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Kuwait Environmental Remediation Program (KERP): Total
Remediation Strategy (TRS)

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Study Objectives

□ The purpose of this paper is to explain in detail the Total Remediation Strategy for the Kuwait Environmental Remediation Program (KERP), which will indicate the Current and future projects.



Background

- After the Gulf war, in February 1991, Kuwait's oil wells were damaged and set on fire, resulting in oil contamination of the land.
- Environment Contamination occurred from oil spreading over the land surface and penetrated the soil to varying depths forming oil lakes.
- These large oil lakes and other contaminated features still exist today in KOC field with an estimated volume of 26 million cubic meters.
- This Unique Programme is currently the largest environmental inland cleanup in the world.



KERP - Overview/ History

2006

**Kuwait Gov.
established
KNFP**

2010

**MOU
between
KNFP and
KOC**

2012

**KOC
established
Soil
Remediation
Group**

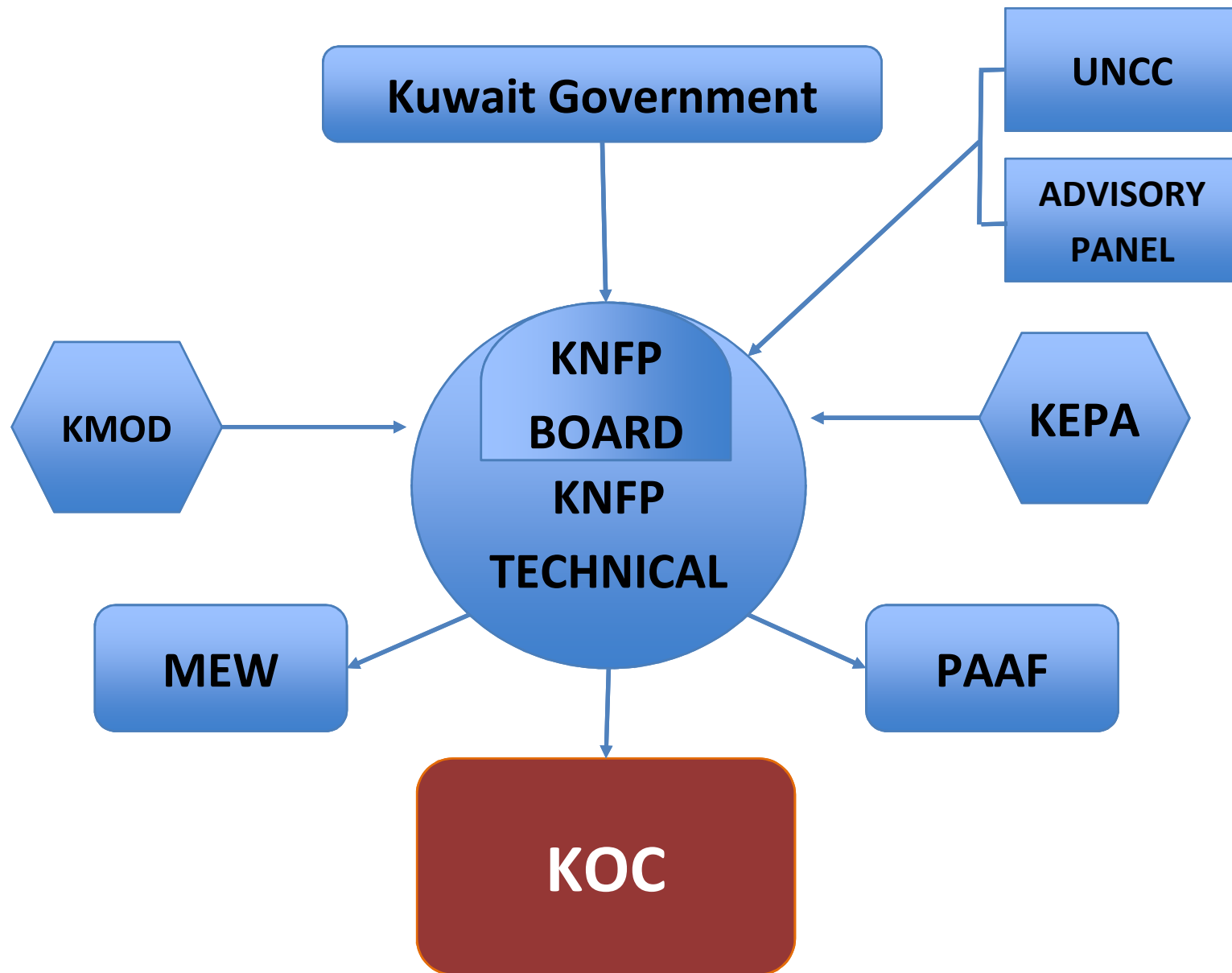
2012

**Amec
Foster
wheeler
appointed
as PMC**

2015

**Approval
of KERP
Strategy**

KERP Stakeholders Organization



KERP - KOC Claim Elements Awarded

The following Environmental Claim elements were awarded to KOC by United Nations Compensation Commission under Decision 258.

Claim No. 5000259

**(Coastal & Marine
Resources)**

Claim No.5000450

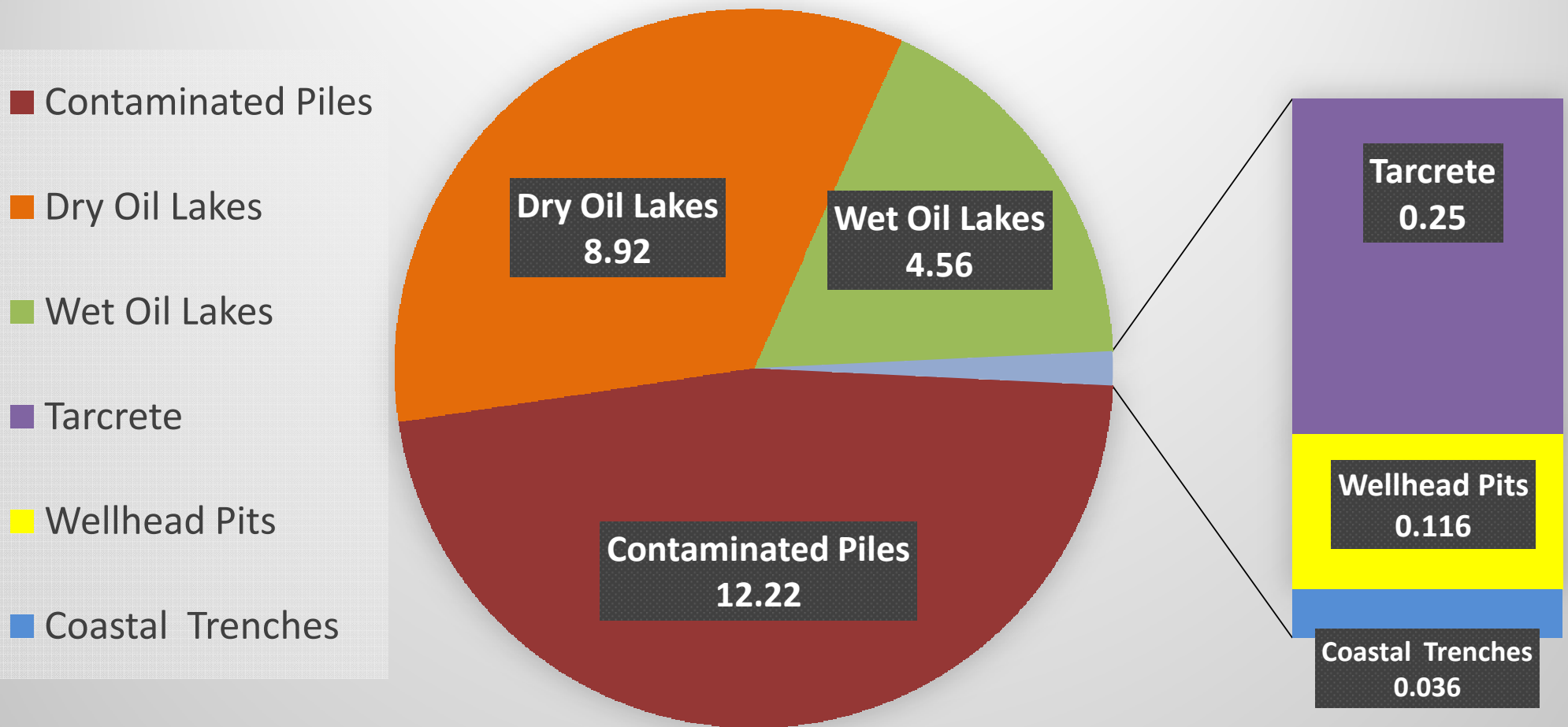
**(Remediation of areas in
and around wellhead pits
and Tarcrete)**

