

DANUBE RIVER BASIN MANAGEMENT PLAN

UPDATE 2021

ANNEX 5

Nutrient Emission Modelling with MONERIS

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of the Danube River
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Nutrient emissions from point and diffuse sources were calculated with the MONERIS model for the reference period 2015-2018. Summarizing tables of the modelling results are presented in the followings.

Detailed technical information is available: *Nutrient Emissions and Loads in the Danube River Basin - Current situation and scenarios for the 3rd Danube River Basin Management Plan. Final Report, Deliverable of the EU LIFE Project "Support for the Development of the 3rd Danube River Basin Management and 2nd Flood risk Management Plan Update 2021" (LIFE19 PRE AT 006 – LIFE DRBMP DFRMP 2021), IGB, 2021.*

Table 1: Total nitrogen emissions according to countries and pathways in tons N per year

Country	Atmospheric deposition	Surface runoff	Urban runoff	Sediment transport	Tile drainages	Subsurface flow	Point source discharges	Total
DE	1,655.8	5,169.8	1,147.0	298.5	13,412.3	39,512.9	10,874.3	72,070.6
AT	1,948.3	5,913.1	1,184.2	3,958.6	2,266.2	39,387.4	9,560.6	64,218.4
CZ	174.0	1,011.0	1,686.8	237.9	4,142.0	12,469.0	1,643.9	21,364.6
SK	415.4	2,010.9	3,547.1	486.9	1,211.4	14,910.9	3,573.2	26,155.8
HU	1,401.1	1,660.8	1,364.6	593.5	336.8	7,797.6	8,224.6	21,379.0
SI	439.4	1,676.9	1,969.3	482.3	250.1	10,438.6	1,296.6	16,553.2
HR	563.1	2,289.2	3,514.0	237.6	2,695.3	18,104.6	2,831.7	30,235.4
BA	368.0	2,843.7	9,013.9	417.8	198.8	25,997.9	904.8	39,744.9
ME	140.6	784.1	335.6	26.5	16.2	4,211.1	122.6	5,636.8
RS	726.4	3,428.3	17,475.1	551.8	626.2	35,286.1	6,908.3	65,002.3
RO	2,737.9	6,196.8	11,624.2	3,276.6	893.4	49,797.1	14,513.9	89,039.9
BG	164.0	649.6	3,751.7	1,002.4	1,489.5	13,404.2	2,755.4	23,216.8
MD	27.5	77.0	1,504.5	124.6	94.2	1,083.3	373.4	3,284.4
UA	480.2	1,842.9	4,149.1	84.8	425.5	10,910.1	1,184.2	19,077.0
Other countries	42.0	169.7	30.8	980.7	103.3	1,357.7	215.8	2,900.1
Basin	11,283.8	35,723.9	62,297.8	12,760.5	28,161.1	284,668.8	64,983.2	499,879.2

Table 2: Total phosphorus emissions according to countries and pathways in tons P per year

Country	Atmospheric deposition	Surface runoff	Urban runoff	Sediment transport	Tile drainages	Subsurface flow	Point source discharges	Total
DE	21.0	236.9	172.8	274.5	132.8	564.7	718.6	2,121.2
AT	44.0	447.0	214.7	2,388.3	16.7	996.6	639.3	4,746.7
CZ	3.4	39.0	135.5	158.8	16.3	136.8	128.7	618.4
SK	10.0	97.9	231.0	364.3	54.8	359.0	276.9	1,394.0
HU	35.9	69.9	260.0	463.4	5.2	531.2	1,275.9	2,641.4
SI	8.9	131.5	214.0	324.8	7.6	267.6	206.7	1,161.1
HR	13.3	152.7	494.6	193.8	29.2	356.2	739.6	1,979.3
BA	11.9	253.8	839.3	297.2	4.3	552.5	199.2	2,158.3
ME	7.6	121.1	25.9	15.0	0.5	174.3	25.4	369.8
RS	21.1	229.1	1,500.0	397.3	8.8	892.4	547.5	3,596.1
RO	89.8	317.2	1,103.6	2,073.6	25.3	1,433.0	1,521.3	6,563.8
BG	5.5	28.5	298.5	848.1	10.3	167.3	356.2	1,714.4
MD	0.9	3.6	124.9	114.0	4.5	57.7	113.5	419.1
UA	16.2	75.7	271.4	53.4	9.9	281.4	139.2	847.2
Other countries	2.4	25.2	3.7	588.6	0.4	66.6	42.6	729.5
Basin	292.0	2,228.9	5,889.9	8,555.0	326.8	6,837.2	6,930.6	31,060.4

