

**Table S1.** Complete characterization of backfilling materials (C1-C7), contaminated deep soil sample (R1), natural soil samples (T1-T7) and white sample (B).

Sample	UoM	C1	C2	C3	C4	C5	C6	C7	R1	T1	T2	T3	T4	T5	T6	T7	B
s																	
Cd	mg/Kg	0.5	1.1	0.6	<0.2	0.6	0.9	0.5	<0.8	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	0.2
Cr	mg/Kg	1,232	2,371	1,853	38	3,309	2,775	1,812	3,280	63	80	74	76	65	103	90	107
Cr(VI)	mg/Kg	9.0	15.0	9.4	0.6	8.9	5.0	6.0	25.0	1.2	3.2	1.2	1.4	1.4	1.6	2.6	2.0
Ni	mg/Kg	55	53	58	22	48	66	34	44	43	35	45	53	48	69	42	102
Pb	mg/Kg	26	63	26	17	30	31	24	48	13	<10	10	11	15	16	13	15
Cu	mg/Kg	53	124	135	29	101	192	107	99	21	16	16	22	23	40	22	41
Zn	mg/Kg	135	285	135	36	234	214	167	279	53	47	62	71	59	87	54	90
As	mg/Kg	5.8	7.8	7.6	3.1	6.5	6.9	6.6	4.3	6.6	6.0	7.2	7.5	7.4	9.4	0.3	8.7
Sb	mg/Kg	7.3	18.0	9.0	<1	13.0	15.0	12.0	18.0	<1	<1	<1	<1	<1	<1	<1	<1
Be	mg/Kg	0.5	0.6	0.6	0.5	0.5	0.5	0.4	0.3	1.1	0.9	1.2	1.3	1.1	1.7	0.9	1.5
Co	mg/Kg	8.4	9.3	9.0	5.0	9.3	13.0	6.7	8.5	11.0	8.7	9.8	11.0	12.0	15.0	9.7	13.0
Fe	mg/Kg	25,48	25,92	20,90	10,05	32.56	36.18	22.20	24,98	20,58	18,27	22,53	34,09	21,66	38,61	19,45	31,77
Mn	mg/Kg	8	8	5	2	7	4	4	0	9	4	1	4	1	2	1	5
Mo	mg/Kg	-	3.1	1.9	0.3	3.6	1.9	2.7	3.9	0.4	0.4	0.4	0.4	0.1	0.4	0.4	6.5
Hg	mg/Kg	0.6	0.7	0.1	<0.1	0.2	0.3	1.5	0.2	<0.1	0.1	<0.1	0.1	<0.1	<0.1	0.3	<0.1
Se	mg/Kg	0.6	2.5	1.4	<0.3	2.1	42.0	0.9	1.8	0.4	<0.3	0.5	0.4	<0.3	0.8	<0.3	0.8
Sn	mg/Kg	-	22.0	9.5	1.3	10.0	21.0	12.0	14.0	1.6	1.6	2.1	1.8	1.7	2.5	1.7	3.1
Tl	mg/Kg	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.4	0.2	0.3
V	mg/Kg	25	22	29	23	25	23	18	24	43	35	50	55	42	70	35	78

**Table S2.** Leaching test results of backfill material samples (C1-C7) and contaminated deep soil sample (R1).

<b>Samples</b>	<b>UoM</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>C5</b>	<b>C6</b>	<b>C7</b>	<b>R1</b>
Sulfates	mg/l	432	921	233	61.2	1007	1008	333	1425
Chlorides	mg/l	16.6	8.1	2.5	3.8	34.6	31.8	22.1	26
Fluorides	mg/l	0.54	0.25	0.5	0.65	0.52	< 0.05	0.39	< 0.25
Barium	µg/l	36	36	32	25	31	35	36	34
Copper	µg/l	1.9	1.2	1.3	53	2.6	< 1	2.5	< 1
Zinc	µg/l	< 1	2.1	< 1	< 1	< 1	< 1	< 1	1.7
Nickel	µg/l	< 1	1.1	< 1	< 1	< 1	ND	ND	1.2
Arsenic	µg/l	1.9	1.3	3	2.9	1.3	1.5	1.6	1.6
Cadmium	µg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total chromium	µg/l	756	2068	824	21	780	486	1160	2800
Lead	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Selenium	µg/l	1.4	1.7	1.9	0.8	1	1.9	1.9	1.8
Mercury	µg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	µg/l	17	23	14	6.8	38	27	25	33
Antimony	µg/l	7.8	17	16	1.4	7,4	17	13	19
Chromium (VI)	µg/l	756	2068	824	21	780	486	1160	2800

