



intersol'2007

6^{ème} Congrès-Exposition International sur les Sols, les Sédiments et l'Eau

6th International Conference-Exhibition on Soils, Sediments and Water

Environmental risk management of the reuse of non- conventional materials in road construction: Application to contaminated soil

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LROP and CETE of Lyon belong to Scientific and Technical network of French ministry for infrastructure

AHSP

PRESENTATION OUTLINE

- I. Administrative context
- II. Practise evolution 70' - 2007: case studies
- III. Non-conventional material management in road construction: Actual practises
- IV. Methodology used for characterisation and determining suitability for road reuse
- V. Conclusions / Perspectives

ADMINISTRATIVE/LEGISLATIVE CONTEXT

Solid waste management (EU Framework Directive on waste):

- Restrict landfill
 - Promote valorisation and recycling
- Sustainable development**

Beneficiation network:

<=> economical/geotechnical/environmental criterion

Public works and road construction is a key field for reuse of non-conventional materials

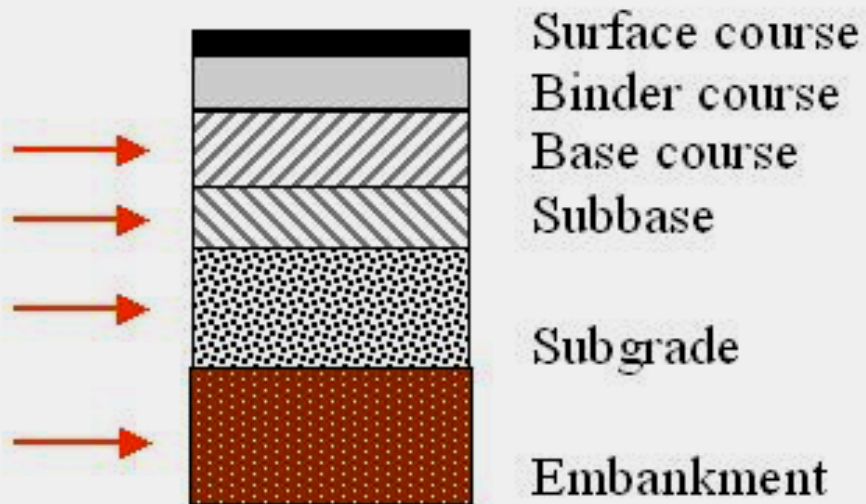
In France administrative / legislative organisation in the 90 ' for:

- Municipal solid waste incineration (MSWI)
- Pulverised fly ashes
- Foundry sands

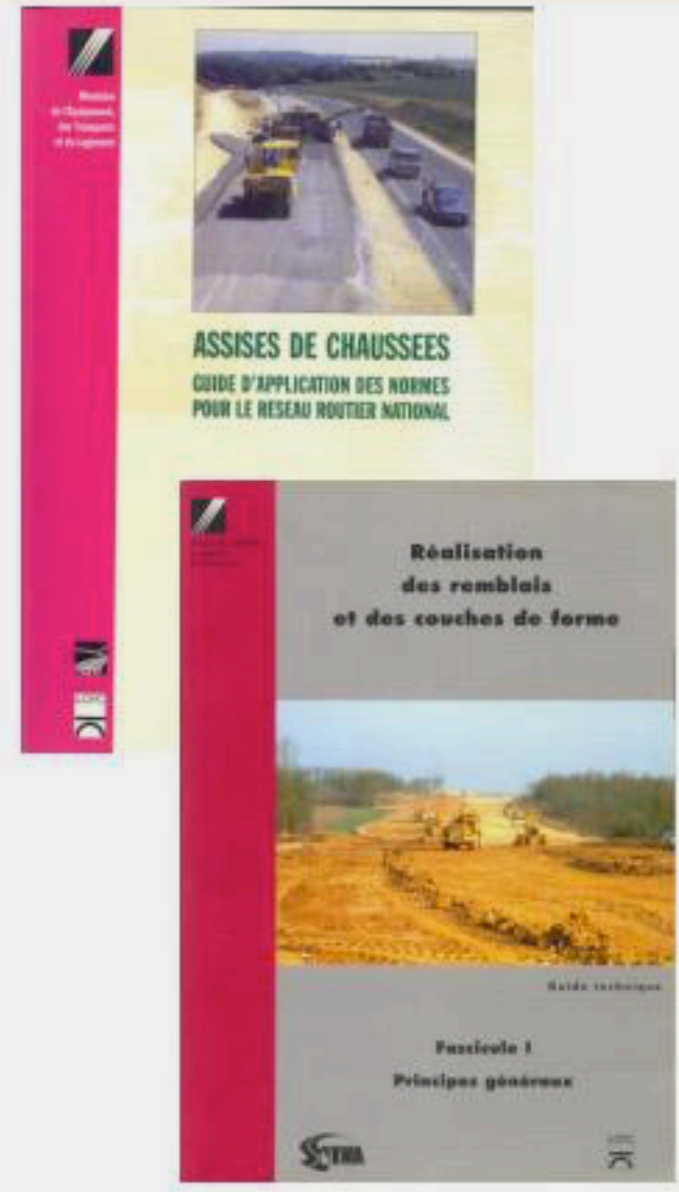
=> Need for reuse guidelines of solid waste materials in road construction

