

Pre-alpine river – 435a

Variation inlet gate: Installed on the turbine-side part of the dividing pier

28.11.2022

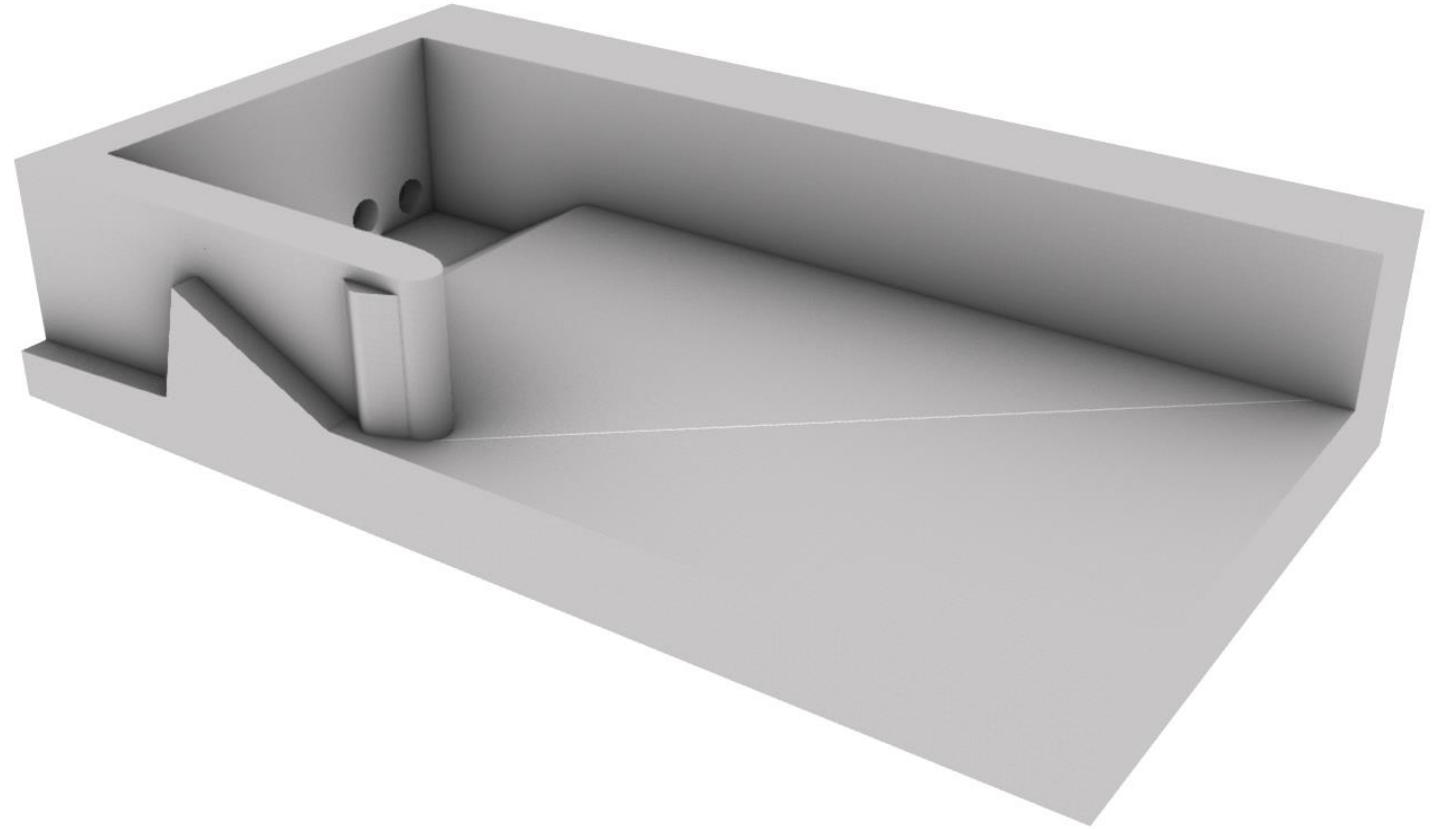
435a - General

River:

- Pre-alpine river
- Discharge: $50 \text{ m}^3/\text{s}$
- Mean flow velocity: 0.36 m/s
- River width: 35 m
- Weir width: 16 m
- Flow depth: 4 m
- No slope

Turbines:

- 6 turbines with 1.4 m diameter
- Design discharge: $48 \text{ m}^3/\text{s}$
- Head: 3 m
- Headrace channel width: 15 m



Section of the entire model

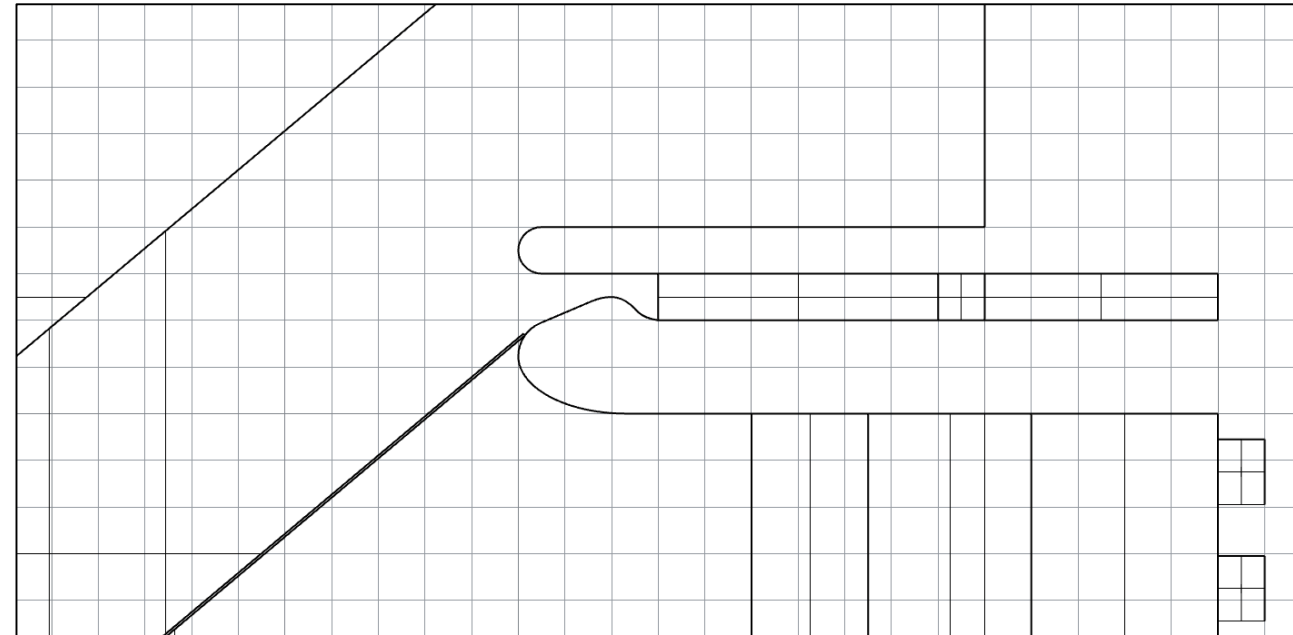
435a - General

Bypass:

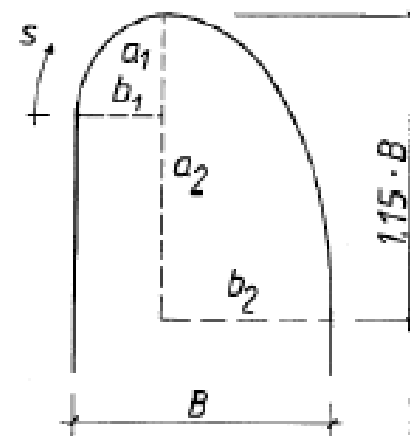
- Based on the angled bar rack bypass system by Ebel, Gluch & Kehl
- Bypass width: 1 m
- Ramp inclination: 26.6°
- Q (Bypass): $2 \text{ m}^3/\text{s}$ (4.0% of Q_{River})

Dividing pier – turbine-side part:

- Based on Häusler
- Width B : 2 m
- Length: 15 m
- $a_1 = b_1 = 0.77 \text{ m}$
- $b_2 = 1.23 \text{ m}$
- $a_2 = 2.31 \text{ m}$
- Inlet gate: „Streamlined“ with 0.5 m width over the whole water column



