

# Alpine river – 501a

Initial design

28.11.2022

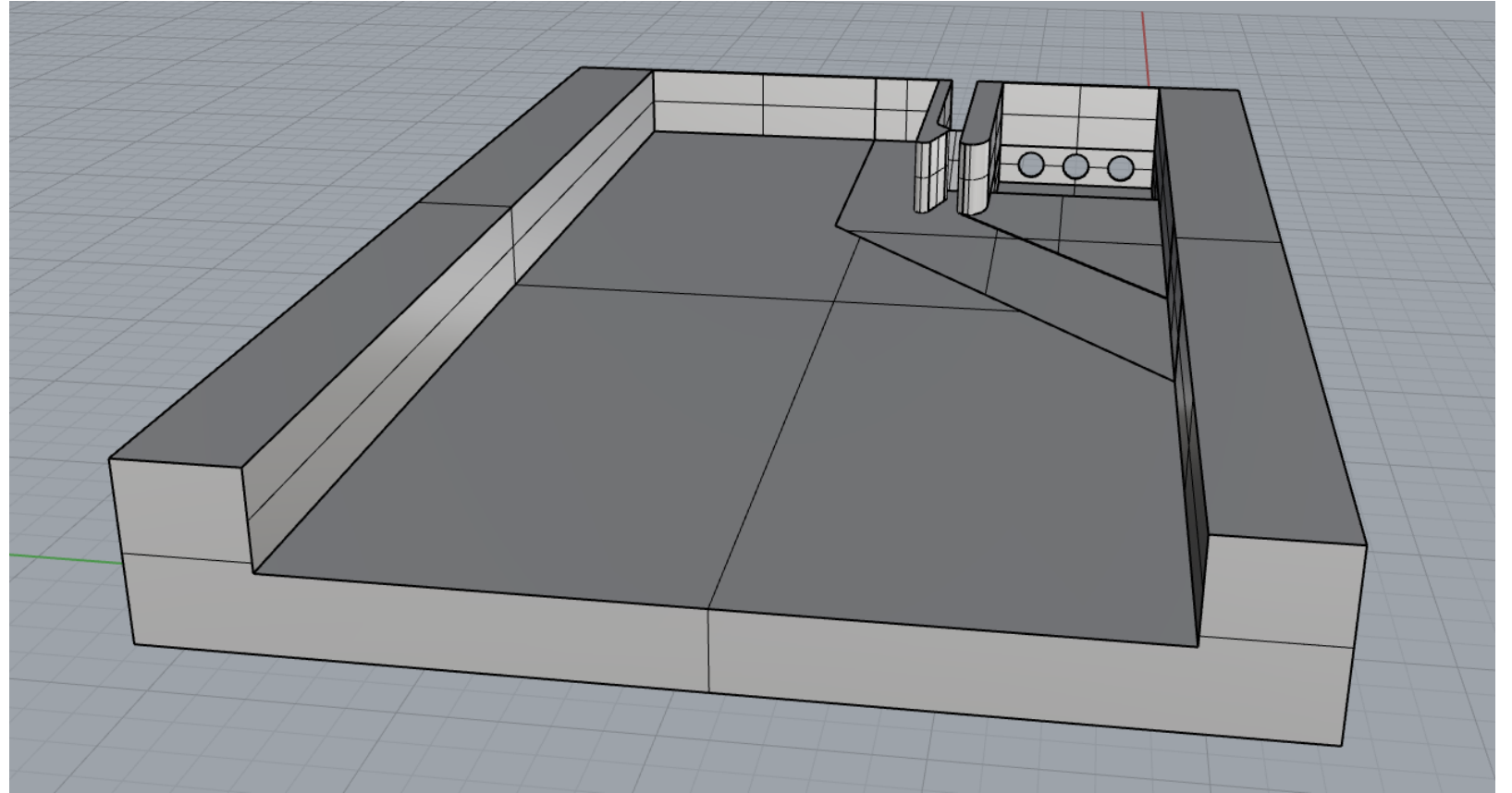
## 501a - General

### River:

- Alpine river
- Discharge:  $10 \text{ m}^3/\text{s}$
- Mean flow velocity:  $0.25 \text{ m/s}$
- 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:  $9.5 \text{ m}^3/\text{s}$
- Head: 2 m
- Headrace channel width: 6 m



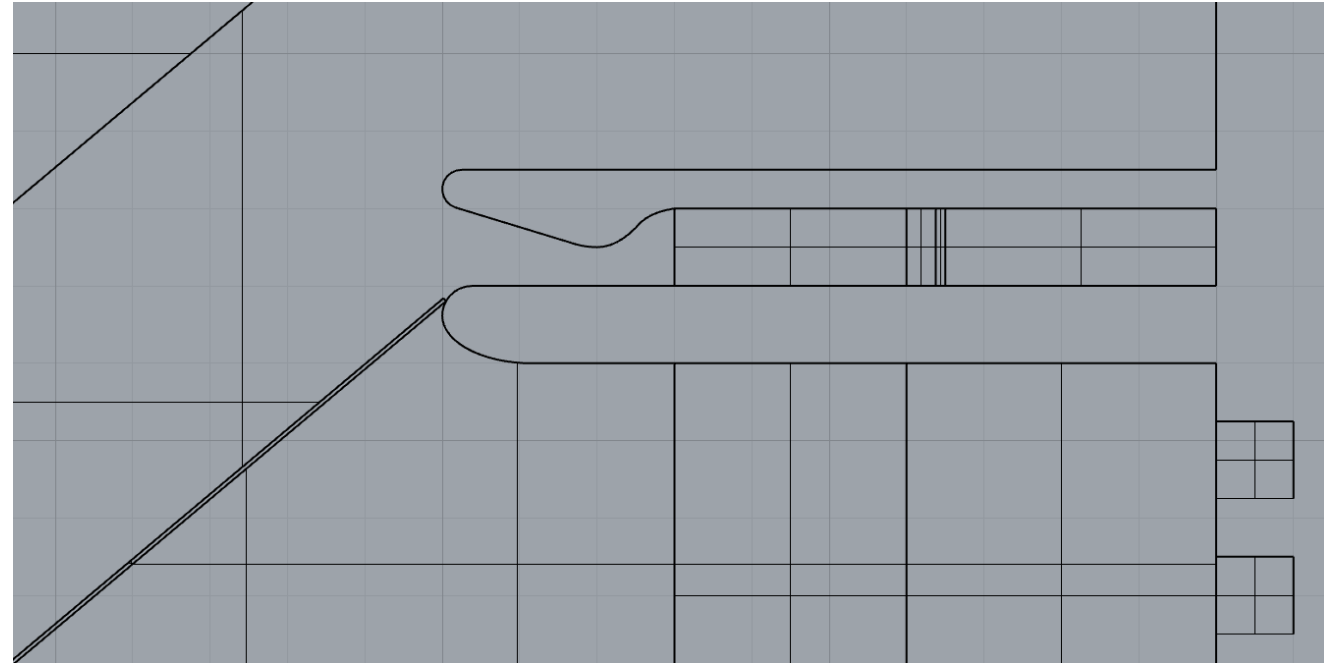
# 501a - General

## Bypass:

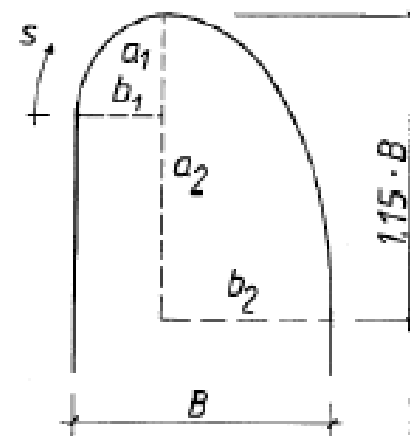
- Based on the angled bar rack bypass system by Ebel, Gluch & Kehl
- Bypass width: 1 m
- Ramp inclination:  $26.6^\circ$
- $Q$  (Bypass):  $0.5 \text{ m}^3/\text{s}$  (5.0% of  $Q_{\text{River}}$ )

## Dividing pier – turbine-side part:

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



Layout of the bypass and dividing pier



$$\begin{aligned} b_1 &= 1/3 \cdot B \\ a_1 &= 1.15 \cdot b_1 \\ b_2 &= 2/3 \cdot B \\ a_2 &= 3 \cdot a_1 \end{aligned}$$