ROAD CONSTRUCTION

Road typical cross section



**Possible
use of non-
conventional
materials**



ACTUAL PRACTISES: VALORISATION AND RECYCLING

Non-conventional material (MSWI, Slags, ...) has demonstrated its geotechnical suitability as a material for road/embankment construction

Reduce landfill

sustainable development (i.e. natural resources conservation)

Secondary raw material
(MSWI, Slags, etc.)

Potentially contaminated soil

Potentially non-conventional materials

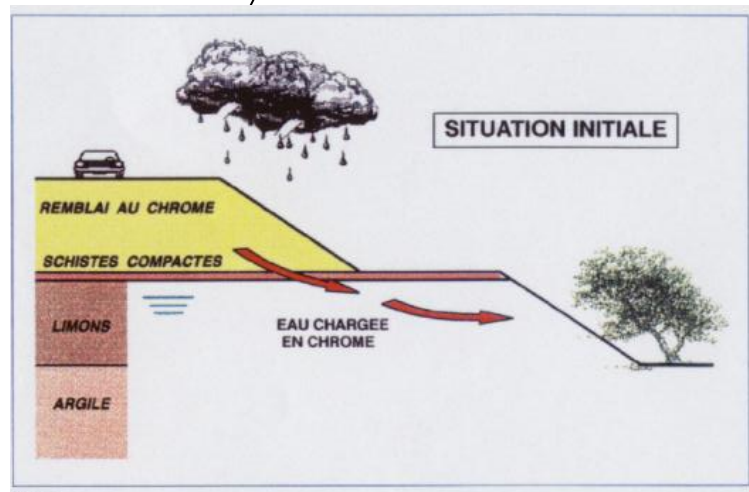
Acceptable impacts on the environment and on human health in order to

Reuse in road construction

A22 HIGHWAY: 1969-71

~ 500' 000 tons of Cr ore treatment by-products were used for embankment

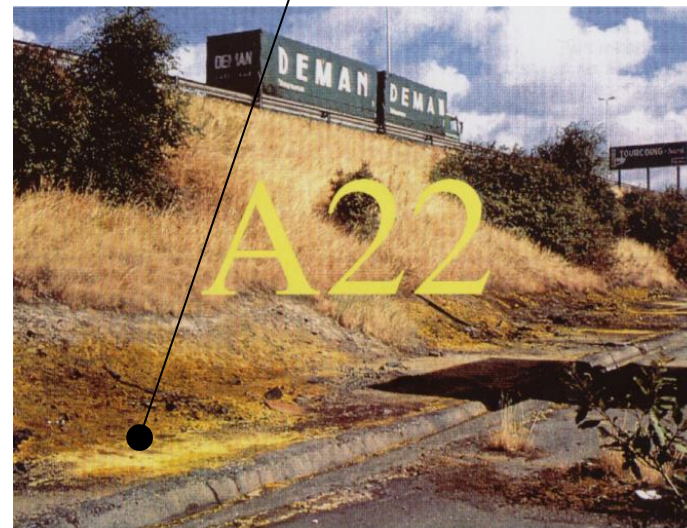
Technically suitable, low costs *but* contaminated with soluble and toxic Cr => used in the heart of the road structure with a tightness



During the wet seasons, there is a leaching of chromium in these materials and transport to adjacent surface and subsurface water bodies

Cf. Bulletin de liaison des laboratoires des ponts et chaussées, n°188 (1993)

