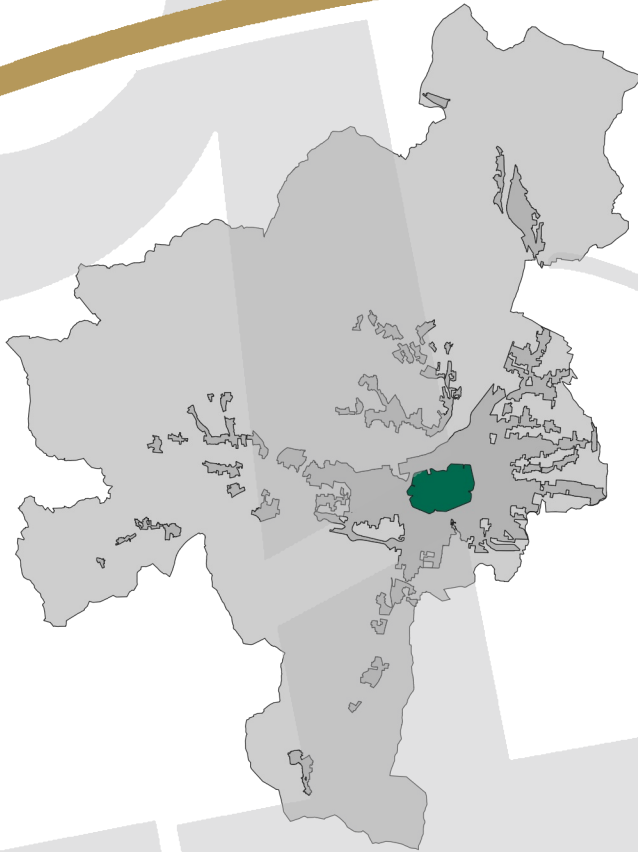




Città  
di Lucca

La casa  
della Città

# il Piano Operativo



## Quadro geologico - tecnico

All. I2.1 - Idraulica  
Simulazioni sul sistema Rio Mulerna

Assessore all'Urbanistica

Serena Mammini

Sindaco

Alessandro Tambellini

**Adozione**



## MODELLI IDRAULICI MONODIMENSIONALI

Si riportano gli output forniti dal codice di calcolo Hec-Ras sul reticolo idraulico con simulazione del deflusso trentennale e duecentennale. Si allegano

- I profili;
- Le sezioni dei corsi d'acqua;
- L'output tabellare con i risultati delle simulazioni svolte.

## LEGENDA DELLE TABELLE

Le grandezze riportate in tabella hanno il seguente significato:

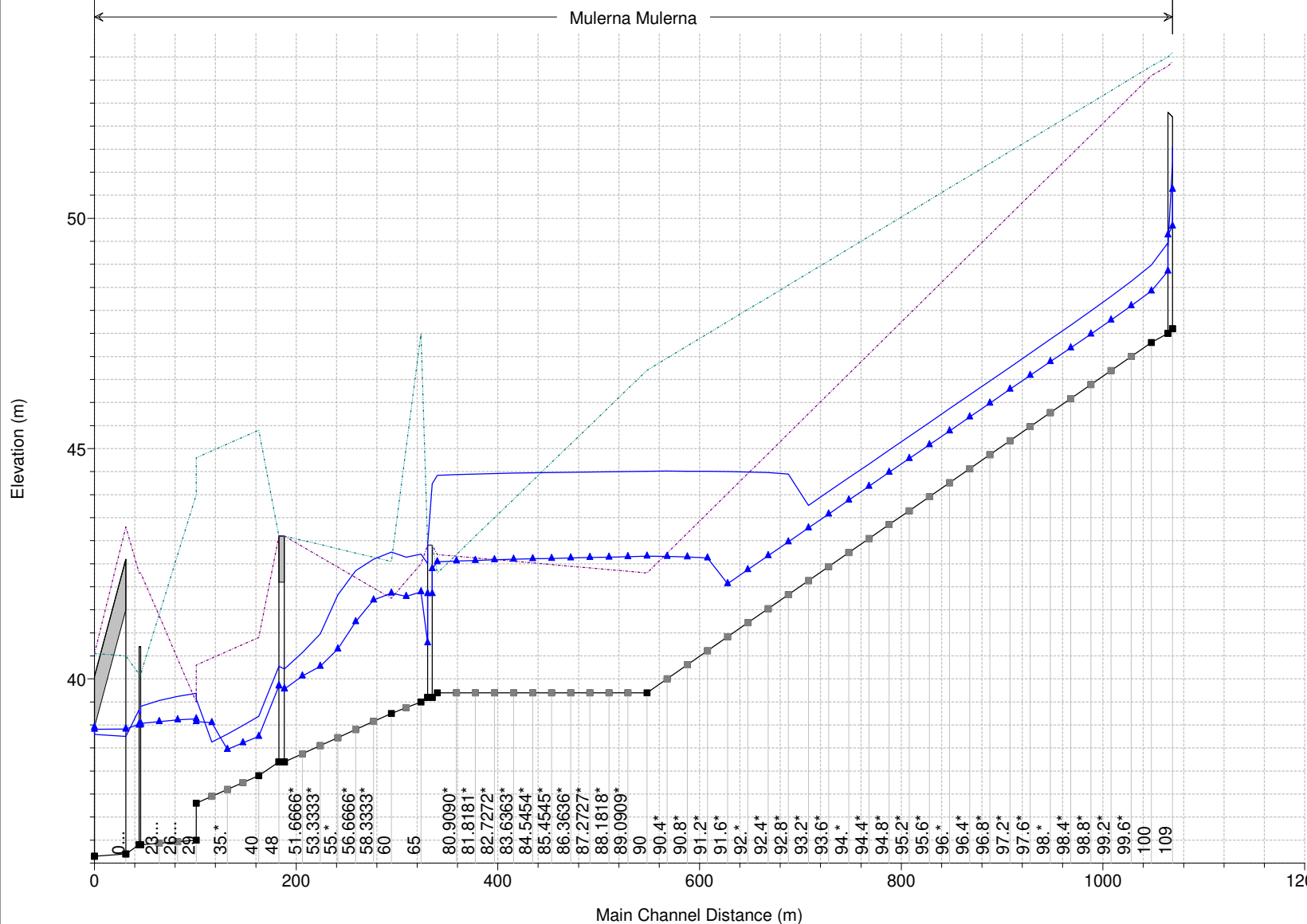
- **River station** Sezione trasversale del corso d'acqua
- **Q Total** Portata idraulica
- **Min Ch Elev** Quota del fondo rispetto al prescelto sistema di riferimento
- **W.S. Elev** Quota del pelo libero rispetto al prescelto sistema di riferimento
- **Max Chl Dpth** Tirante idraulico massimo (differenza dei termini W.S Elev e il termine Min Ch Elev)
- **LOB Elev** Quota della sommità arginale sinistra rispetto al prescelto sistema di riferimento
- **ROB Elev** Quota della sommità arginale destra rispetto al prescelto sistema di riferimento
- **L.Freeboard** Franco sinistro: differenza fra il termine LOB Elev e il termine W.S Elev
- **R.Freeboard** Franco destro: differenza fra il termine ROB Elev e il termine W.S Elev
- **Vel Chnl** Velocità media della corrente
- **Froude n.** Numero di Froude: se maggiore di 1 indica la presenza di corrente veloce, se inferiore a 1 segnala la presenza di corrente lenta



