universität innsbruck
Arbeitsbereich für Wasserbau

Alpine river – 503d

Variation bypass dotation: 2.0 m³/s (20% of river discharge)

28.11.2022

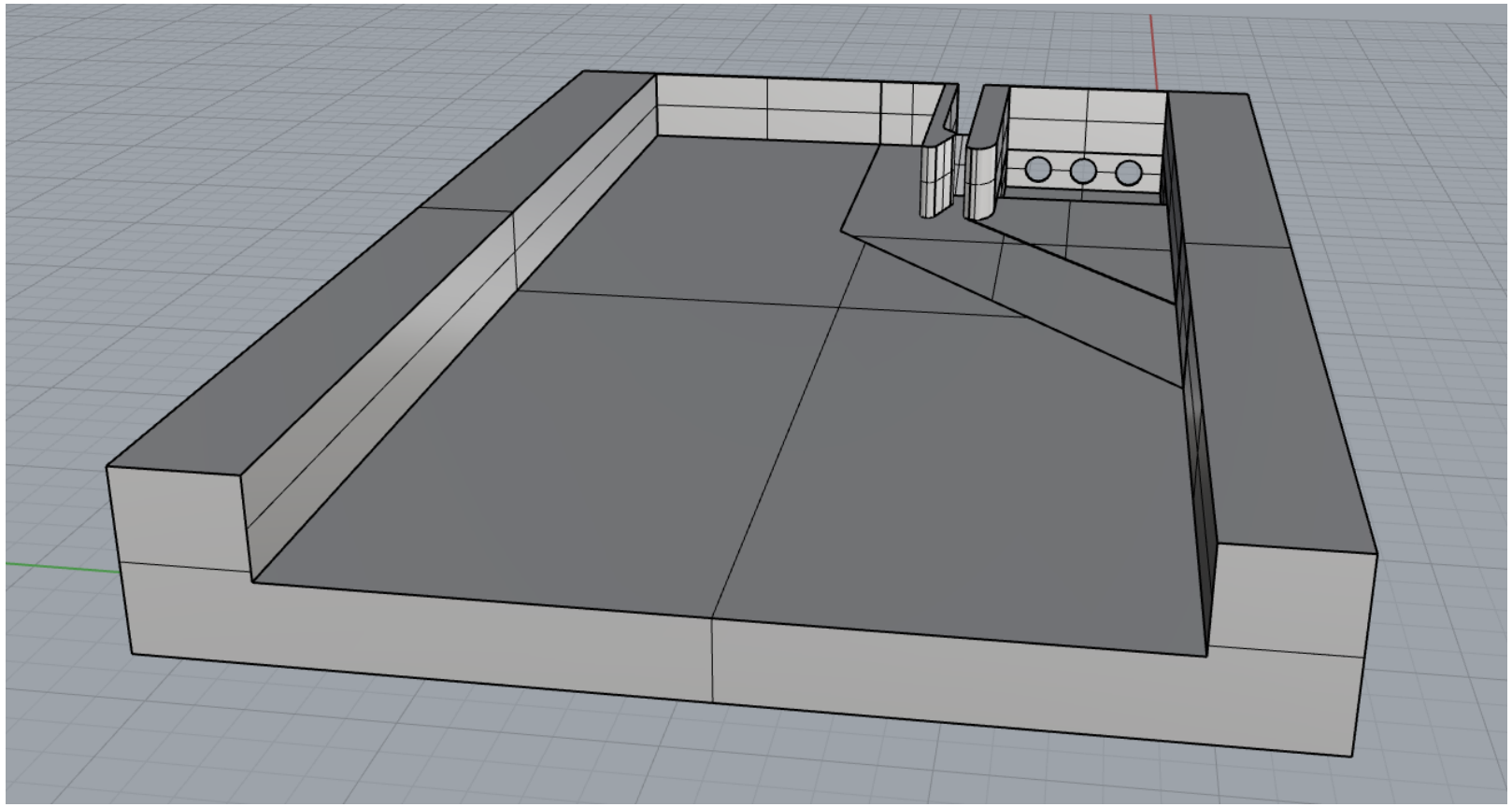
503d - General

River:

- Alpine river
- Discharge: 10 m³/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: 8 m³/s
- Head: 2 m
- Headrace channel width: 6 m



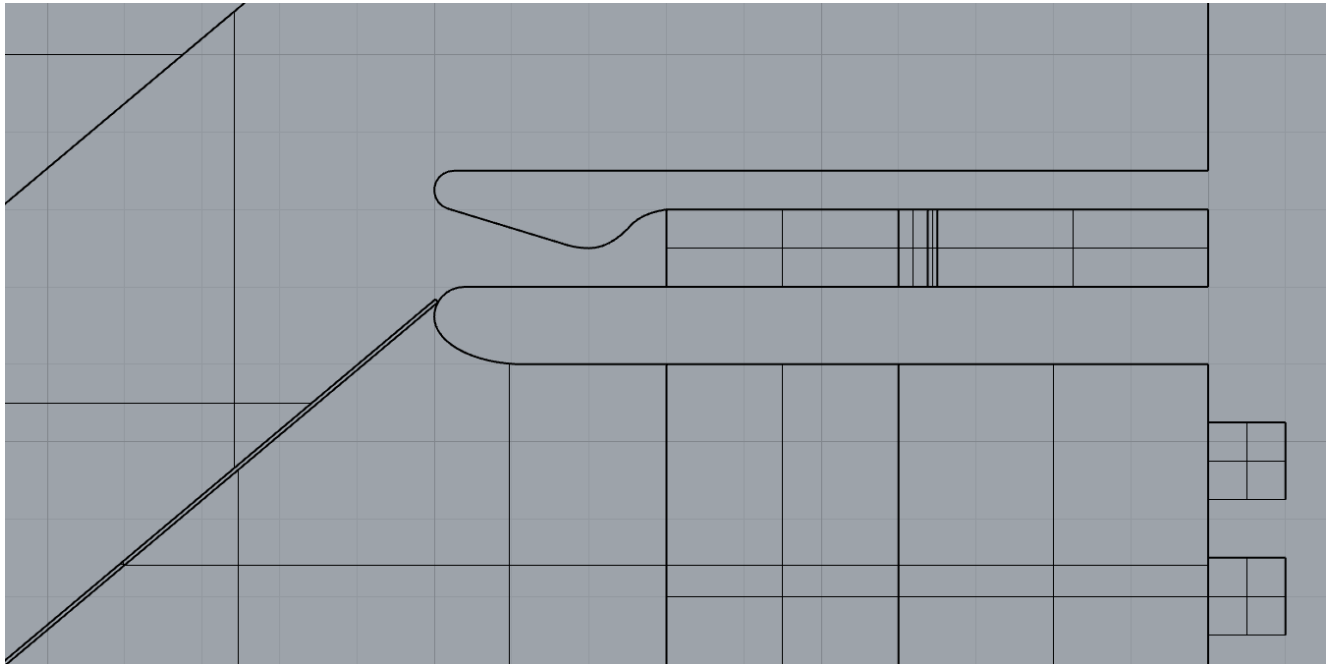
503d - General

Bypass:

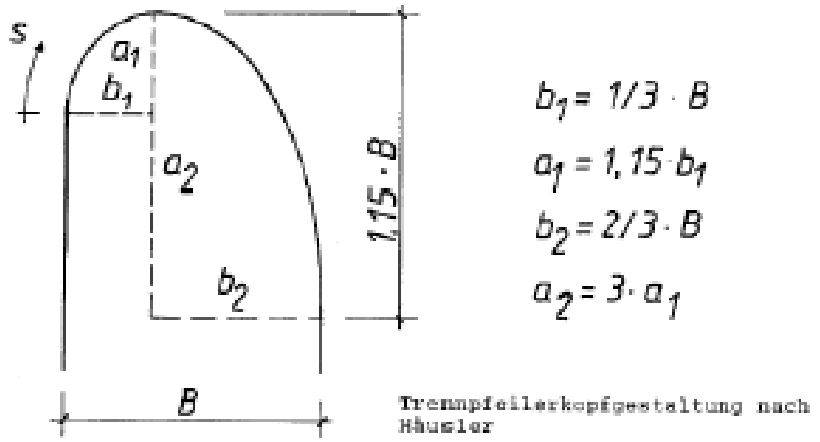
- Based on the angled bar rack bypass system by Ebel, Gluch & Kehl
- Bypass width: 1 m
- Ramp inclination: 26.6°
- Q (Bypass): 2.0 m³/s (20.0% of Q_{River})

