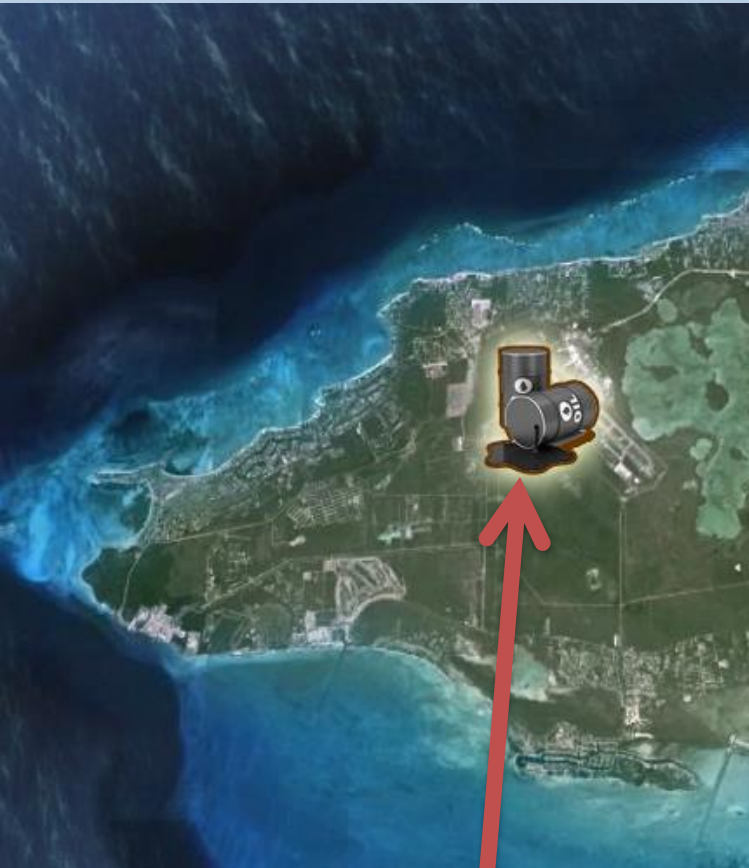
BEC power plant at Bluehills cont'd



180,000 gallons

Thought to be
sabotage

Linden Pindling airport - Windsor airfield



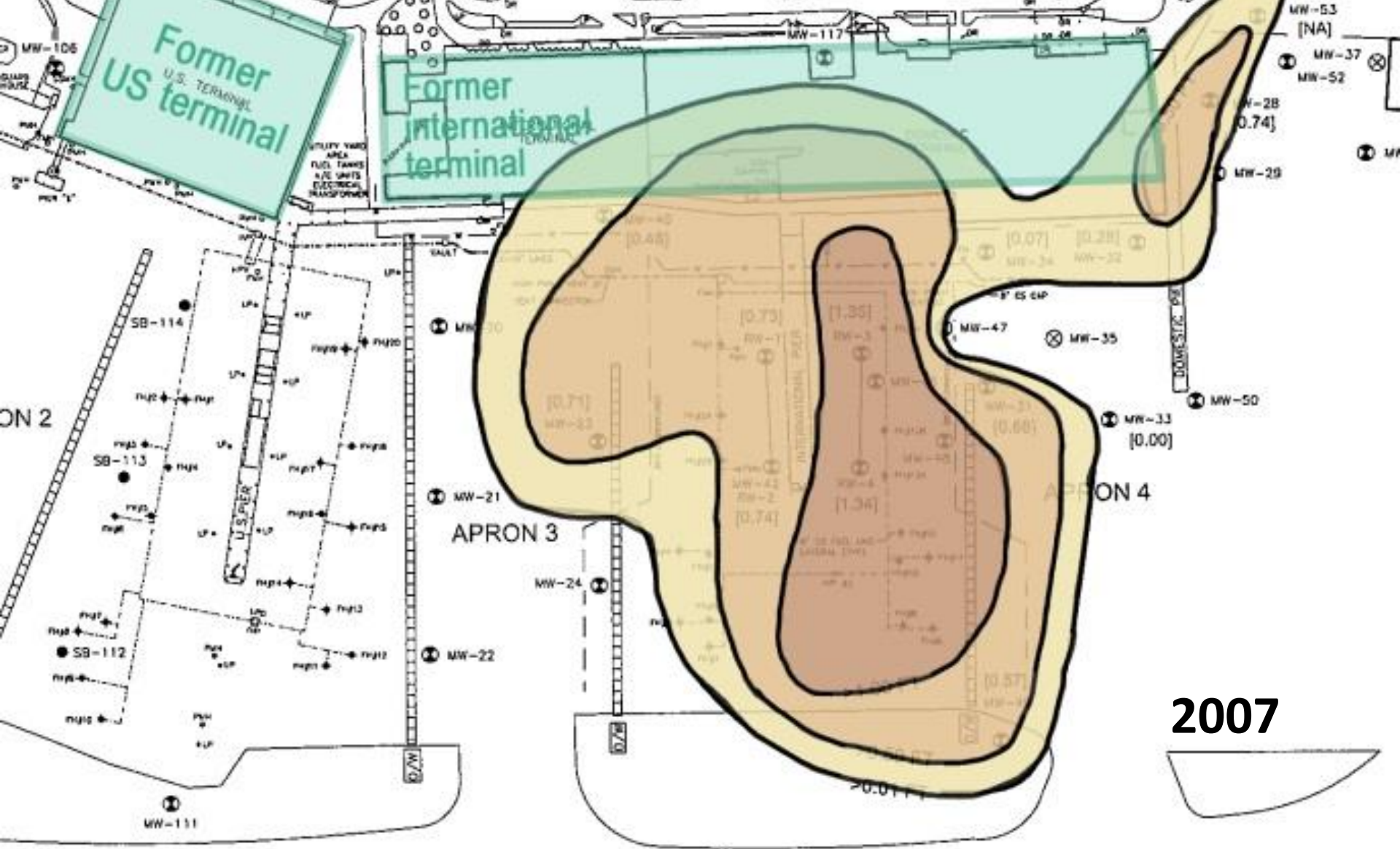
Windsor airfield

Multiple events

Thought to date back to 1940s when the RAF were using the airfield.

Unknown quantities involved

Appear to have covered a large area.



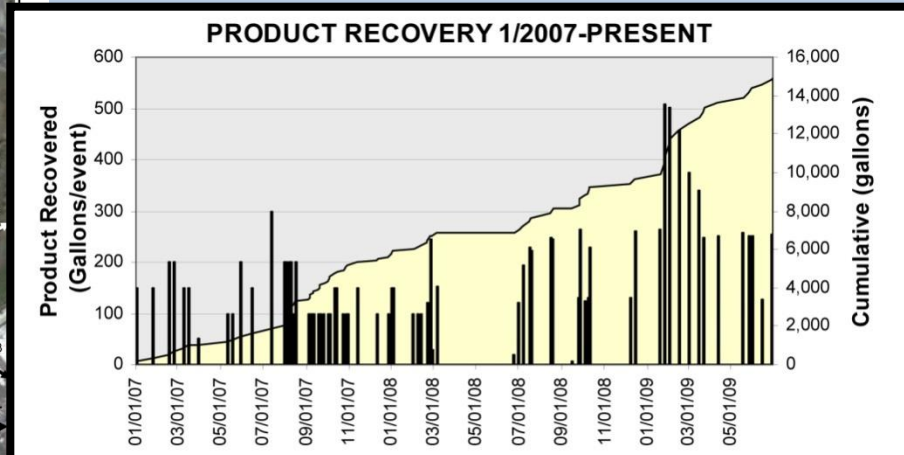
NAD became very involved in investigating the history of the various spills.



● MONITOR WELL - NO PRODUCT PRESENT
 ● MONITOR WELL - PRODUCT PRESENT
 ● MONITOR WELL
 ● HYDRANT SYSTEM PIPING
 ● RECOVERY TRENCH

THE PLAN
 NASSAU INTERNATIONAL AIRPORT
 NASSAU, NEW PROVIDENCE ISLAND
 THE BAHAMAS

FIGURE
2



Product thickness over time in selected monitor and recovery wells is shown graphically in Figure 6.



● MONITOR WELL - NO PRODUCT PRESENT
 ● MONITOR WELL - PRODUCT PRESENT
 ● JET FUEL HYDRANT SYSTEM PIPING
 PRODUCT THICKNESS:

- 1-FOOT
- >0.5 FEET
- >0.1 FEET

Well ID	Product Thickness (feet)
MW-20	0.00
MW-21	0.00
MW-22	0.00
MW-23	0.64
MW-24	0.00
MW-29	0.00
MW-31	0.94
MW-32	0.00
MW-33	0.00
MW-34	0.07
MW-40	0.16
MW-43	0.34
MW-46	0.57
MW-47	0.00
MW-49	0.54
MW-50	0.00
MW-51	0.00
MW-52	0.00
MW-53	0.07
RW-1	0.43
RW-2	0.41

Several consultants report produced.

Clifton Pier



Clifton Pier



Clifton Pier cont'd



Responsible parties:

- B.E.C.
- the oil companies with storage facilities in the area
- and even Bacardi who lost 70,000 gallons of molasses there.

Volumes never determined

Texaco reported losing 90-100,000 gallons of kerosene of which 60% was recovered.

Hopefully a full investigation will be completed at some point in time to decide what further action is needed.