Trennpfeilerkopfgestaltung nach Häusler

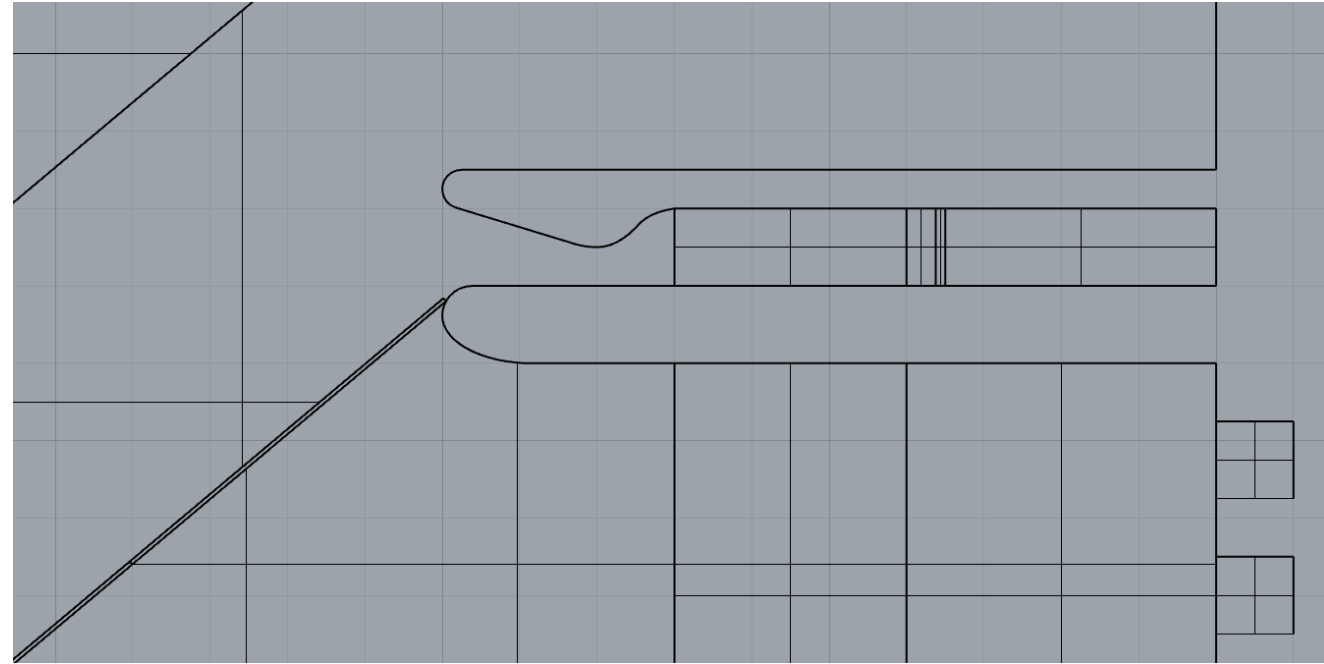
## 501a - General

### 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:  
 $v = Q/A = 0.45 \text{ m/s}$
- Circular bar trash rack with  $40^\circ$  angle to the unaffected flow direction
- Head loss values depending on the horizontal inflow angle and the rack configuration

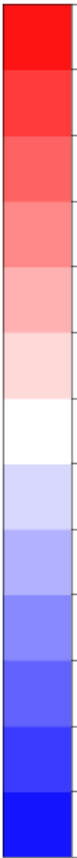


Layout of the bypass and dividing pier

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



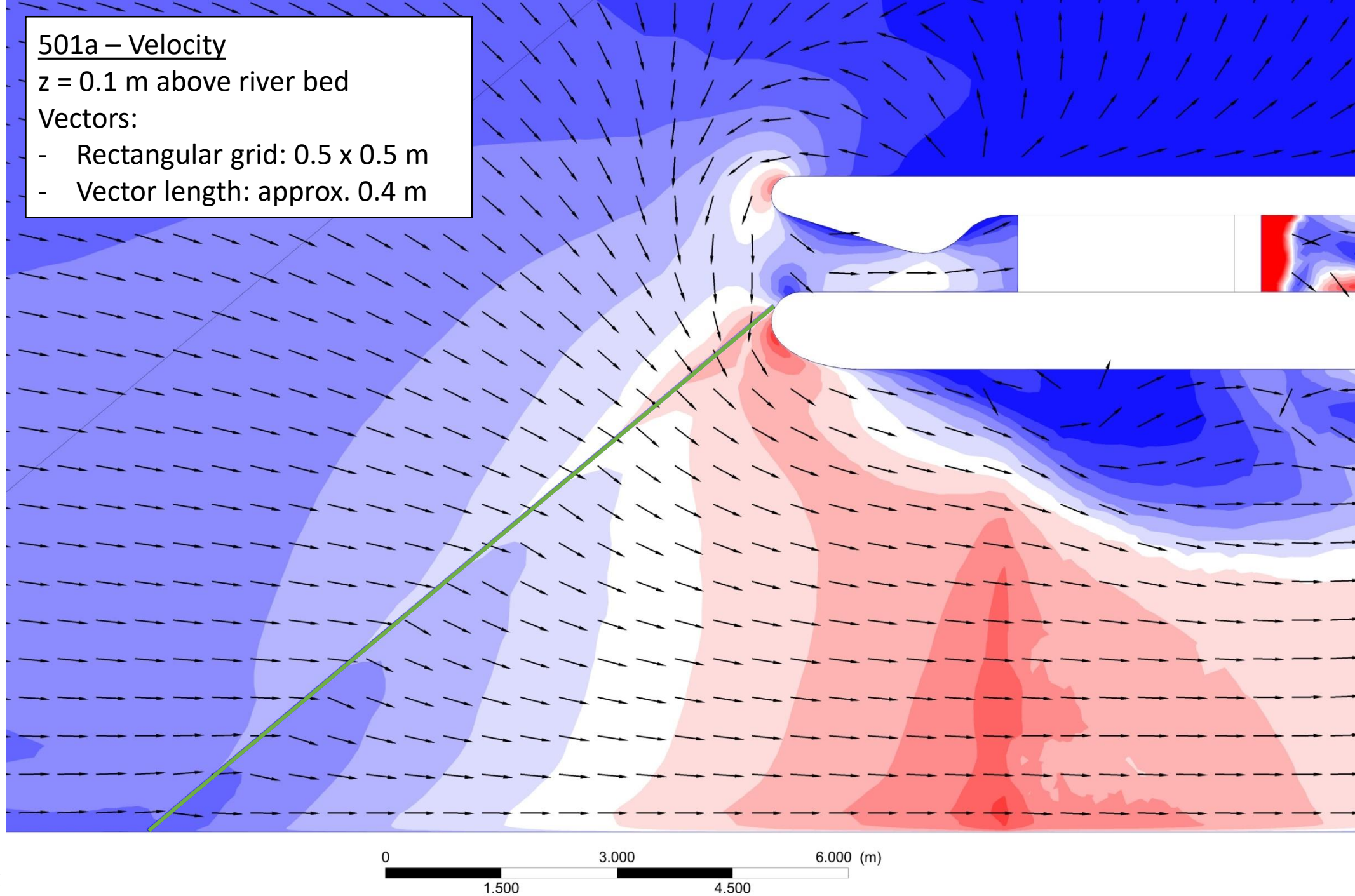
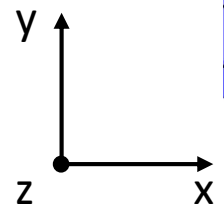
[m s<sup>-1</sup>]

501a – Velocity

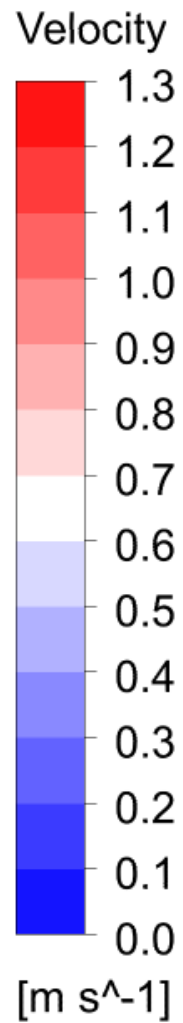
z = 0.1 m above river bed

Vectors:

- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m





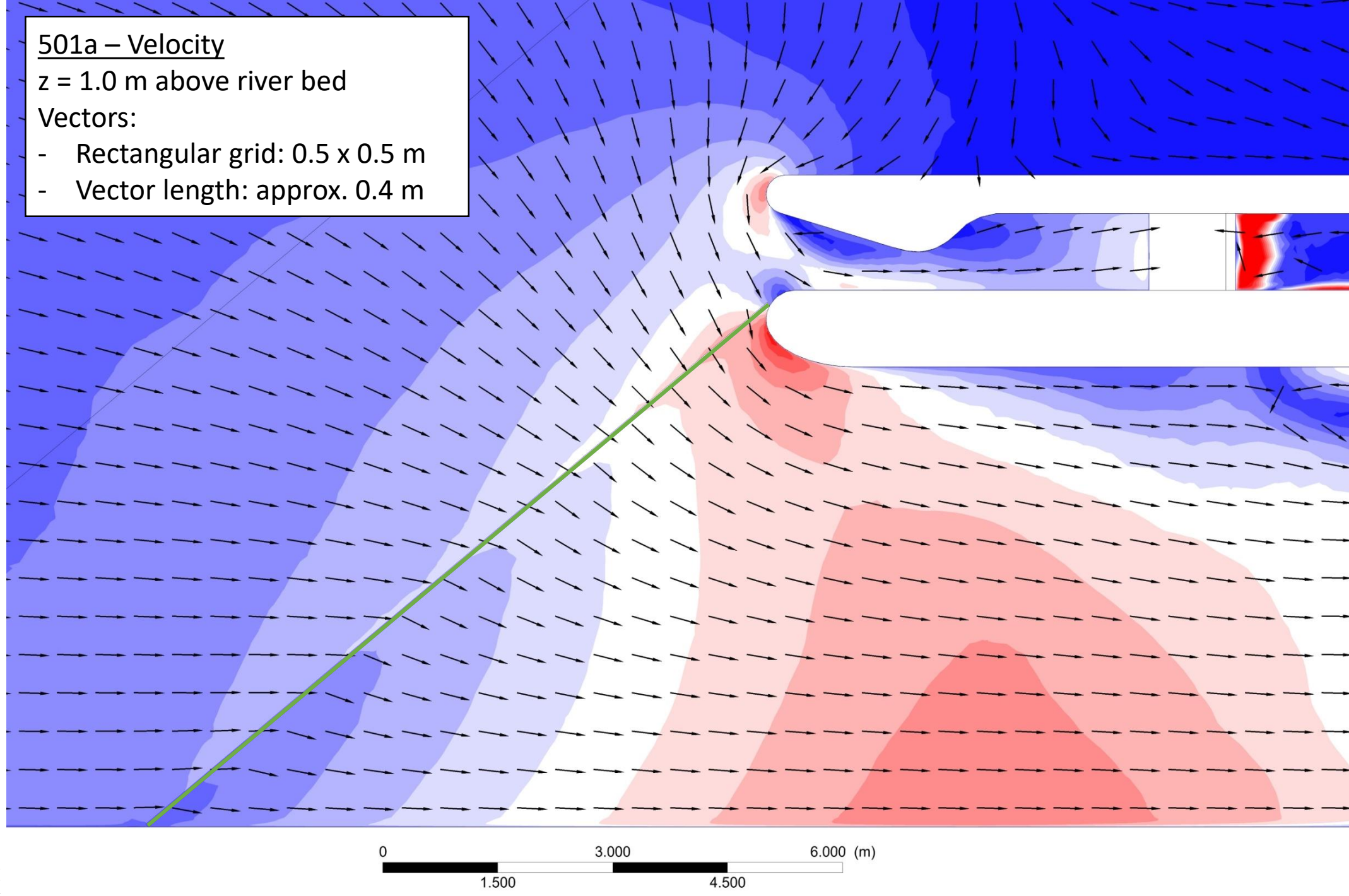
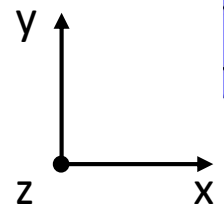