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



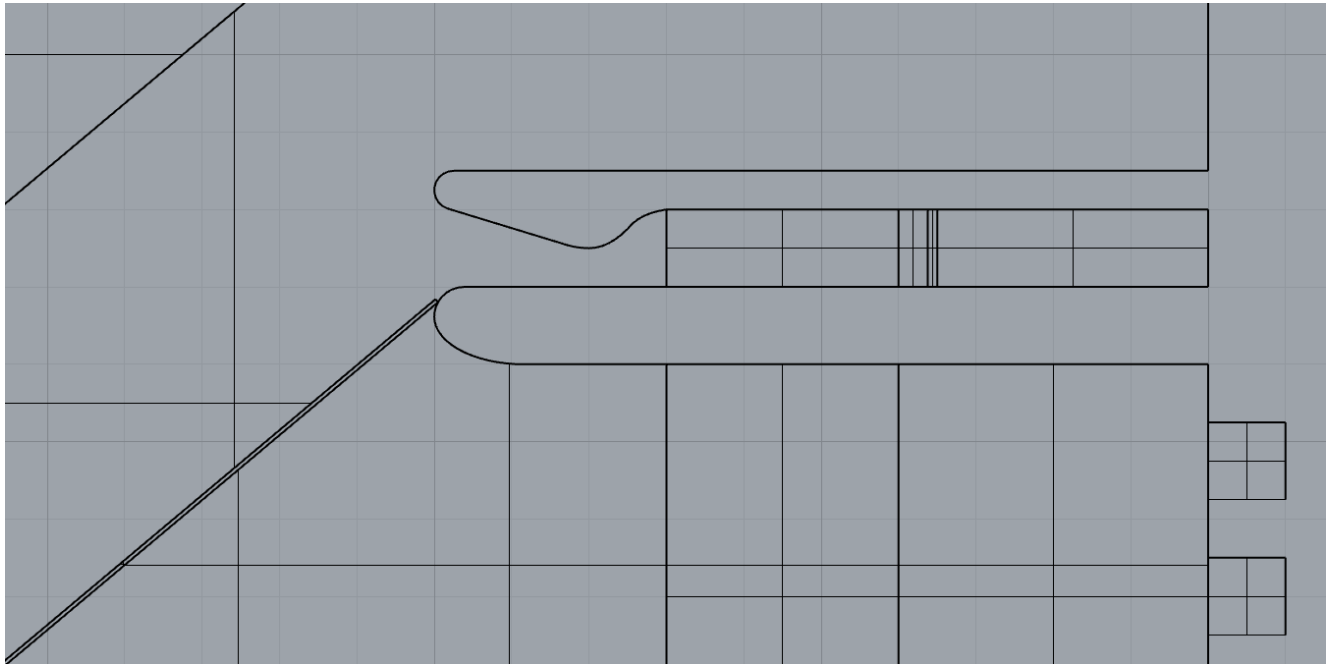
503d - General

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):

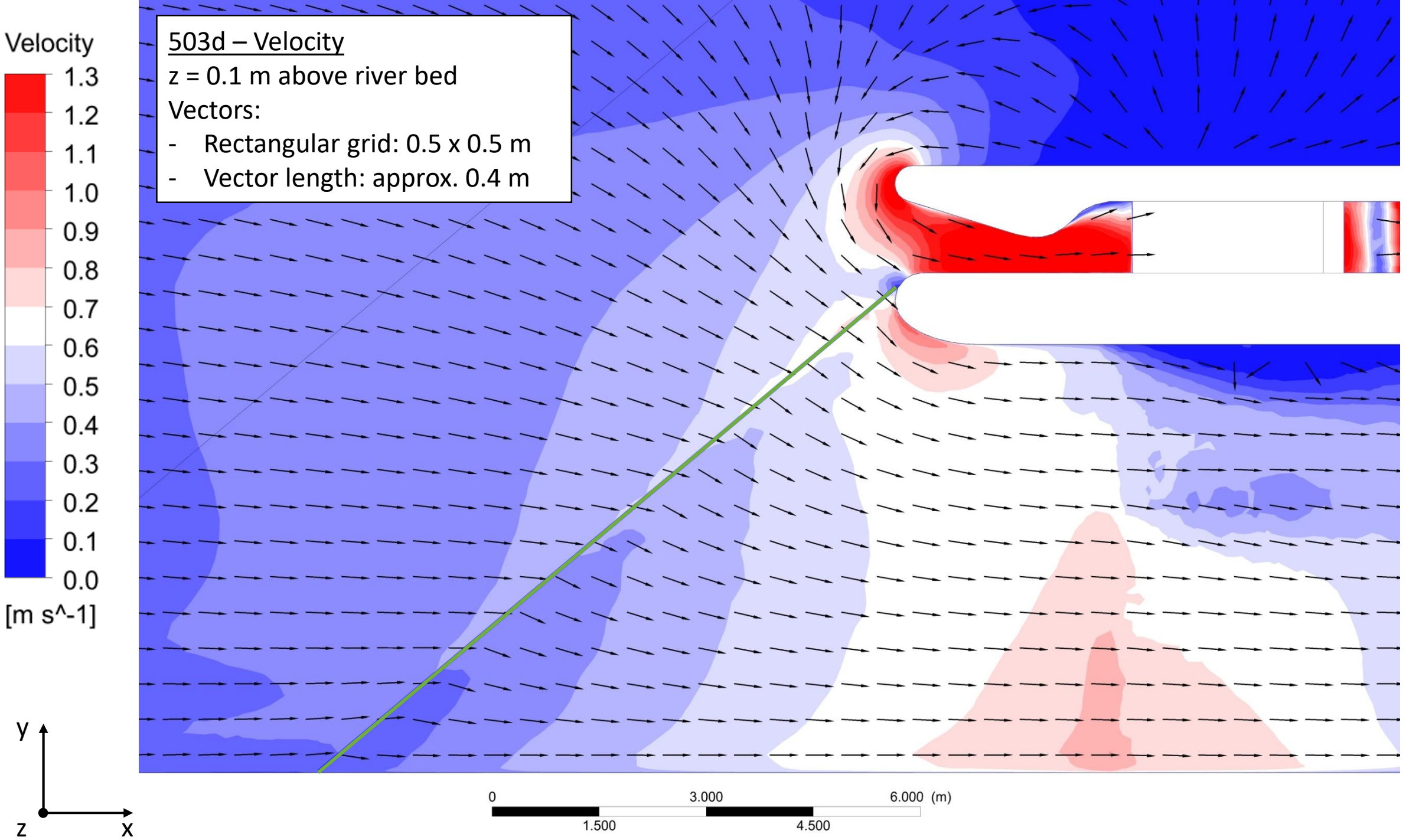
- Rack length: 10.58 m
- Mean velocity at rack:
  v = Q/A = 0.38 m/s
- Circular bar trash rack with 40° angle to the unaffected flow direction
- Head loss values depending on the horizontal inflow angle and the rack configuration

