universität innsbruck
Arbeitsbereich für Wasserbau

Alpine river – 505a

Variation rack angle: 20°

28.11.2022

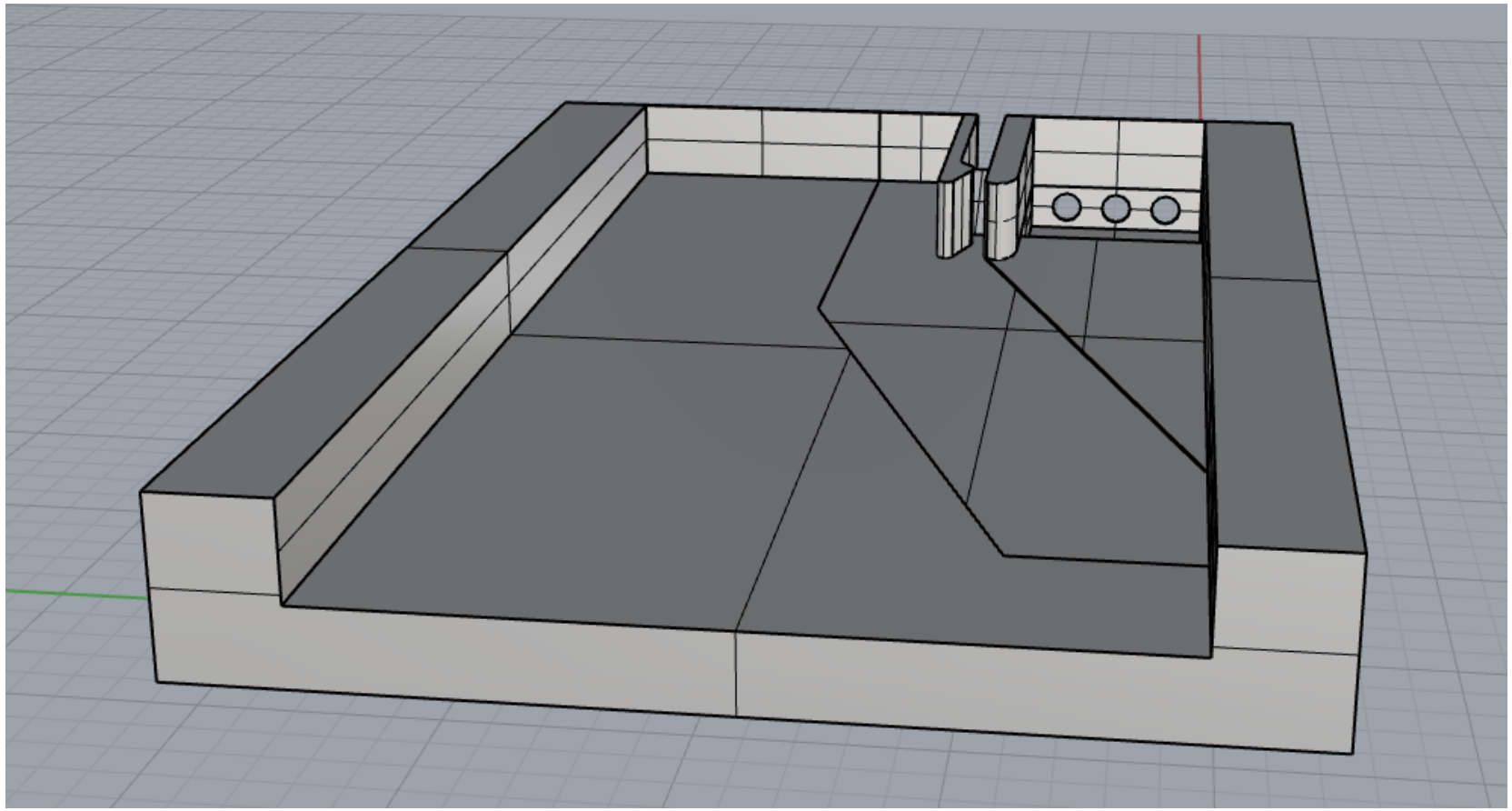
505a - General

River:

- Alpine river
- Discharge: 10 m^3/s
- Mean flow velocity: 0.25 m/s
- River width: 20 m
- Weir width: 11.5 m
- Flow depth: 2 m
- No slope

Turbines:

- 3 turbines with 1.0 m diameter
- Design discharge: 9 m^3/s
- Head: 2 m
- Headrace channel width: 6 m



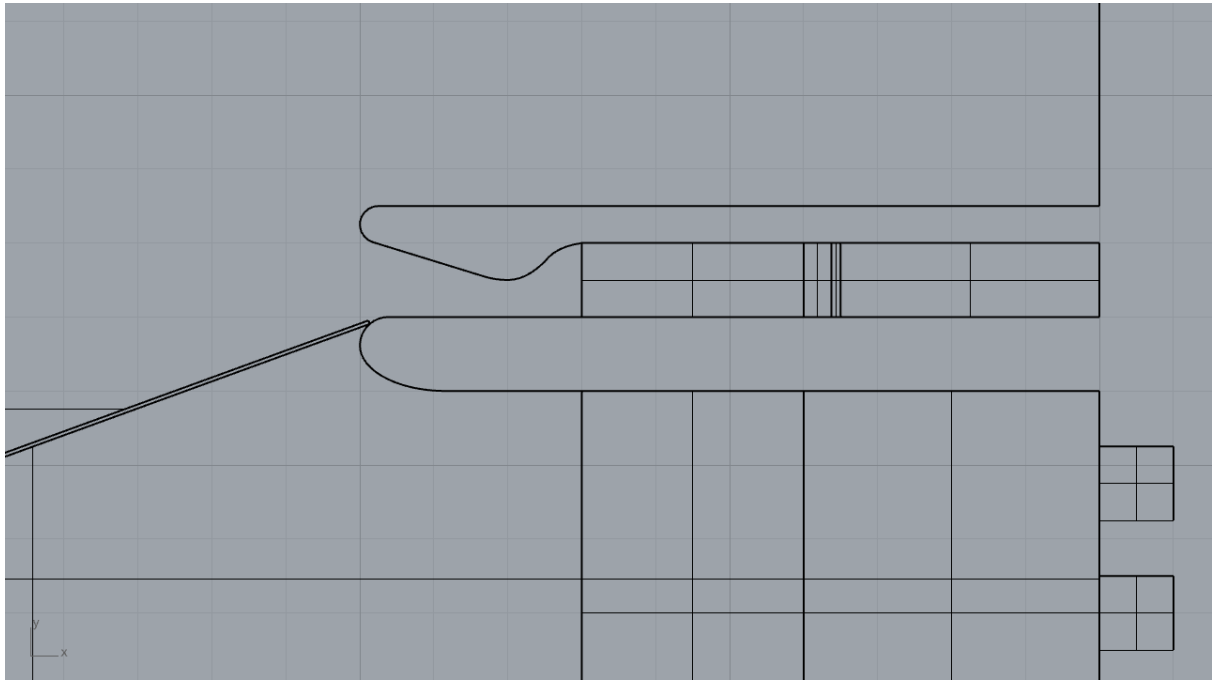
505a - General

Bypass:

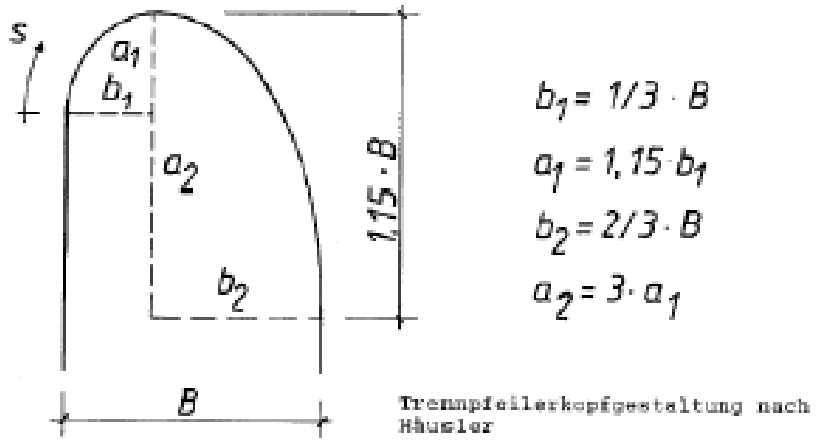
- Based on the angled bar rack bypass system by Ebel, Gluch & Kehl
- Bypass width: 1 m
- Ramp inclination: 26.6°
- Q (Bypass): 1.0 m³/s (10.0% of Q_{River})

Dividing pier – turbine-side part:

- Based on Häusler
- Width B: 1 m
- Length: 10 m
- $a_1 = b_1 = 0.335$ m
- $b_2 = 0.615$ m
- $a_2 = 1.155$ m