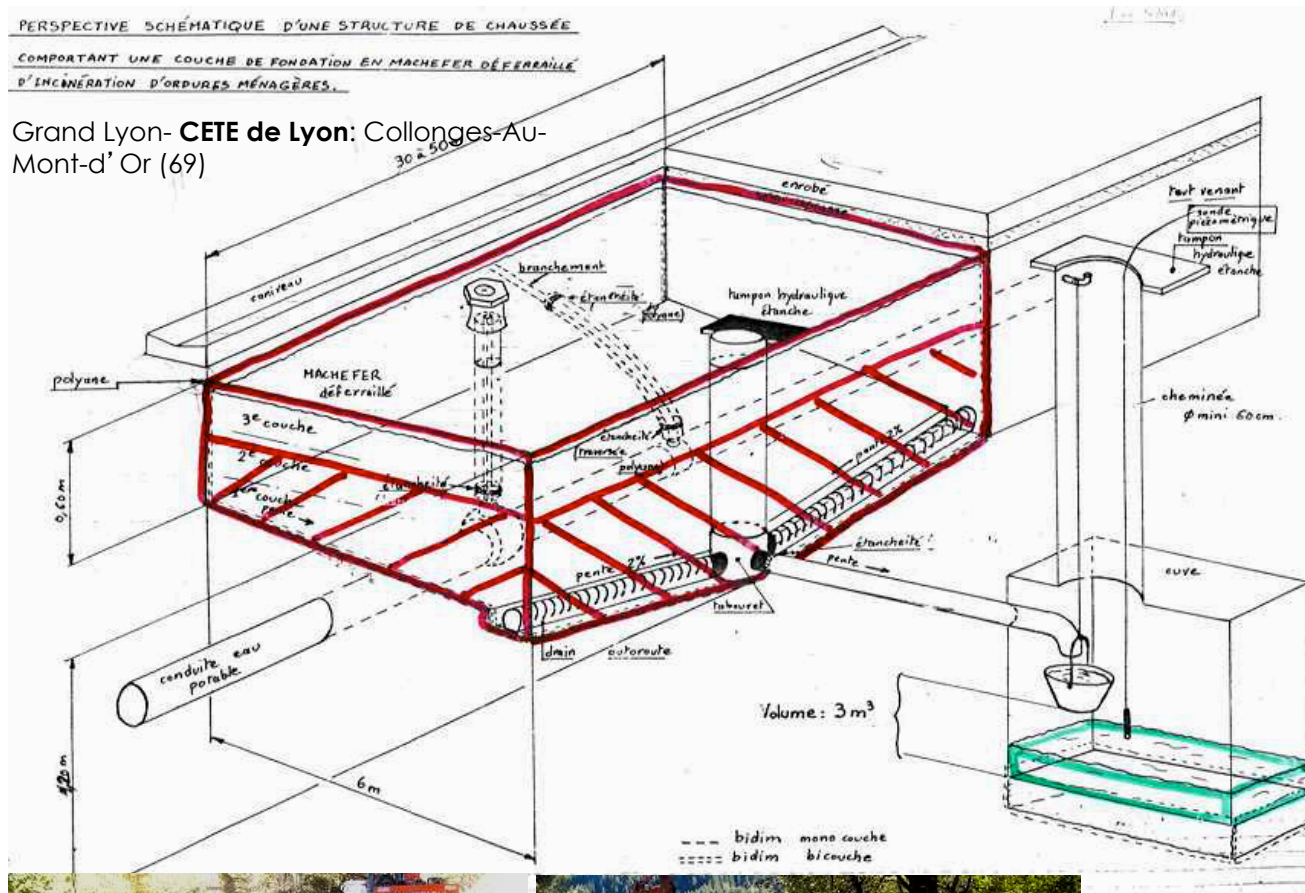
Chromium release



Test road : MSWI (1992), Steel slag (2003)

PERSPECTIVE SCHEMATIQUE D'UNE STRUCTURE DE CHAUSSEE
COMPORTANT UNE COUCHE DE FONDATION EN MACHEFER DÉFERRAILLÉ
D'INCINÉRATION D'ORDURES MÉNAGÈRES.

