- Landfill Design
- Other Issues, e.g. future use of waste space, environmental control

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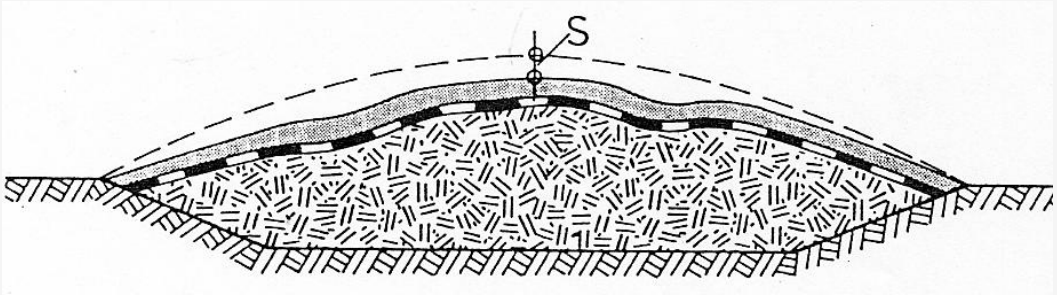
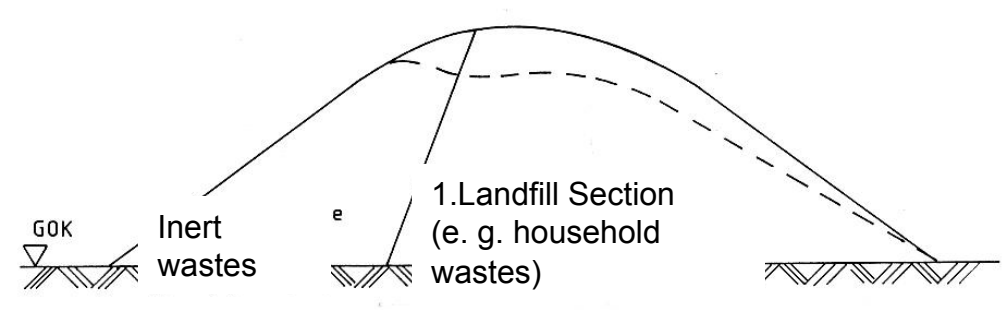
Settlement Behavior of Landfill Bodies schematic

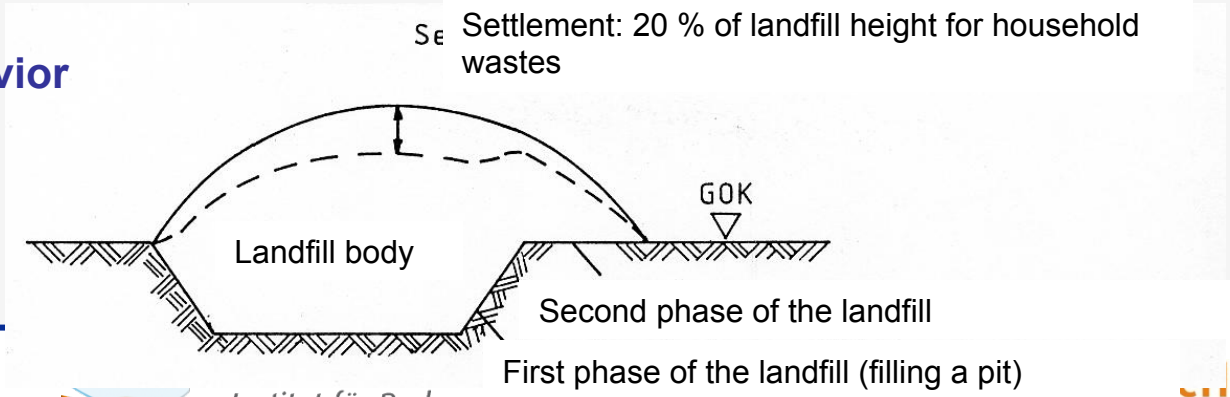
A prognosis of the settlement behavior of landfill bodies is difficult