Layout of the bypass and dividing pier



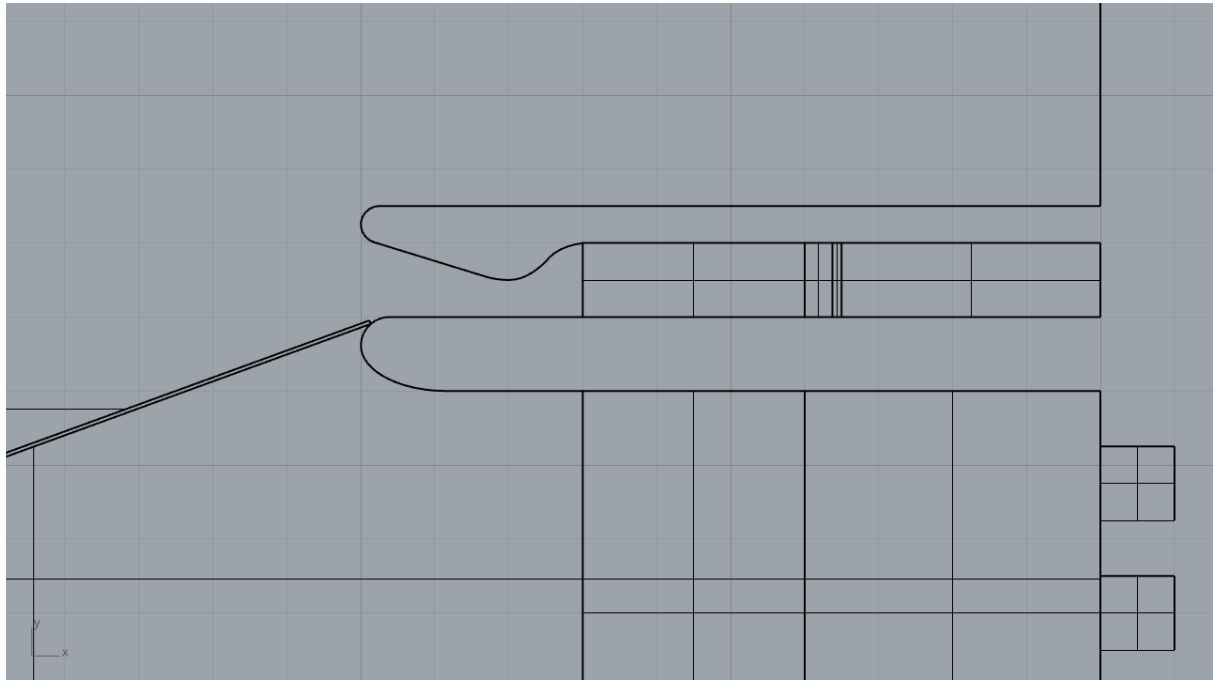
505a - General

Dividing pier – weir-side part:

- Width: 0.5 m
- Shape: Circular rounded
- Inlet gate: „Streamlined“ with 0.5 m width over the whole water column

Fish guidance structure (FGS):

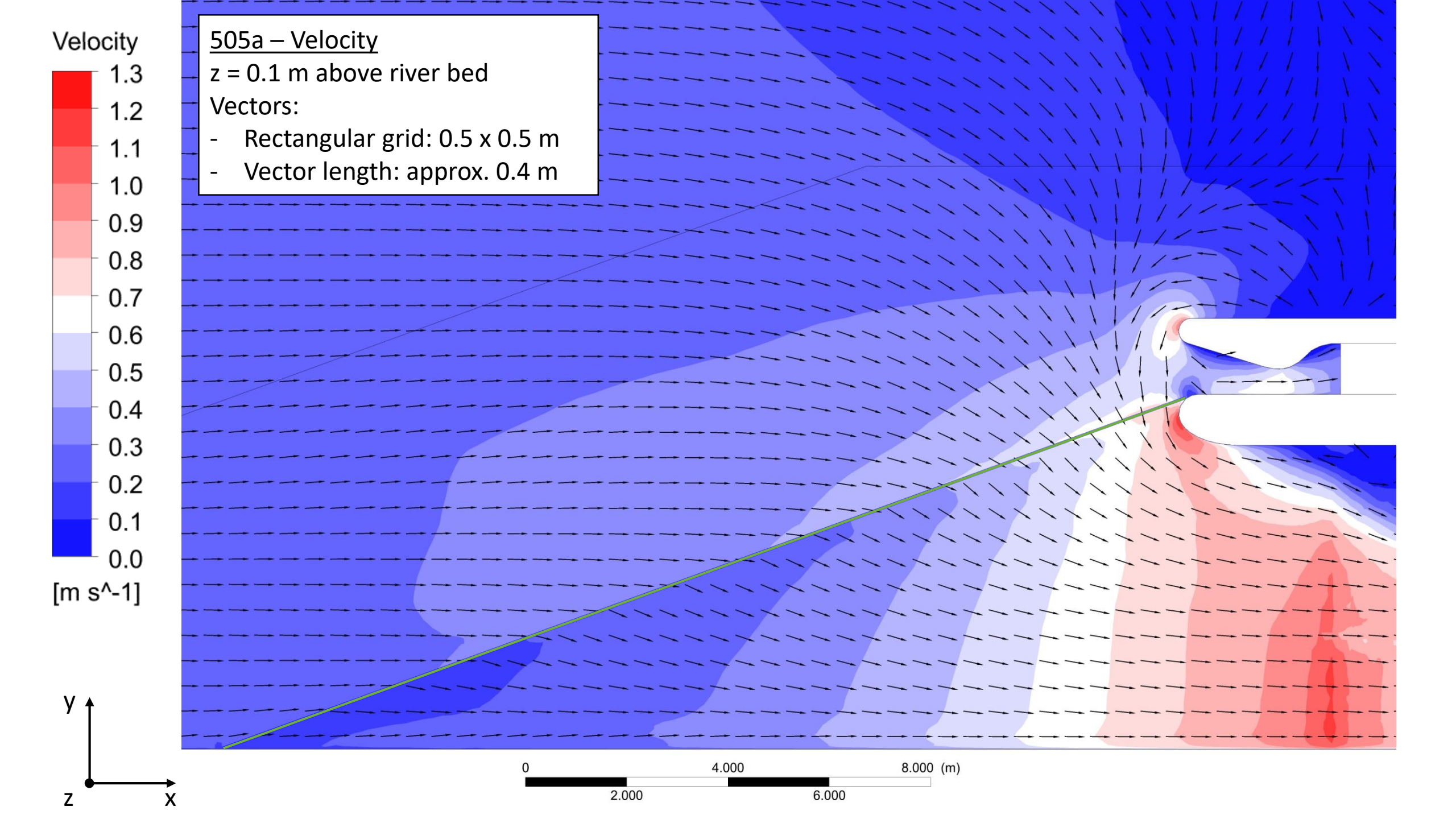
- Rack length: 20.19 m
- Mean velocity at rack:
  v = Q/A = 0.24 m/s
- Circular bar trash rack with 20° angle to the unaffected flow direction
- Head loss values depending on the horizontal inflow angle and the rack configuration