Gas stations

The most common of serious spills

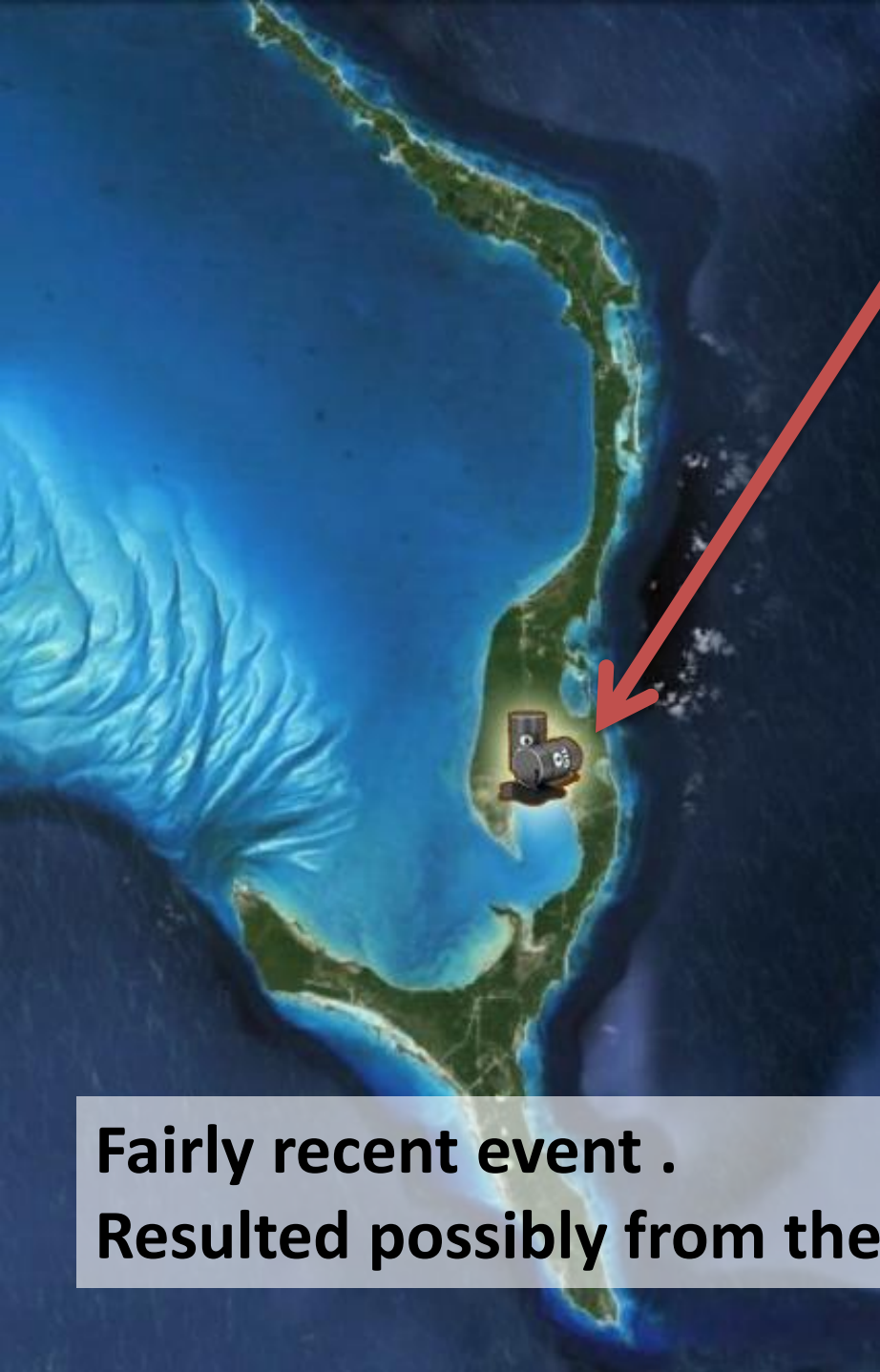
Details exist on at least 5 events

Examples: Carmichael Road, Shirley Street, Blue Hills Road, Bay Street, and Robinson Road.

Many residential properties and businesses impacted. Legal ramifications often involved.



Rock Sound airport



Fairly recent event .
Resulted possibly from theft, and clumsiness.

Major fuel storage facilities

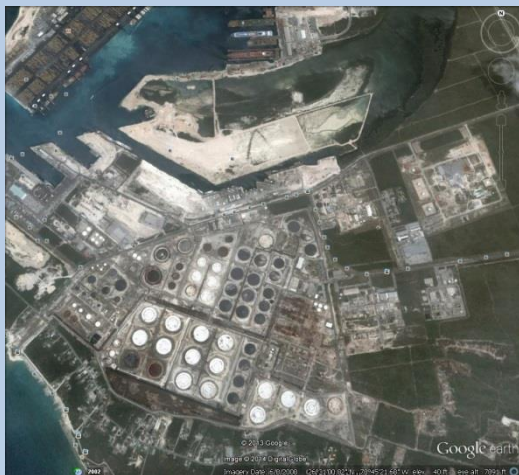


Grand Bahama fuel storage facilities



BORCO

South riding point



BORCO site

100 million barrels of oil had been lost over many years.