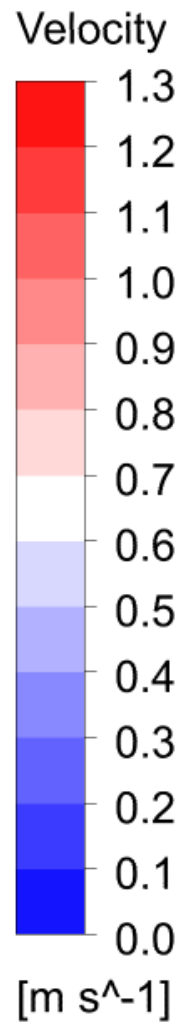
501a – Velocity

z = 1.0 m above river bed

Vectors:

- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m



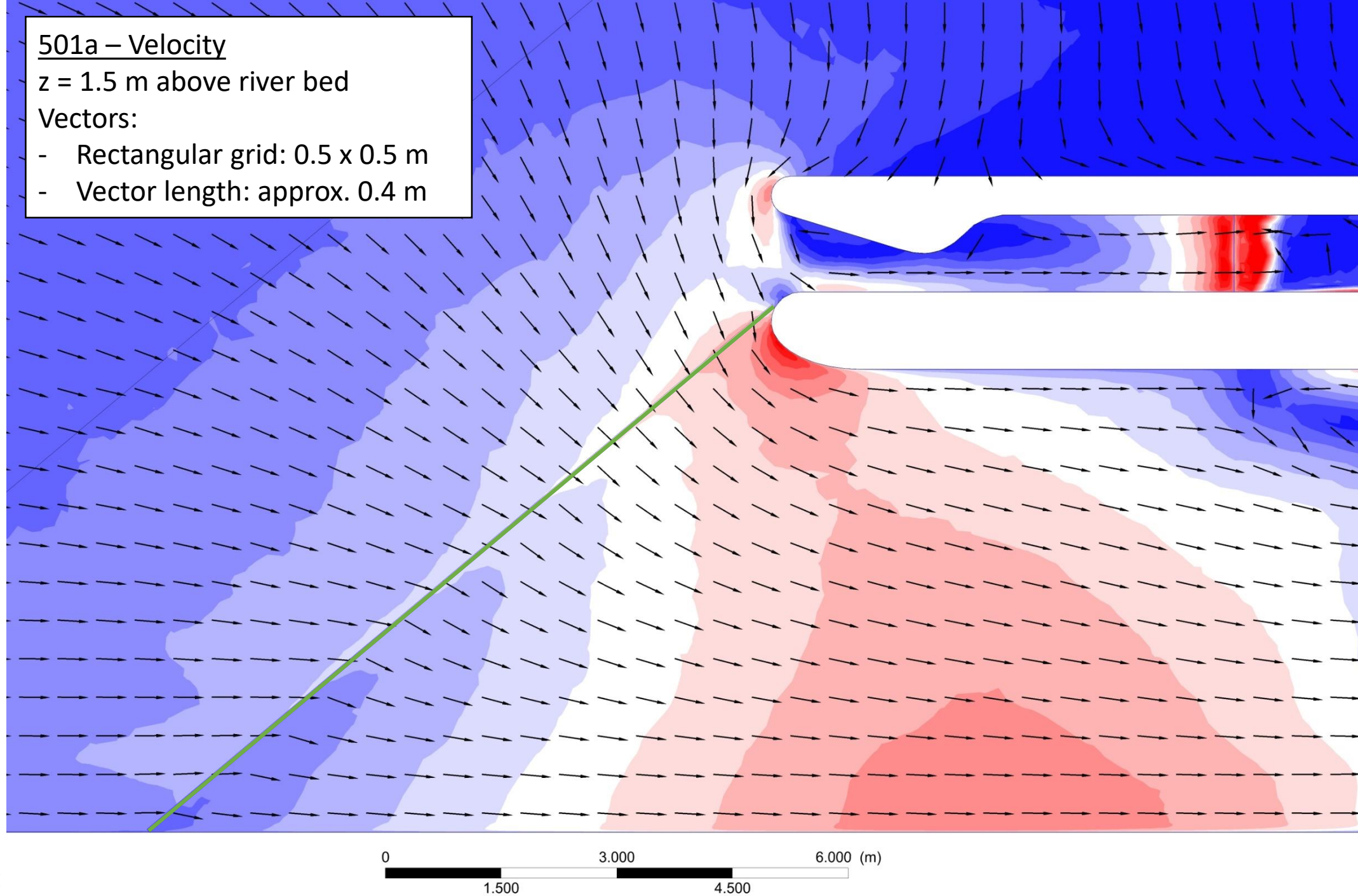
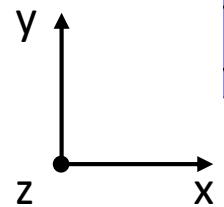


501a – Velocity

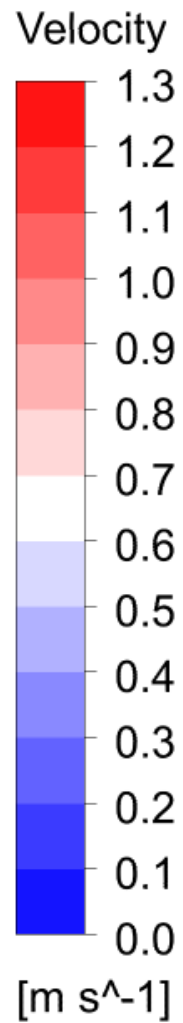
z = 1.5 m above river bed

Vectors:

- Rectangular grid: 0.5 x 0.5 m
- Vector length: approx. 0.4 m





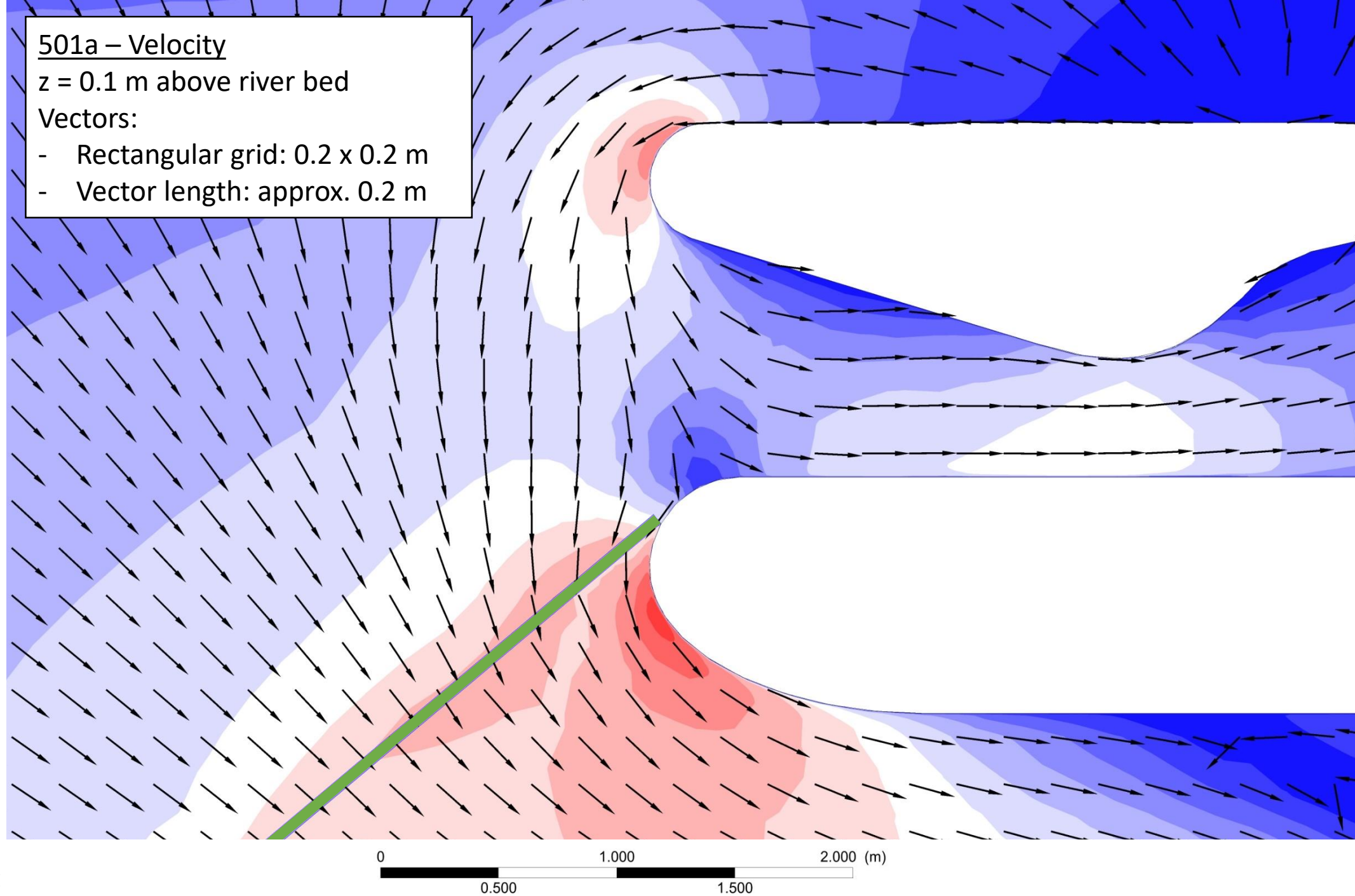
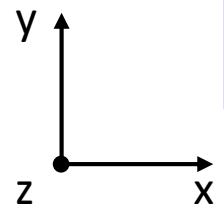