## **SISTEMA RIO MULERNA**



Mulerna Plan: Mulerna\_2010 7/1/2021



**Legend**

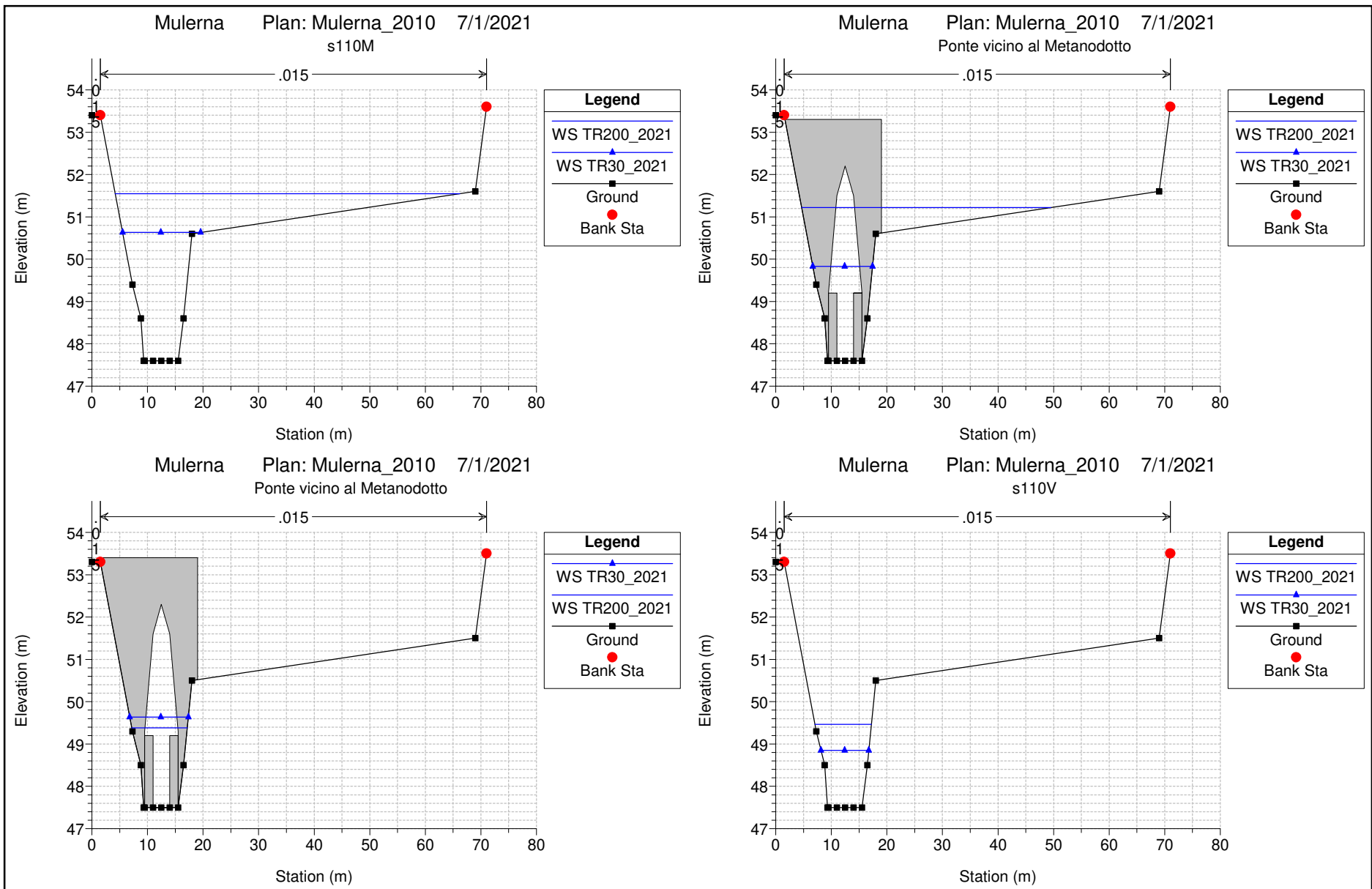
- WS TR200\_2021
- WS TR30\_2021
- Ground
- LOB
- ROB