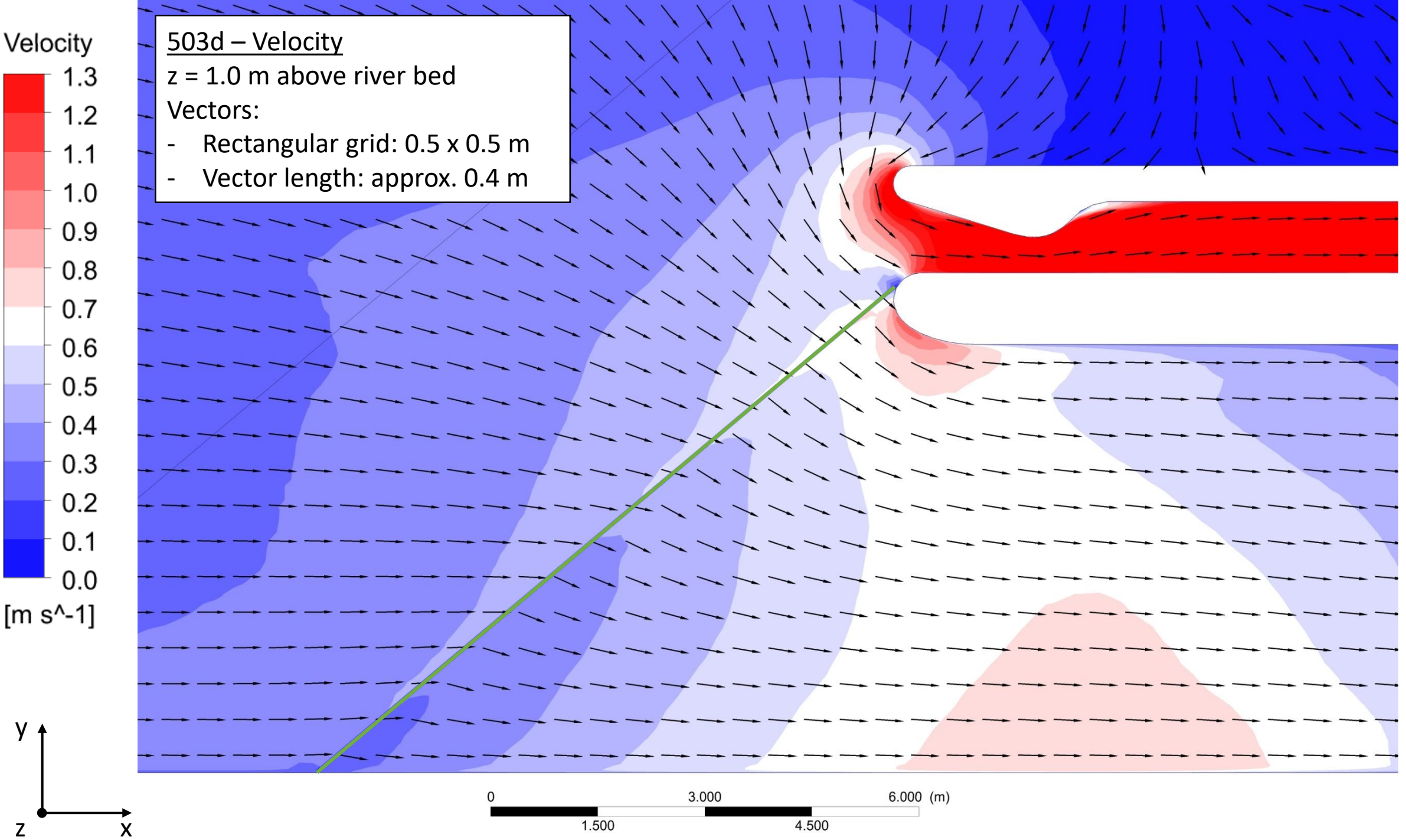


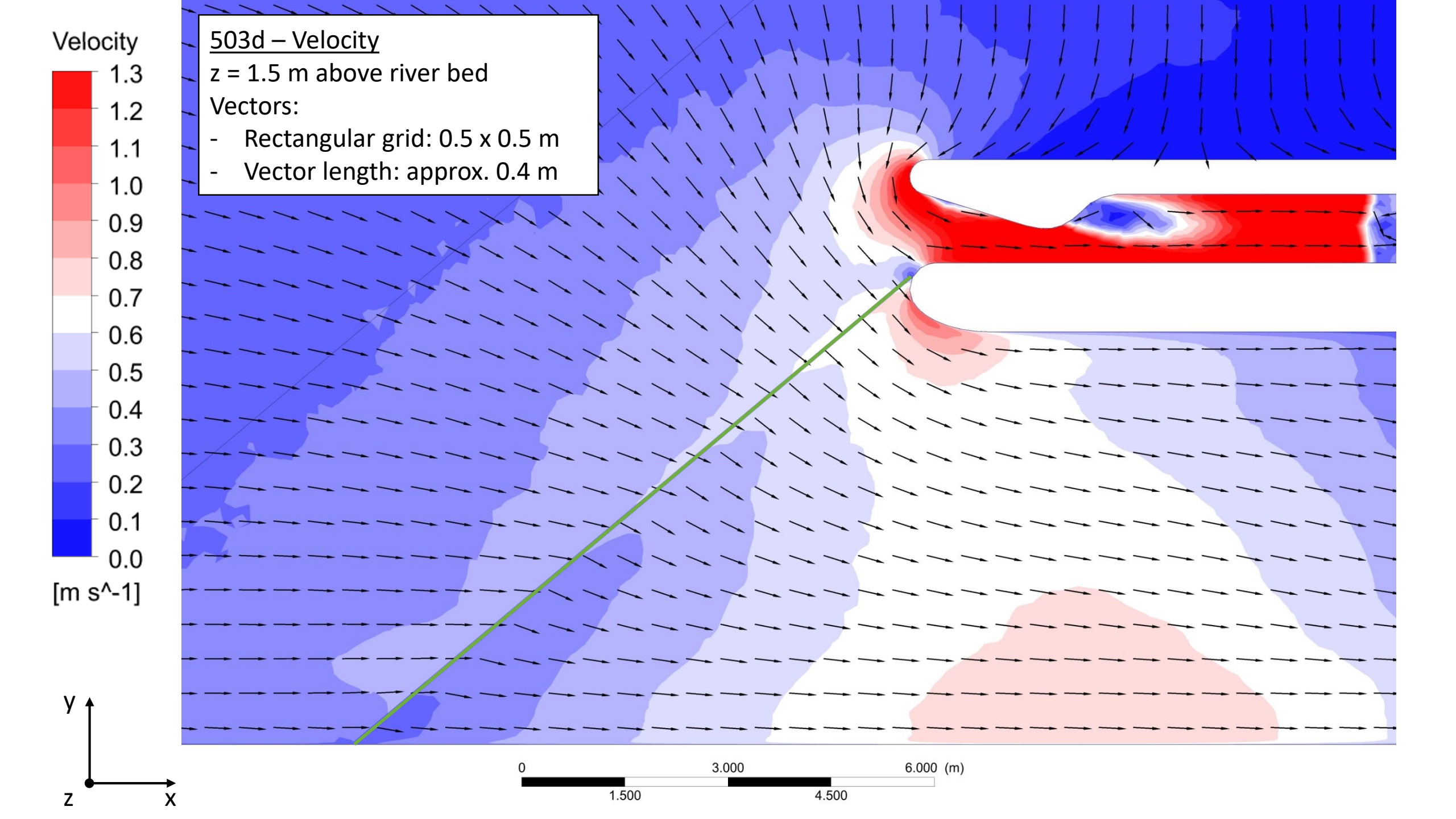
Layout of the bypass and dividing pier

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


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]
503d – Velocity
z = 0.1 m above river bed
Vectors:
- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m
y
z
x
0
3.000
6.000 (m)
1.500
4.500


503d – 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
3.000
6.000 (m)
1.500
4.500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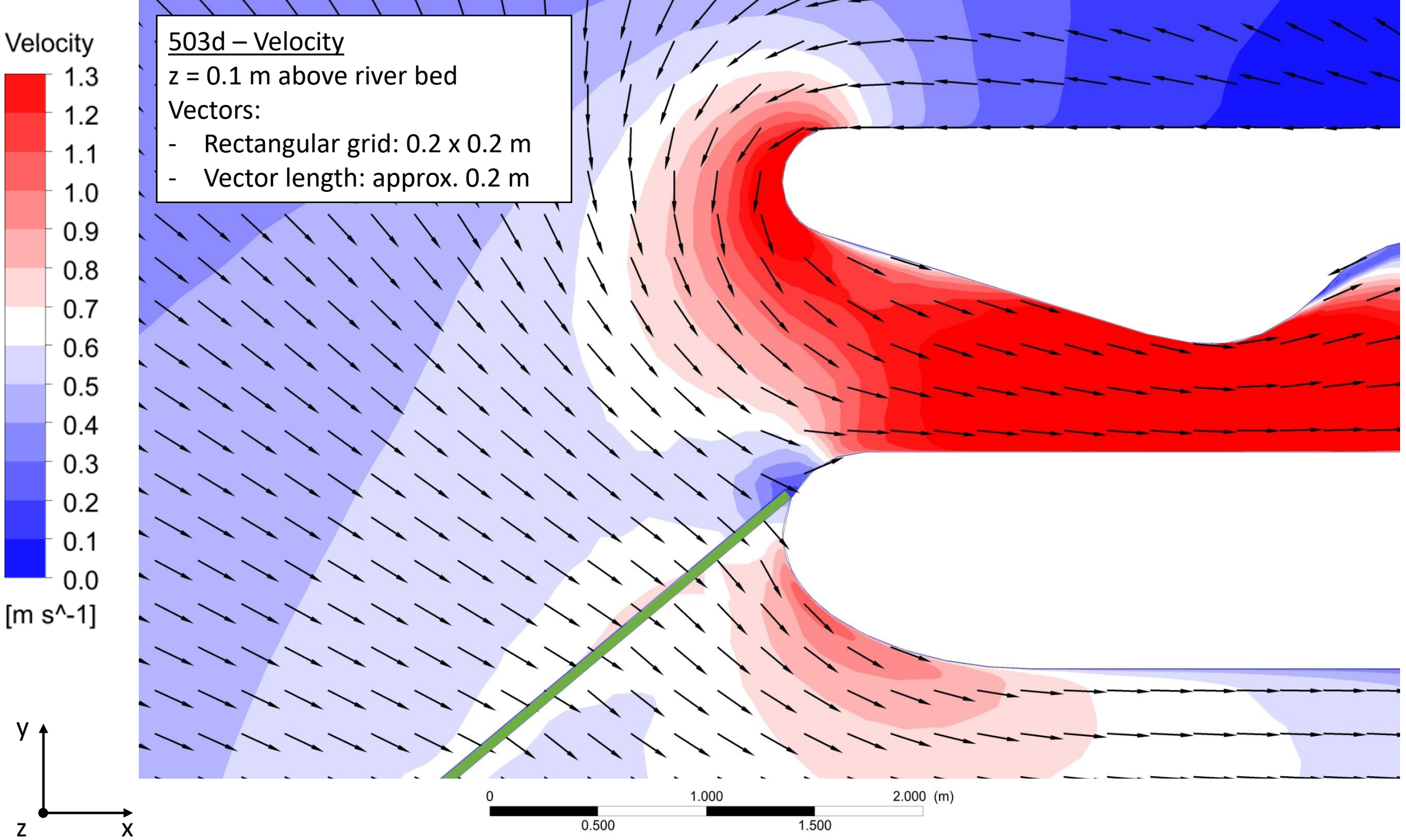
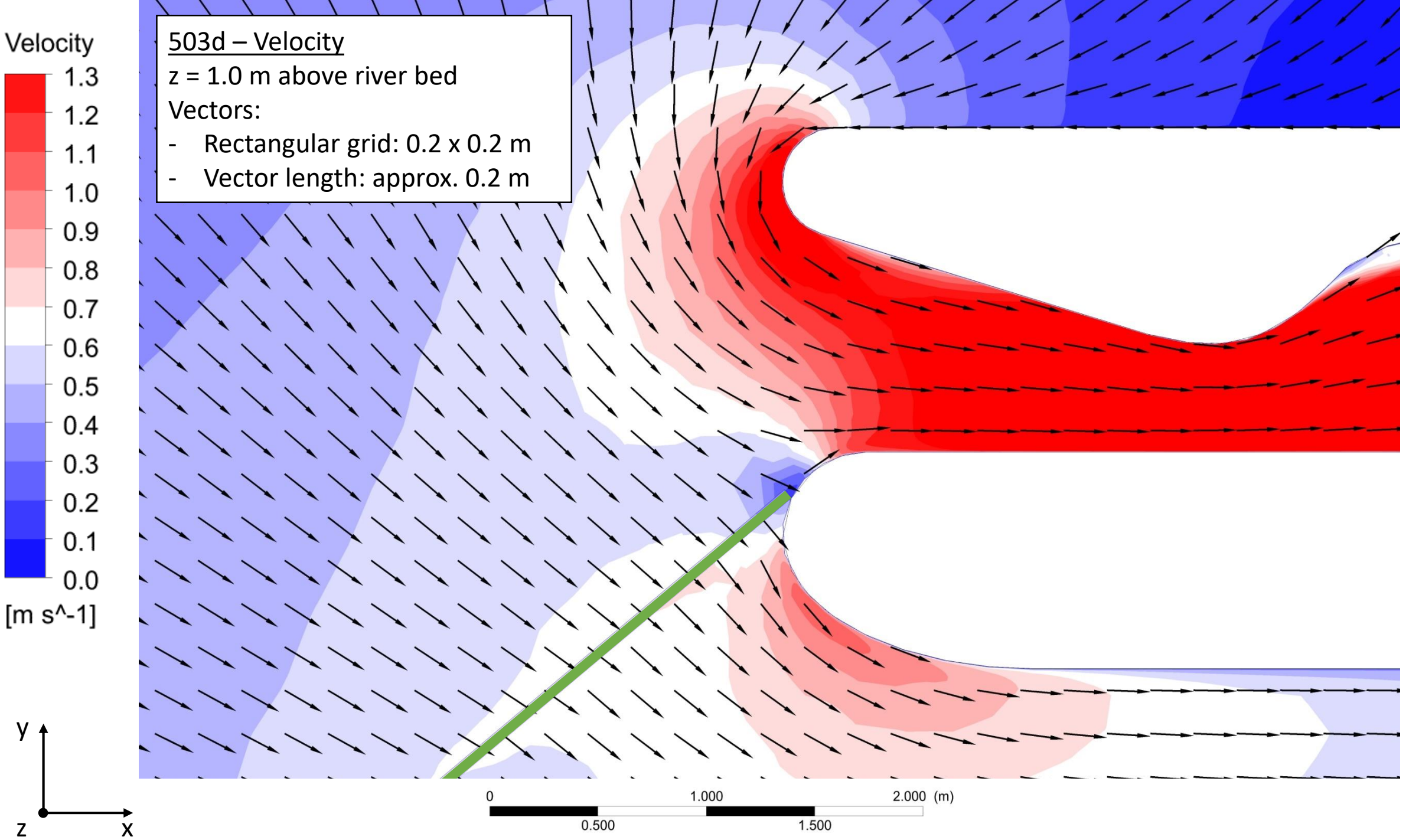
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
y
z
x
0
3.000
6.000 (m)
1.500
4.500