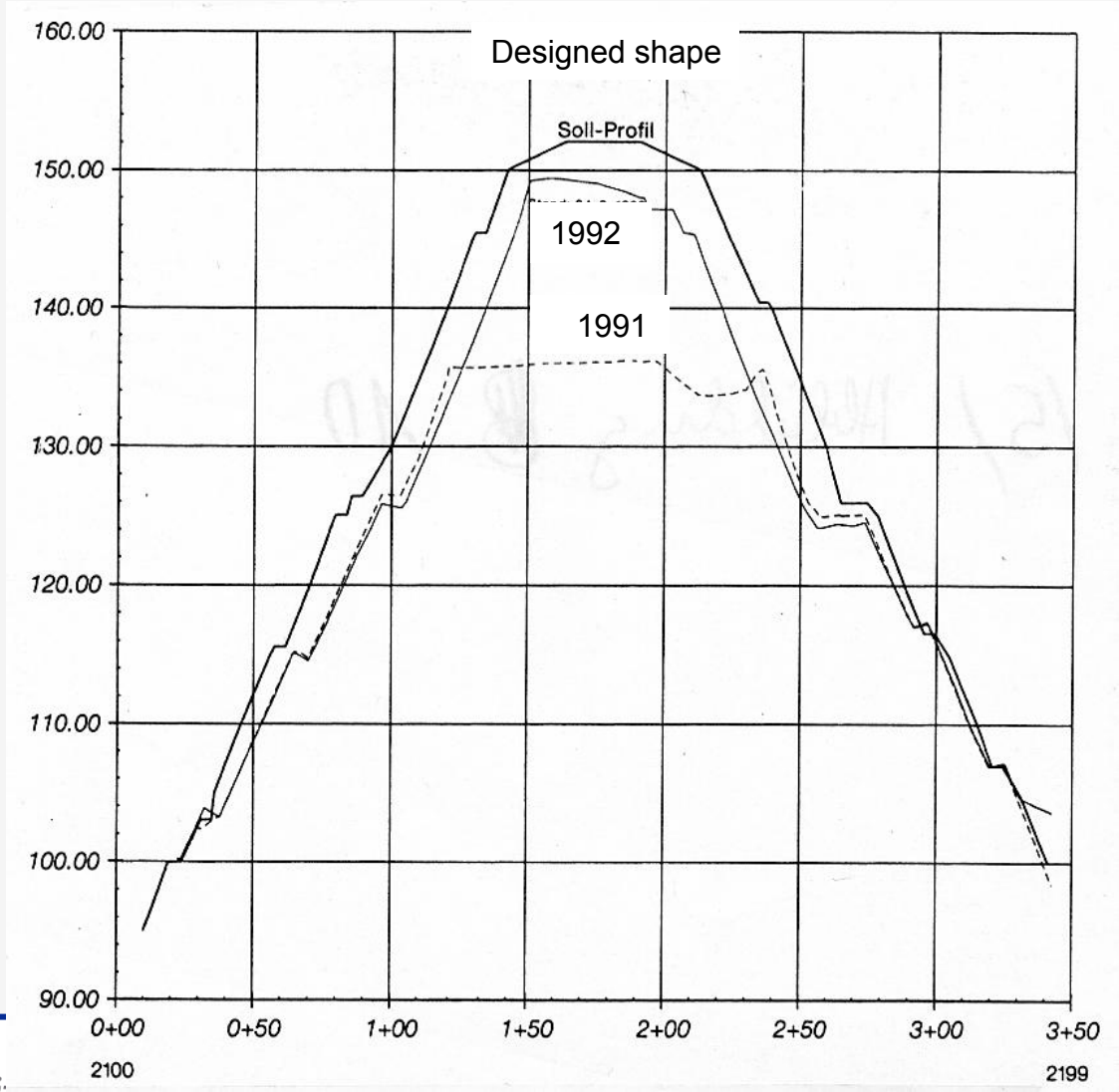
Differences in settlement behavior caused by different waste types