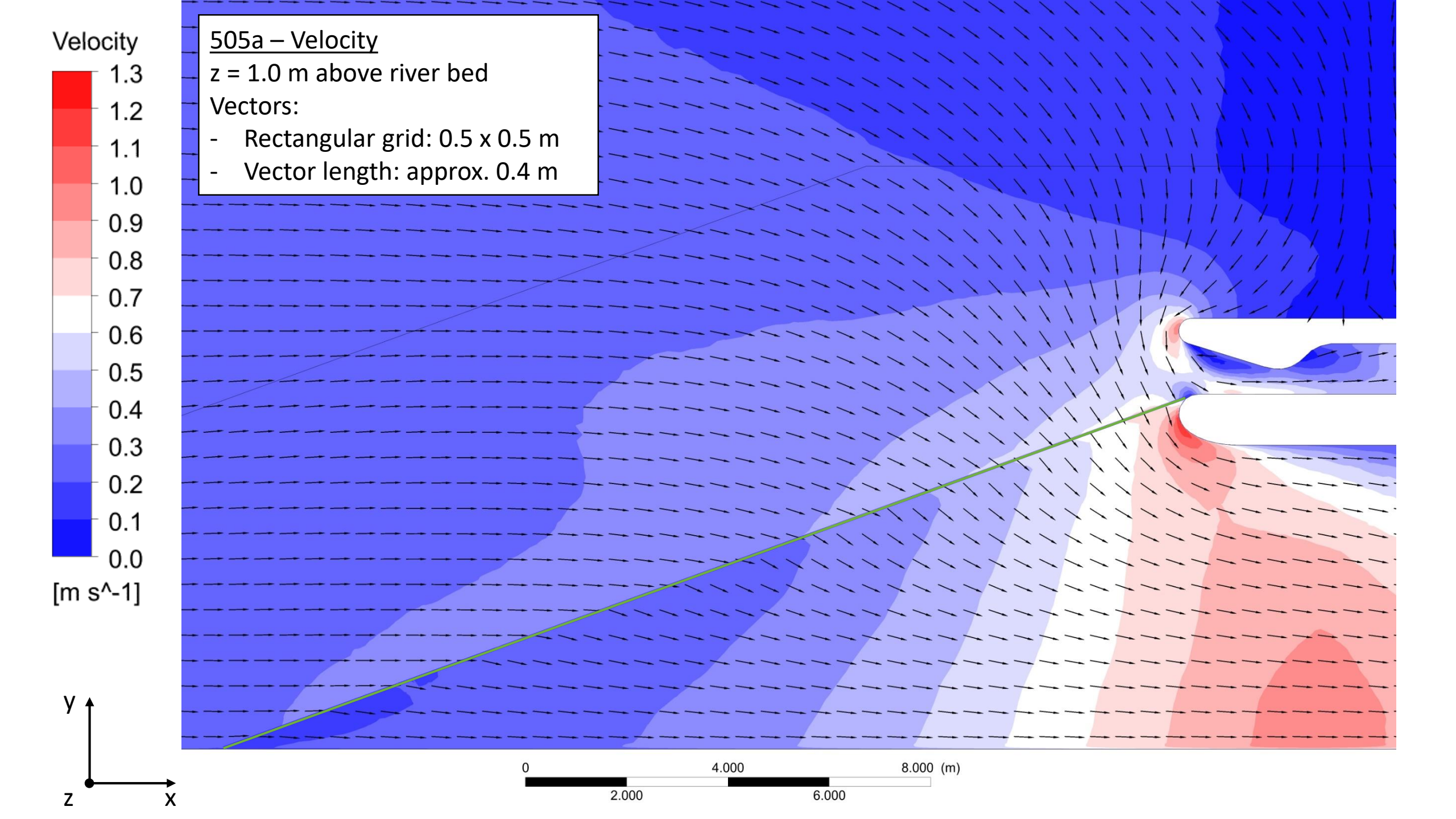


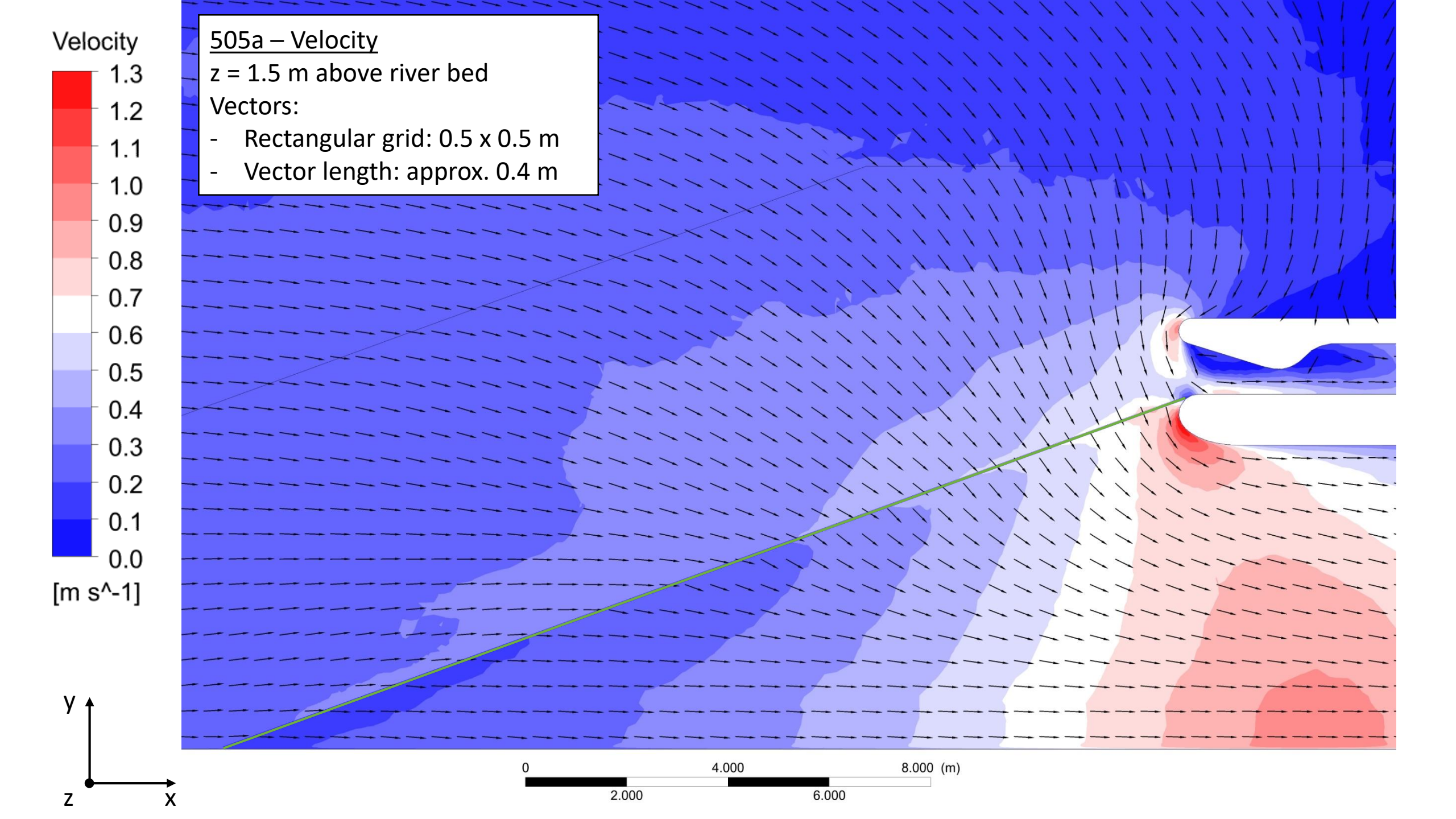
Layout of the bypass and dividing pier

CBTR, 50% blocking ratio
(Formula: mod. Meusburger)

Degree	Head loss value
10	0.31
20	0.61
30	0.90
40	1.15
50	1.37
60	1.55
70	1.68
80	1.76
90	1.79


505a – Velocity
z = 0.1 m above river bed
Vectors:
- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
y
z
x
0
4.000
8.000 (m)
2.000
6.000