501a – Velocity

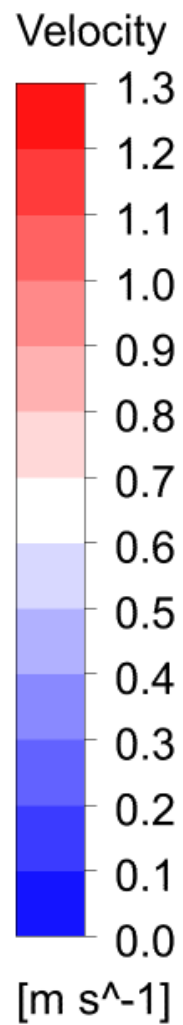
z = 0.1 m above river bed

Vectors:

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





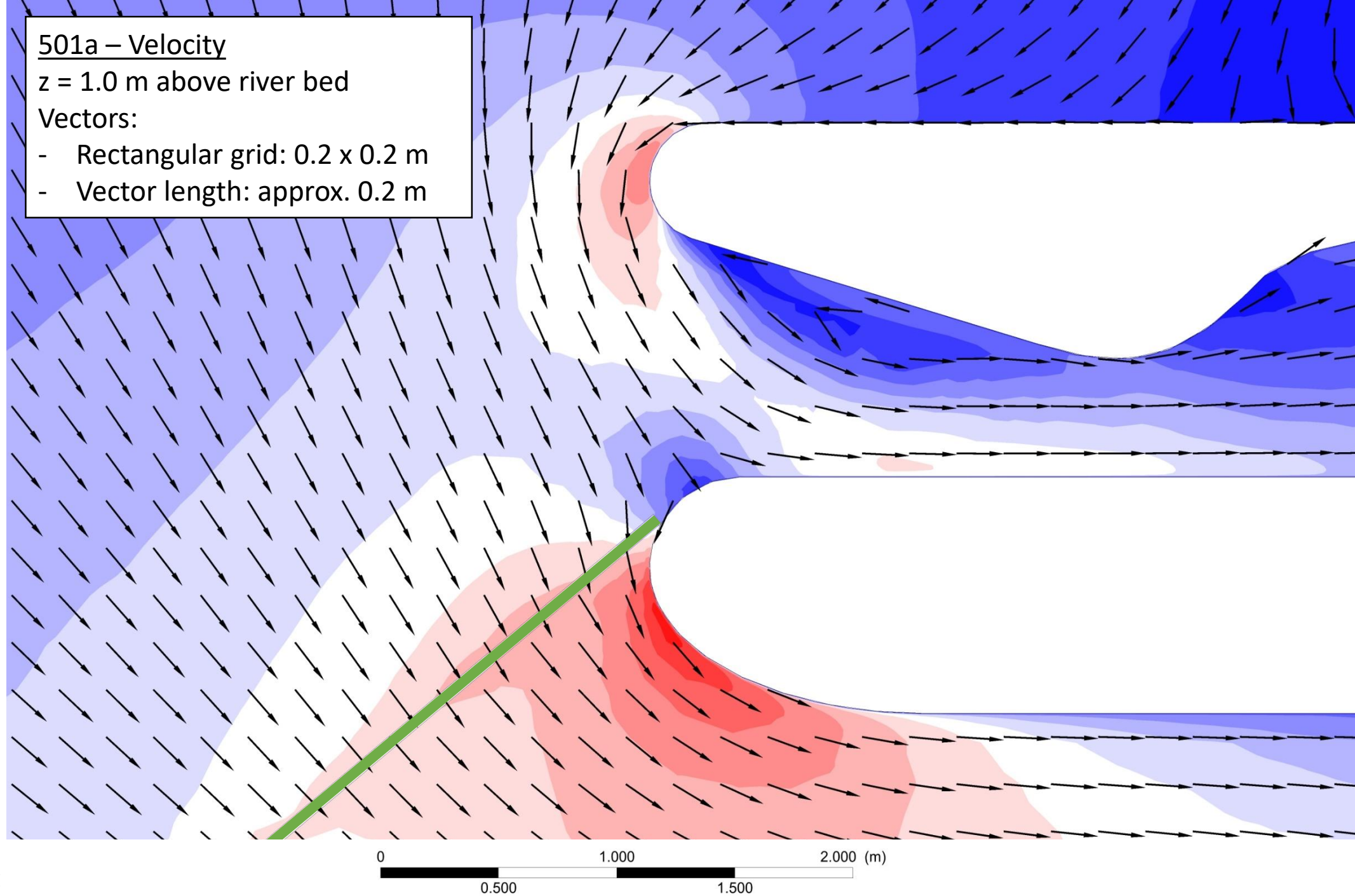
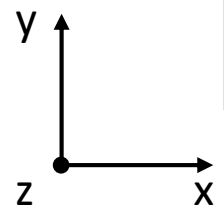


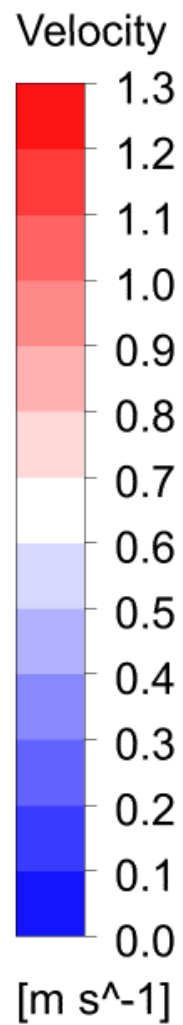
501a – Velocity

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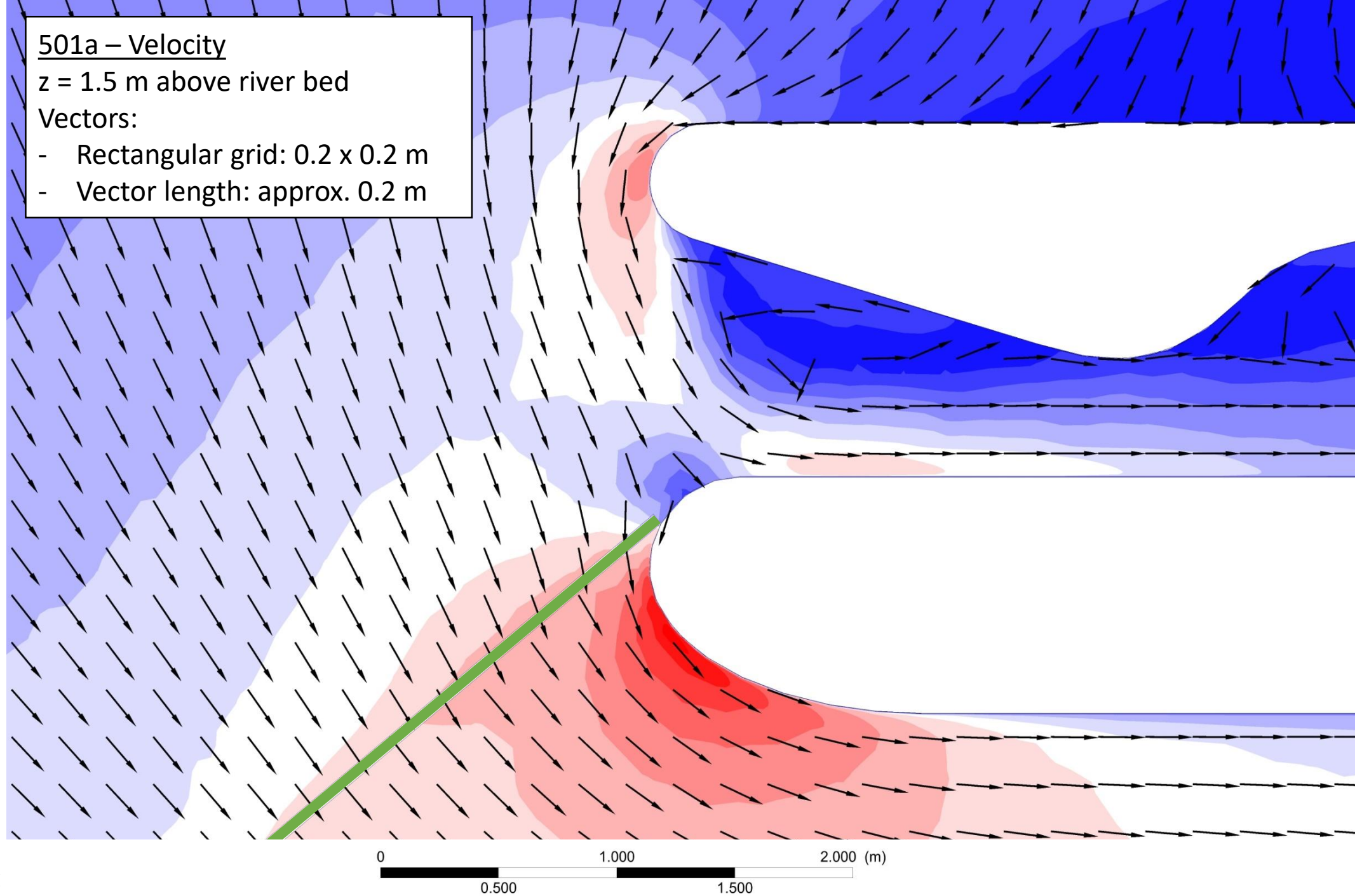
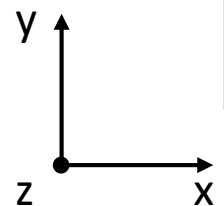