Layout of the bypass and dividing pier



$$b_1 = 1/3 \cdot B$$

$$a_1 = 1.15 \cdot b_1$$

$$b_2 = 2/3 \cdot B$$

$$a_2 = 3 \cdot a_1$$

Trennpfeilerkopfgestaltung nach Häusler

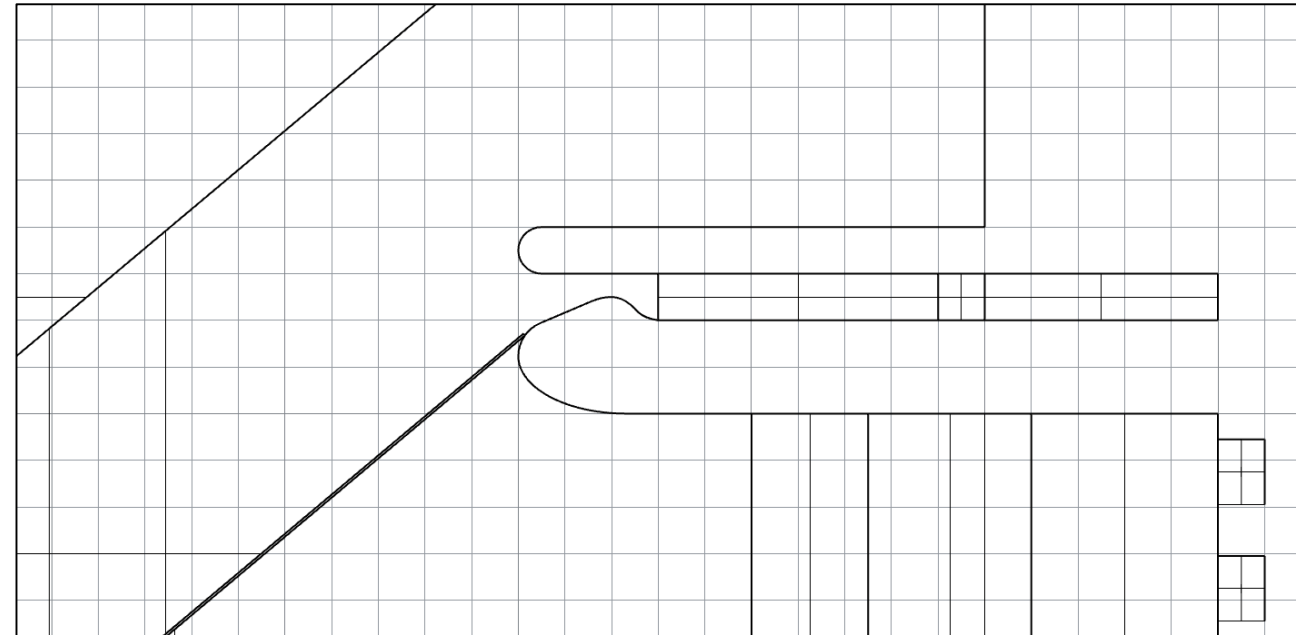
435a - General

Dividing pier – weir-side part:

- Width: 2 m
- Shape: Circular rounded
- Inlet gate on turbine-side part

Fish guidance structure (FGS):

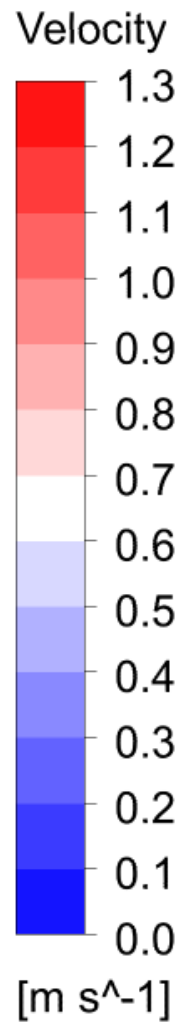
- Rack length: 25.94 m
- Mean velocity at rack:
 $v = Q/A = 0.46 \text{ m/s}$
- Circular bar trash rack with 40° angle to the unaffected flow direction
- Head loss values depending on the horizontal inflow angle and the rack configuration



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

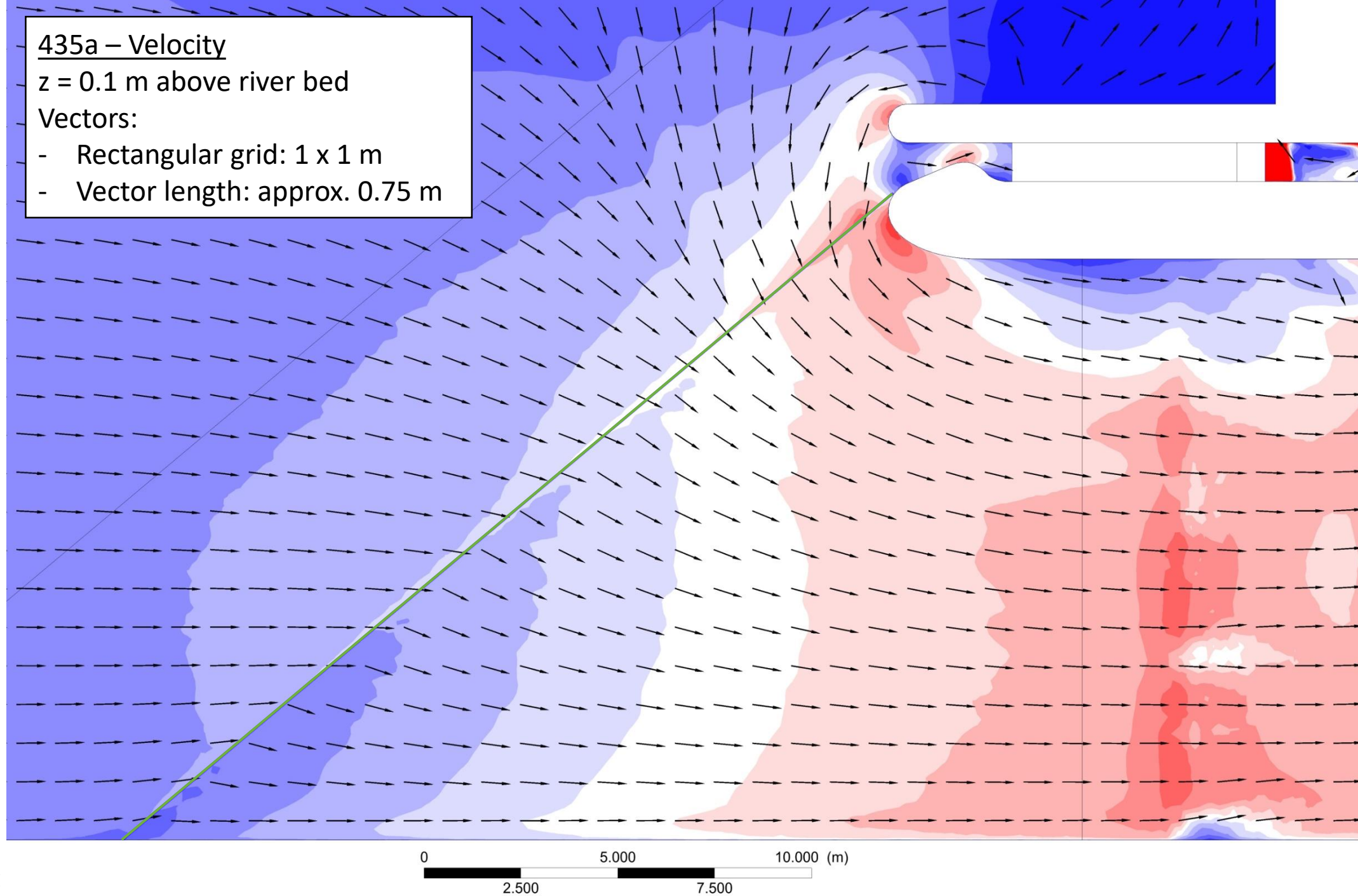
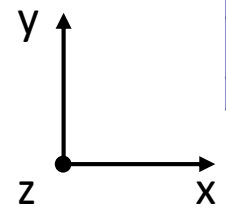


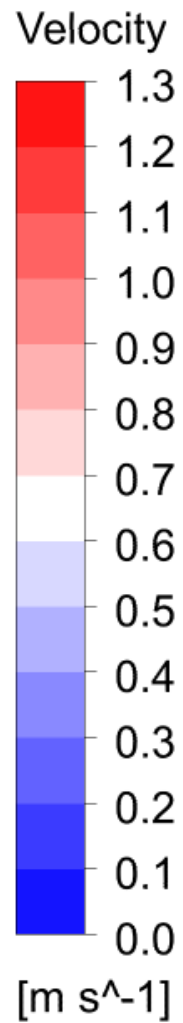
435a – Velocity

z = 0.1 m above river bed

Vectors:

- Rectangular grid: 1 x 1 m
- Vector length: approx. 0.75 m



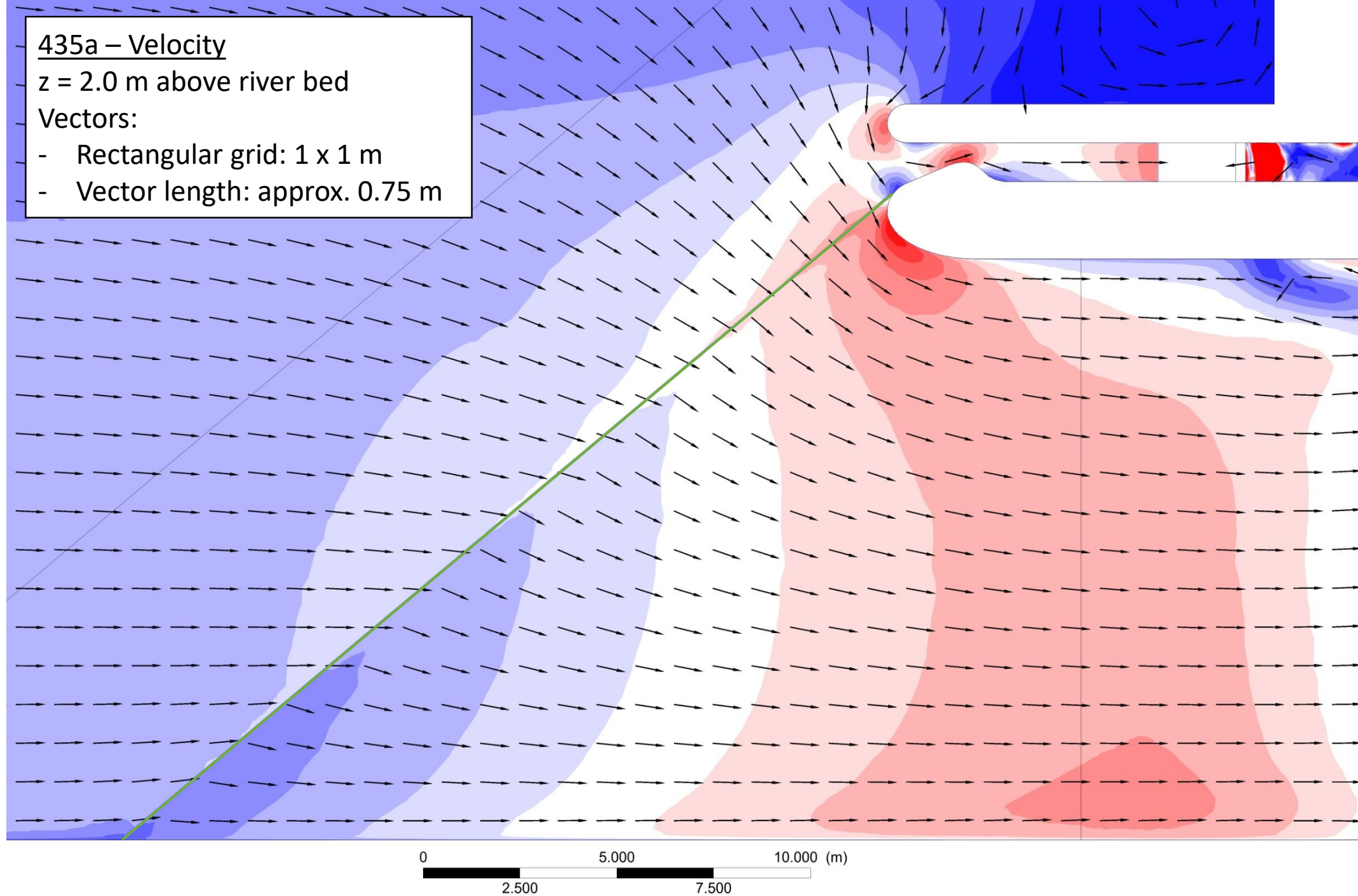
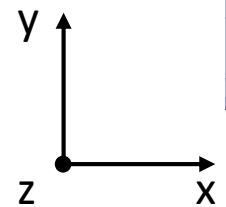


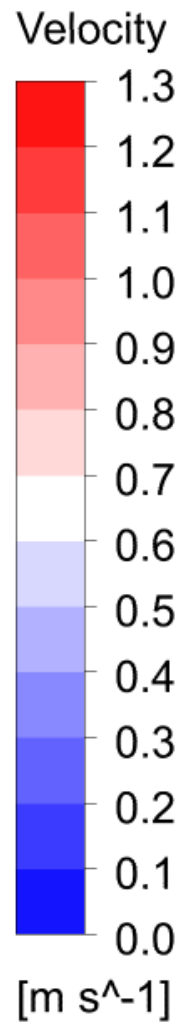
435a – Velocity

z = 2.0 m above river bed

Vectors:

- Rectangular grid: 1 x 1 m
- Vector length: approx. 0.75 m



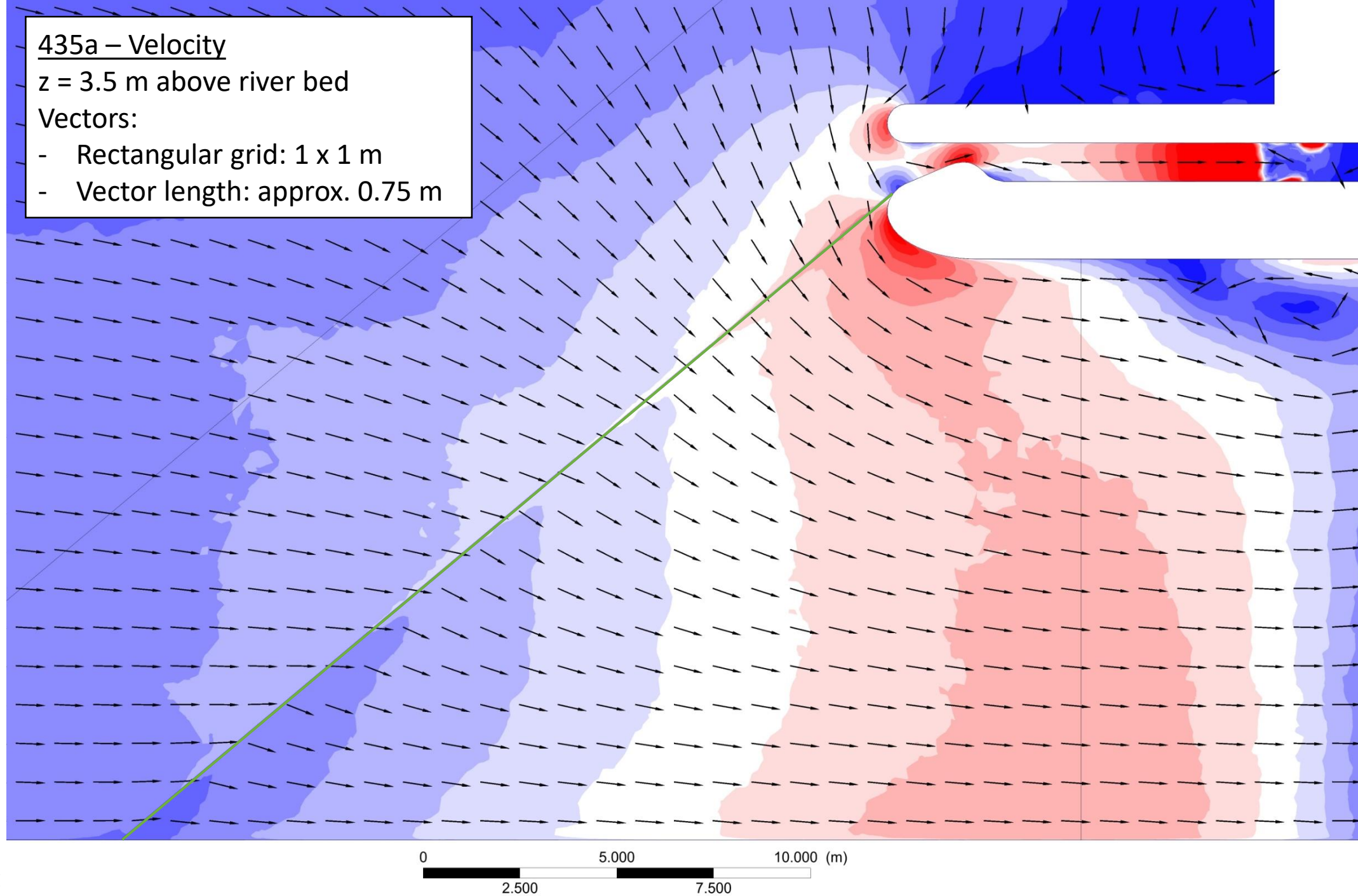
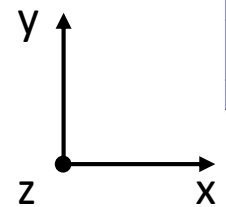


435a – Velocity

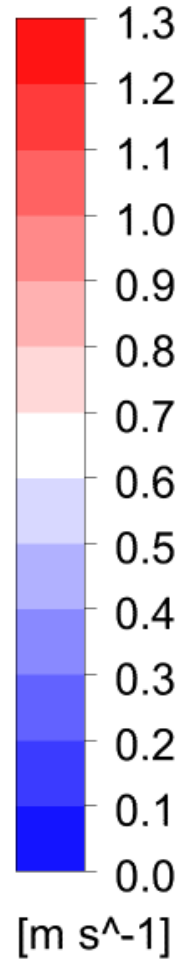
z = 3.5 m above river bed

Vectors:

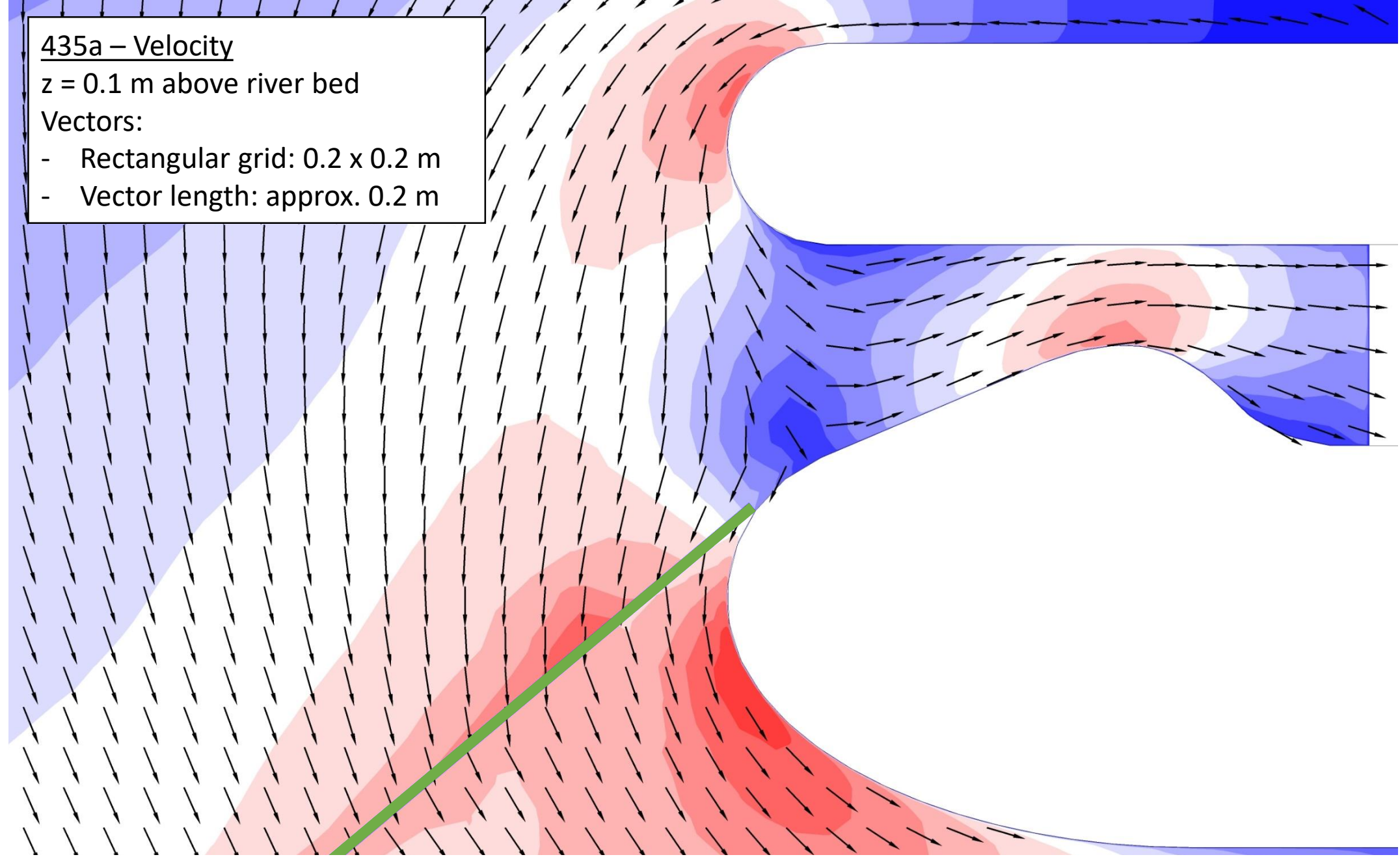
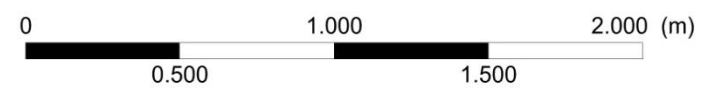
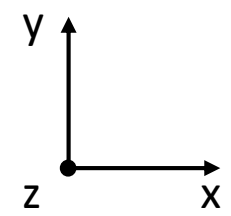
- Rectangular grid: 1 x 1 m
- Vector length: approx. 0.75 m

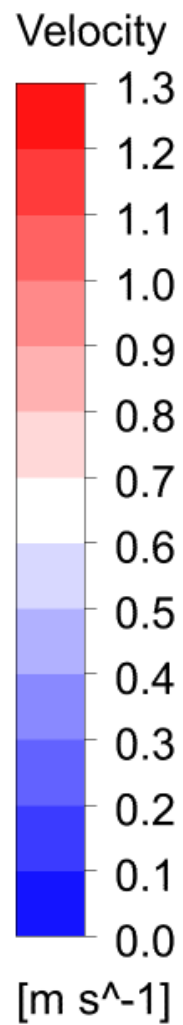


Velocity



435a – Velocity
z = 0.1 m above river bed
Vectors:
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m



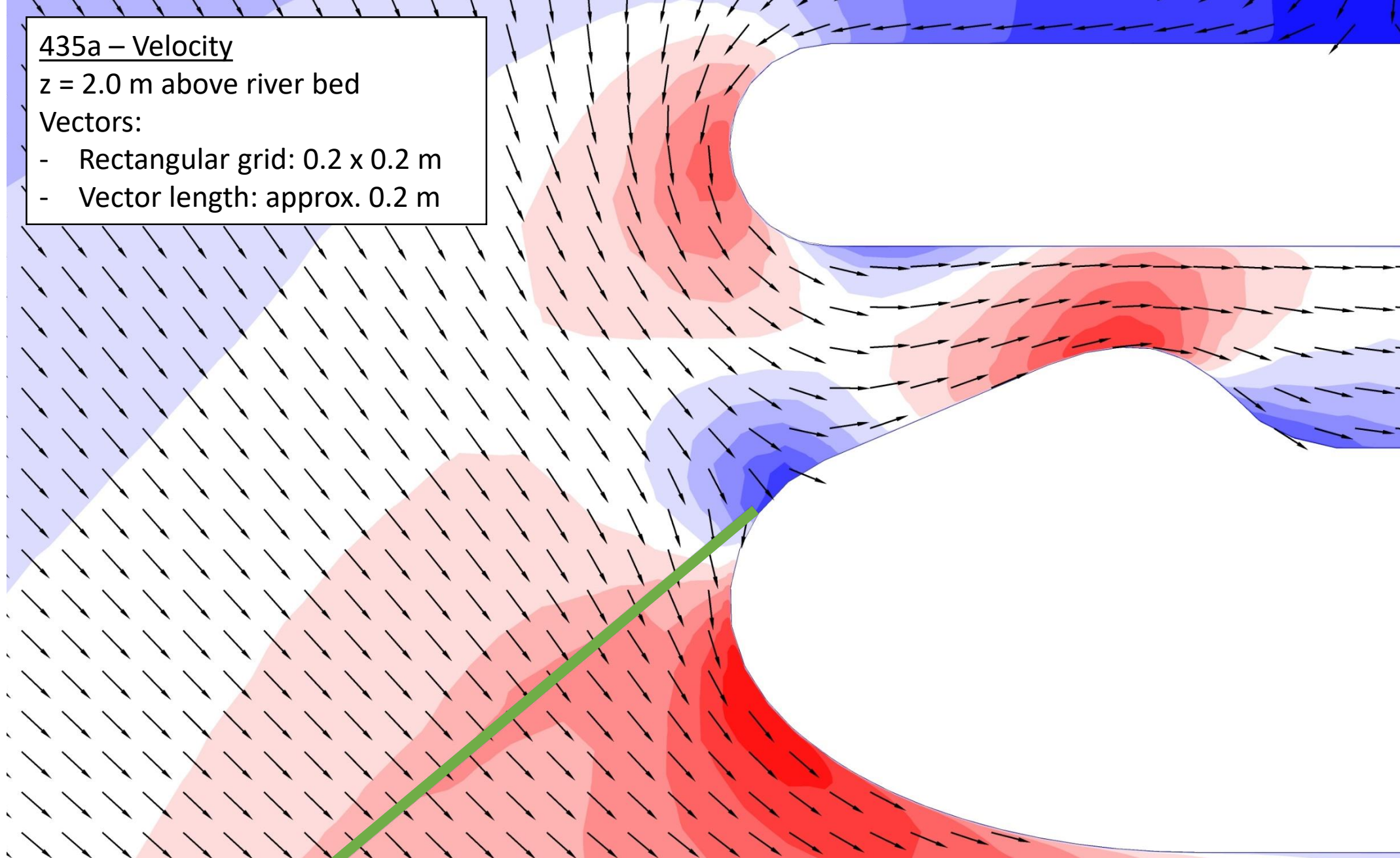
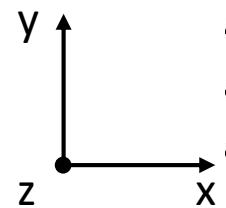


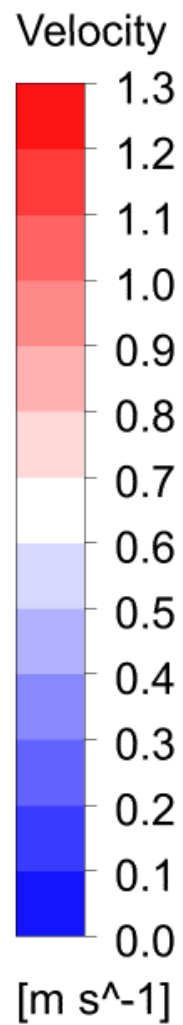
435a – Velocity

z = 2.0 m above river bed

Vectors:

- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m



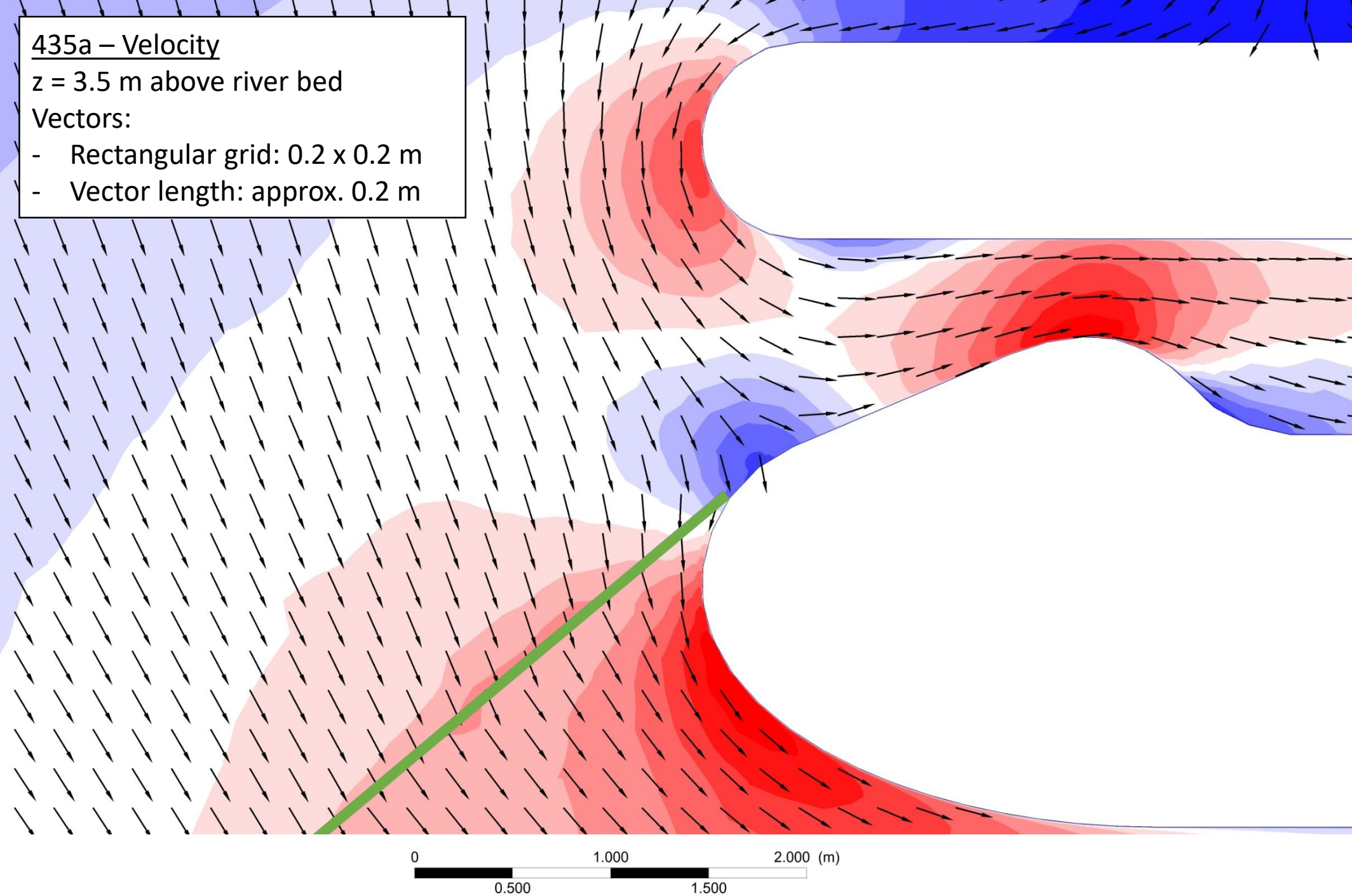
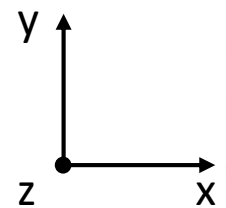


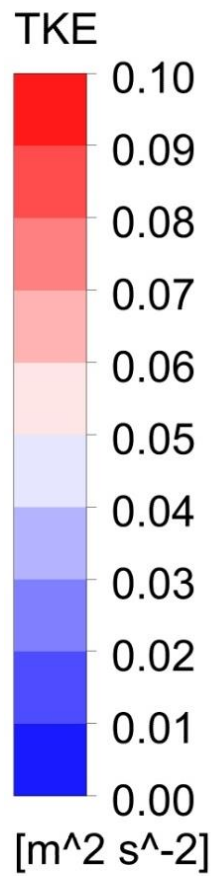
435a – Velocity

z = 3.5 m above river bed

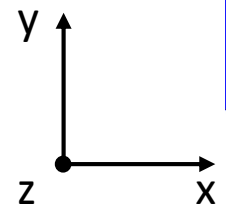
Vectors:

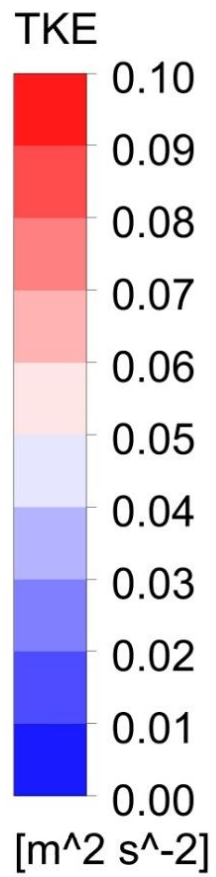
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m



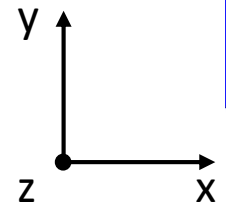


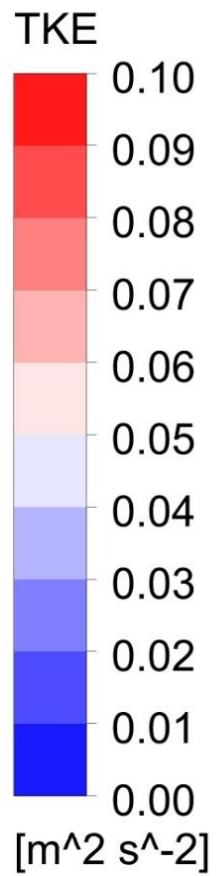
435a – Turbulence Kinetic Energy
z = 0.1 m above river bed



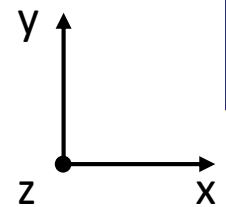


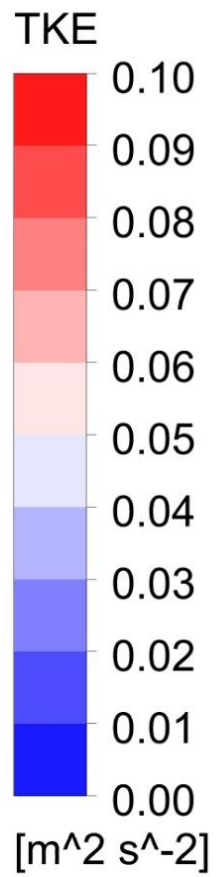
435a – Turbulence Kinetic Energy
z = 2.0 m above river bed



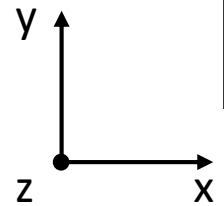


435a – Turbulence Kinetic Energy
z = 3.5 m above river bed





435a – Turbulence Kinetic Energy
z = 0.1 m above river bed

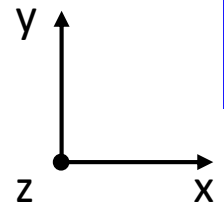


TKE

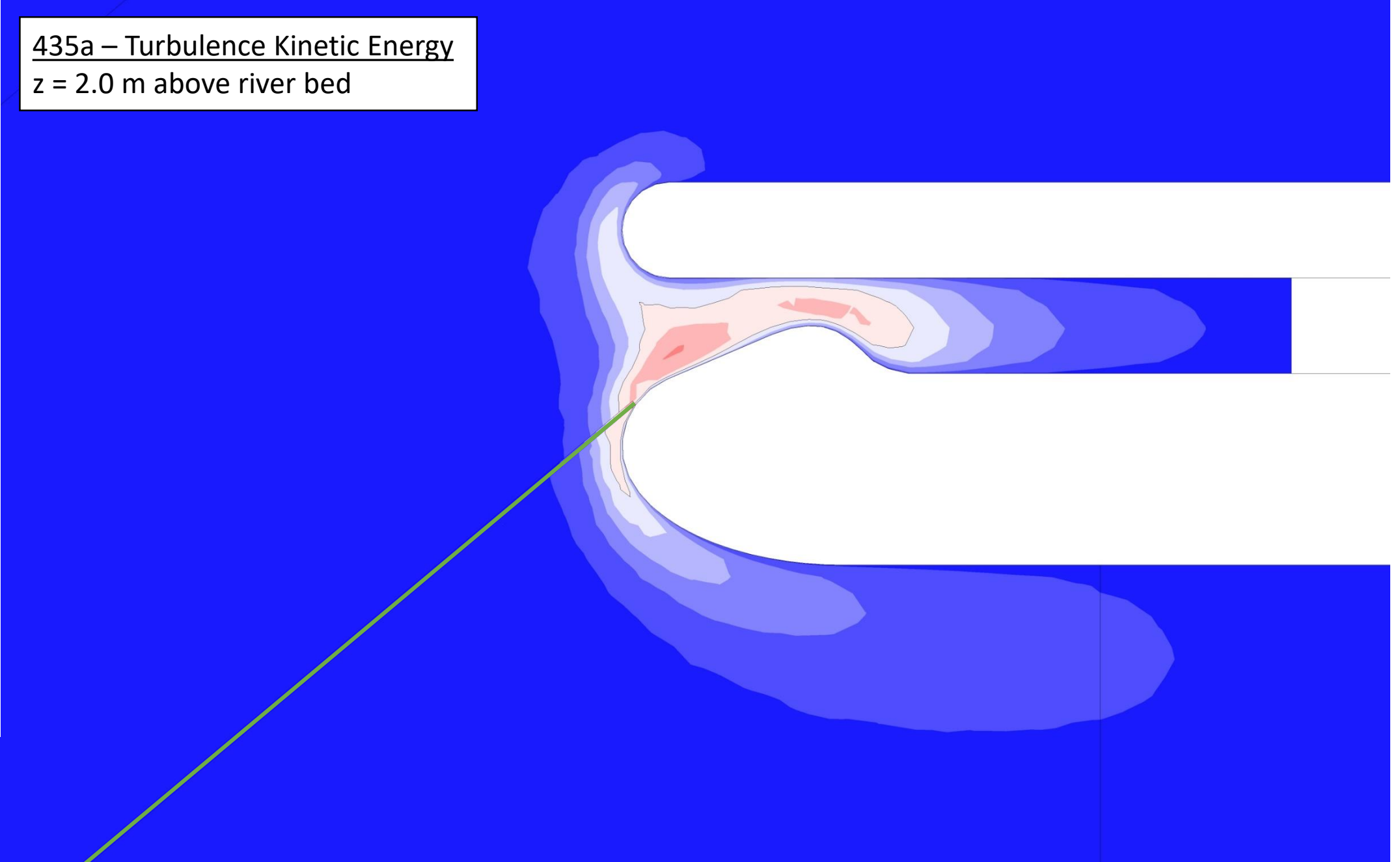
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00