505a – Velocity
z = 1.0 m above river bed
Vectors:
- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
y
z
x
0
4.000
8.000 (m)
2.000
6.000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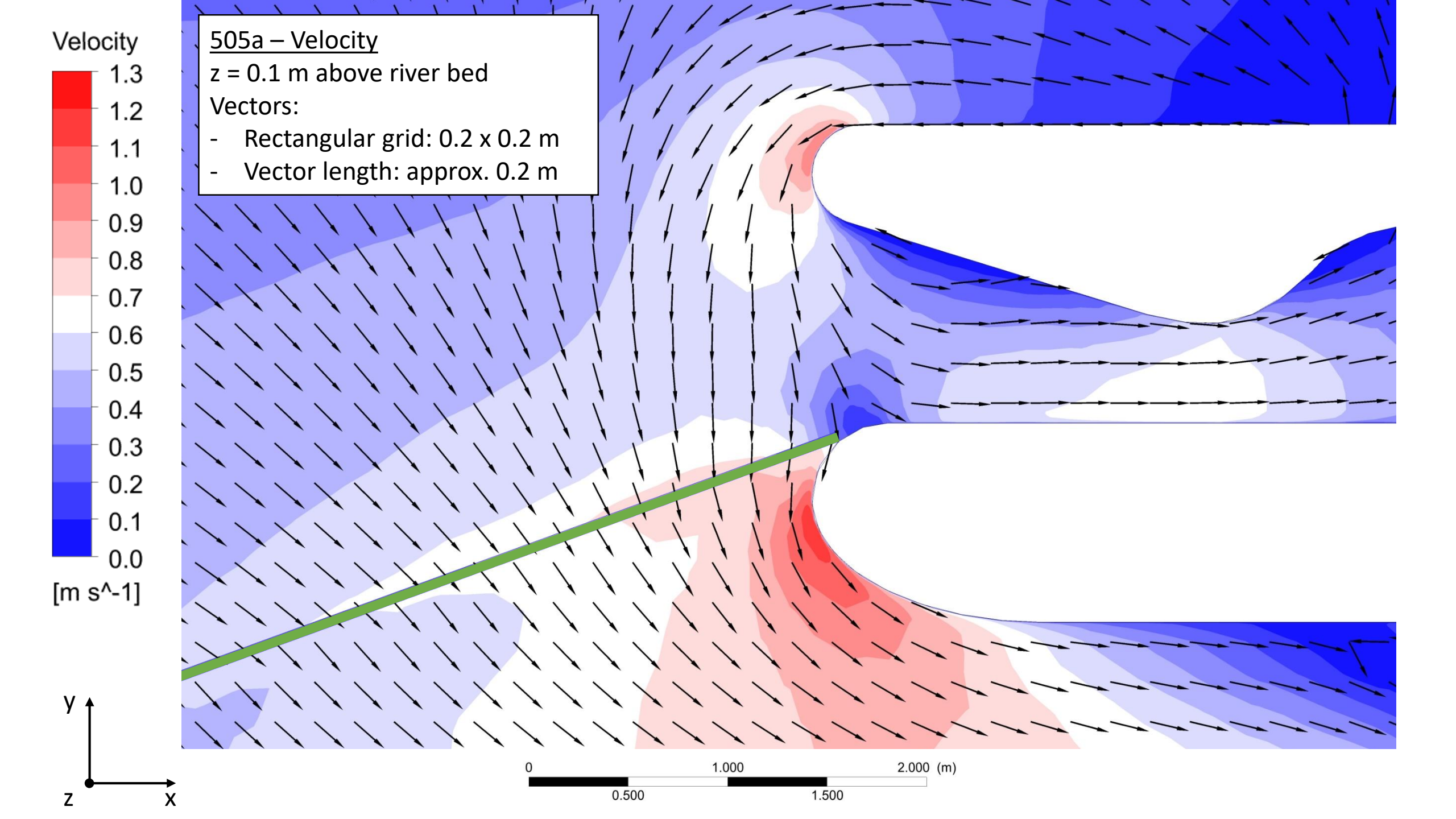
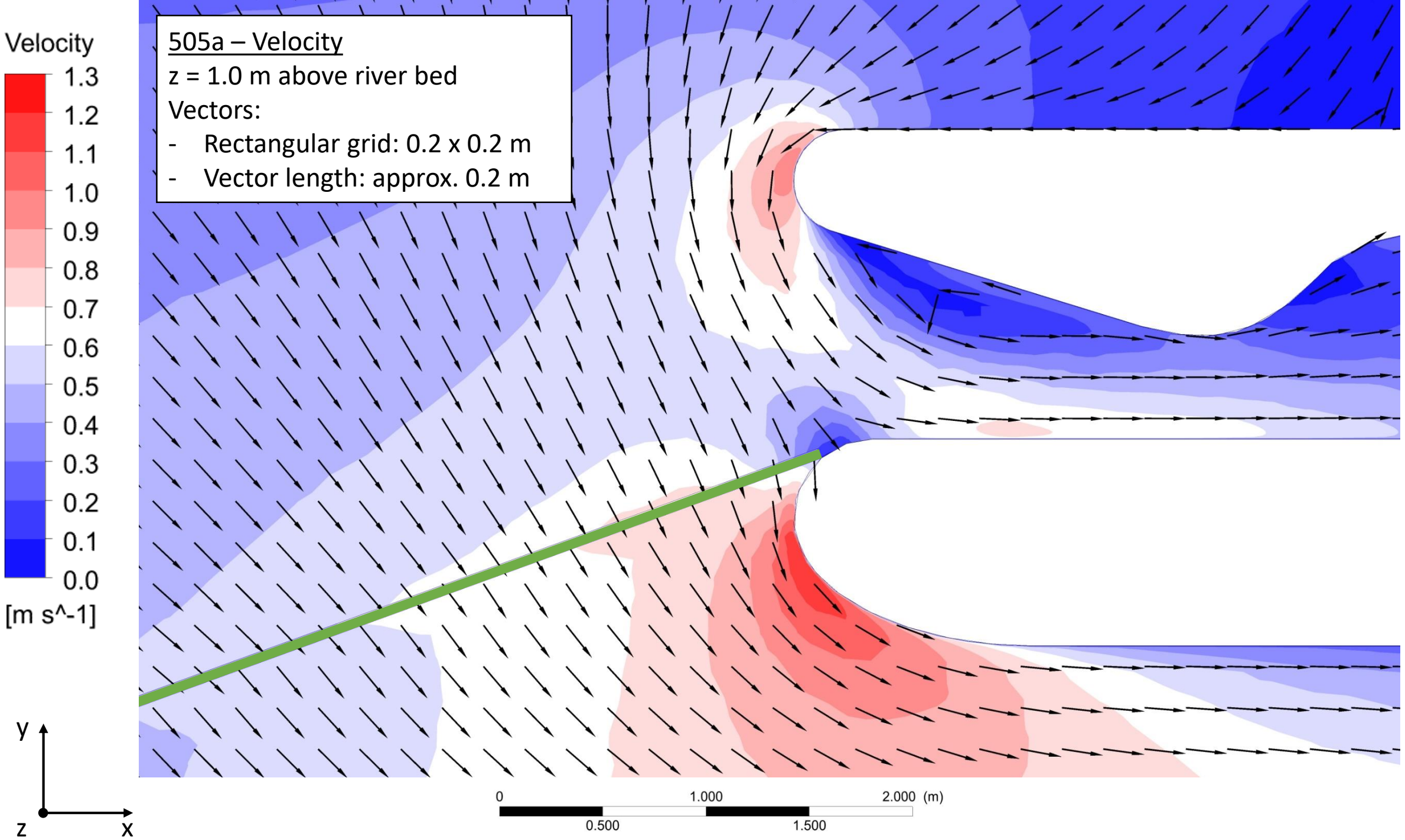
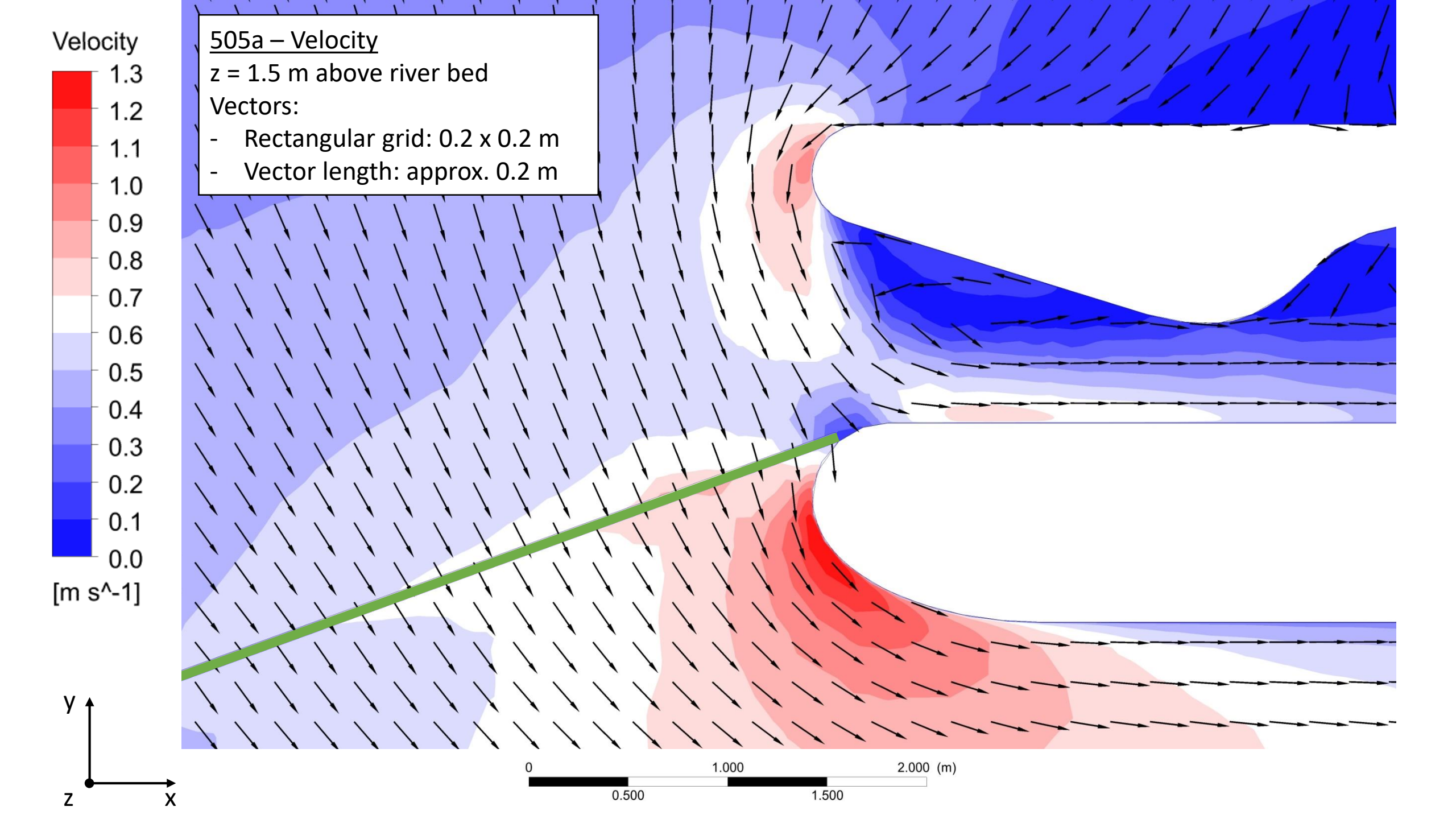
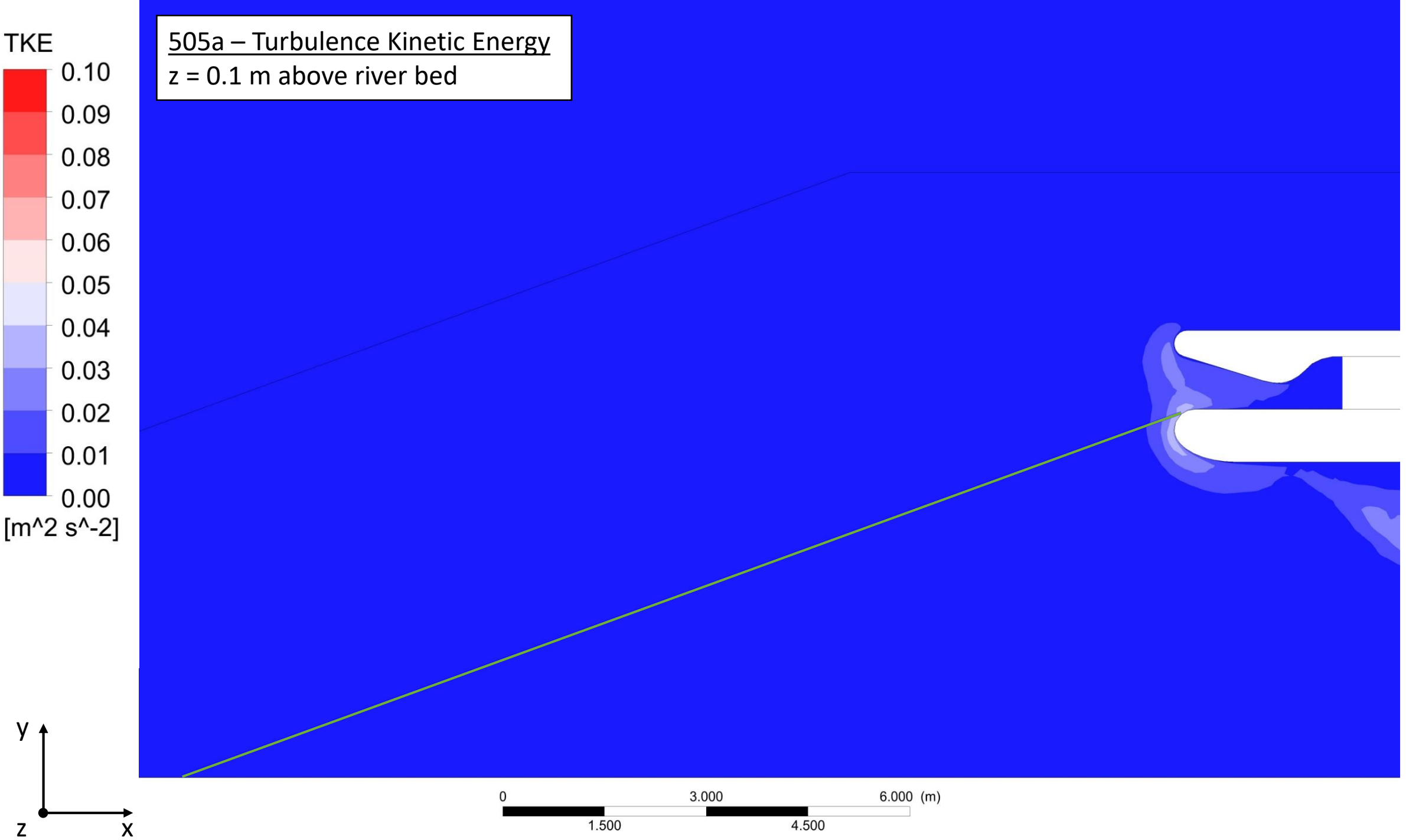
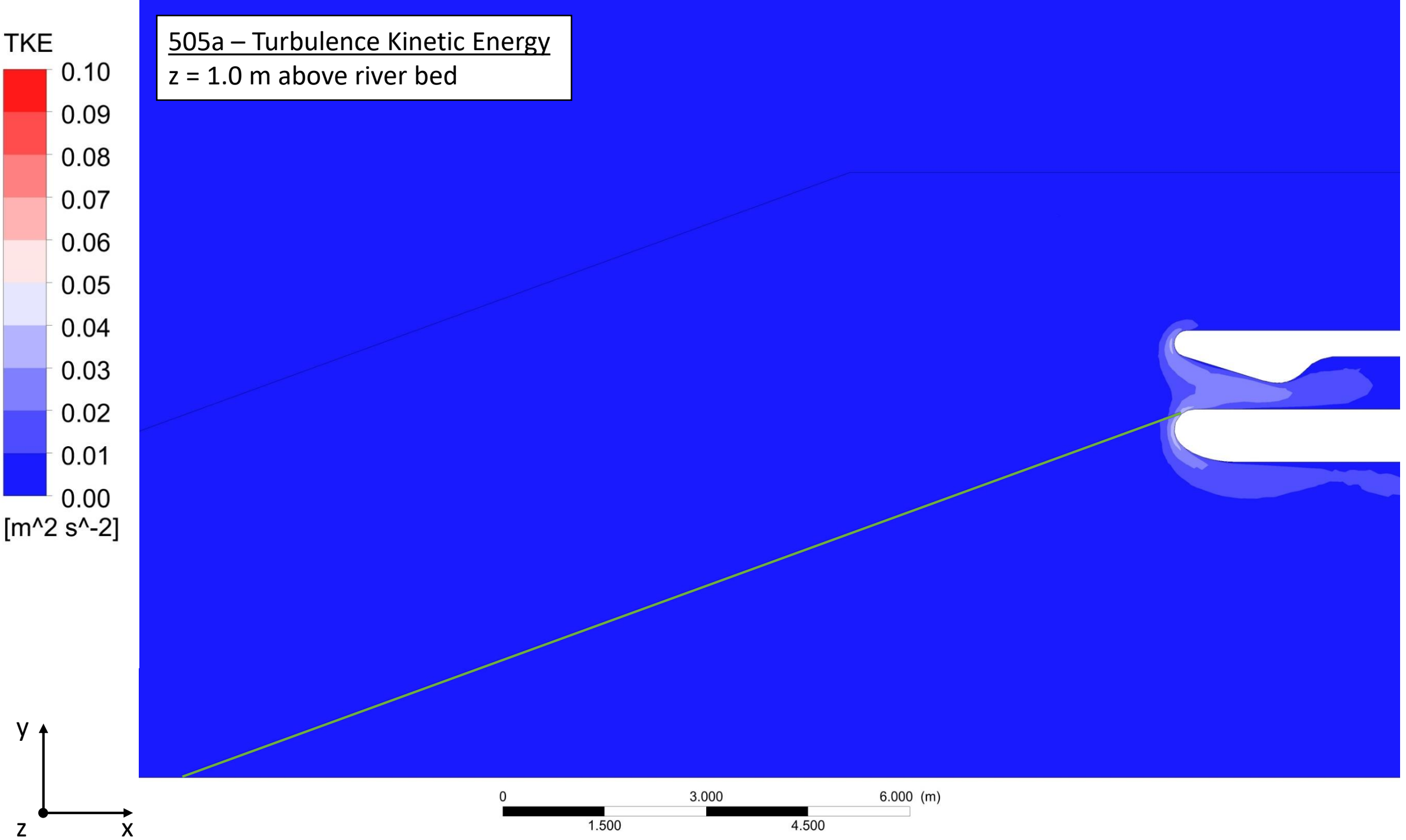
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
y
z
x
0
4.000
8.000 (m)
2.000
6.000