Grand Lyon- **CETE de Lyon**: Collonges-Au-Mont-d'Or (69)



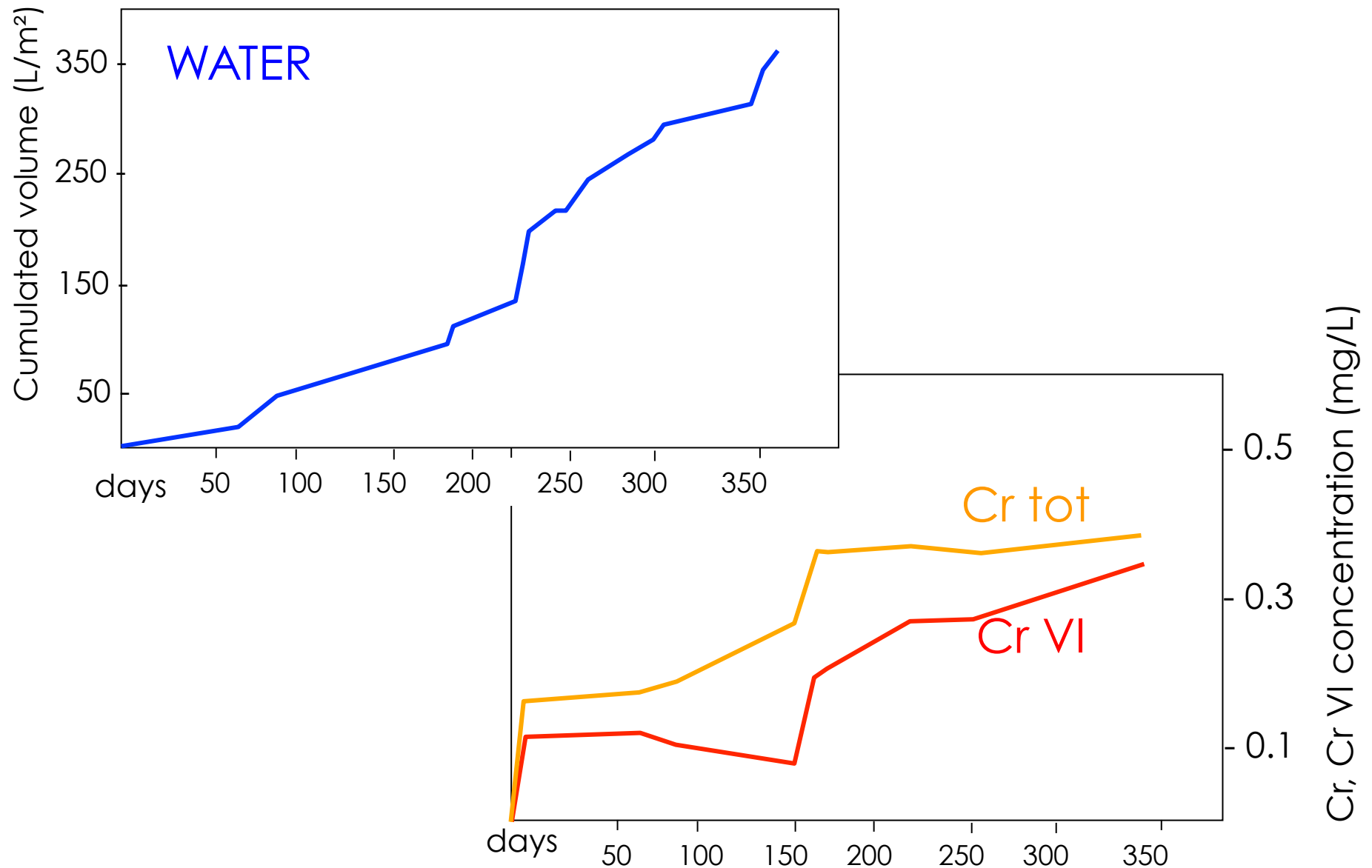
The environmental impact (analyses of leachate collected beneath the « test road » will be monitored for at least 1 year (1 hydrological cycle)