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]
503d – 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
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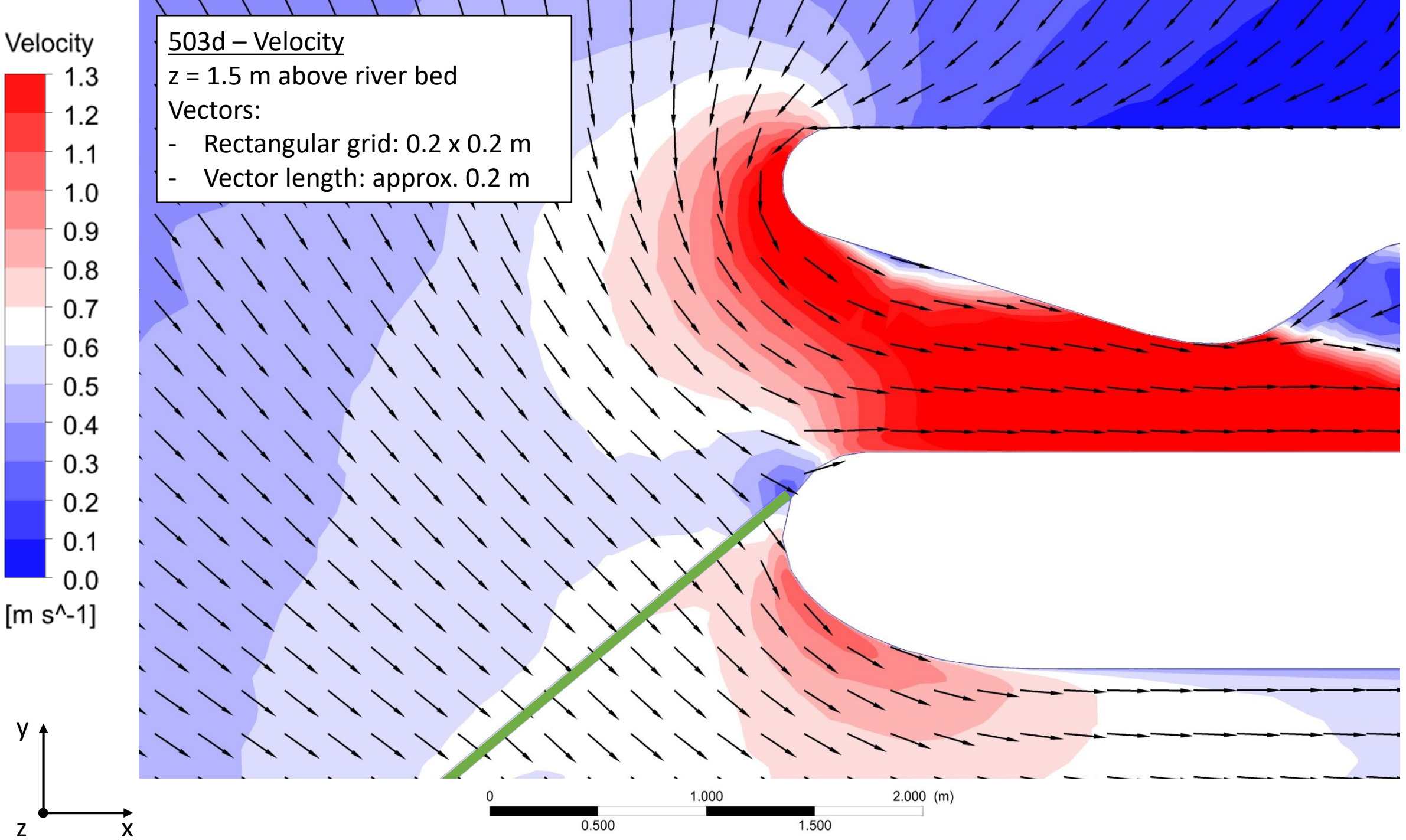
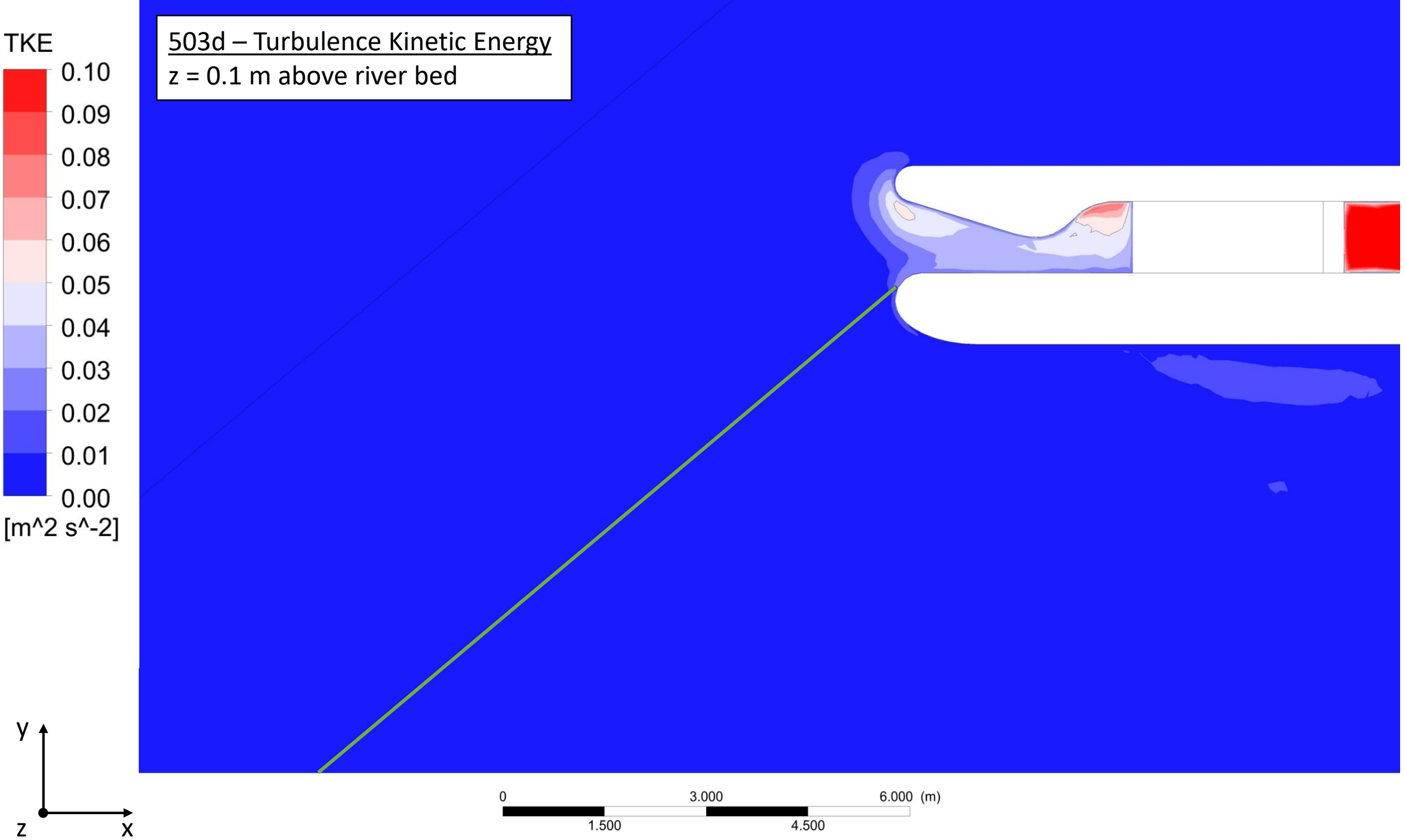
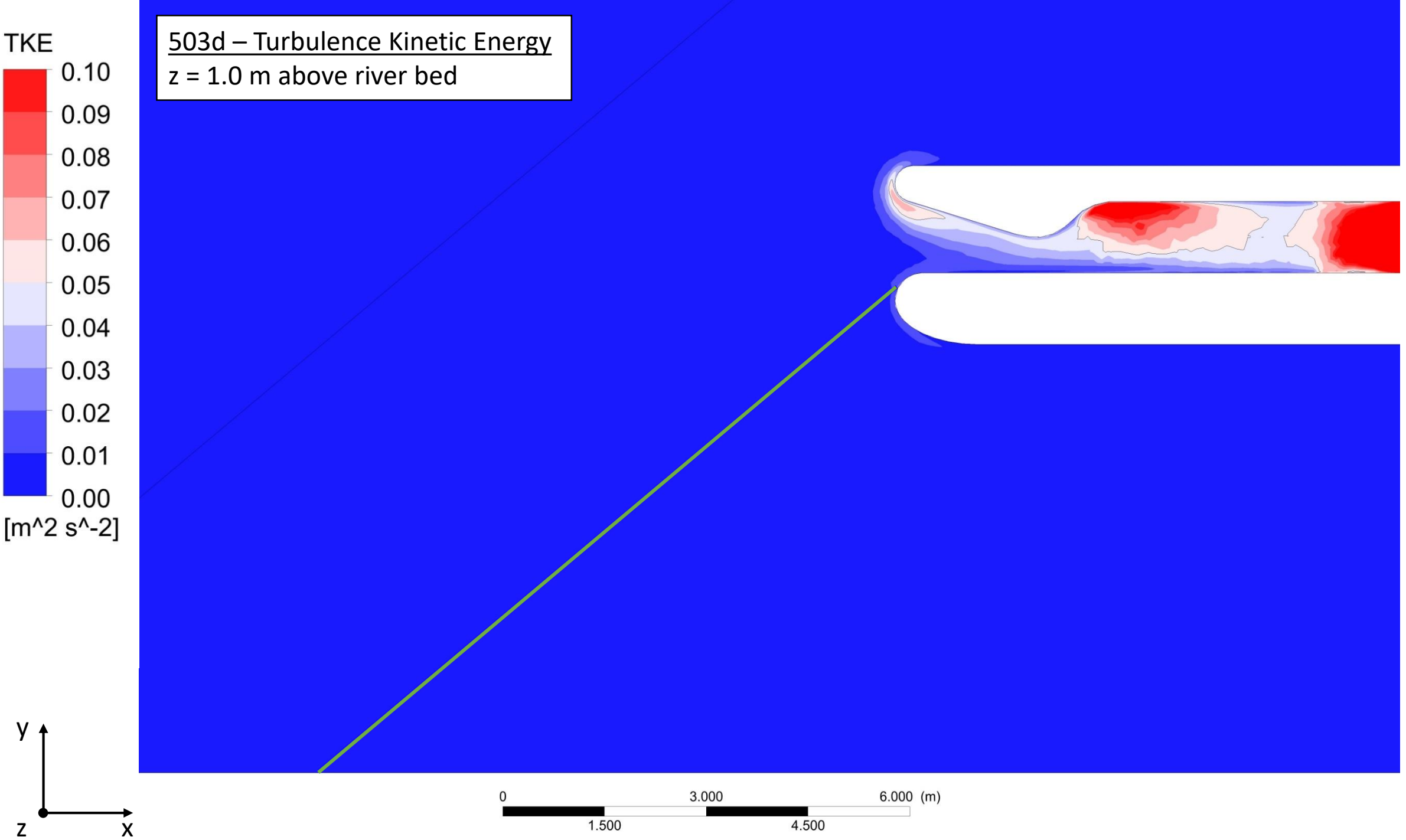