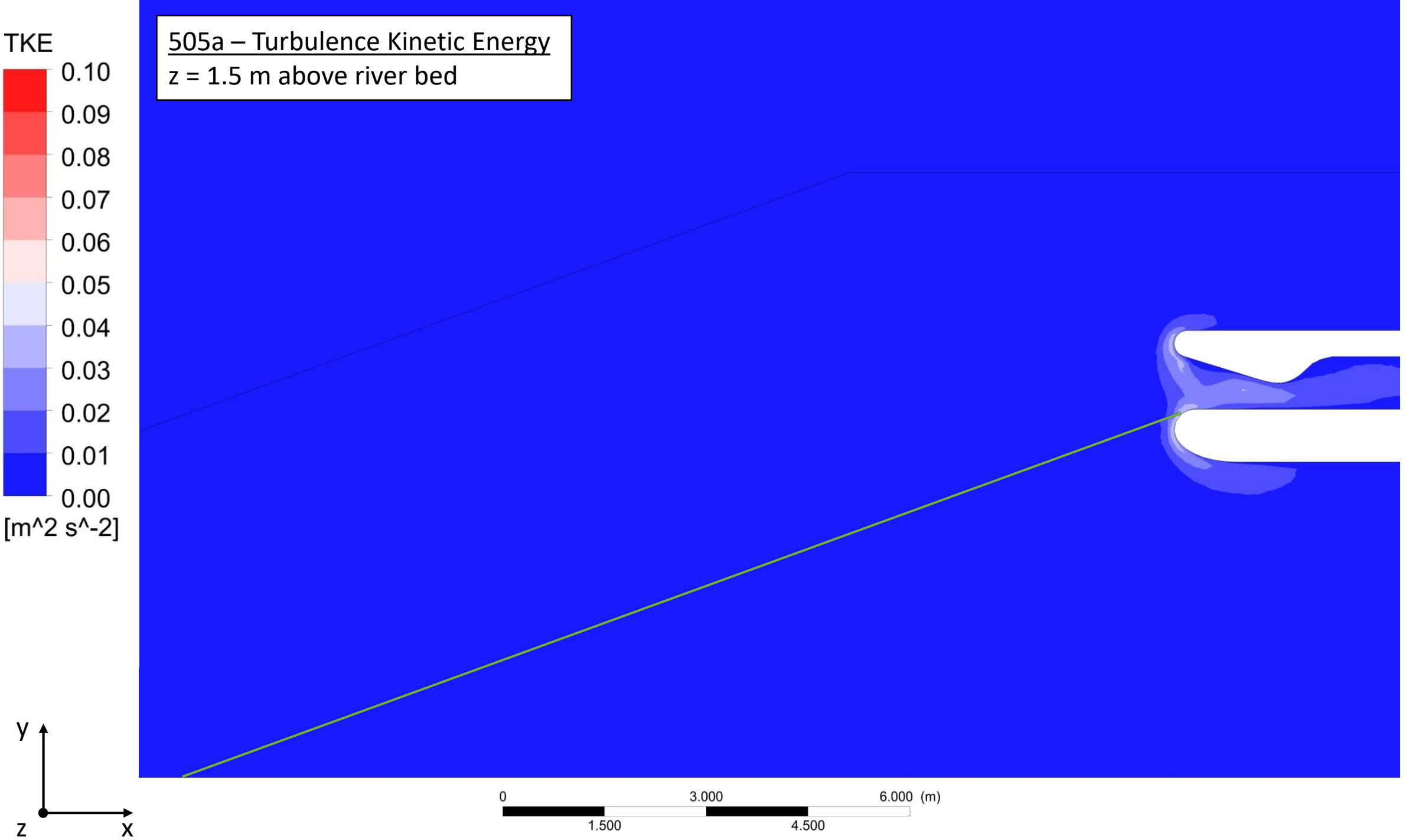

Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
505a – Velocity
z = 0.1 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m
y
z
x
0
1.000
2.000 (m)
0.500
1.500