[m² s⁻²]

435a – Turbulence Kinetic Energy
z = 2.0 m above river bed

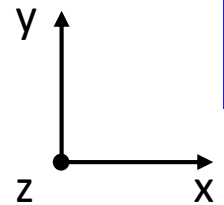


0 1.250 2.500 3.750 5.000 (m)

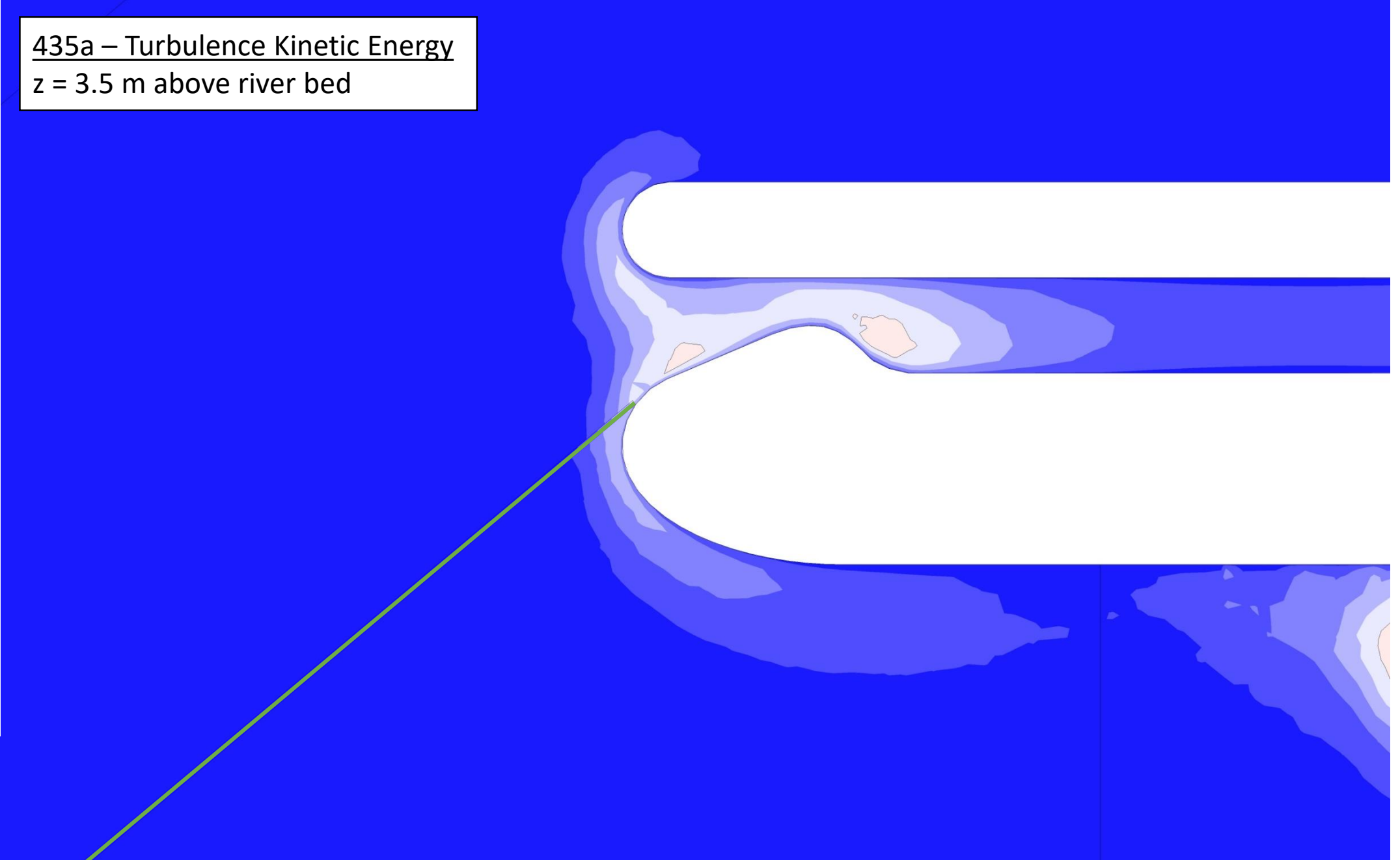


TKE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
[m² s⁻²]

435a – Turbulence Kinetic Energy
z = 3.5 m above river bed

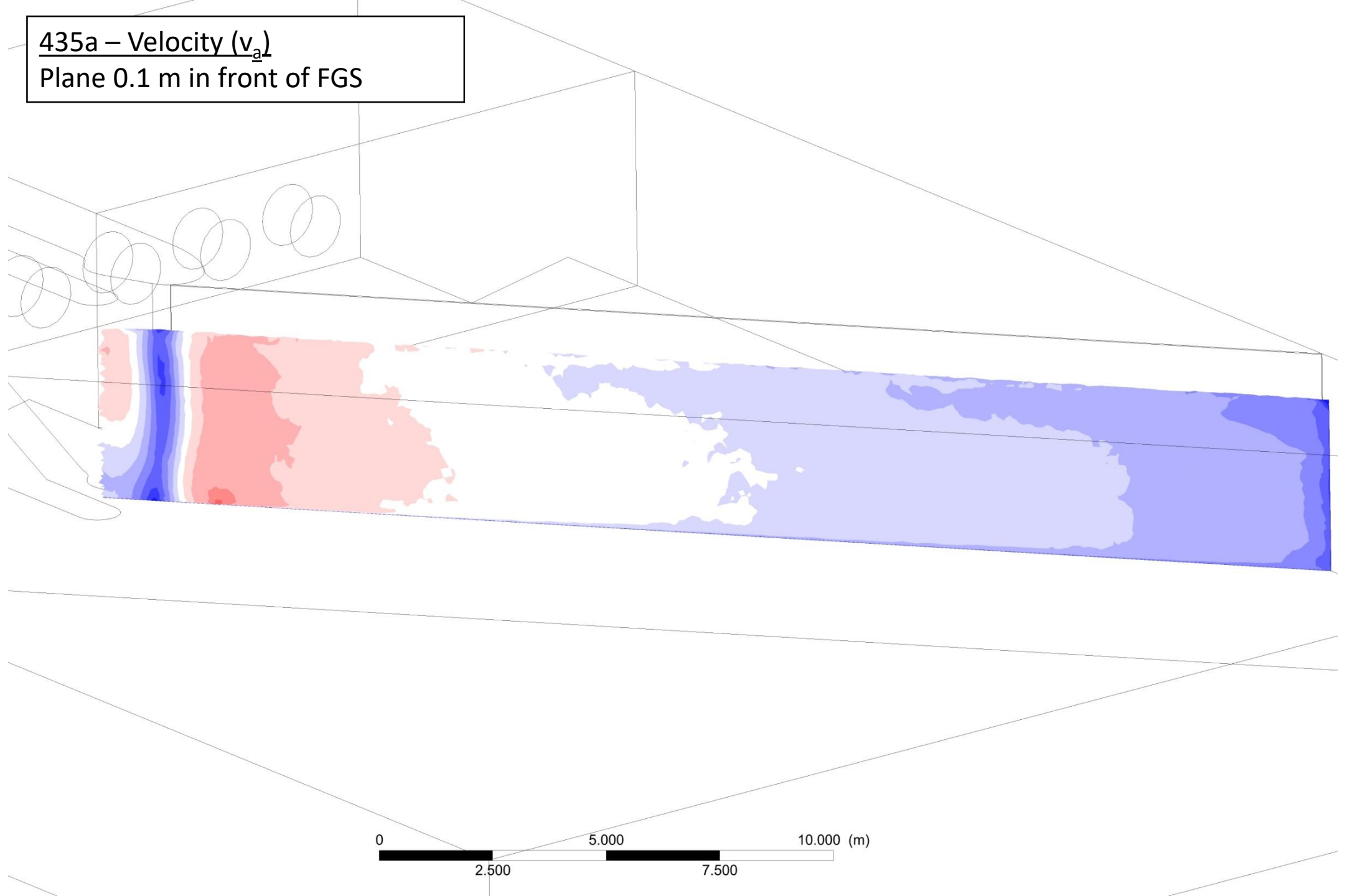


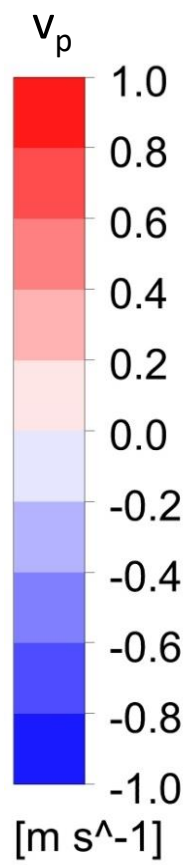
0 1.250 2.500 3.750 5.000 (m)