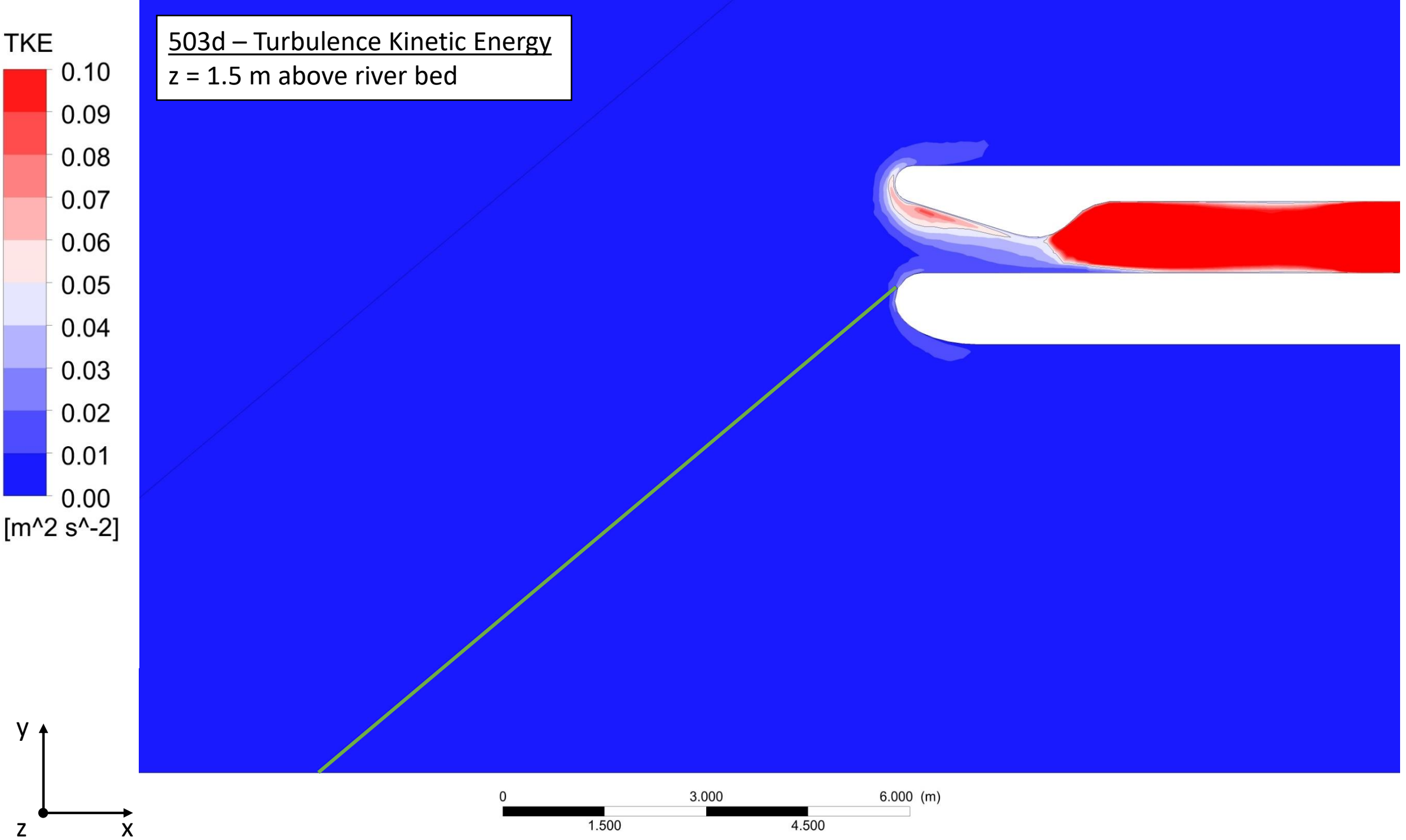
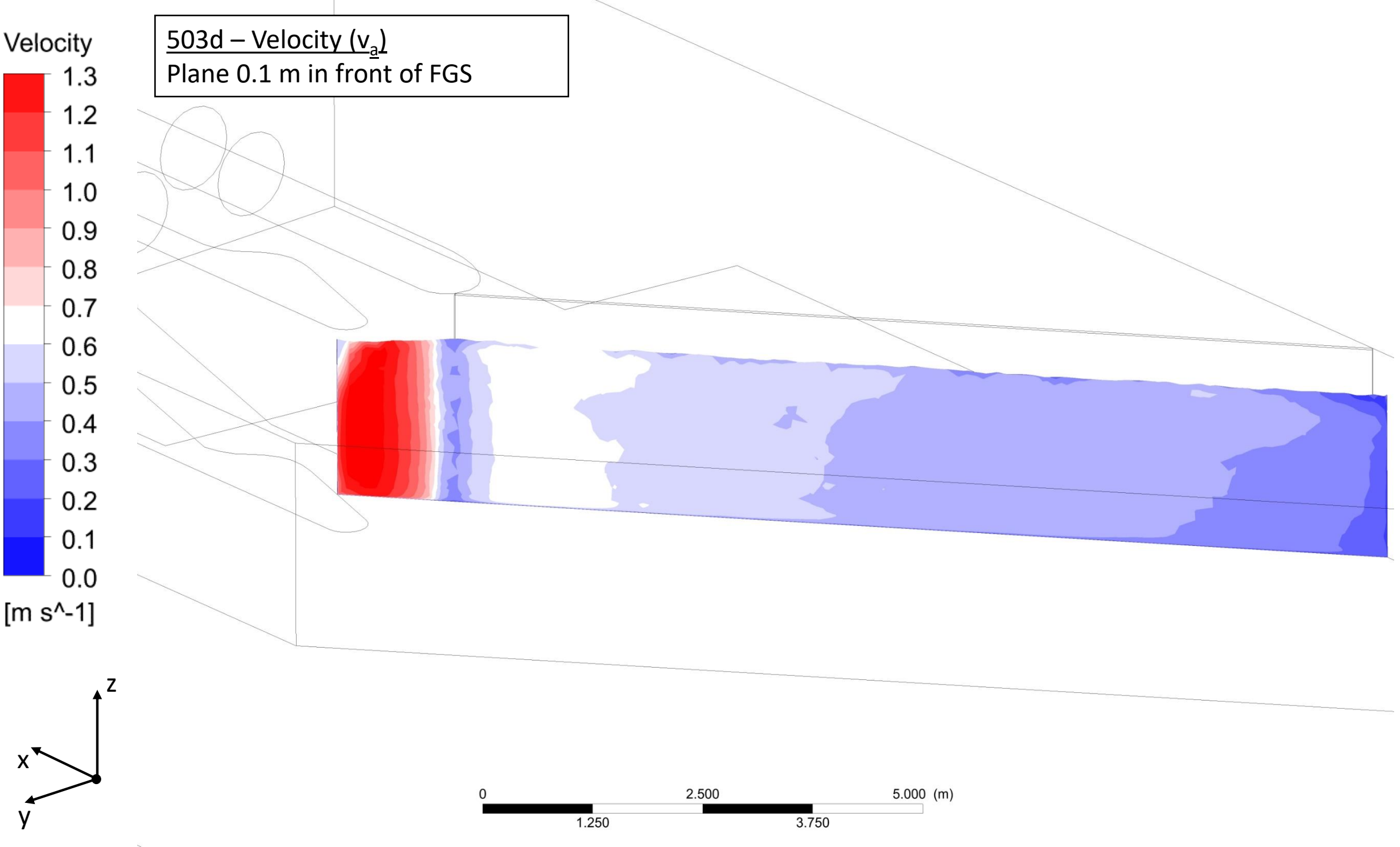
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
503d – Velocity
z = 1.0 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m
y
z
x
0
1.000
2.000 (m)
0.500
1.500