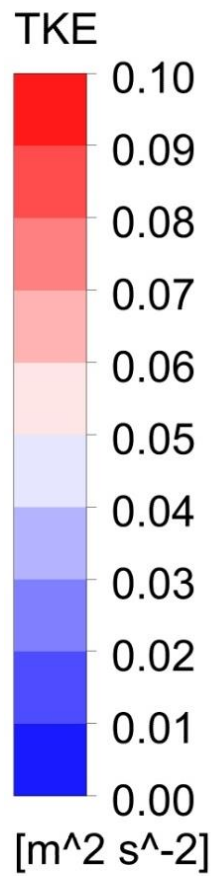
501a – Velocity

z = 1.5 m above river bed

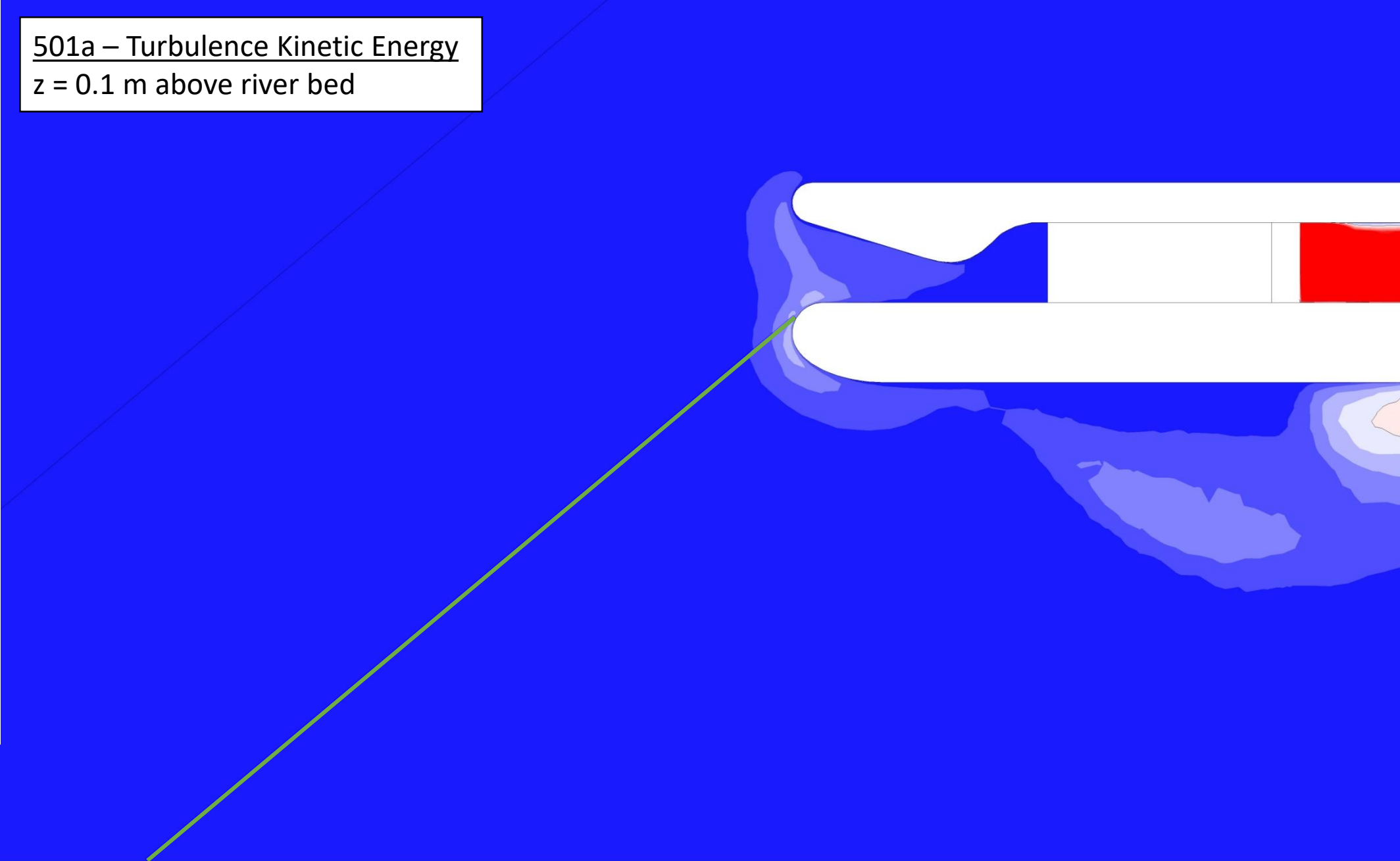
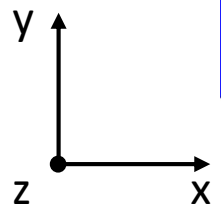
Vectors:

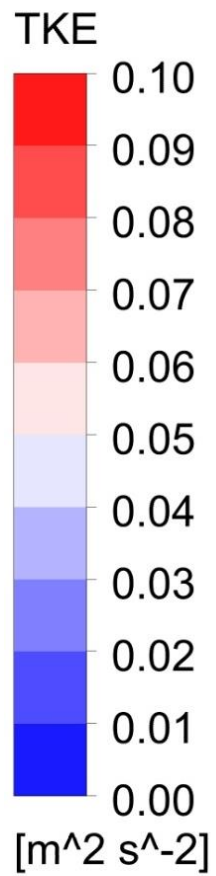
- Rectangular grid: 0.2 x 0.2 m
- Vector length: approx. 0.2 m



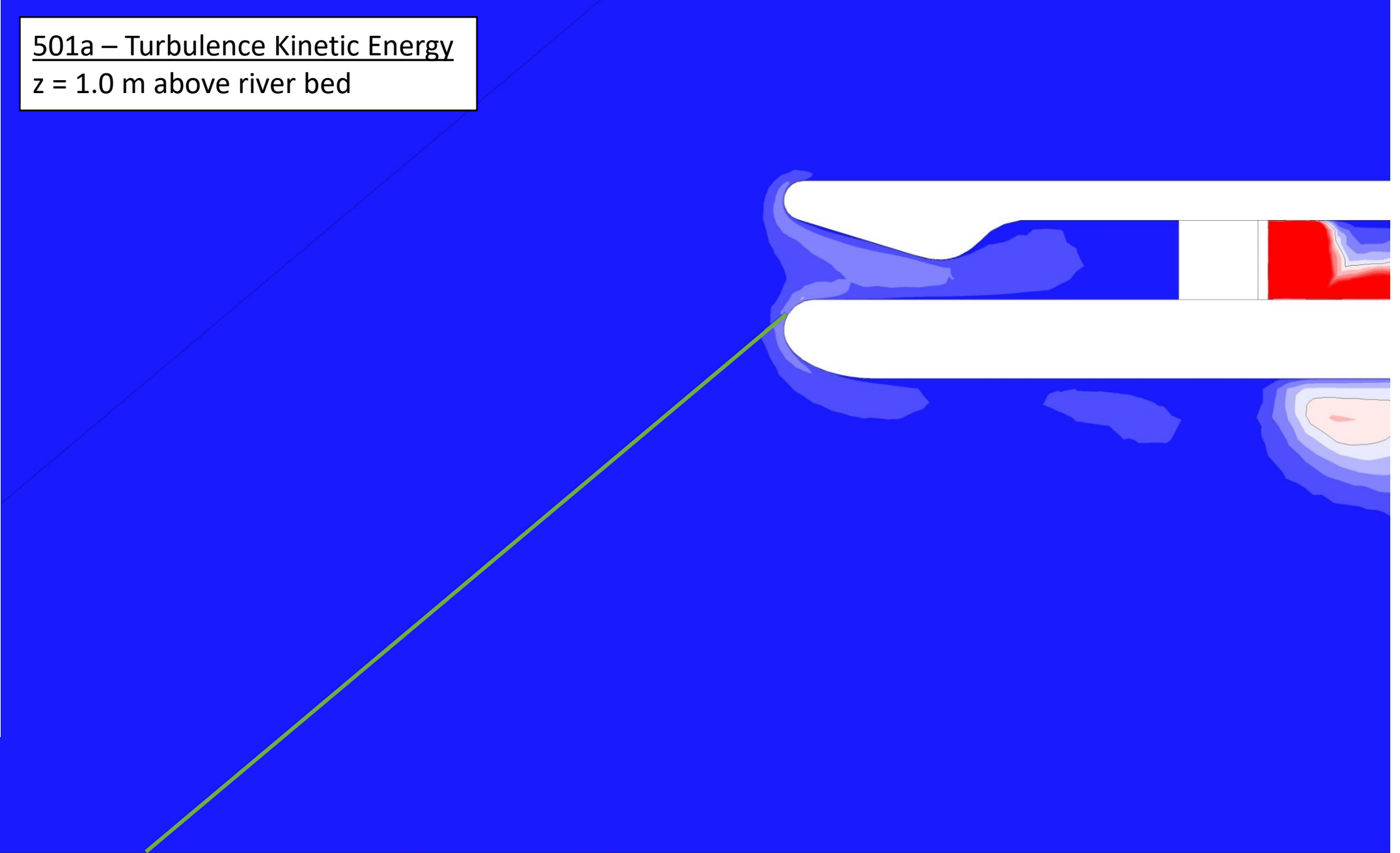
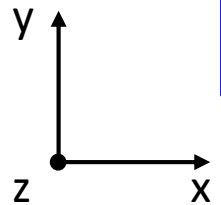