Differences of settlement behavior caused by topography

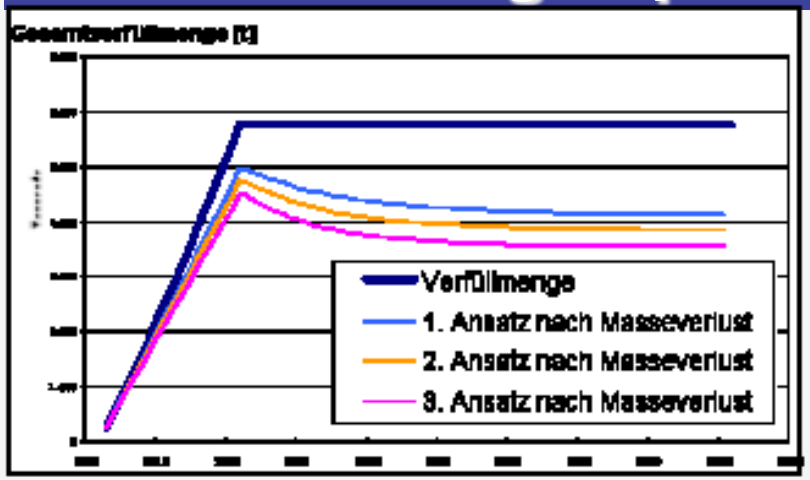


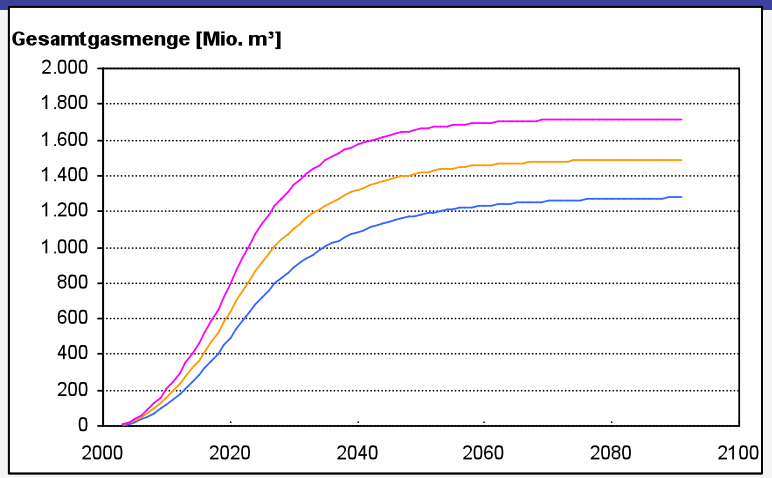
Settlement Behavior of Landfill Bodies
Results of a Topographic Survey