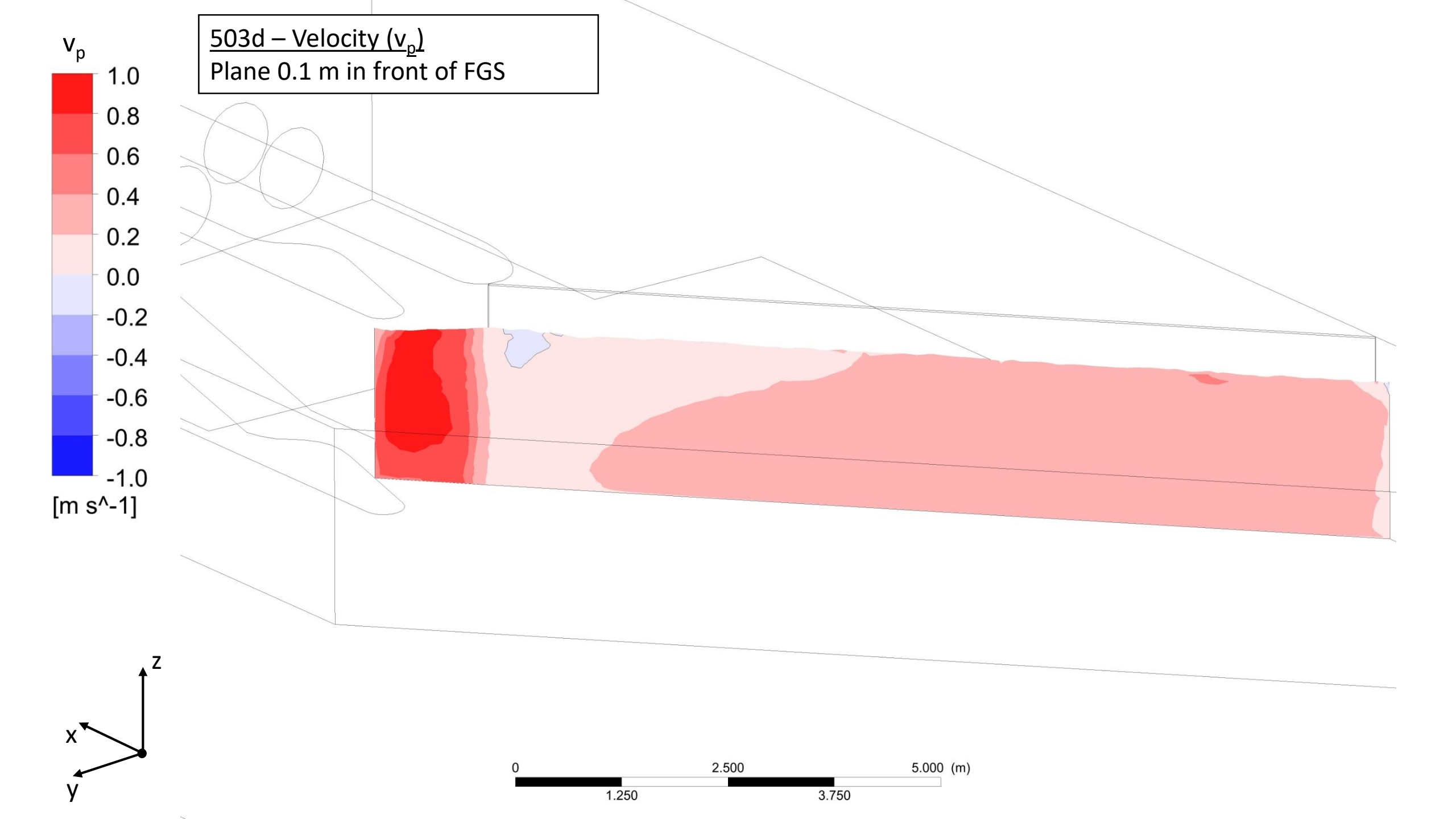

Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
503d – Velocity
z = 1.5 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m
y
z
x
0
1.000
2.000 (m)
0.500
1.500