Table 3: Total nitrogen emissions according to countries and source areas in tons N per year

Country	Agricultural land	Urban area	Natural area	Open area	Wetland & Open water	Total
DE	44,789.9	13,149.5	11,867.1	86.2	2,177.8	72,070.6
AT	21,372.7	12,180.0	24,069.8	4,357.1	2,238.8	64,218.4
CZ	15,253.8	3,612.4	2,312.0	6.2	180.2	21,364.6
SK	8,127.0	9,072.9	8,484.7	25.6	445.6	26,155.8
HU	6,742.8	10,016.2	2,724.0	18.3	1,877.8	21,379.0
SI	5,444.8	3,555.3	6,959.5	44.7	548.9	16,553.2
HR	16,379.8	7,350.6	5,803.6	9.0	692.4	30,235.4
BA	19,426.3	10,489.8	9,386.3	42.4	400.1	39,744.9
ME	2,431.8	550.5	2,439.0	67.1	148.4	5,636.8
RS	27,422.9	27,736.5	8,865.1	56.3	921.4	65,002.3
RO	31,192.1	32,133.8	21,356.6	116.6	4,240.7	89,039.9
BG	13,391.1	7,082.9	2,474.3	61.5	207.0	23,216.8
MD	1,211.7	1,990.8	39.9	0.4	41.6	3,284.4
UA	4,713.5	7,893.0	5,790.0	6.1	674.4	19,077.0
Other countries	772.3	267.1	581.0	1,196.7	83.0	2,900.1
Basin	218,807.2	146,863.2	113,223.3	6,098.0	14,887.4	499,879.2

Table 4: Total phosphorus emissions according to countries and source areas in tons P per year

Country	Agricultural land	Urban area	Natural area	Open area	Wetland & Open water	Total
DE	974.5	908.4	207.6	4.5	26.1	2,121.2
AT	1,097.4	882.9	794.4	1,924.5	47.5	4,746.7
CZ	311.4	269.6	33.9	0.1	3.5	618.4
SK	665.7	577.5	139.3	0.7	10.7	1,394.0
HU	937.3	1,554.5	102.1	0.6	47.0	2,641.4
SI	530.2	427.5	187.3	5.3	10.8	1,161.1
HR	522.2	1,272.5	168.5	0.3	15.8	1,979.3
BA	723.7	1,060.9	359.4	1.9	12.4	2,158.3
ME	131.5	55.6	159.5	15.4	7.8	369.8
RS	1,089.3	2,178.8	297.0	2.9	28.2	3,596.1
RO	3,037.1	2,863.4	543.5	3.5	116.3	6,563.8
BG	941.5	675.7	68.1	23.0	6.3	1,714.4
MD	167.9	243.8	5.8	0.0	1.5	419.1
UA	198.5	509.2	114.8	0.5	24.2	847.2
Other countries	21.2	47.3	52.3	605.8	2.9	729.5
Basin	11,391.5	13,463.0	3,245.5	2,598.4	362.1	31,060.4

Table 5: Basin-wide total nitrogen emissions according to pathways and future scenarios in tons N per year

Scenario	Atmospheric deposition	Surface runoff	Urban runoff	Sediment transport	Tile drainages	Subsurface flow	Point source discharges	Total
Reference	11,283.8	35,723.9	62,297.8	28,161.1	12,760.5	284,668.8	64,983.2	499,879.2
Baseline	11,283.8	33,480.6	47,747.0	27,512.1	11,762.2	265,998.8	72,815.2	470,599.8
Vision I	11,283.8	31,984.9	20,387.0	18,337.8	8,735.1	226,244.1	72,607.7	389,580.4
Vision II	11,283.8	25,209.3	20,387.1	18,337.8	6,772.8	226,244.1	72,607.7	380,842.5
Vision I - dry	9,947.7	29,617.1	20,228.4	19,327.2	7,851.9	193,108.3	72,607.7	352,688.1
Vision I - wet	13,678.7	41,976.3	20,822.0	18,318.6	10,756.3	306,170.8	72,607.7	484,330.4