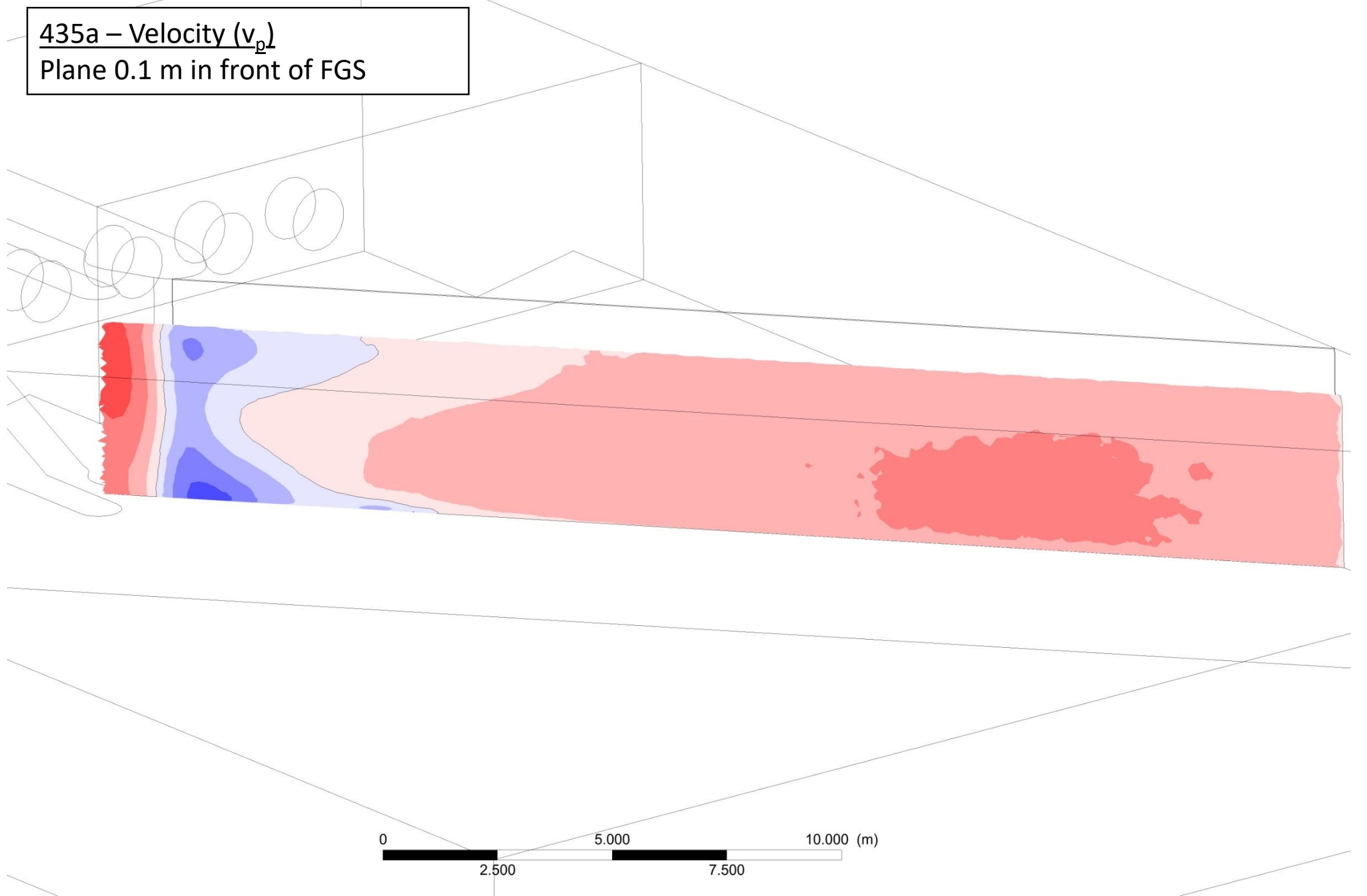
Velocity
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
[m s⁻¹]

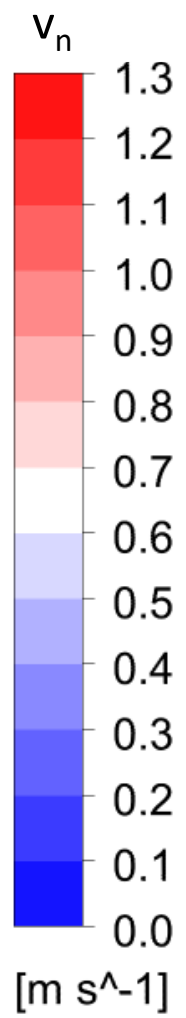
435a – Velocity (v_a)
Plane 0.1 m in front of FGS



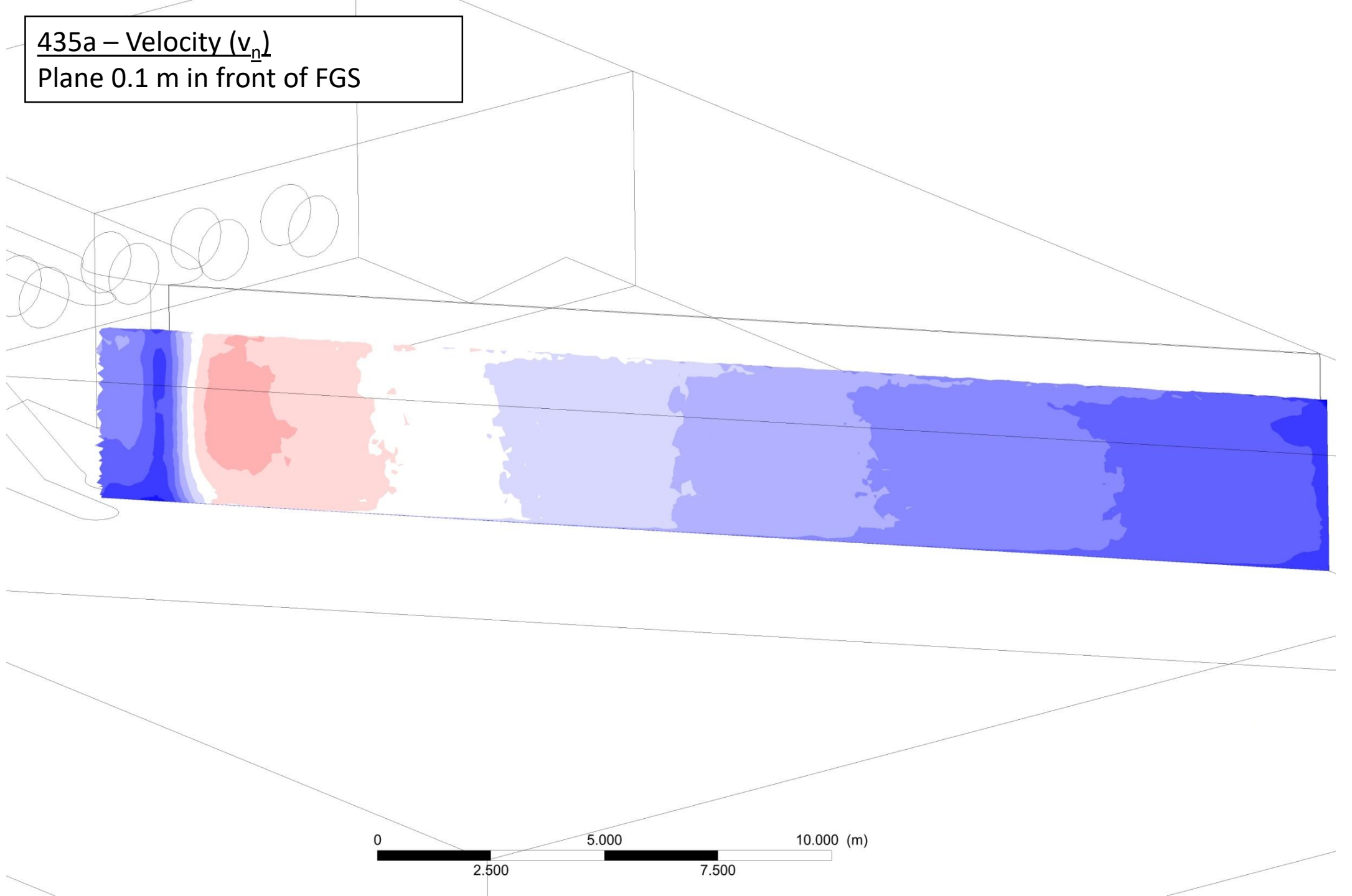


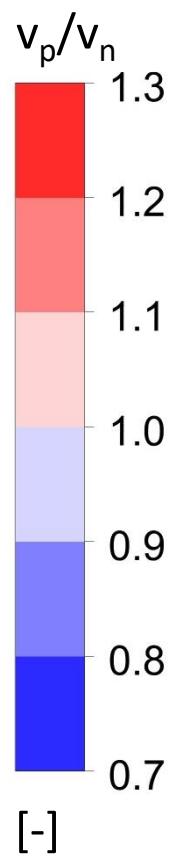
435a – Velocity (v_p)
Plane 0.1 m in front of FGS