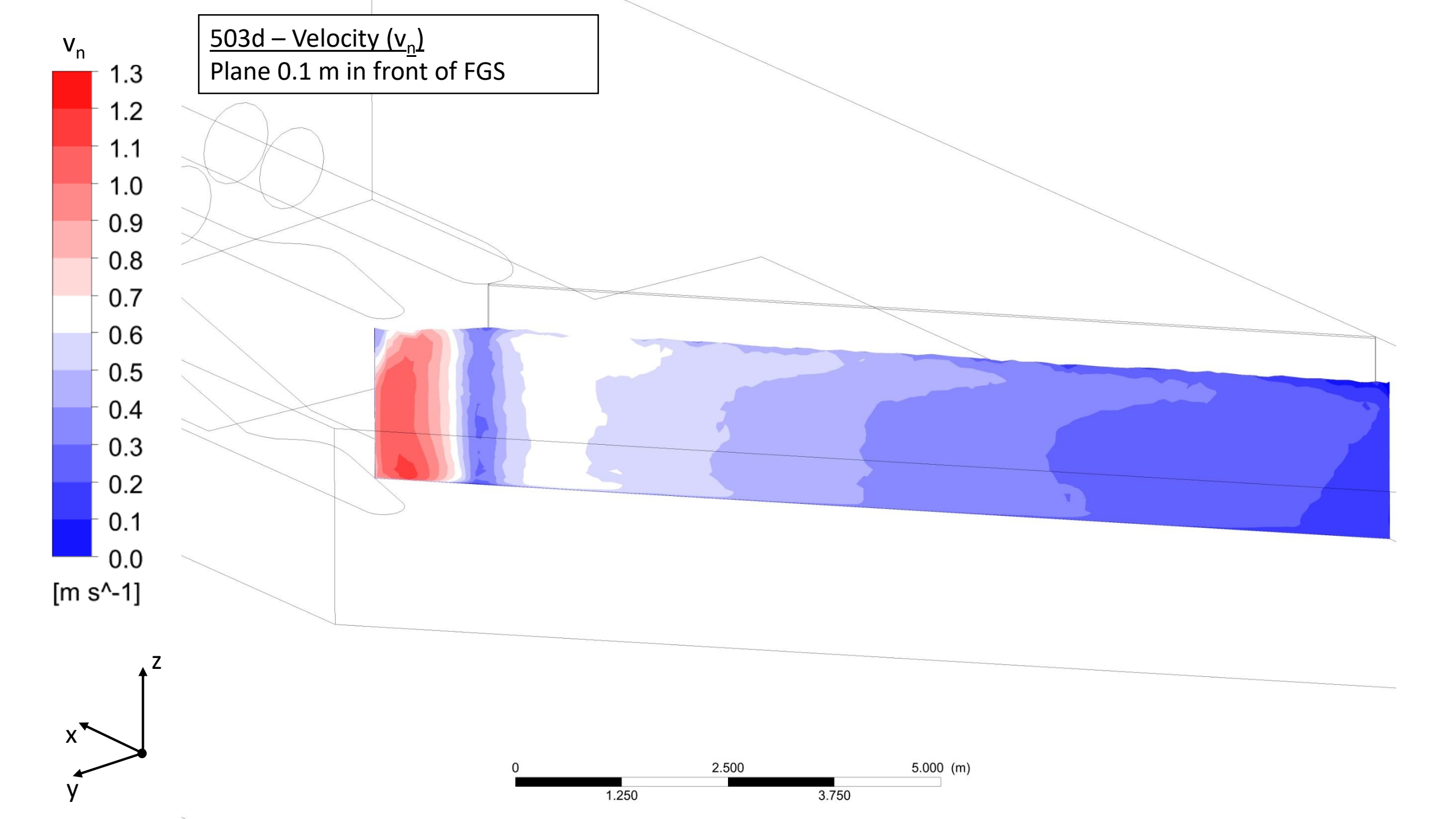

TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
503d – Turbulence Kinetic Energy
z = 0.1 m above river bed
y
z
x
0
3.000
6.000 (m)
1.500
4.500

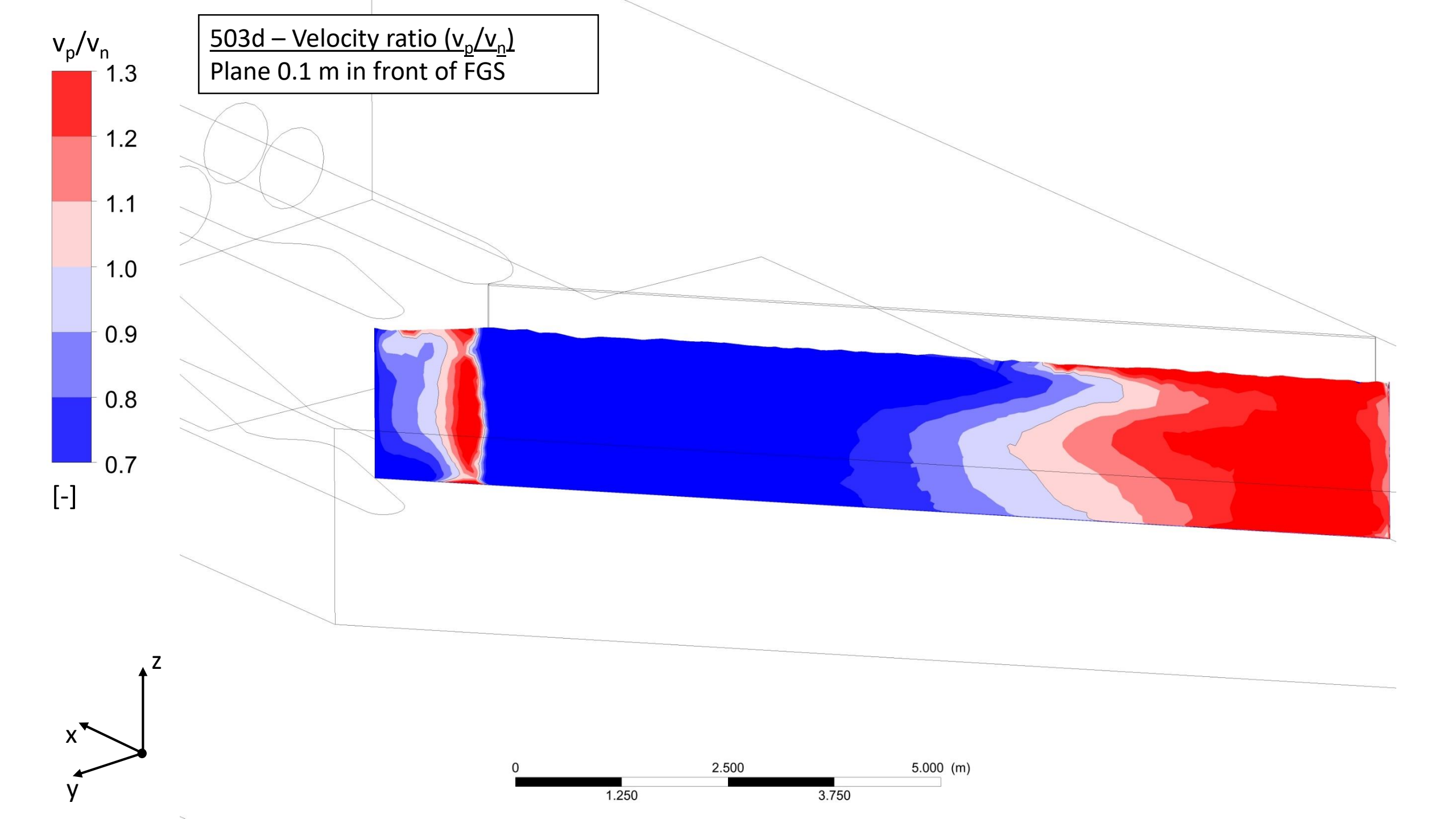

TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
503d – Turbulence Kinetic Energy
z = 1.0 m above river bed
y
z
x
0
3.000
6.000 (m)
1.500
4.500

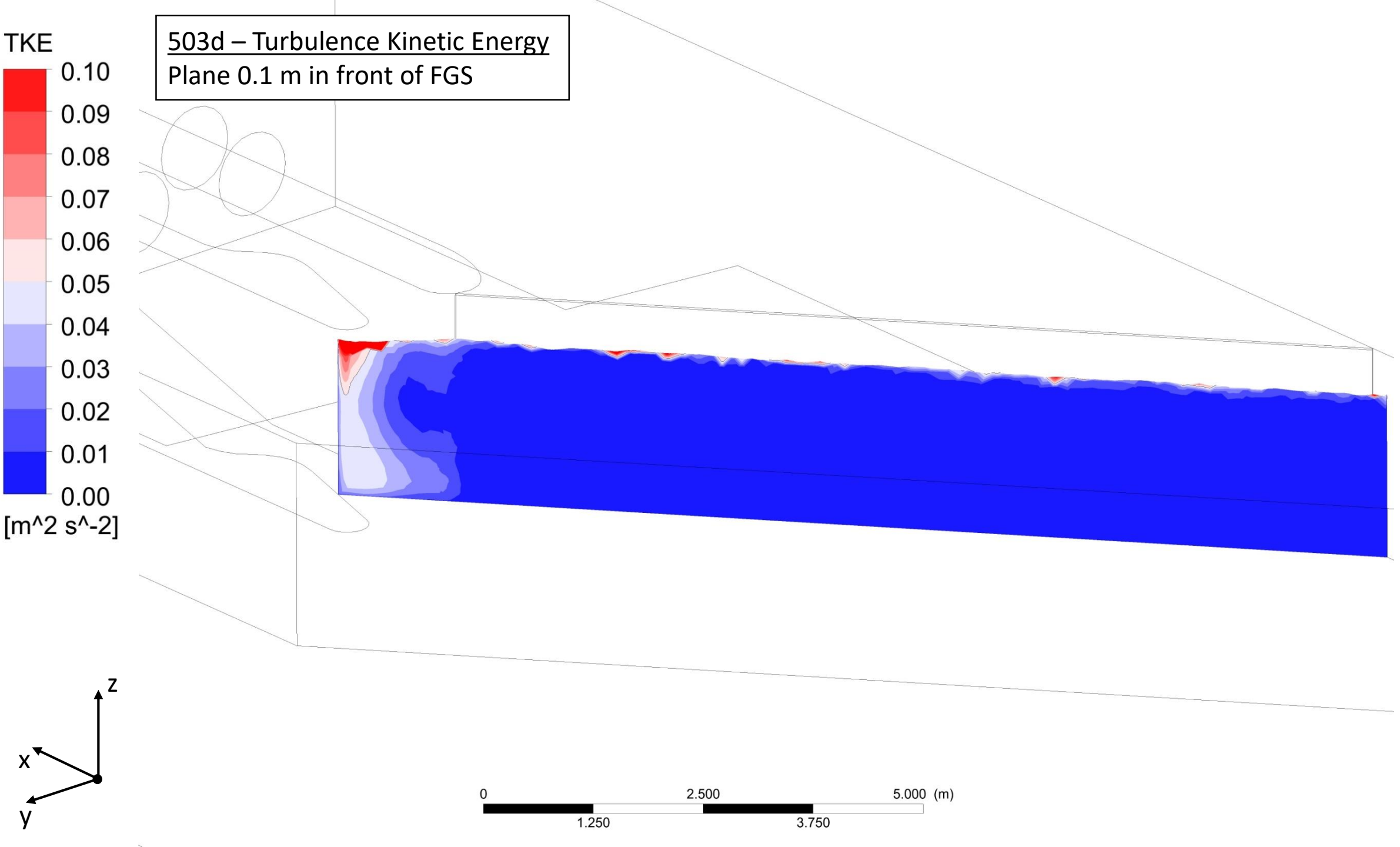

TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m^2 s^-2]
503d – Turbulence Kinetic Energy
z = 1.5 m above river bed
y
z
x
0
3.000
6.000 (m)
1.500
4.500