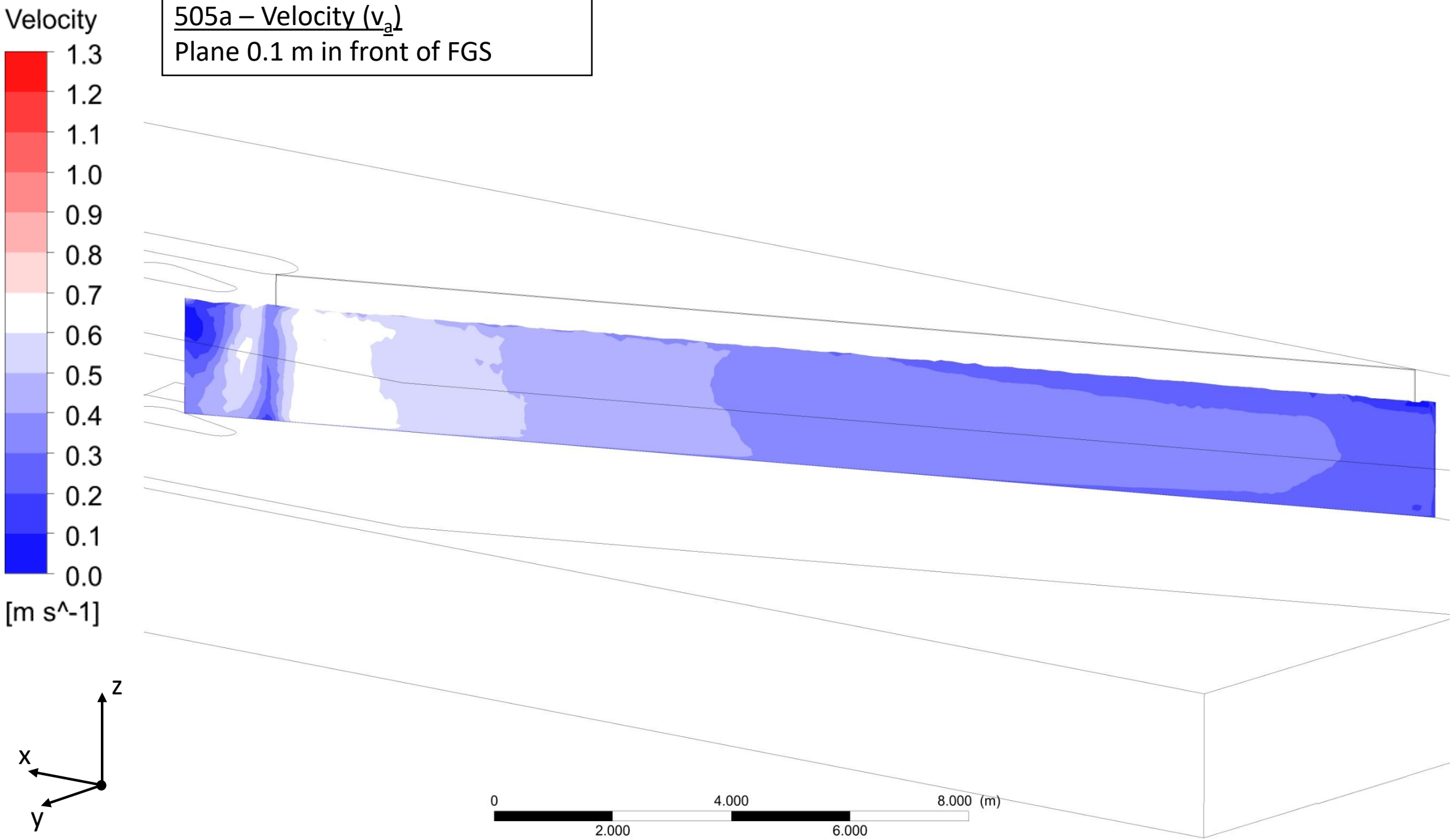

Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
505a – Velocity
z = 1.0 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m
y
z
x
0
1.000
2.000 (m)
0.500
1.500

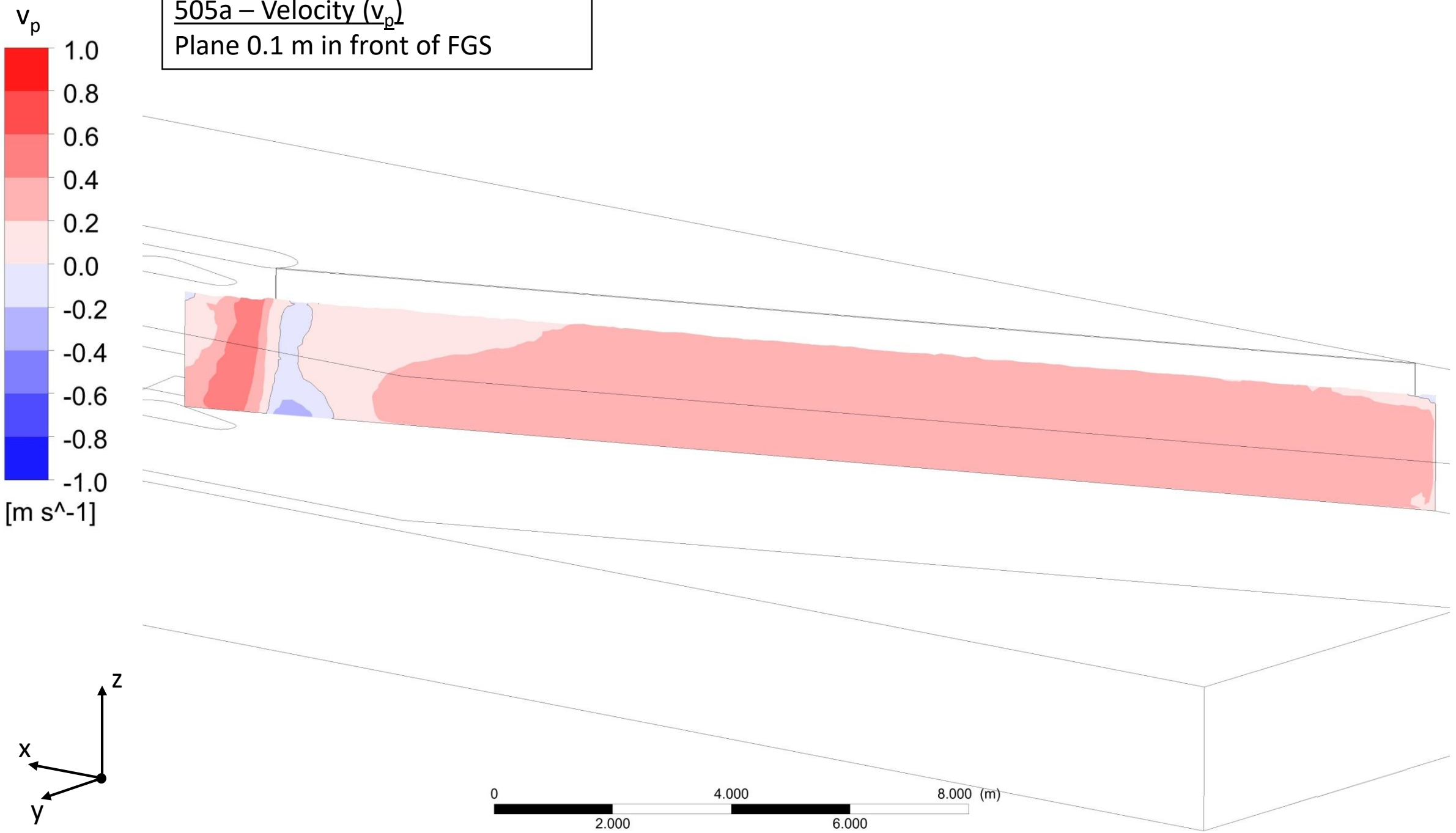

505a – Velocity
z = 1.5 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
y
z
x
0
1.000
2.000 (m)
0.500
1.500