Cf. Grand Lyon-CETE de Lyon (1995) TSM n° 5 p 427 à 430



⇐ (a) construction of the "test road" (steel slag) (b) detail of membranes

Test road: monitoring example



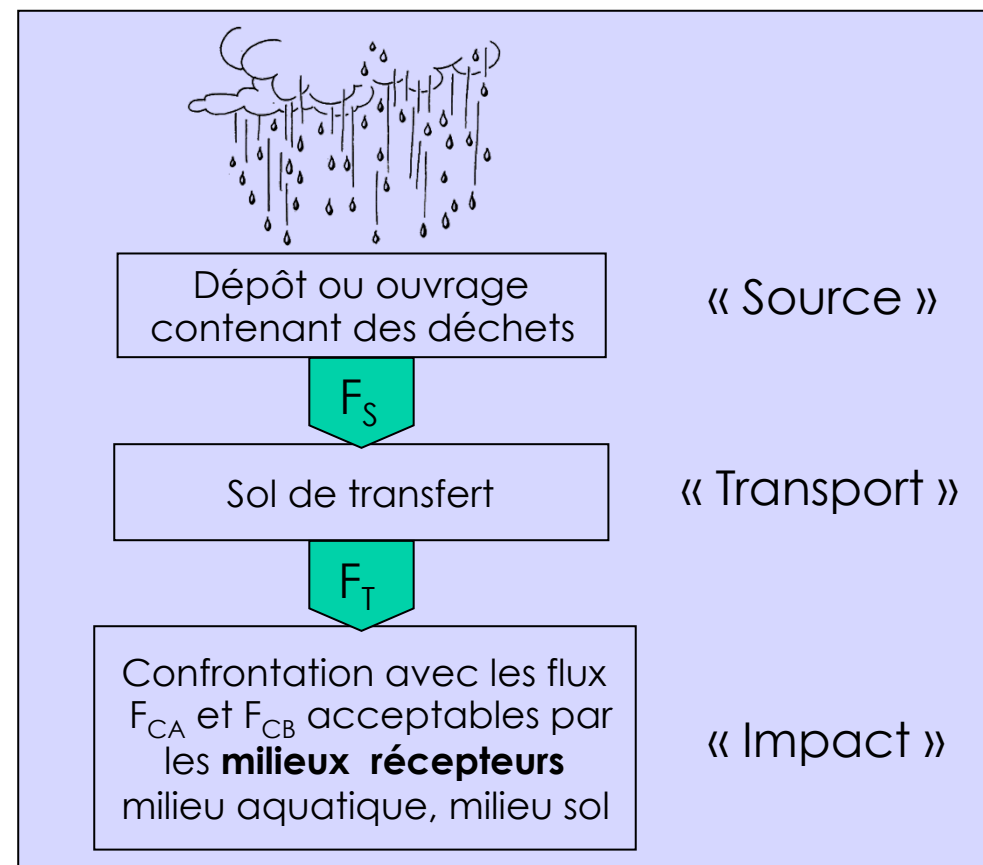
Data interpretation

- 90 s MSWI, Fly ashes, Foundry sands reuses based on limited laboratory characterisations => Insufficient ?
- Test roads: how to (un)validate reuse scenarios from monitoring ?

=> Eco-compatibility approach (ADEME, 2002)

Waste eco-compatibility for a given scenario:

$$F_T \leq F_{CA} \text{ and } F_T \leq F_{CB}$$



GLOBAL METHODOLOGY USED FOR CHARACTERISATION AND DETERMINING SUITABILITY FOR ROAD REUSE ENV 12920

FIRST REUSE OF NON-CONVENTIONAL MATERIAL

Physico-chemical composition
Origin, Variability, status, etc.

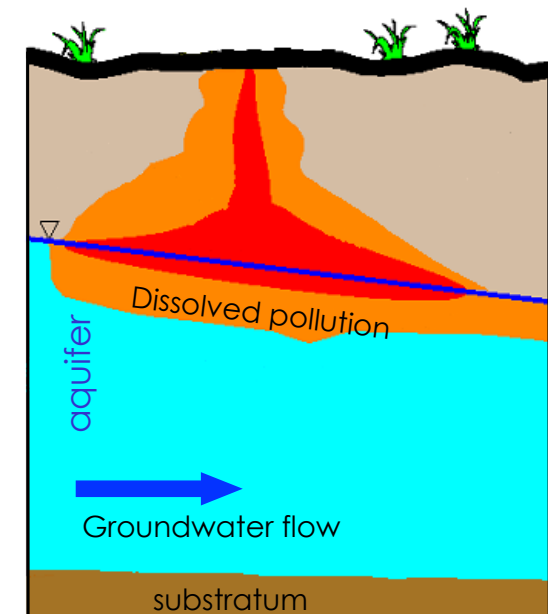
Environmentally evaluated from the perspective of the material itself

LABORATORY CHARACTERISATION

Batch leaching test, percolation test, lysimeter test, ...