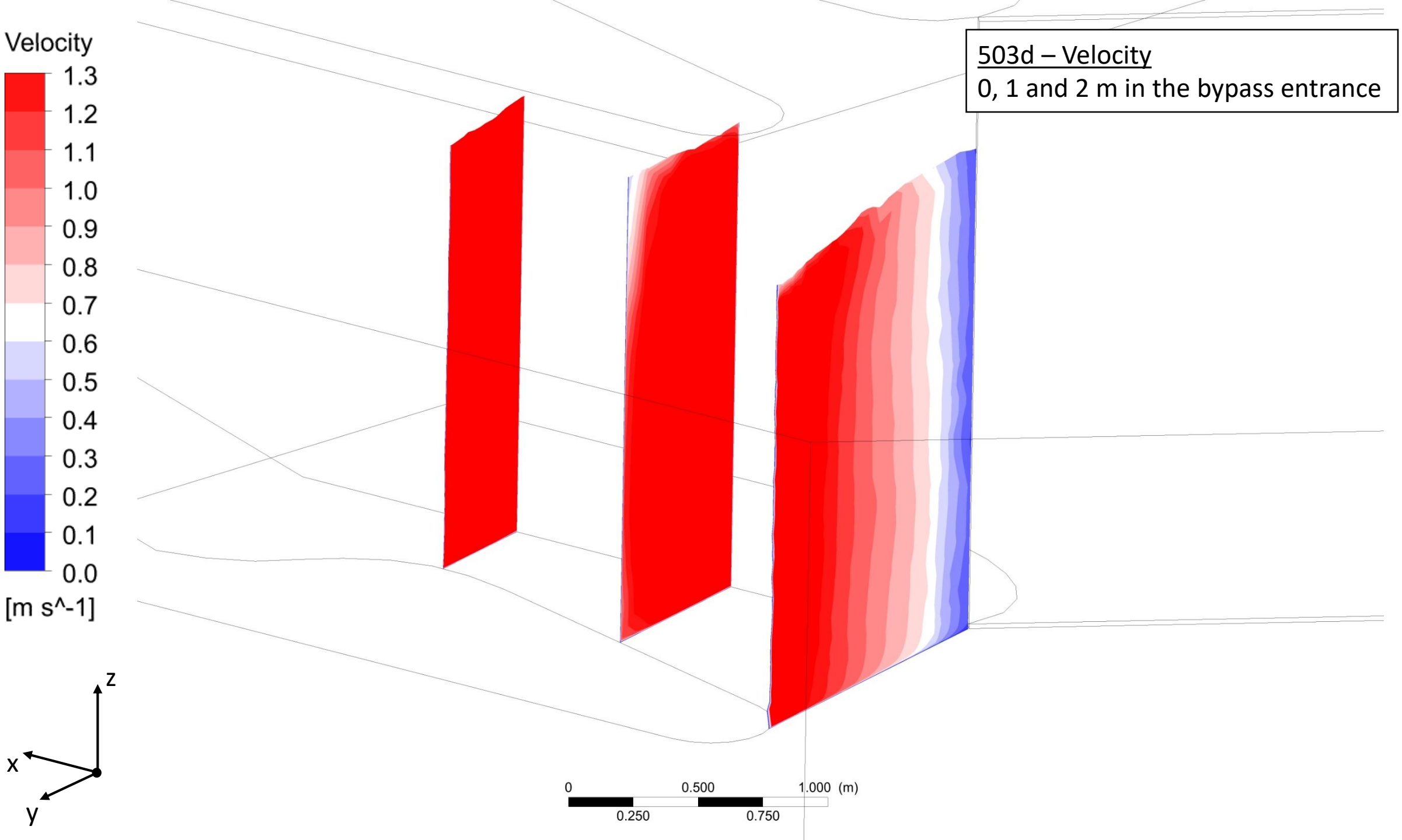

503d – Velocity (v_a)
Plane 0.1 m in front of FGS
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s^-1]
z
x
y
0
2.500
5.000 (m)
1.250
3.750

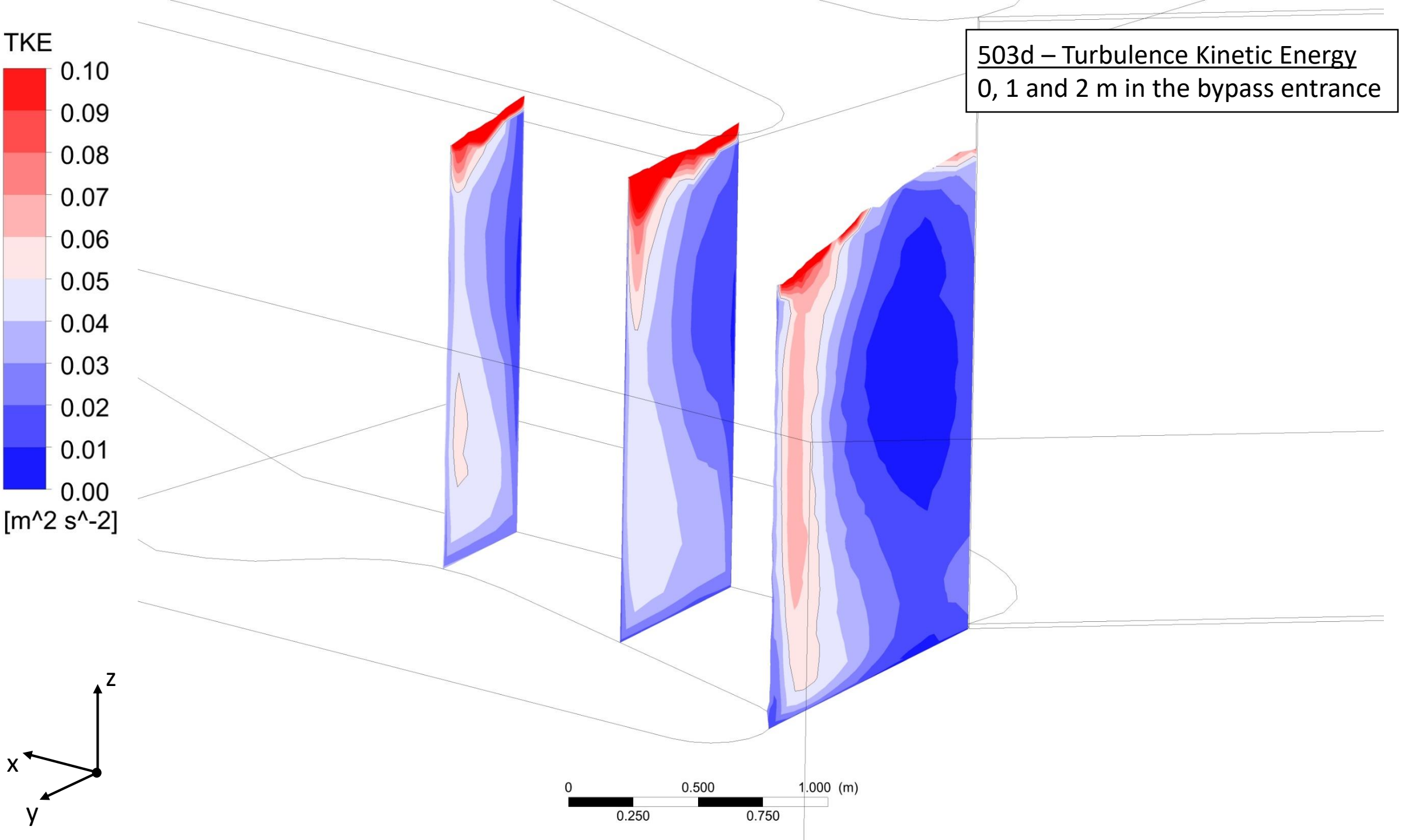

503d – Velocity (v_p)
Plane 0.1 m in front of FGS
v_p
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
[m s^-1]
z
x
y
0
2.500
5.000 (m)
1.250
3.750


503d – 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
2.500
5.000 (m)
1.250
3.750


503d – Velocity ratio (v_p/v_n)
Plane 0.1 m in front of FGS
v_p/v_n
1.3
1.2
1.1
1.0
0.9
0.8
0.7
[-]
z
x
y
0
2.500
5.000 (m)
1.250
3.750


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]
503d – Turbulence Kinetic Energy
Plane 0.1 m in front of FGS
z
x
y
0
2.500
5.000 (m)
1.250
3.750


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]
503d – 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]
503d – 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