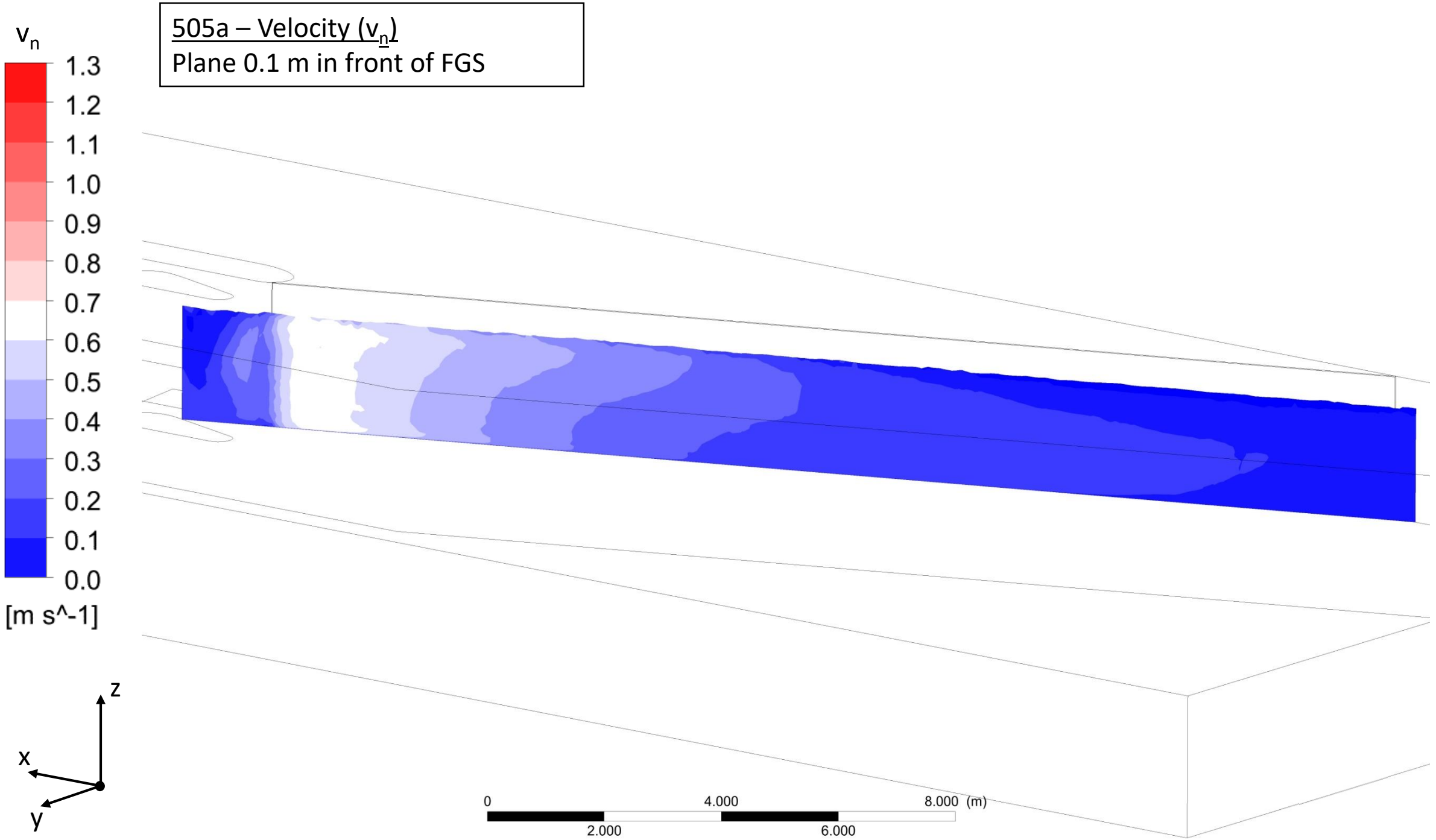

505a – Turbulence Kinetic Energy
z = 0.1 m above river bed
TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
y
z
x
0
3.000
6.000 (m)
1.500
4.500

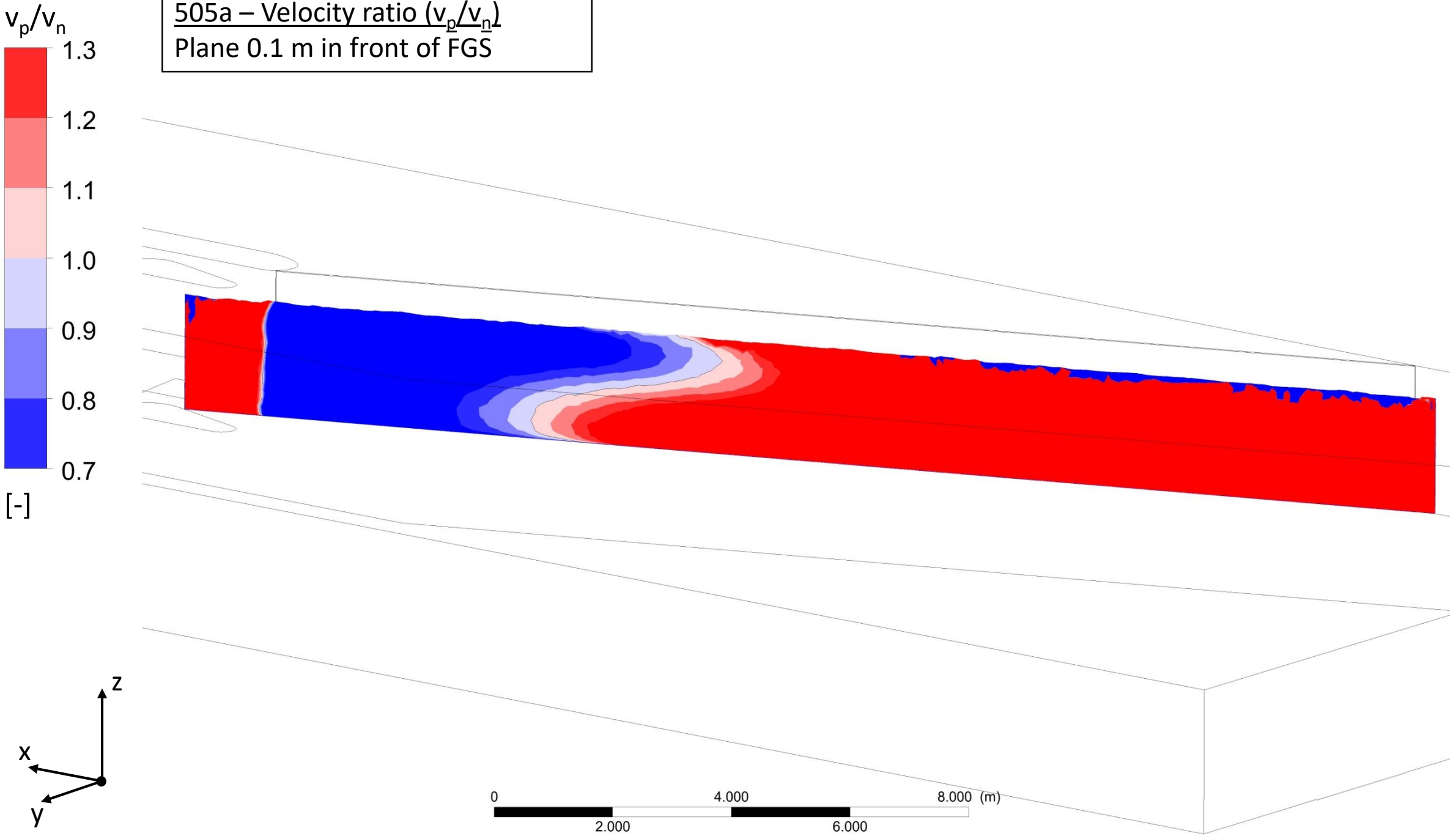

TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
505a – Turbulence Kinetic Energy
z = 1.0 m above river bed
y
z
x
0
3.000
6.000 (m)
1.500
4.500

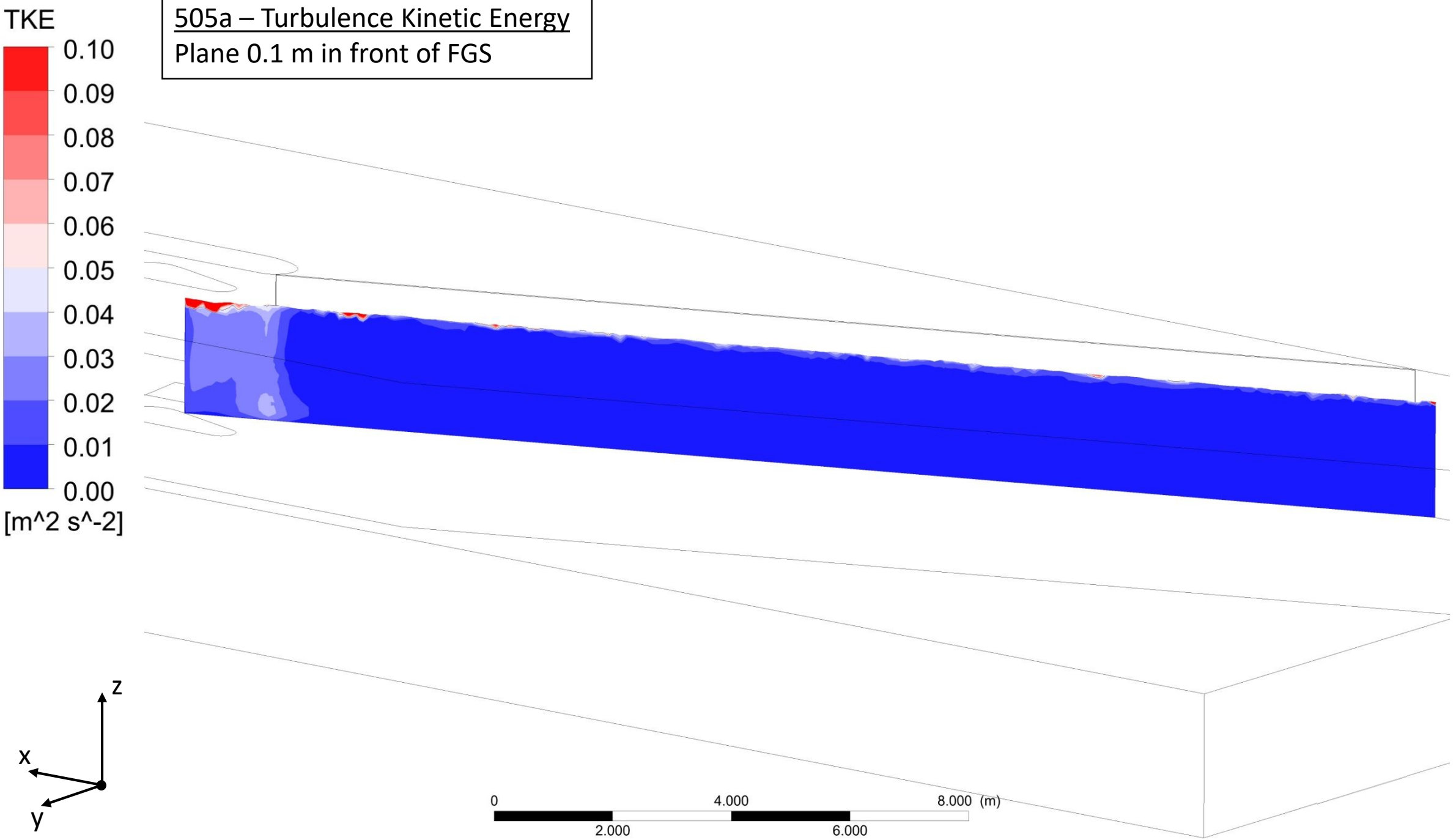

TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
505a – Turbulence Kinetic Energy
z = 1.5 m above river bed
y
z
x
0
3.000
6.000 (m)
1.500
4.500