Claim No. 5000454

**(Remediation of areas
damaged by oil lakes, oil-
contaminated piles, oil
trenches & oil spills)**

Types Of Contamination

Total Volume 26.102 million m³



Wet Oil Lakes

- Areas covered with black liquid (highly weathered oil) and semi solid oil saturated material resulting from oil flow damaged oil wells.
- Occur in areas where large liquid oil accumulated because of local topography and micro relief.
- Investigations revealed that the average depth of oil contamination in the wet contaminate areas is approximately 63 cm.



Dry Oil Lakes

- Dry Oil Lakes: are areas covered with thin and moderately hard dry black tar layer.
- Dry oil lakes are generally found in shallow depressions and/or flat areas.
- The dry contamination areas cover almost 100 square Km of the desert, with an average depth of approximately 25 cm.



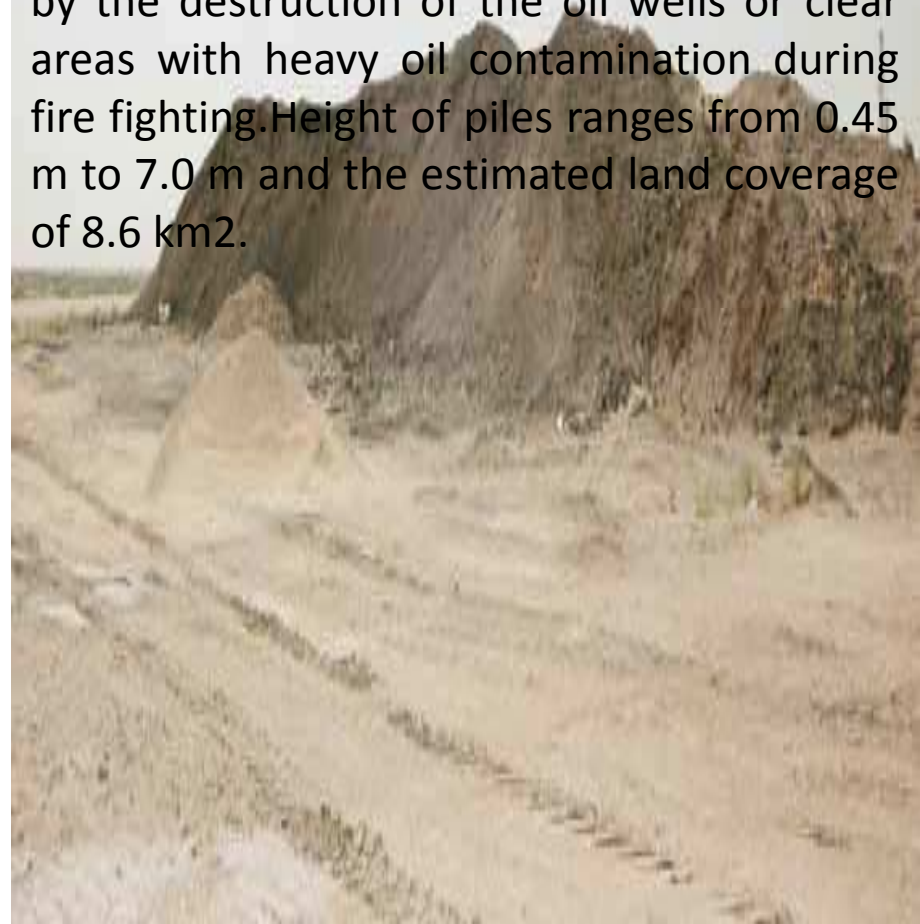
Wellhead Pits

Wellhead Pits: were constructed to store sea water used for fighting the oil well fires. Oil sludge and/or contaminated soil got accumulated at these pits.



Contaminated Piles

Contaminated piles: are oil-contaminated soil collected as mounds. The soil piles were made to stop the spread of oil flows caused by the destruction of the oil wells or clear areas with heavy oil contamination during fire fighting. Height of piles ranges from 0.45 m to 7.0 m and the estimated land coverage of 8.6 km².



Tarcrete

- Tarcrete is a solidified material, which reassembles asphalt. This is a result of air borne pollution from the crude oil well fires that settled out and accumulated in desert landscape area.
- The tarcrete forms a crust of varying thickness across large areas of the desert.
- Underlying soil is considered non-contaminated.
- Tarcrete layer covers over 270 km² of desert areas.



Coastal Trenches

- The coastal oil deposit is an area with visible surface oily contamination, and is located in the supra-tidal zone north of Kuwait Bay.