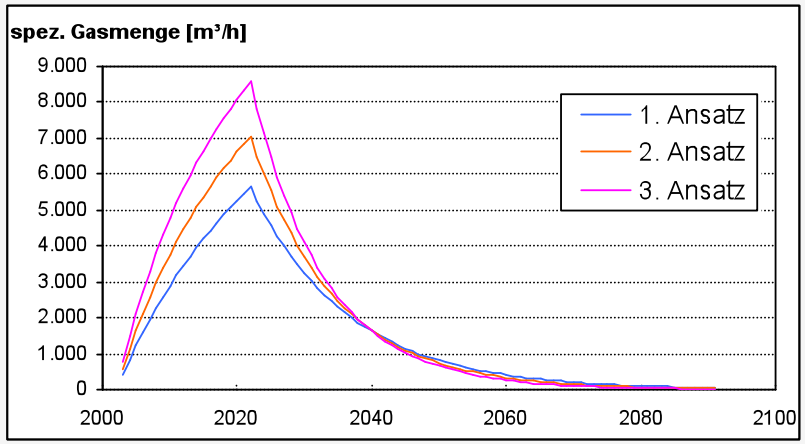


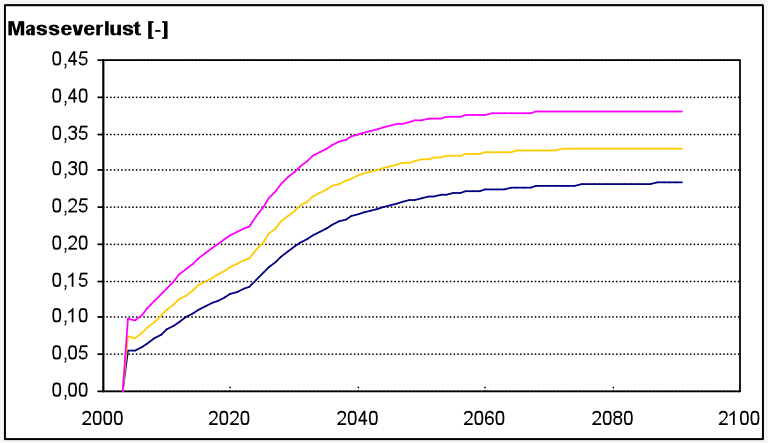
Landfill at Wiesbaden, Germany

Settlements due to landfill gas production and loss of mass



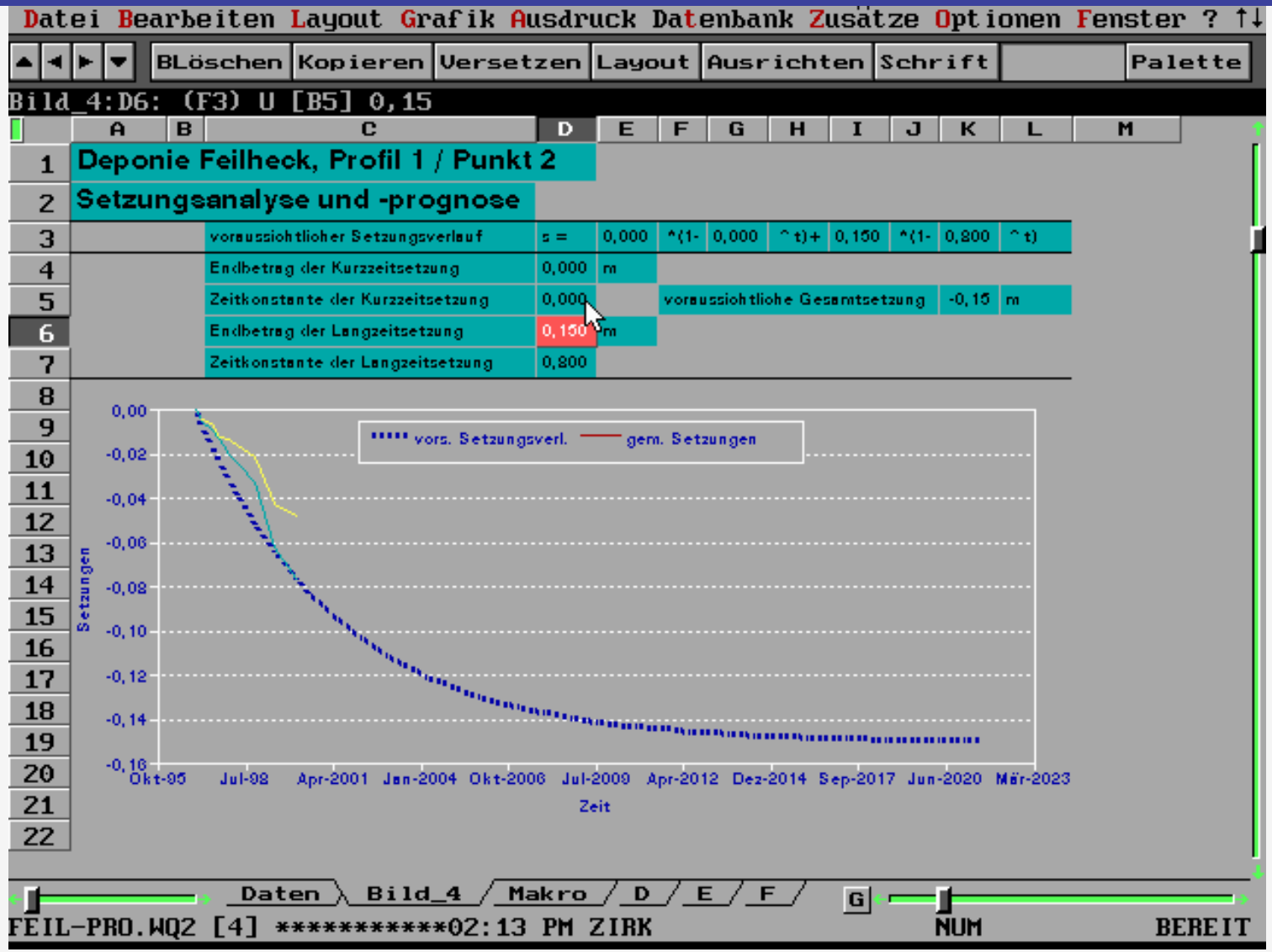






Gasprognose in 3 Ansätzen Version 7 / 2002				Parameter:	1. Ansatz	2. Ansatz	3. Ansatz
Projekt:	**al multaqaa**			Corg. [kg/t]	170	180	190
				Abbaukonstante [-]	0,03	0,035	0,04
				Temperatur [°C]	30	35	40

Calculation of landfill settlement: special designed software



Major Ponding in Parking Lot


Significant Cracking
in Access Road


Major Settlement
in Tennis Court

Design Aspects for Cap Sealings: Compaction of the Old Landfill

- concern is both total and differential settlement
- depends on age, composition, thickness, placement and original site subgrade
- heavy proofrolling is generally adequate
- deep dynamic compaction may be advisable or necessary
- finish by appropriate contouring with native soil (this is foundation for new liner)
- place new liner system accordingly

Differential Settlement of Final Cover

Differential Settlement of Final Cover

Slope Stability of Landfill Capping Systems

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Landfill design and construction

Stability

The emplacement of waste on the site shall take place in such a way as to ensure stability of the mass of waste and associated structures, particularly in respect of avoidance of slippages.

Where an artificial barrier is established it must be ascertained that the geological substratum, considering the morphology of the landfill, is sufficiently stable to prevent settlement that may cause damage to the barrier.

Landslide at a landfill at Braunschweig, Germany

Monitoring

- visual observation
- surveying methods
- inclinometers
- load and strain measurements
- temperature and gas monitoring

Landfill design and construction

Nuisances and hazards

Measures shall be taken to minimise nuisances and hazards arising from the landfill through:

- emissions of odours and dust,
- wind-blown materials,
- noise and traffic,
- birds, vermin and insects,
- formation and aerosols,
- fires.

The landfill shall be equipped so that dirt originating from the site is not dispersed onto public roads and the surrounding land.

Landfill design and construction

Barriers

The landfill shall be secured and fenced to prevent free access to the site. The gates shall be locked outside operating hours. The system of control and access to each facility should contain a programme of measures to detect and discourage illegal dumping in the facility.