**Table S3.** Environmental data used for the Do-Nothing scenario and LCIA results.

			Abiotic depletion	Abiotic depletion (fuel)	Global warming	Ozone layer depletion	Human toxicity	Fresh water aquatic ecotox.	Marine aquatic ecotoxicity	Terrestrial ecotoxicity	Photochemical oxidation	Acidification	Eutrophication
Process	Quantity	UoM	kg Sb eq	MJ	kg CO2 eq	kg CFC-11 eq	kg 1,4-DB eq	kg 1,4-DB eq	kg 1,4-DB eq	kg 1,4-DB eq	kg C2H4 eq	kg SO2 eq	kg PO4 eq
Cd	5.1	kg	0	0	0	0	3,4E+02	4,0E+03	5,7E+05	8,6E+02	0	0	0
Cr	15,722.7	kg	0	0	0	0	0	0	0	0	0	0	0
Cr(VI)	72.1	kg	0	0	0	0	3,6E+04	1,5E+03	1,9E+05	4,5E+05	0	0	0
Ni	434.3	kg	0	0	0	0	8,6E+04	7,3E+05	5,1E+08	1,0E+05	0	0	0
Pb	235.6	kg	0	0	0	0	6,9E+04	1,5E+03	1,8E+05	7,7E+03	0	0	0
Cu	974.8	kg	0	0	0	0	1,2E+03	5,8E+05	1,2E+08	1,4E+04	0	0	0
Zn	1,292.4	kg	0	0	0	0	5,5E+02	6,2E+04	9,3E+06	3,2E+04	0	0	0
As	56.0	kg	0	0	0	0	5,7E+04	7,5E+03	4,3E+06	1,9E+05	0	0	0
Sb	83.2	kg	0	0	0	0	2,2E+05	8,3E+02	1,1E+06	1,0E+02	0	0	0
Be	4.4	kg	0	0	0	0	3,1E+04	2,0E+05	1,2E+09	1,6E+04	0	0	0
Co	71.8	kg	0	0	0	0	4,2E+03	1,2E+05	1,6E+08	1,6E+04	0	0	0
Fe	188,993.9	kg	0	0	0	0	0	0	0	0	0	0	0
Mn	3,397.3	kg	0	0	0	0	0	0	0	0	0	0	0
Mo	15.3	kg	0	0	0	0	4,7E+04	4,0E+03	1,8E+07	5,5E+02	0	0	0
Hg	2.5	kg	0	0	0	0	2,7E+03	2,1E+03	4,1E+05	1,4E+05	0	0	0
Se	40.4	kg	0	0	0	0	1,1E+06	5,9E+04	5,1E+08	4,4E+03	0	0	0
Sn	84.2	kg	0	0	0	0	4,4E+01	5,8E+02	7,0E+04	2,5E+03	0	0	0
Tl	0.8	kg	0	0	0	0	9,2E+04	3,2E+03	1,1E+07	5,4E+02	0	0	0
V	205.2	kg	0	0	0	0	3,5E+05	9,5E+05	9,1E+08	2,8E+05	0	0	0
<b>Total</b>	<b>-</b>	<b>-</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2,1E+06</b>	<b>2,7E+06</b>	<b>3,4E+09</b>	<b>1,3E+06</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Table S4.** Environmental data used for the Dig and Dump scenario and LCIA results.

			Abiotic depletion	Abiotic depletion (fuel)	Global warming	Ozone layer depletion	Human toxicity	Fresh water aquatic ecotox.	Marine aquatic ecotoxicity	Terrestrial ecotoxicity	Photochemical oxidation	Acidification	Eutrophication
Process	Quantity	UoM	kg Sb eq	MJ	kg CO2 eq	kg CFC-11 eq	kg 1,4-DB eq	kg 1,4-DB eq	kg 1,4-DB eq	kg 1,4-DB eq	kg C2H4 eq	kg SO2 eq	kg PO4 eq
Excavator transport	58.8	tkm	1,1E-05	8,1E+01	5,3E+00	1,0E-06	2,3E+00	7,4E-01	1,6E+03	7,1E-03	6,7E-04	1,7E-02	3,8E-03
Excavator consumption	56,100.0	kWh	1,0E-02	2,5E+05	1,8E+04	3,1E-03	2,2E+03	1,9E+03	3,2E+06	6,3E+00	3,0E+00	1,4E+02	3,2E+01
Backfill material transport	534,109.5	tkm	1,0E-01	7,4E+05	4,8E+04	9,2E-03	2,1E+04	6,7E+03	1,4E+07	6,4E+01	6,1E+00	1,6E+02	3,4E+01
Vehicles for EoL transport	42.9	tkm	8,3E-06	5,9E+01	3,9E+00	7,4E-07	1,7E+00	5,4E-01	1,1E+03	5,2E-03	4,9E-04	1,3E-02	2,8E-03
Excavator transport	58.8	tkm	1,1E-05	8,1E+01	5,3E+00	1,0E-06	2,3E+00	7,4E-01	1,6E+03	7,1E-03	6,7E-04	1,7E-02	3,8E-03
Backfill materials disposal	8,976.6	t	5,8E+00	7,9E+06	9,9E+06	6,1E-02	5,9E+05	2,0E+06	1,8E+09	6,5E+03	2,2E+03	7,4E+03	9,3E+04
Quarry stabilized production	9,200.0	t	6,5E-01	3,5E+05	3,1E+04	3,6E-03	3,0E+04	3,0E+04	4,8E+07	8,8E+01	8,7E+00	2,0E+02	5,7E+01
Quarry stabilized transport	213,440.0	tkm	4,1E-02	3,0E+05	1,9E+04	3,7E-03	8,4E+03	2,7E+03	5,7E+06	2,6E+01	2,4E+00	6,3E+01	1,4E+01
Bobcat consumption	5,440.0	kWh	9,7E-04	2,4E+04	1,8E+03	3,0E-04	2,2E+02	1,8E+02	3,1E+05	6,1E-01	2,9E-01	1,3E+01	3,1E+00
<b>Total</b>			<b>6,6E+00</b>	<b>9,6E+06</b>	<b>1,0E+07</b>	<b>8,0E-02</b>	<b>6,5E+05</b>	<b>2,1E+06</b>	<b>1,9E+09</b>	<b>6,7E+03</b>	<b>2,2E+03</b>	<b>8,0E+03</b>	<b>9,3E+04</b>