- The coastal trench was a deliberate man-made trench filled crude oil.
- Trench to be excavated contains visible contaminated material and is a 1.4 km long coastal oil trench with associated oil spills located in the supra-tidal area near Subiyah.



Developing KERP Strategy

Dec.2003 Landfilling is the favored environmental solution recommended by the UNCC “F4” Panel.

March. 2008 The Independent Reviewers excluded landfilling as preferred environmental solution.

March.2010 KNFP organized an Oil Lake/Soil Remediation Forum and in cooperation with the KOC, was held in Kuwait and the main objective is to identify the technologies that could be included in demonstration field trials.

April.2010 to October.2012 The Joint Technical Team was formed with representatives from KNFP,KOC, MEW,KEPA,PAFF and KISR, aiming to demonstrate the implementation of KERP programme.

2012 to September.2013 Bi-Annual Reports number 8th, 9th, and phasing plan which compiled the new structures and specific projects to develop the KERP Programme.

Developing KERP Strategy

Jan.2015 Total Remediation Strategy approach was developed and approved by KNFP/Advisory Panel.

The TRS will utilize soil remediation technologies together with a reduced scope for soil remediation through use of the Risk Based Approach (RBA).

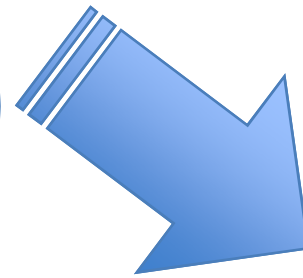
It is the intention to maintain the existing program in North Kuwait (NK) in order to address the high priority contamination features to limit any potential on-going impacts to the underlying groundwater aquifer.

The proposed revised strategy is to be undertaken in an early implementation of the TRS in South Kuwait (SK) oilfields which is environmentally less sensitive than the NK oilfields. Successful demonstration of the proposed solutions in SK and the benefits shown shall be integrated into the NK remedial action at the earliest.

Original Plan

Original direction was
disposal

Is this the legacy we
want to leave?