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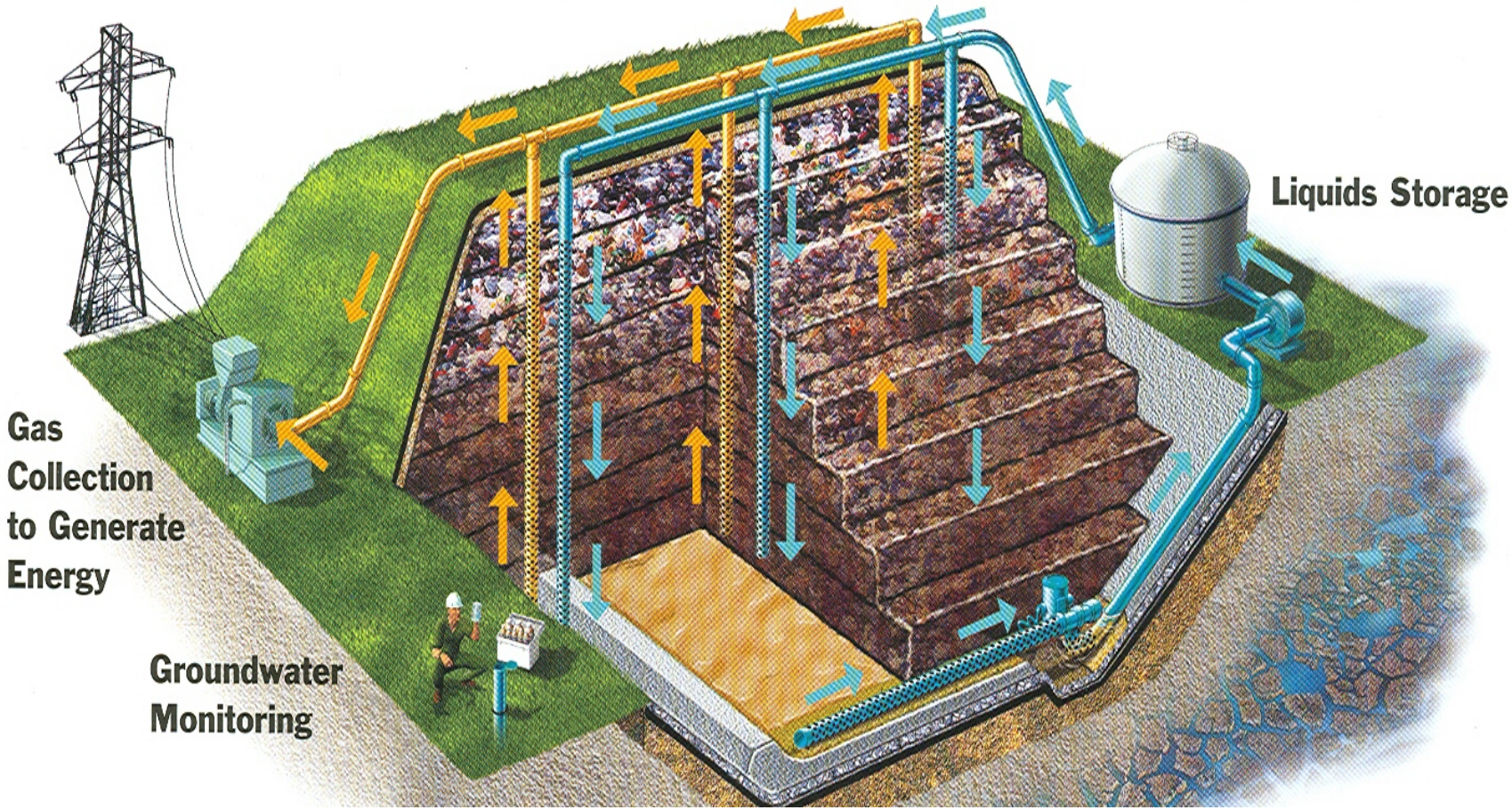
der Bundeswehr Universität München

Future Use of Landfills
Environmental Aspects

Regional landfills (megafills) with gas capture for energy production will be common



Golf Courses and Driving Ranges

- perfect fit for closed landfills
- need ~ 200 acres for 18- holes
- natl. Golf Fed. Lists 62 references
- many examples exist
- see following (Mission Canyon, 1976)