501a – Turbulence Kinetic Energy  
z = 0.1 m above river bed

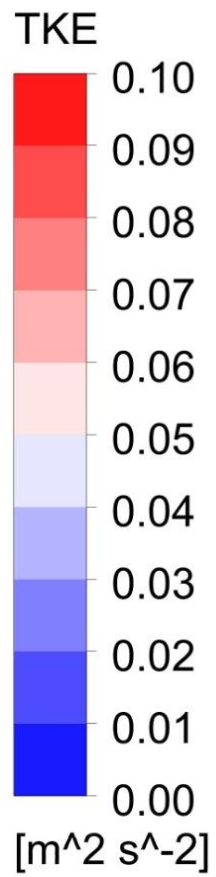




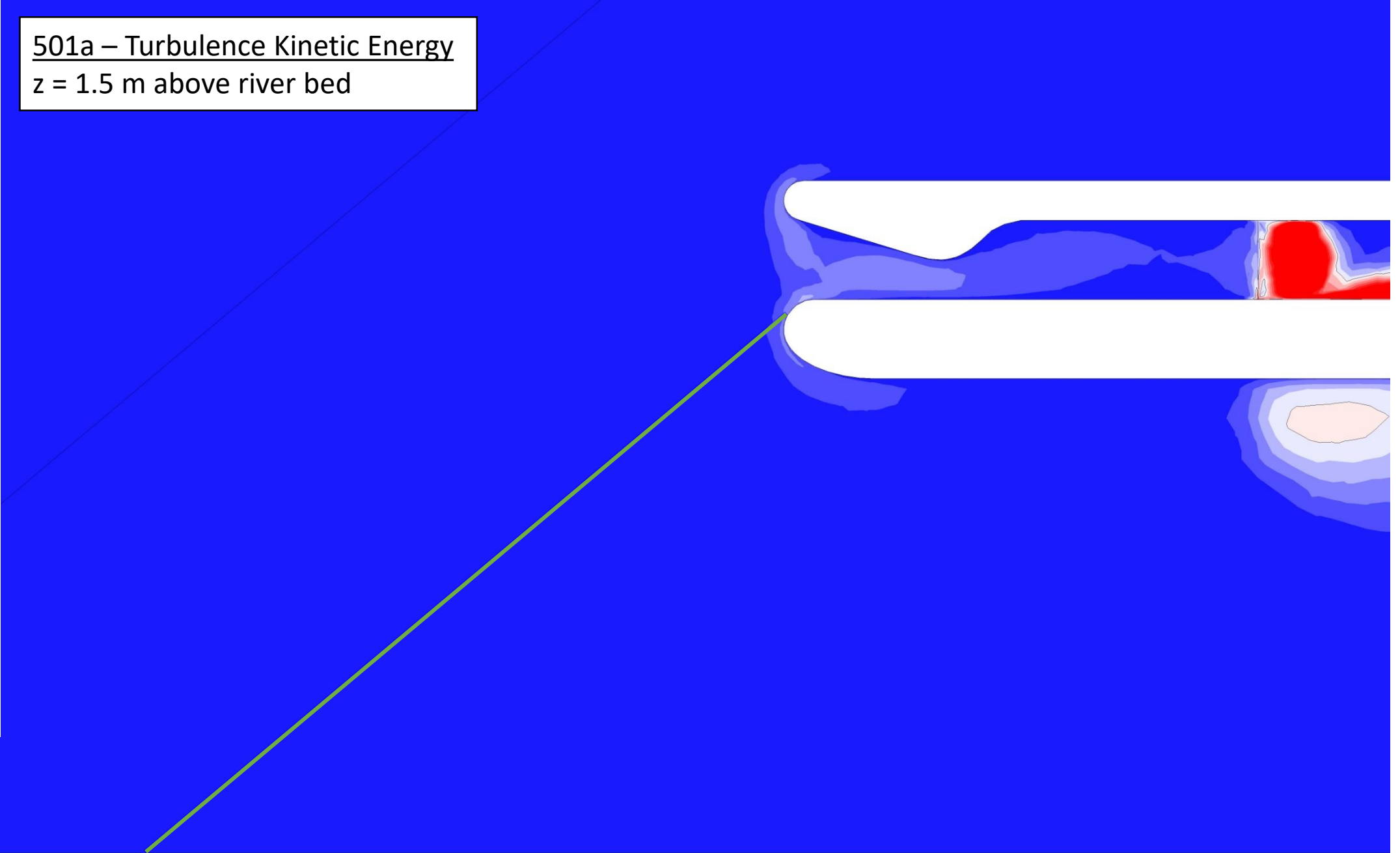
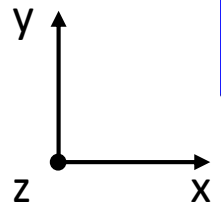
501a – Turbulence Kinetic Energy  
z = 1.0 m above river bed





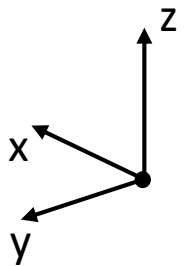
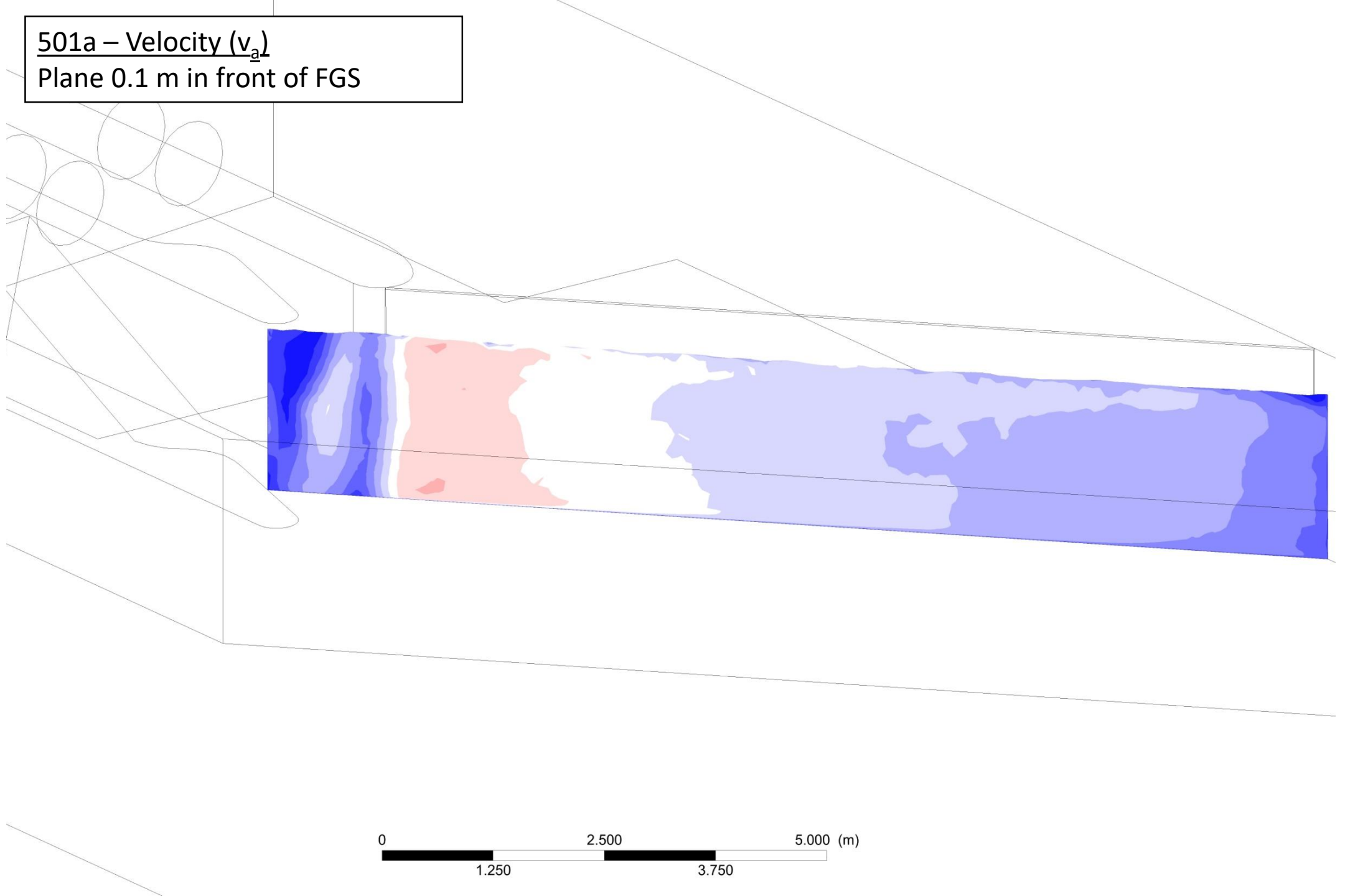


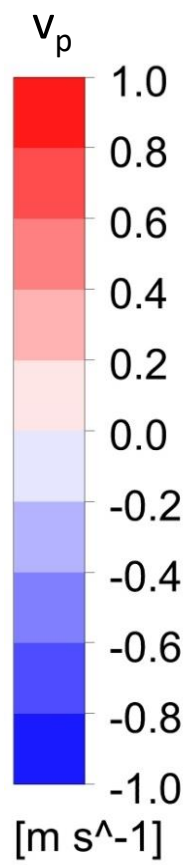
501a – Turbulence Kinetic Energy  
z = 1.5 m above river bed