KERP-Strategy

Total Remediation Solution

Risk Based Approach

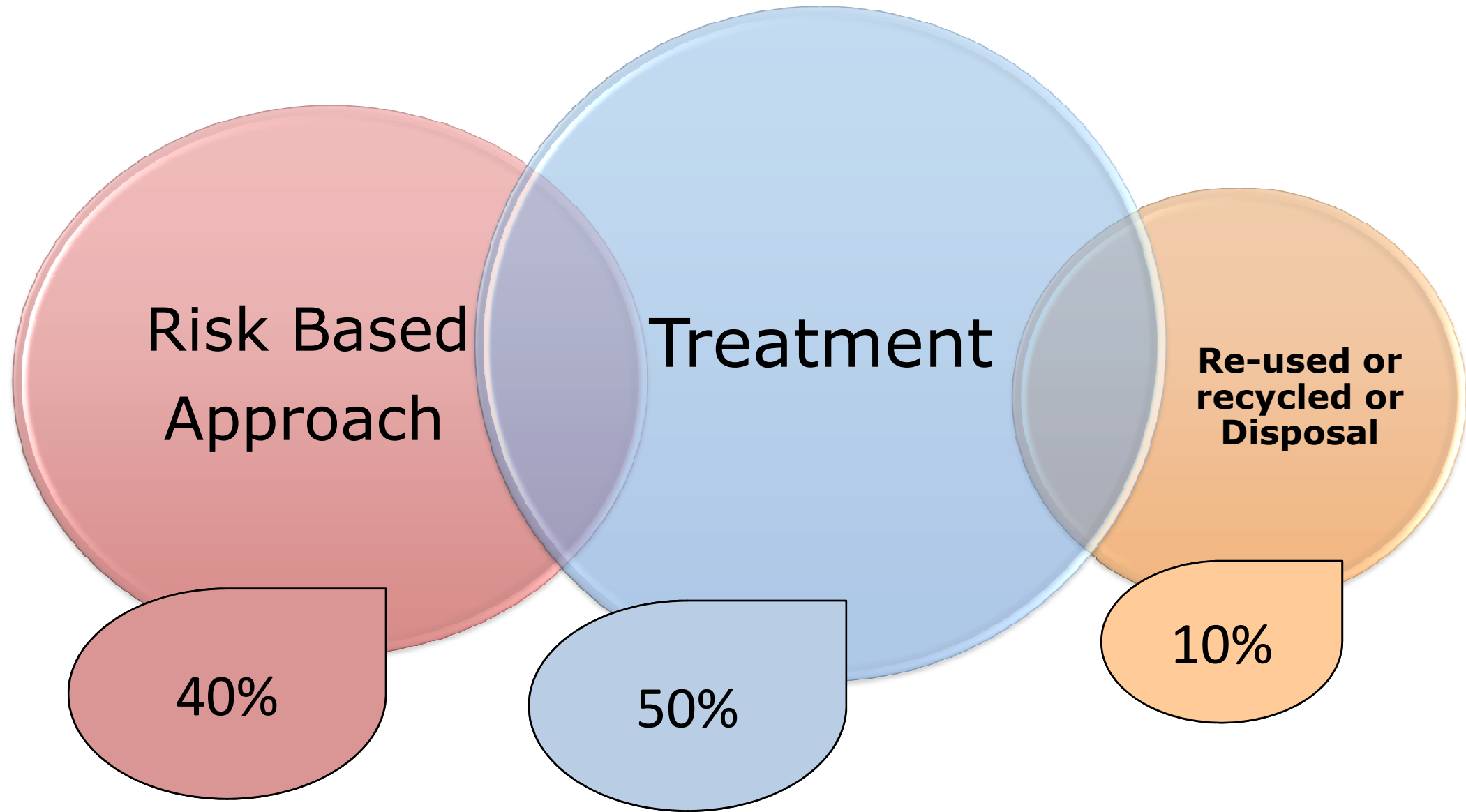
40%

Treatment

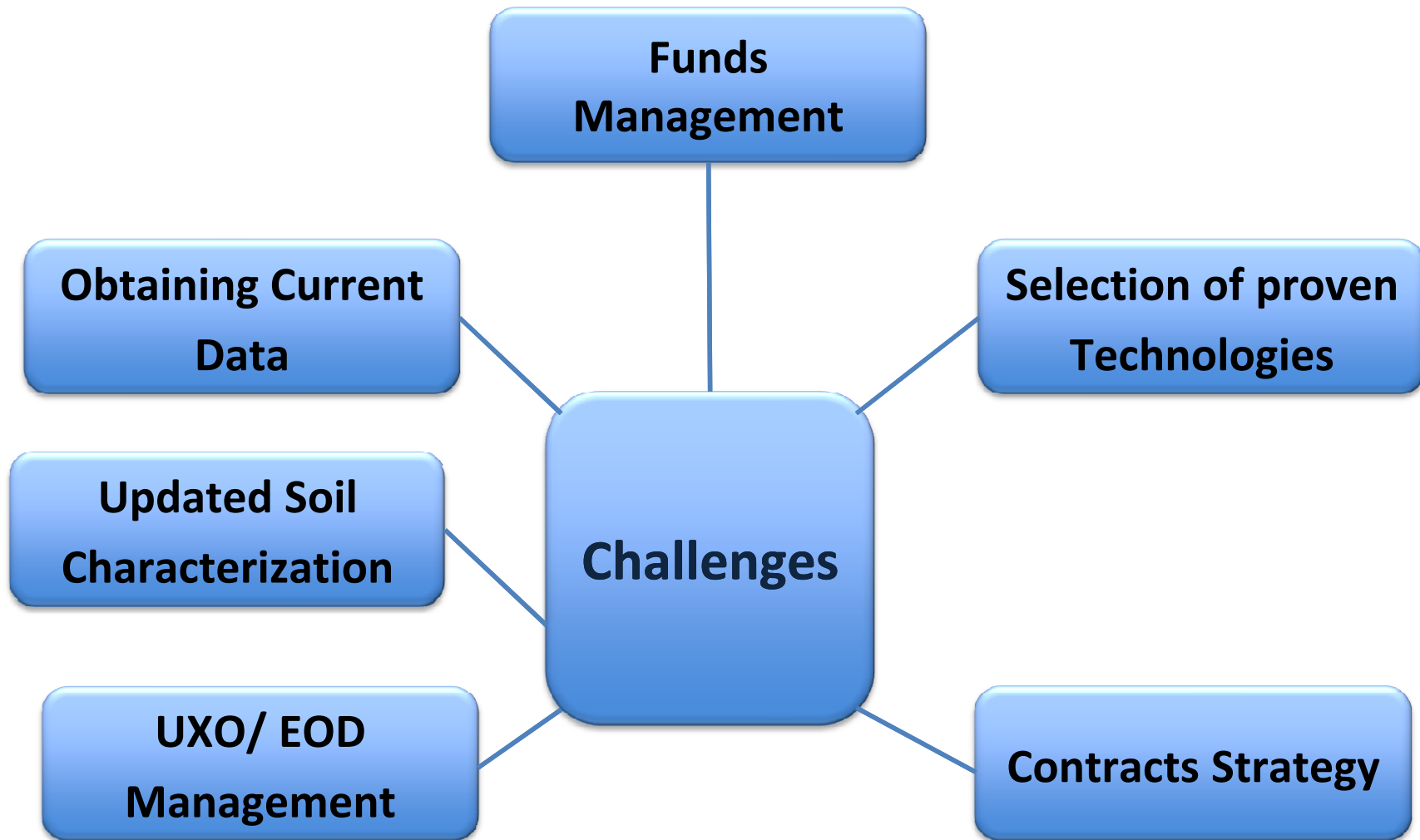
50%

Re-used or recycled or Disposal

10%

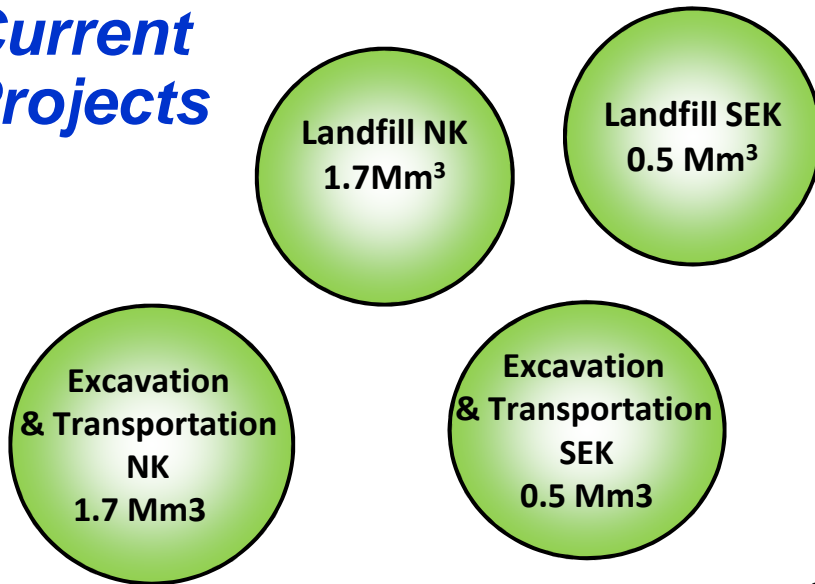


Key Challenges

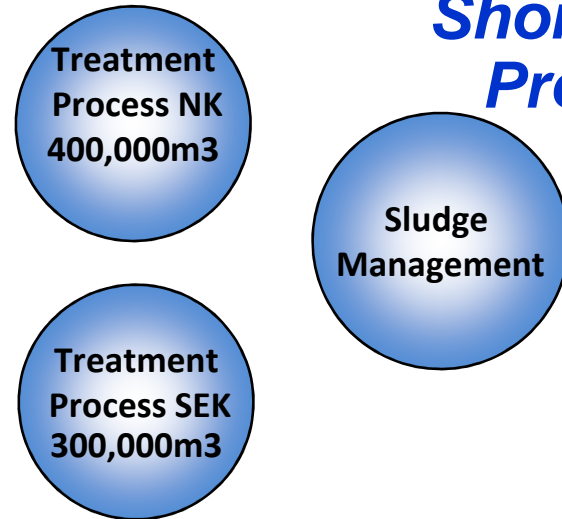


Kuwait Environment Remediation Projects

Current Projects



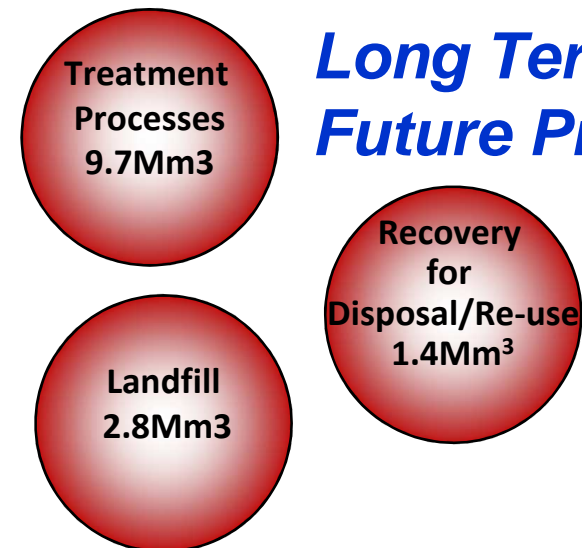
Short Term Projects



Enabling Projects



Long Term/ Future Projects



Conclusions

- TRS is successful in meeting stakeholder objectives and remains compliant with the intent of the UNCC directives
- TRS provides a flexible solution that is not reliant on the success of one element but the interaction of all the TRS elements
- TRS allows greater efficiency in management of materials in order to prioritise high risk materials addressed early and limits unnecessary disposal of soil and high double handling cost
- RBA promotes 'value engineering' which provides cost savings, appropriate allocation of UN funds

Conclusions - contd.

- RBA minimizes the disturbance of vegetation that has regrown in moderately contaminated area
- Treatment technologies and enhanced bioremediation promotes sustainability via re-use of previously contaminated soil
- TRS reduces the legacy of landfill management, maintenance and the loss of operational land with potential oil reserves
- TRS initiates projects in an integrated manner to eliminate program delays and provides alternatives to manage and mitigate known and unforeseen key risks

Thank you

Question ?