SCENARII IN ROAD CONSTRUCTION

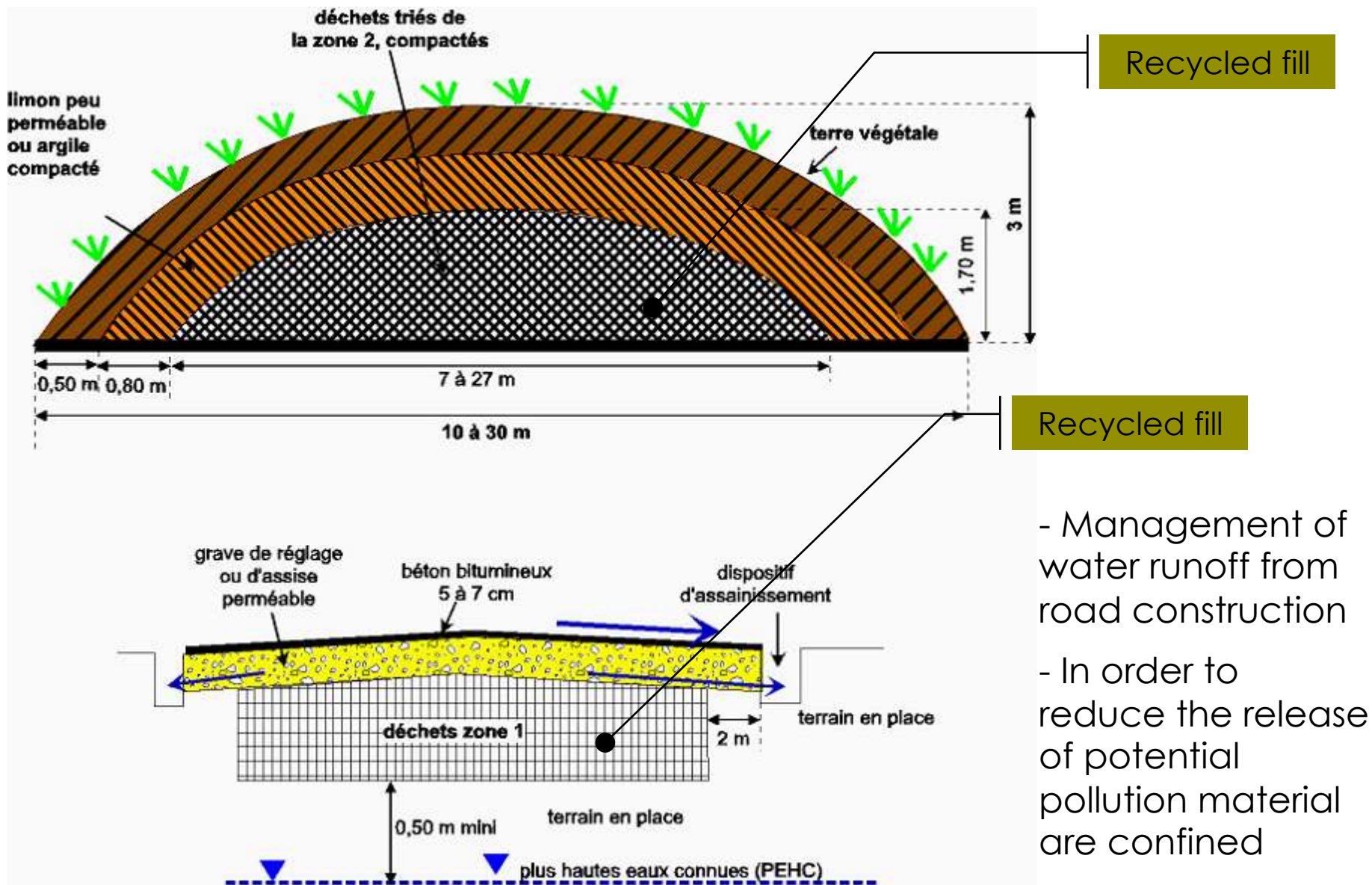
System boundaries, dimensions of road structure, geotechnical and environmental approaches, ...