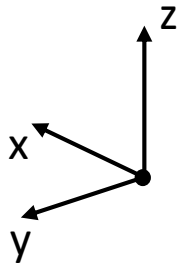
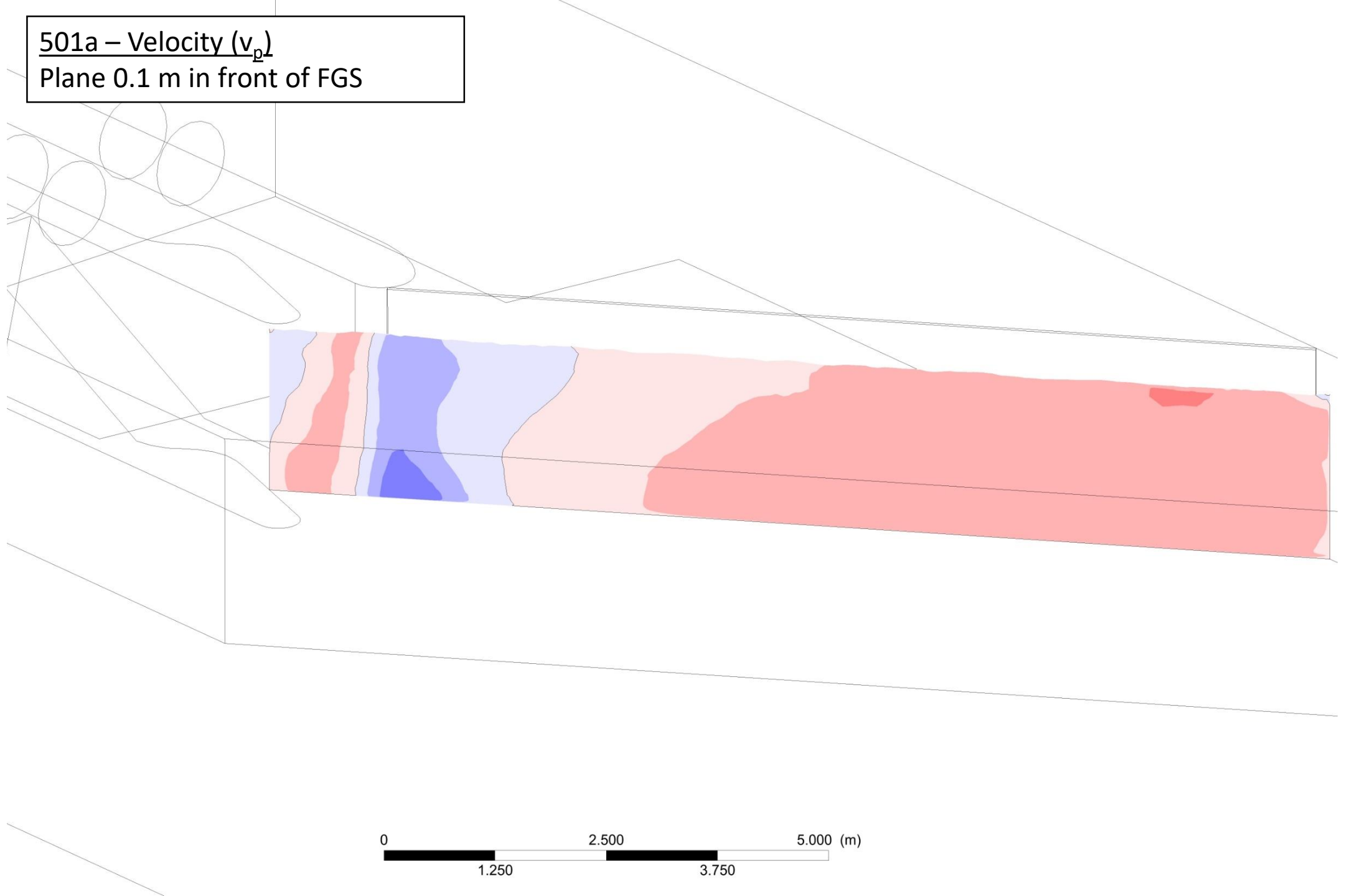
Velocity  
1.3  
1.2  
1.1  
1.0  
0.9  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2  
0.1  
0.0  
[m s<sup>-1</sup>]

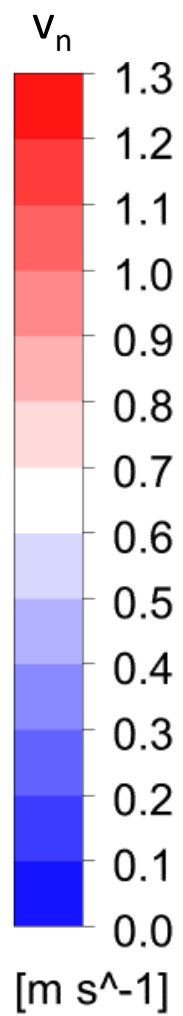
501a – Velocity ( $v_a$ )  
Plane 0.1 m in front of FGS



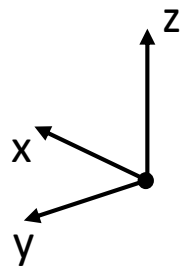
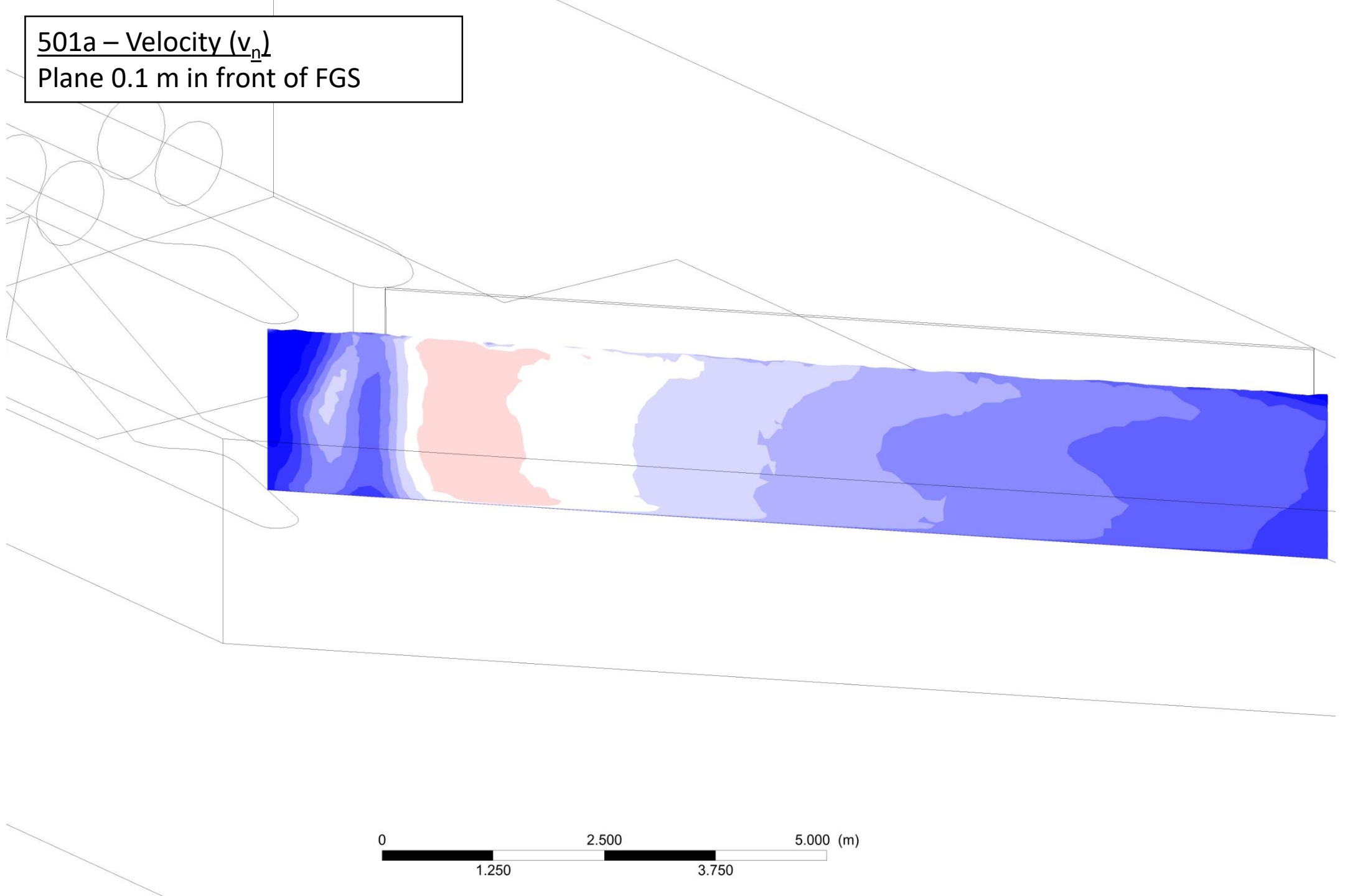