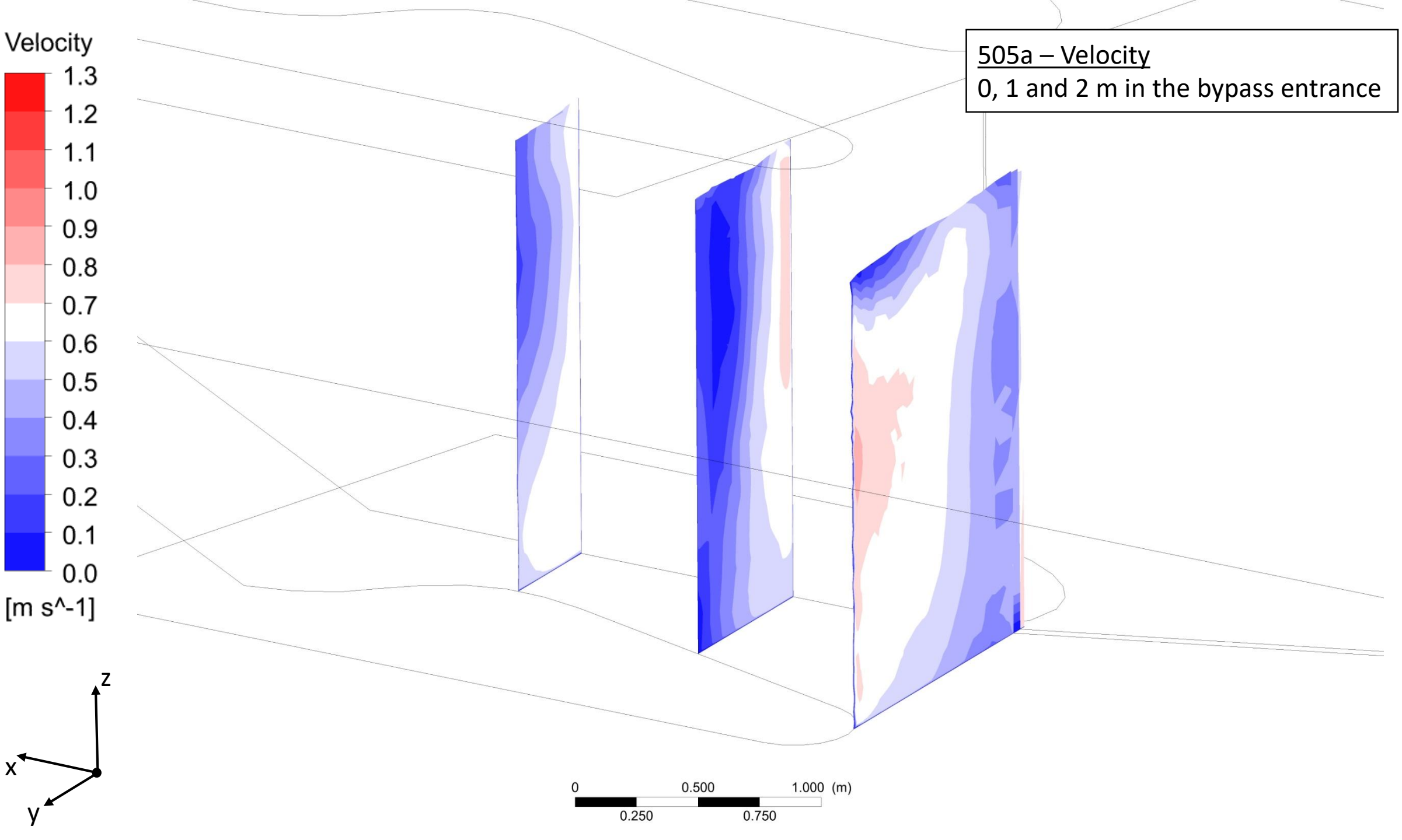

505a – Velocity (v_a)
Plane 0.1 m in front of FGS
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
z
x
y
0
4.000
8.000 (m)
2.000
6.000

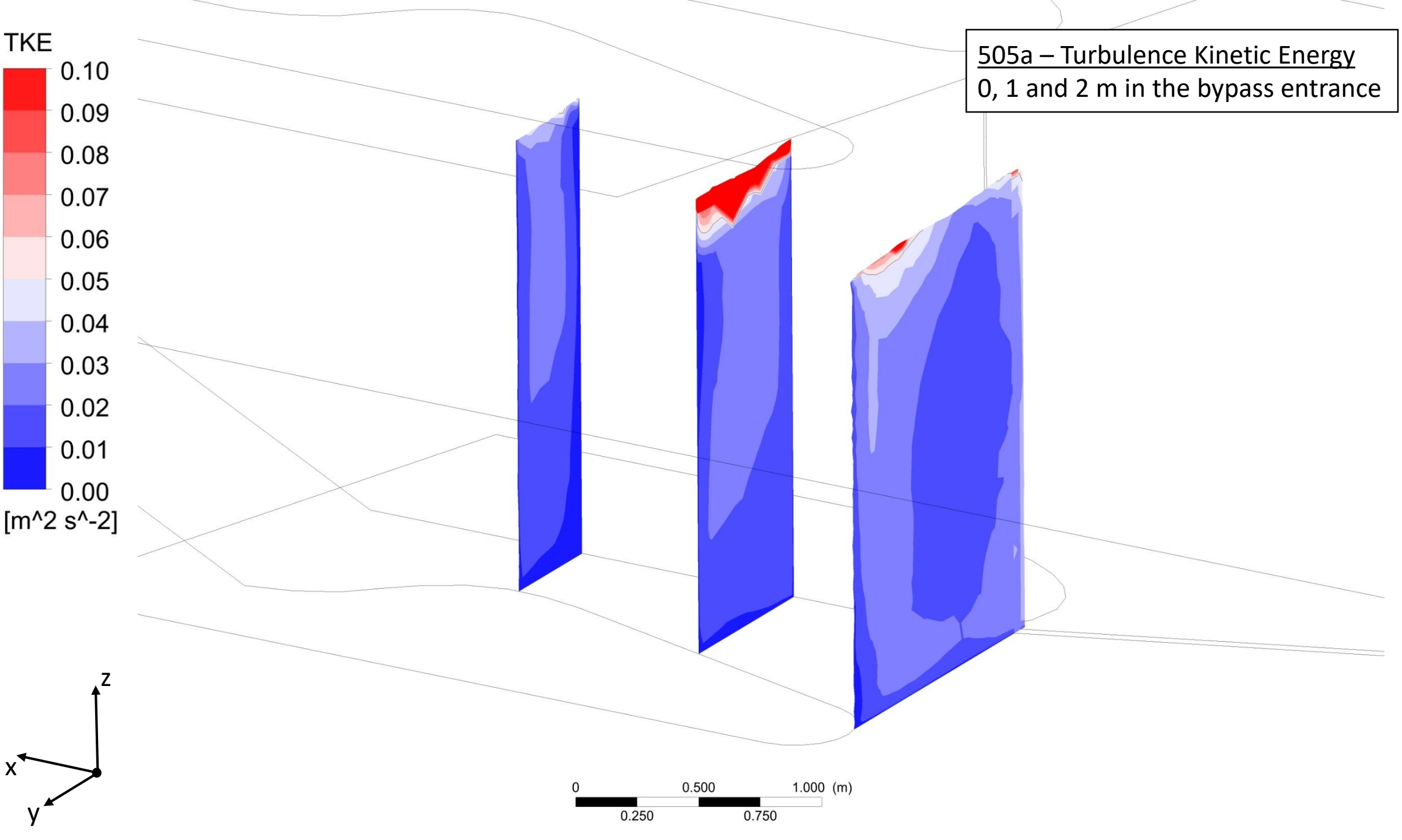

505a – Velocity (v_p)
Plane 0.1 m in front of FGS
v_p
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
[m s^-1]
z
x
y
0
4.000
8.000 (m)
2.000
6.000


505a – Velocity (v_n)
Plane 0.1 m in front of FGS
v_n
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
z
x
y
0
4.000
8.000 (m)
2.000
6.000


v_p/v_n
1.3
1.2
1.1
1.0
0.9
0.8
0.7
[-]
505a – Velocity ratio (v_p/v_n)
Plane 0.1 m in front of FGS
z
x
y
0
4.000
8.000 (m)
2.000
6.000


505a – Turbulence Kinetic Energy
Plane 0.1 m in front of FGS
TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
z
x
y
0
4.000
8.000 (m)
2.000
6.000


Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
505a – Velocity
0, 1 and 2 m in the bypass entrance
z
x
y
0
0.500
1.000 (m)
0.250
0.750


TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
505a – Turbulence Kinetic Energy
0, 1 and 2 m in the bypass entrance
z
x
y
0
0.500
1.000 (m)
0.250
0.750