75% of the spilt oil had been recovered.

Could these figures be exaggerated?

BORCO mops up spilled oil

File 296/3.

BY DENISE MAYCOCK
Tribune Freeport Reporter

FREEPORT - The Bahamas Oil Refining Company (BORCO) has recovered about 75 per cent of the 100 million barrels of oil lost beneath the earth as a result of years of underground spills at its facility in Grand Bahama.

Company president Jamie Verrgas said that clean-up and recovery efforts will continue until all underground sites are completely oil free.

"When we at PDVSA (Petroleos De Venezuela) bought the refinery (in 1990 from Chevron) we inherited close to 100 million barrels of underground oil spill, and to this day we have recovered about 75 per cent of that."

"The progress of 75 per cent recovery is a lot and we will continue to work on that until the ground is clean and is deemed oil-free," he said Monday.

BORCO is presently undergoing a \$15 million refurbishment of its oil storage facility on West Sunrise Highway. There are currently 42 tanks in service. Thirty-one are under repair.

Vernal Martinborough, fire safety official, said the spill is confined within the BORCO facility and poses no immediate threat to residents and other surrounding areas.

"We have done underground mapping of the oil spill and it has not escaped us. And where we have located the exact concentrations we have gone and constructed underground wells to extract the oil from the ground and put it in our storage facility for further use," he explained.

Mr Martinborough said that tested water samples have shown no traces of contamination.

He admitted that while the oil is just above the water table, it is isolated.

Mechanisms have been put in place to avoid any further or future

underground spills and prevent them from going beyond the facility, said Mr Martinborough.

"It is very much contained on our facility. And, based upon the mapping, tidal influence and general flow of the water, we have been able to predict what direction it may go or is most likely to go. So, what we have done is construct voids in the ground and trenches in that area to cut the pattern off (to) avoid it from going beyond that point," he said.

Mr Martinborough said a "series of things" could have caused the spill - pipeline leaks or tanks with

"We will continue to work until the ground is clean and is deemed oil-free."

flaw leaks when the Chevron company owed the facility.

He noted that the 100-million-barrel spill would have accumulated over many years.

Jeff Hollingsworth, maintenance superintendent, said after some 20 or 30 years tanks normally suffer from metal fatigue and flaw failure.

Usually when that occurs, he said, the tank is taken out of service. It is cleaned thoroughly and inspected to determine the problem.

"We then develop and determine the scope of work that is needed and we outfit those jobs to various contractors to get the tank back in service, which takes about three to four months," he explained.

Maxwell Sweeting said BORCO has enjoyed a very good relationship with residents in the area and addresses their concerns regarding the environment.

He said a meeting was held with Lindy Russell, the MP for the area, Environmental Health officials and

residents regarding the underground spill.

"They came to a meeting here to see those same mappings and left satisfied that we were doing all we could do to contain it in the boundaries of BORCO. The recent mapping has indicated that we have been successful in doing exactly that. Next year March will be like a score card for us to see exactly how well we are doing in terms of the clean-up," he said.

Mr Sweeting said the clean-up of the recent oil spill at its jetty that affected the Mack Town, Hunters, Lewis Yard and Pinders

Point area, would be best left to nature.

While some clean up had been carried out, there is only so much that could be done, he said.

"Unfortunately, only nature can get it back to the way it was. And we

agreed that there are certain things that we did not want to do, in terms of clean up, by using bleach and chlorine that would kill the reef. So, we elected with Environmental Health not to go that route, and allow it to clean up by itself," Mr Sweeting said.

He said BORCO would also be making itself more visible in the community when such incidents occur and by supporting and adopting local schools in the area and attending town meetings.

He said the company plans to adopt the Lewis Yard School.

"As you know Lewis Yard was adopted by Uniroyal, which is no longer in business, and our adopted school was Goombayland (St George's High). But, we will most likely switch emphasis and deal with Lewis Yard since they are in our backyard," he said.

"We also agreed to have a representative present at their next town meeting to assure them that we are concerned about what happens in their community, that the atmosphere is safe."

South riding Point

There have been unconfirmed reports of spills at the South Riding Point facility

But no details are available on these.

Recommended mitigation measures

- **Use of non corrosive materials for pipework and tanks**
- **Use of water tight bunds around tank sites**
- **Making it possible to inspect pipework**
- **Keeping accurate records of fuel movements**
- **Installing proper monitor wells**
- **The Government also needs to ensure consultants involved in investigations and recovery process are fully familiar with Bahamian conditions especially the hydrogeology.**

Any Questions?