501a – Velocity ( $v_p$ )  
Plane 0.1 m in front of FGS

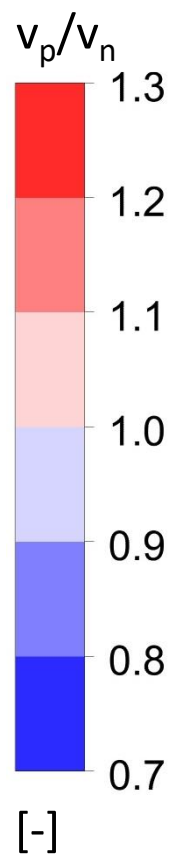




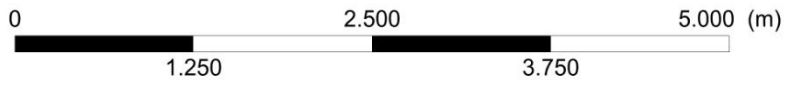
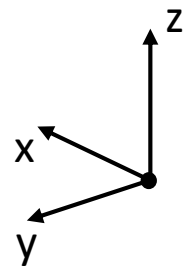
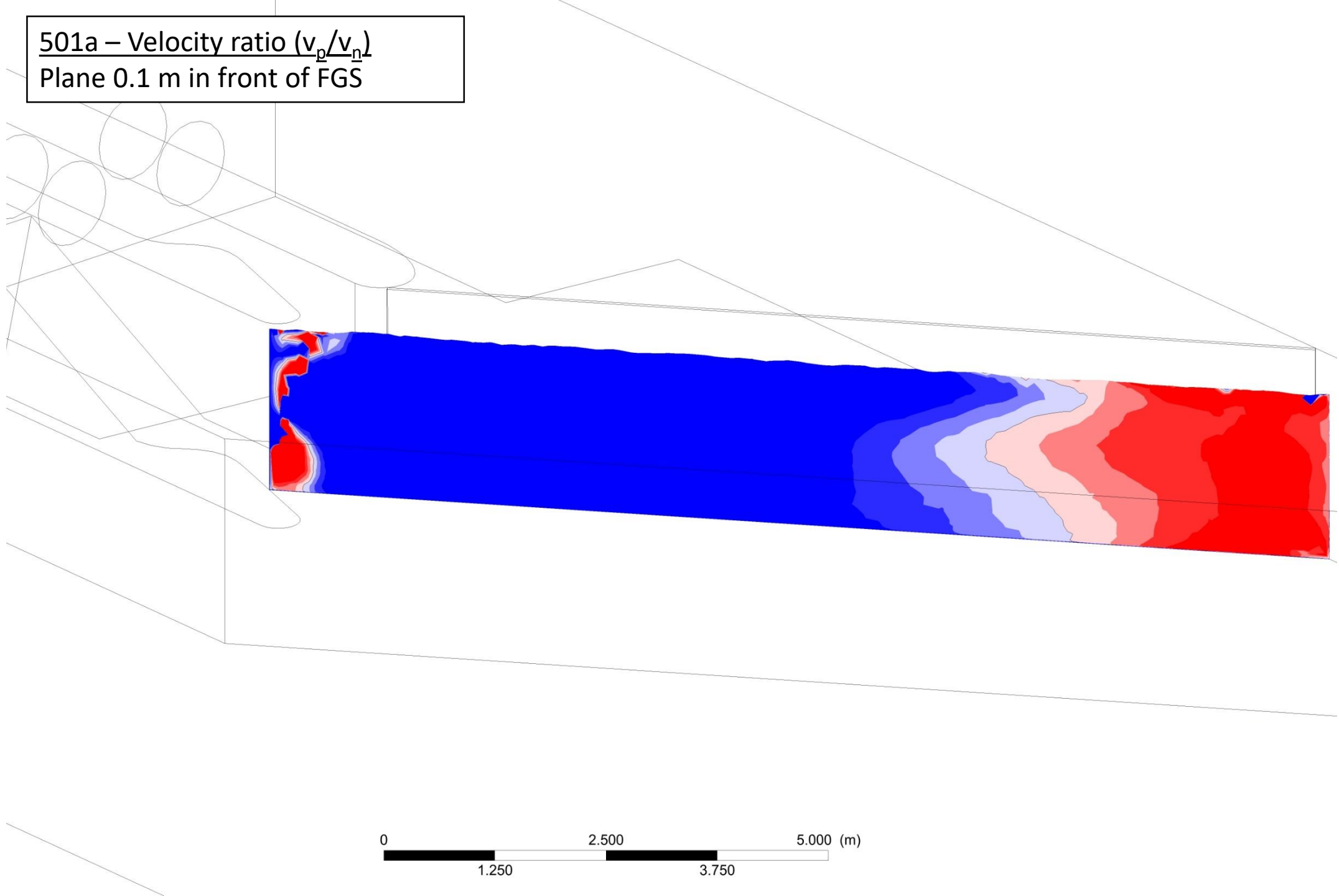
501a – Velocity ( $v_n$ )  
Plane 0.1 m in front of FGS

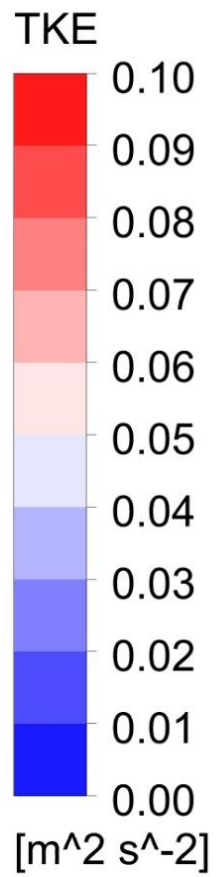




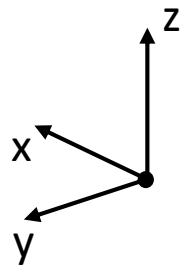
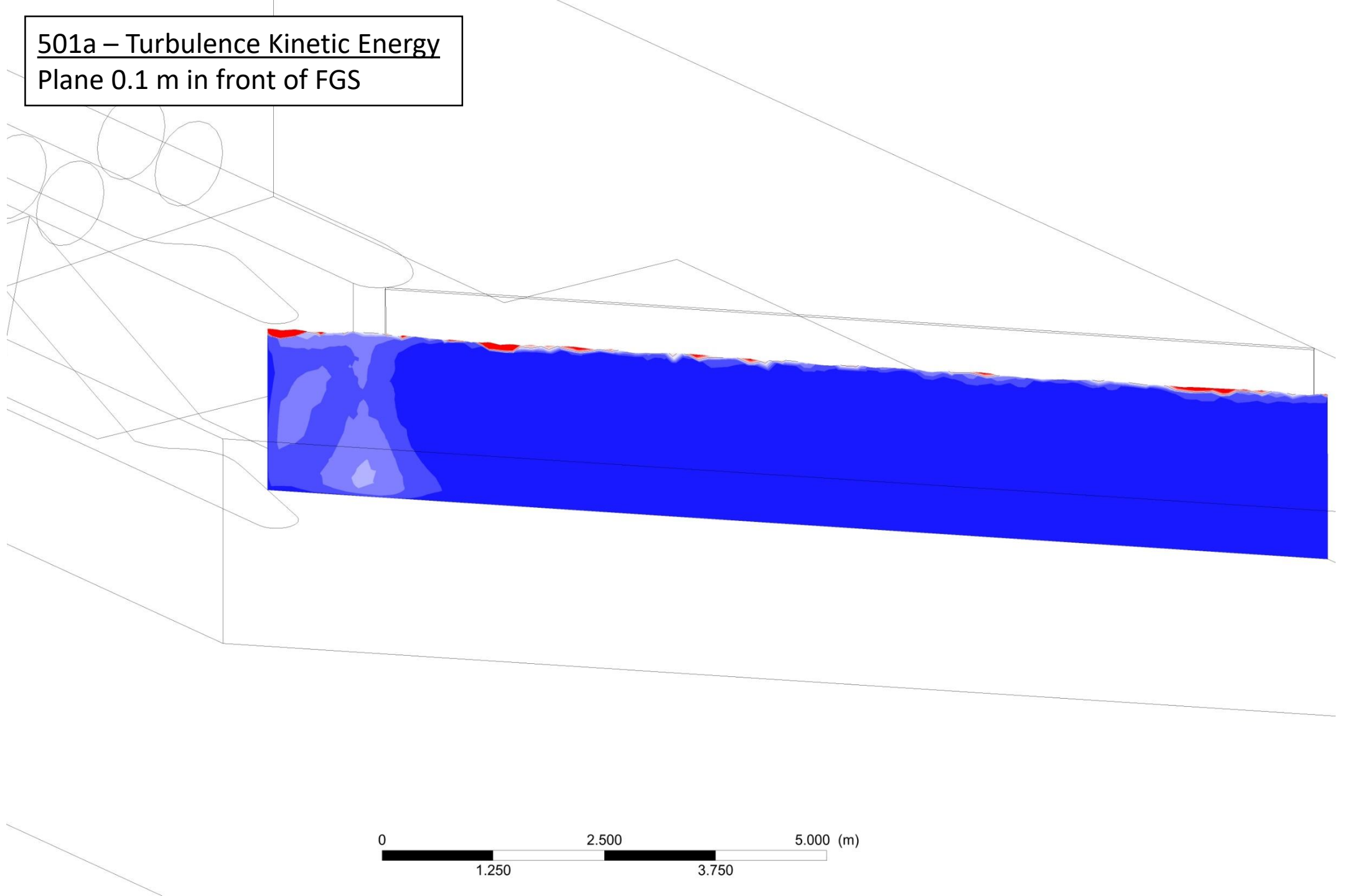


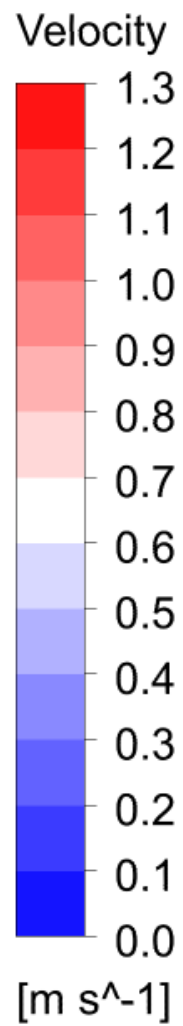
501a – Velocity ratio ( $v_p/v_n$ )  
Plane 0.1 m in front of FGS



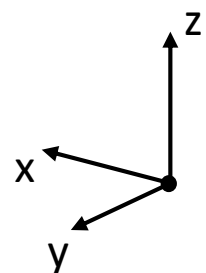


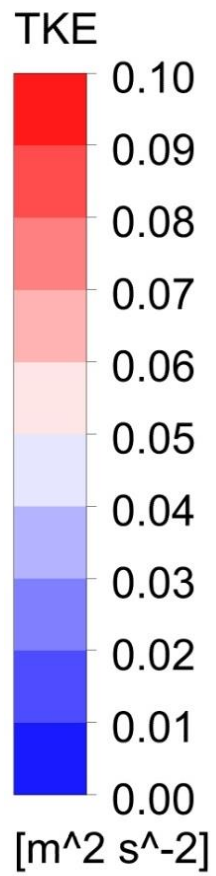
501a – Turbulence Kinetic Energy  
Plane 0.1 m in front of FGS





501a – Velocity  
0, 1 and 2 m in the bypass entrance





501a – Turbulence Kinetic Energy  
0, 1 and 2 m in the bypass entrance