Table 6: Basin-wide total phosphorus emissions according to pathways and future scenarios in tons P per year

Scenario	Atmospheric deposition	Surface runoff	Urban runoff	Sediment transport	Tile drainages	Subsurface flow	Point source discharges	Total
Reference	292.0	2,228.9	5,889.9	326.8	8,555.0	6,837.2	6,930.6	31,060.4
Baseline	292.0	2,095.4	4,041.1	328.6	7,927.5	6,596.9	7,273.3	28,554.8
Vision I	292.0	1,977.8	1,956.8	328.6	5,841.4	6,387.7	6,724.1	23,508.3
Vision II	292.0	1,552.1	1,956.8	328.6	4,549.7	6,387.7	6,724.1	21,790.9
Vision I - dry	257.6	1,441.6	1,935.7	250.8	5,210.7	5,328.2	6,724.1	21,148.7
Vision I - wet	360.9	3,196.1	2,021.2	385.2	7,270.8	8,814.5	6,724.1	28,772.8

Table 7: Basin-wide total nitrogen emissions according to source areas and future scenarios in tons N per year

Scenario	Agricultural land	Urban area	Natural area	Open area	Wetland & Open water	Total
Reference	218,807.2	146,863.2	113,223.3	6,098.0	14,887.4	499,879.2
Baseline	198,317.1	137,670.3	113,931.8	5,788.2	14,892.5	470,599.8
Vision I	144,396.5	106,496.3	118,156.3	5,662.9	14,868.4	389,580.4
Vision II	140,068.4	106,496.3	114,658.8	4,750.6	14,868.4	380,842.5
Vision I - dry	126,431.0	103,552.3	103,078.8	5,569.2	14,057.0	352,688.1
Vision I - wet	199,613.1	113,961.2	147,401.9	5,882.6	17,471.6	484,330.4

Table 8: Basin-wide total phosphorus emissions according to source areas and future scenarios in tons P per year

Scenario	Agricultural land	Urban area	Natural area	Open area	Wetland & Open water	Total
Reference	11,391.5	13,463.0	3,245.5	2,598.4	362.1	31,060.4
Baseline	10,752.6	11,900.2	3,129.3	2,413.2	359.5	28,554.8
Vision I	8,679.0	9,104.7	3,037.7	2,326.4	360.4	23,508.3
Vision II	7,755.5	9,104.8	2,754.8	1,815.4	360.5	21,790.9
Vision I - dry	7,119.3	8,991.7	2,387.2	2,300.0	350.5	21,148.7
Vision I - wet	12,370.9	9,400.2	4,236.1	2,366.8	398.7	28,772.8

Table 9: Nutrient river loads to the Black Sea (at Reni) according to future scenarios in tons per year

Scenario	TN	TP
Reference	335,000.0	17,900.0
Baseline	318,923.2	16,820.5
Vision I	264,244.0	13,851.8
Vision II	258,575.9	13,065.4
Vision I - dry	239,333.4	11,109.0
Vision I - wet	343,950.1	20,159.8

Table 10: Relative changes of the nitrogen emissions from agriculture according to countries and future scenarios as compared to the reference status (%)

Country	Baseline	Vision I	Vision II	Vision I - dry	Vision I - wet
DE	8.2	-34.7	-36.4	-36.1	-27.9
AT	16.5	-12.8	-15.5	-23.5	-8.1
CZ	-0.9	-58.2	-58.7	-60.0	-50.2
SK	-24.2	-30.3	-32.0	-35.7	0.5
HU	-5.5	14.7	11.2	-12.5	219.4
SI	-25.5	1.7	-1.9	-12.8	17.8
HR	-14.2	-45.9	-46.0	-61.9	-11.0
BA	-21.0	-47.5	-49.0	-56.8	-31.3
ME	-8.7	-46.2	-48.0	-49.1	-38.1
RS	-18.2	-45.2	-46.9	-55.3	-16.6
RO	-30.8	-40.8	-44.5	-47.7	-14.4
BG	-15.5	-53.4	-54.1	-57.7	-30.8
MD	-13.9	-5.5	-8.1	-2.4	40.5
UA	-6.1	102.6	98.7	75.9	166.4
Other countries	6.2	-52.3	-53.2	-55.0	-41.2
Basin	-9.3	-34.0	-35.9	-42.0	-9.2