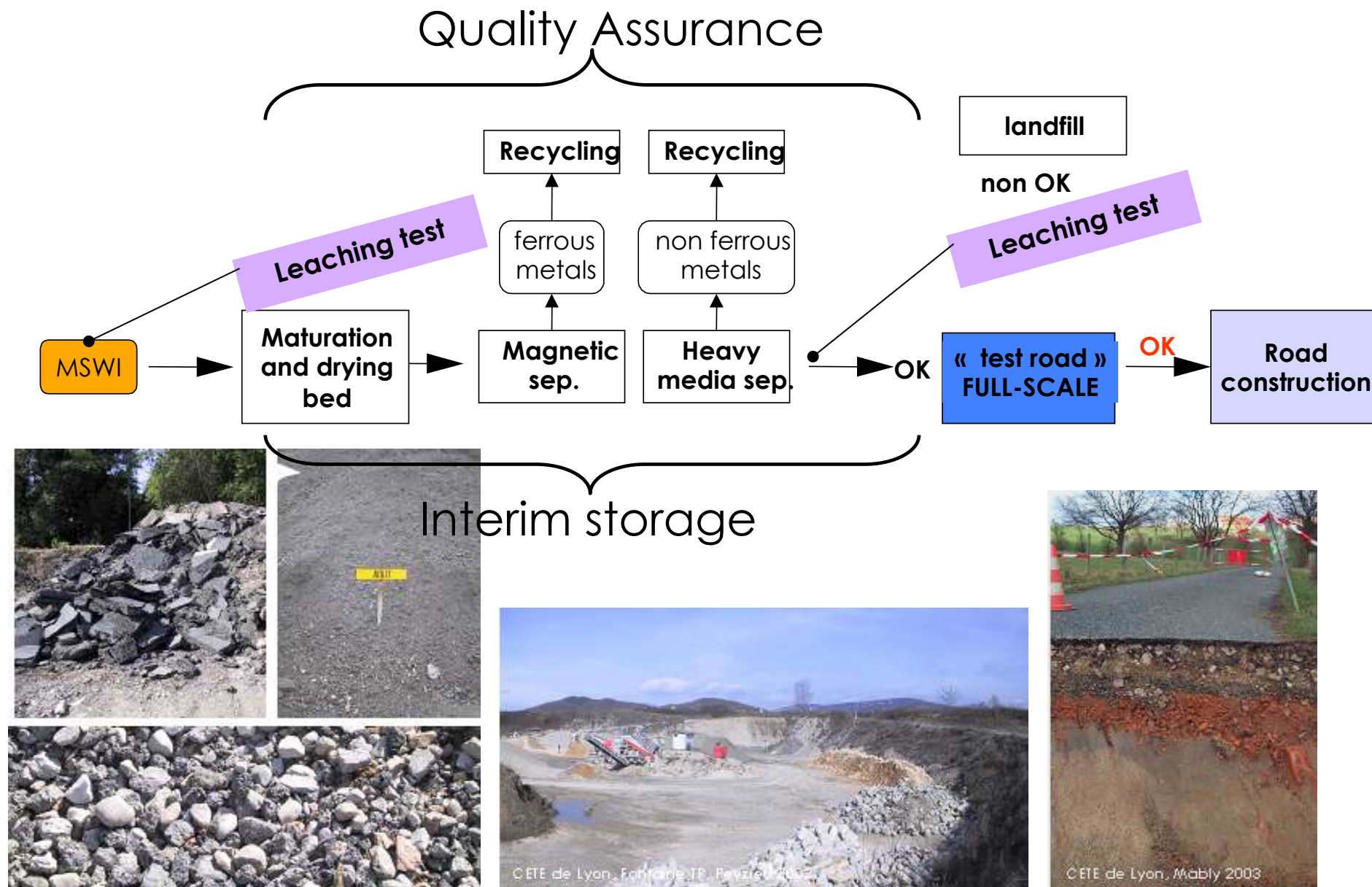
FULL-SCALE TEST – ROAD REFERENCE SCENARII

test road as pilot full-scale, numerical simulation, ...