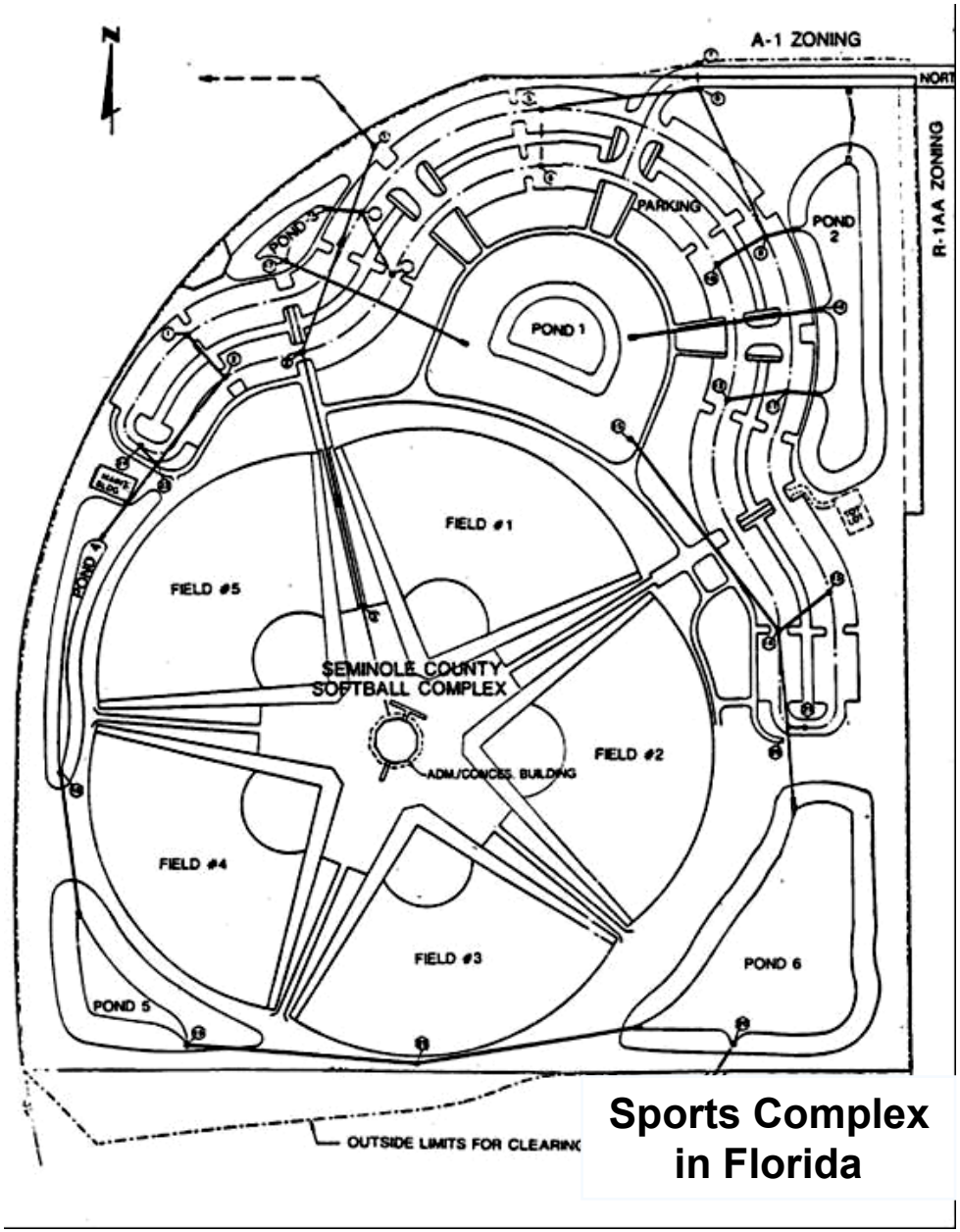
Mission Canyon Landfill, Los Angeles, Waste Age, 1976!

St. Lucie, Florida Landfill

Note Gas Emission Tower in Background!

Other Examples for post use of landfills

- airport runway expansions
- recreational facilities
- sport fields and paths
- wildlife refuge and gardens
- ski hills and motorcross courses
- heliport and pistol range
- windmill (in Holland, MI)
- cemetery (in Georgia)
- parking lots



Sports Complex in Florida

Toboggan Hill Park, Michigan

Rehabilitated landfill

Reuse: Photovoltaic

Photovoltaic systems

- An important question is if landfills can easily be used as a location for photovoltaic systems
- If a photovoltaic system is build on a landfill it is fundamental, that the landfill surface will not be damaged.
- The additional weight may not cause deformation on the seal
- the maintenance of the plant cover is necessary to clarify

This solar project was completed in 2008 at GROWS Landfill in Bucks County, PA

Thank you for your attention!

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