Table 11: Relative changes of the phosphorus emissions from agriculture according to countries and future scenarios as compared to the reference status (%)

Country	Baseline	Vision I	Vision II	Vision I - dry	Vision I - wet
DE	-4.0	-13.4	-21.7	-20.8	1.9
AT	-5.7	-20.7	-30.6	-31.4	-9.3
CZ	-4.0	-23.0	-27.3	-27.0	27.4
SK	0.3	-23.3	-28.5	-35.5	46.8
HU	-3.9	-19.7	-25.4	-36.3	34.1
SI	-9.5	-29.6	-39.7	-46.4	-8.2
HR	-1.1	-14.5	-15.3	-32.4	43.9
BA	-1.7	-17.4	-25.1	-42.7	34.2
ME	-0.9	-7.5	-14.5	-26.5	33.0
RS	-3.2	-18.3	-25.2	-34.0	8.1
RO	-9.3	-29.1	-40.4	-43.0	-2.2
BG	-6.0	-39.9	-46.0	-48.7	-26.7
MD	-2.4	-34.2	-44.4	-42.2	4.1
UA	-0.7	-7.9	-15.6	-22.5	48.8
Other countries	-2.0	-10.8	-16.2	-15.0	24.3
Basin	-5.3	-23.5	-31.7	-37.2	8.7

Table 12: Relative changes of the total point source and diffuse nitrogen emissions according to countries and future scenarios as compared to the reference status (%)

Country	Baseline	Vision I	Vision II	Vision I - dry	Vision I - wet
DE	4.1	-19.9	-21.6	-22.3	-13.2
AT	3.0	-5.3	-8.7	-13.2	-2.6
CZ	-5.2	-42.4	-42.9	-44.9	-33.5
SK	-9.0	-10.3	-11.0	-17.4	17.8
HU	-1.3	3.7	2.2	-8.7	92.2
SI	-20.0	-13.4	-16.0	-23.6	-1.2
HR	-19.6	-34.0	-34.1	-51.6	2.2
BA	-8.7	-40.9	-42.5	-50.0	-25.0
ME	-3.4	-24.7	-27.6	-27.5	-13.2
RS	-0.4	-36.7	-37.9	-43.5	-18.9
RO	-13.9	-17.2	-19.4	-23.4	1.6
BG	-16.0	-35.4	-35.9	-39.5	-17.5
MD	-18.3	-32.3	-33.4	-31.2	-12.9
UA	-1.3	-11.2	-13.2	-21.9	12.4
Other countries	0.2	-20.0	-26.3	-21.0	-13.7
Basin	-5.8	-22.0	-23.8	-29.1	-3.5

Table 13: Relative changes of the total point source and diffuse phosphorus emissions according to countries and future scenarios as compared to the reference status (%)

Country	Baseline	Vision I	Vision II	Vision I - dry	Vision I - wet
DE	-2.3	-6.7	-11.4	-11.6	2.3
AT	-5.8	-9.3	-22.0	-15.1	-5.0
CZ	-17.2	-26.7	-29.0	-29.6	2.1
SK	-3.4	-14.5	-17.2	-23.3	32.5
HU	-10.4	-16.0	-18.1	-22.7	6.6
SI	-29.3	-38.6	-45.0	-51.1	-20.8
HR	-47.1	-50.3	-50.6	-58.5	-26.3
BA	-7.9	-47.5	-51.9	-60.9	-19.6
ME	-0.8	-13.9	-21.2	-29.8	20.8
RS	14.9	-39.7	-42.6	-46.4	-28.4
RO	-5.4	-14.6	-20.6	-23.1	2.5
BG	-14.7	-33.3	-36.7	-38.9	-24.0
MD	-23.9	-43.7	-48.0	-47.0	-27.0
UA	-1.8	-42.1	-45.5	-49.5	-18.6
Other countries	-1.7	-14.0	-27.6	-14.4	-10.1
Basin	-7.7	-24.0	-29.6	-31.5	-7.3