VARIOUS SCENARI: REUSE IN ROAD CONSTRUCTION



Variability assessment, a key feature : MSWI example



Geotechnical & Environmental description: MSWI example

FICHE TECHNIQUE PRODUIT

Grave 0 / 31,5 MIOM "V"

IME SITE X

Arrêté préfectoral du

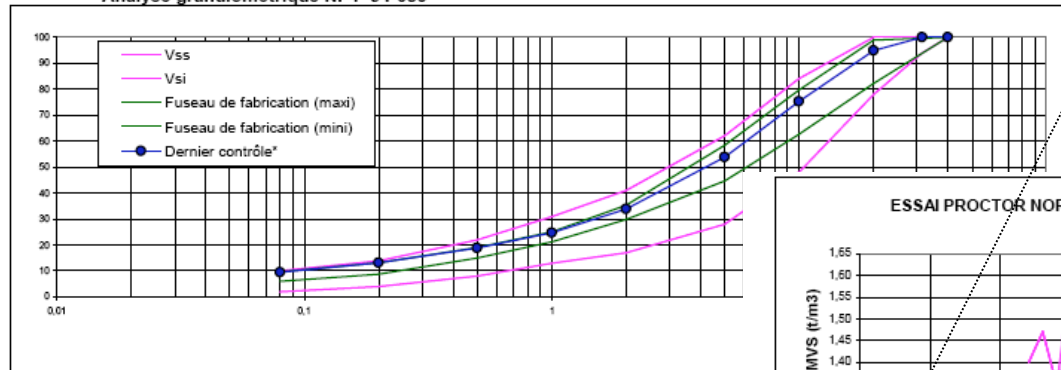
Engagement de granularité (selon XP P18-545)			Caractéristiques intrinsèques et comportement au compactage								Caractéristiques chimiques	
	Passant à 0,08 mm (%)	Passant à 2 mm (%)		w (%)	VBS	LA	MDE	WOPN (%)	MVS à OPN (t/m3)	IPI	pH	Conductivité (mS/cm)
Xt	6	29	moyenne	22,3	0,05	41,3	29,7	18,2	1,53	37	10,9	0,9
Vss	10	41	maxi	27,7	0,05	43,0	32,0	21,5	1,61	42	11,4	1,3
Vsi	2	17	mini	19,5	0,04	40,0	28,0	15,0	1,48	30	10,2	0,7
e	8	24	étendue	8,2	0,01	3,0	4,0	6,5	0,13	12	1,2	0,6
tolérance	4	12	écart-type	4,7	0,01	1,5	2,1	3,3	0,07	6	0,5	0,2
Nombre de valeurs				3	3	3	3	3	3	3	8	8

Dernier contrôle : 29/09/06

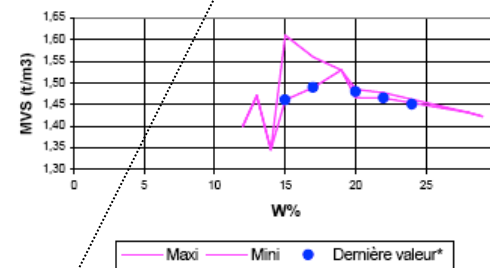
Lot : B 10-11-1205 + 01-02-03-04-0506

9,6	33,8	19,7	0,05	40	28	18,5	1,50	42	-	-
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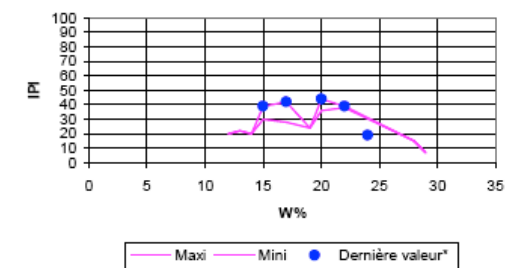
Analyse granulométrique NF P 94-056



ESSAI PROCTOR NORMAL NF P 94-093



INDICE PORTANT IMMEDIAT NF P 94-078



CLASSIFICATION

MIOM V** classé F61 norme NF P 11-300 assimilable à un B31 à D21

Etat hydrique : m état hydrique m moyen permettant une mise en œuvre classique
état hydrique h humide ou th très humide nécessitant une mise en œuvre ultérieure
selon le guide technique d'utilisation des graves de recyclage du Rhône Novembre 2004

Domaine d'emploi
en remblai et couche de forme
en couche de fondation pour trafic < T4
en sous-couche de bâtiment

Conditions d'emploi conformément à la circulaire du ministère de l'environnement du 9 mai 1994

- Geotechnical and materials testing

- environmental testing (leaching test)

CONCLUSION / PERSPECTIVES

- Excavated contaminated soils generally landfilled
 - Large volumes are concerned
 - A similar methodology should be followed for reuse of contaminated excavated soils (with or without cleanup) in road even if mechanical features are not so good
- => embankment, landscaping, ...