**Table S5.** Environmental data used for the Soil Capping scenario and LCIA results.

Process	Quantity	UoM	Abiotic depletion kg Sb eq	Abiotic depletion (fuel) MJ	Global warming kg CO <sub>2</sub> eq	Ozone layer depletion kg CFC-11 eq	Human toxicity kg 1,4-DB eq	Fresh water aquatic ecotox. kg 1,4-DB eq	Marine aquatic ecotoxicity kg 1,4-DB eq	Terrestrial ecotoxicity kg 1,4-DB eq	Photochemical oxidation kg C <sub>2</sub> H <sub>4</sub> eq	Acidification kg SO <sub>2</sub> eq	Eutrophication kg PO <sub>4</sub> eq
Excavator transport	58.8	tkm	1,13E-05	8,14E+01	5,29E+00	1,01E-06	2,31E+00	7,37E-01	1,57E+03	7,10E-03	6,73E-04	1,73E-02	3,79E-03
Excavator consumption	6,732.0	kWh	1,20E-03	3,02E+04	2,20E+03	3,76E-04	2,68E+02	2,26E+02	3,78E+05	7,60E-01	3,57E-01	1,65E+01	3,80E+00
TNT 300 production	3,300.0	kg	1,88E-01	3,08E+05	1,73E+04	3,55E-02	1,13E+04	8,38E+03	1,92E+07	3,27E+01	3,99E+00	7,27E+01	2,76E+01
TNT 300 transport	79.9	tkm	1,51E-03	1,63E+03	1,14E+02	1,99E-05	8,48E+01	5,24E+01	7,50E+04	1,44E-01	6,11E-02	4,62E-01	1,17E-01
LDPE production	1,083.5	kg	1,42E-02	7,24E+04	2,09E+03	3,73E-05	8,75E+02	6,70E+02	1,47E+06	1,97E+00	1,41E+00	6,89E+00	2,13E+00
LDPE transport	84.4	tkm	1,59E-03	1,73E+03	1,20E+02	2,10E-05	8,96E+01	5,54E+01	7,92E+04	1,52E-01	6,45E-02	4,88E-01	1,23E-01
Quarry stabilized production	1,350.0	t	9,54E-02	5,16E+04	4,57E+03	5,26E-04	4,34E+03	4,38E+03	7,09E+06	1,29E+01	1,28E+00	2,90E+01	8,41E+00
Quarry stabilized transport	31,320.0	tkm	6,04E-03	4,34E+04	2,82E+03	5,38E-04	1,23E+03	3,92E+02	8,34E+05	3,78E+00	3,58E-01	9,19E+00	2,02E+00
Bobcat consumption	1,632.0	kWh	2,91E-04	7,32E+03	5,33E+02	9,11E-05	6,49E+01	5,48E+01	9,17E+04	1,84E-01	8,66E-02	3,99E+00	9,22E-01
Binder production	552.5	t	4,28E-01	2,27E+06	3,19E+04	5,15E-02	2,99E+04	2,81E+04	7,07E+07	3,49E+02	1,59E+01	2,62E+02	7,31E+01
Binder, paver and roller transport	8,100.0	tkm	1,56E-03	1,12E+04	7,29E+02	1,39E-04	3,18E+02	1,01E+02	2,16E+05	9,77E-01	9,27E-02	2,38E+00	5,22E-01
Paver and roller	4,760.0	kWh	8,49E-04	2,13E+04	1,55E+03	2,66E-04	1,89E+02	1,60E+02	2,67E+05	5,37E-01	2,53E-01	1,16E+01	2,69E+00

consumption													
Excavator transport	58.8	tkm	1,13E-05	8,14E+01	5,29E+00	1,01E-06	2,31E+00	7,37E-01	1,57E+03	7,10E-03	6,73E-04	1,73E-02	3,79E-03
Total			7,39E-01	2,82E+06	6,39E+04	8,91E-02	4,87E+04	4,26E+04	1,00E+08	4,04E+02	2,38E+01	4,15E+02	1,21E+02