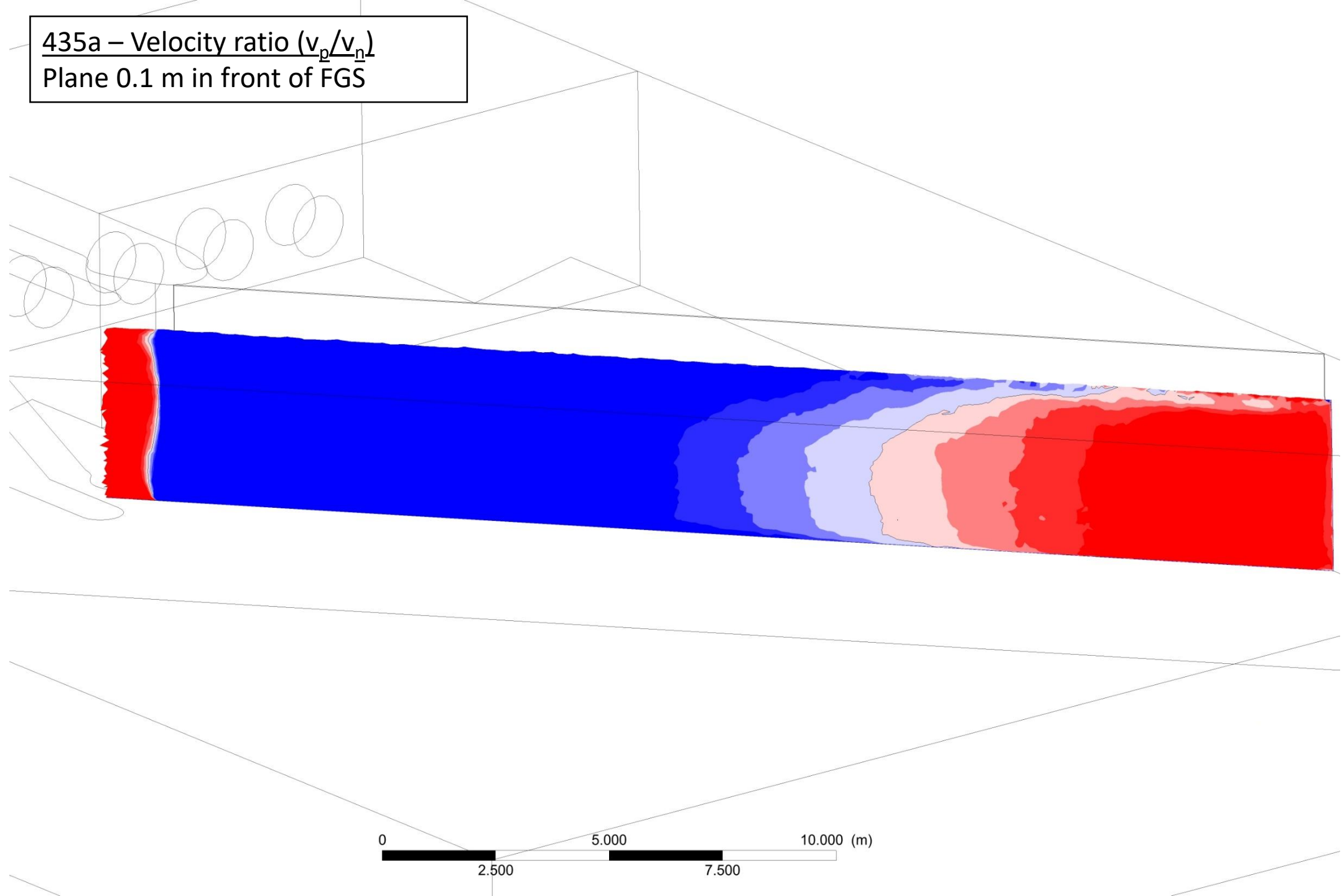


435a – Velocity (v_n)
Plane 0.1 m in front of FGS





435a – Velocity ratio (v_p/v_n)
Plane 0.1 m in front of FGS

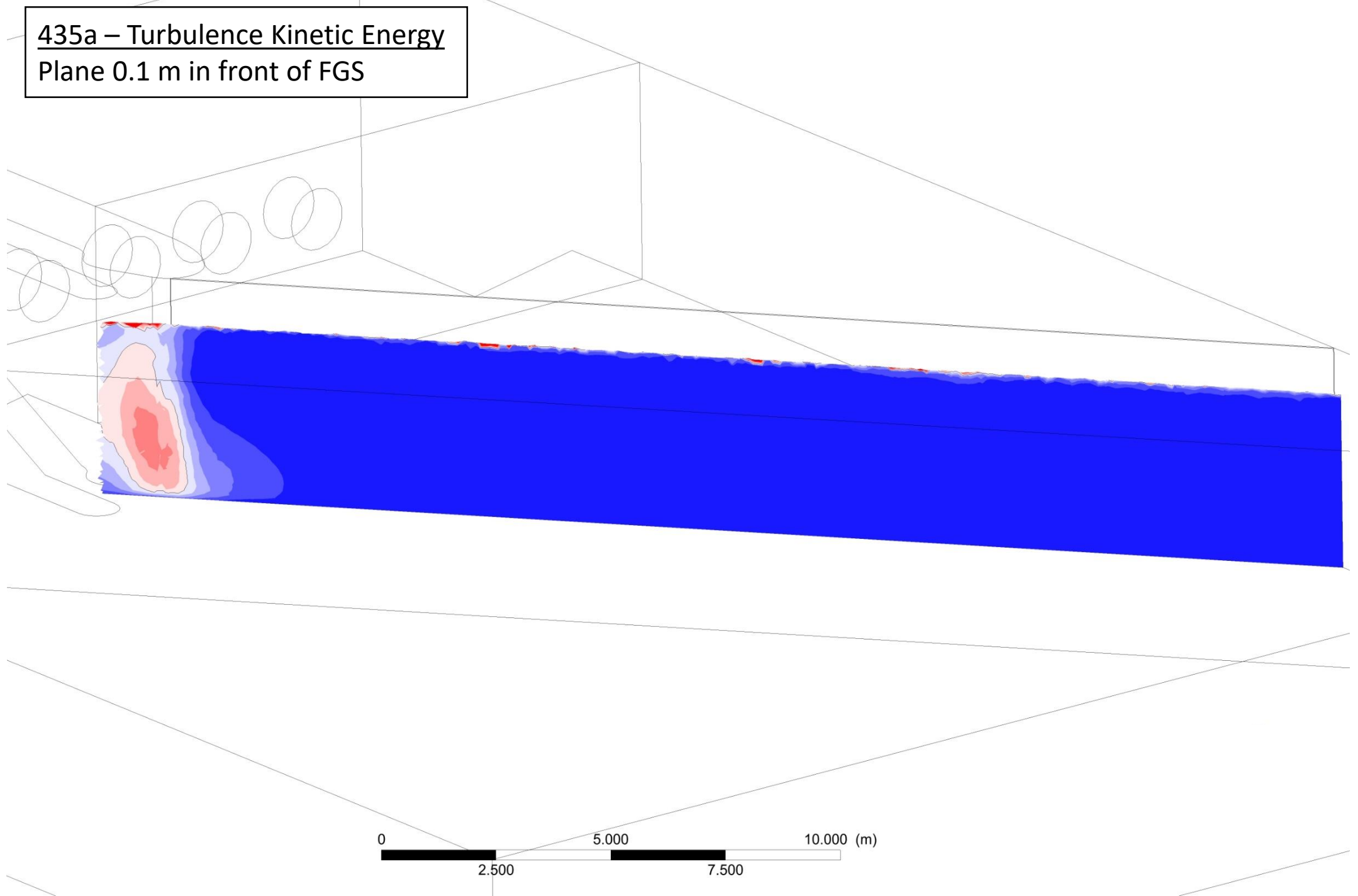


TKE

0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00

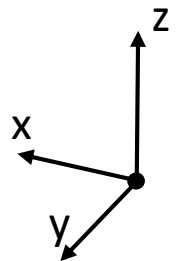
[m² s⁻²]

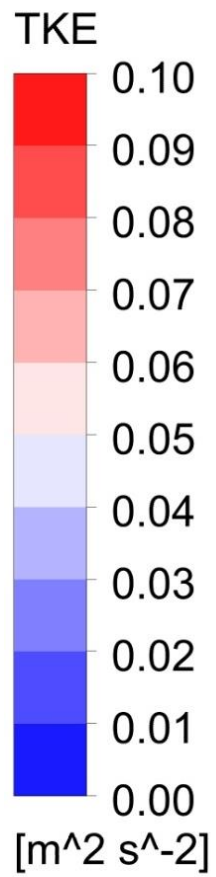
435a – Turbulence Kinetic Energy
Plane 0.1 m in front of FGS



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]

435a – Velocity
0, 1 and 2 m in the bypass entrance





435a – Turbulence Kinetic Energy
0, 1 and 2 m in the bypass entrance