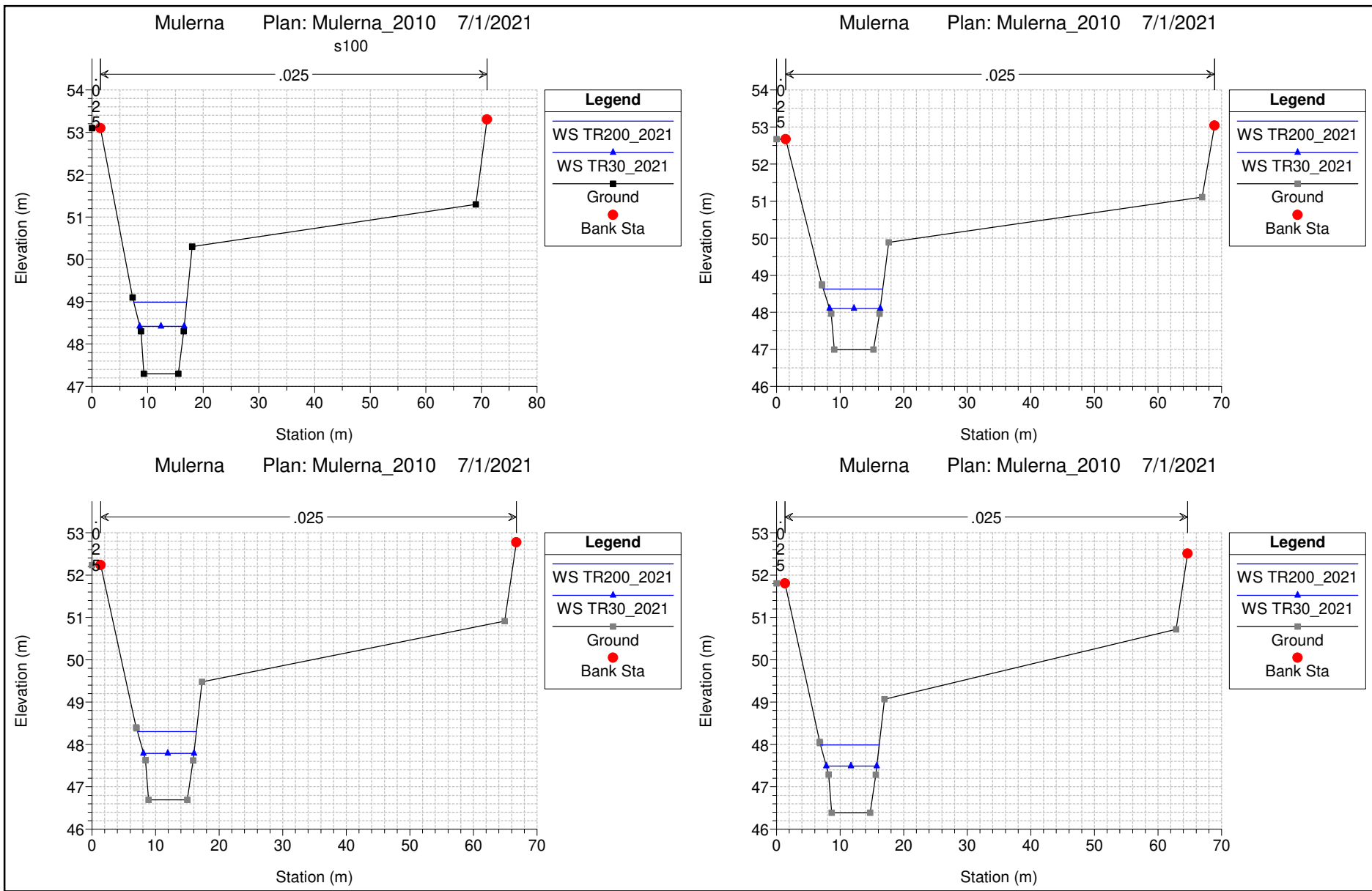




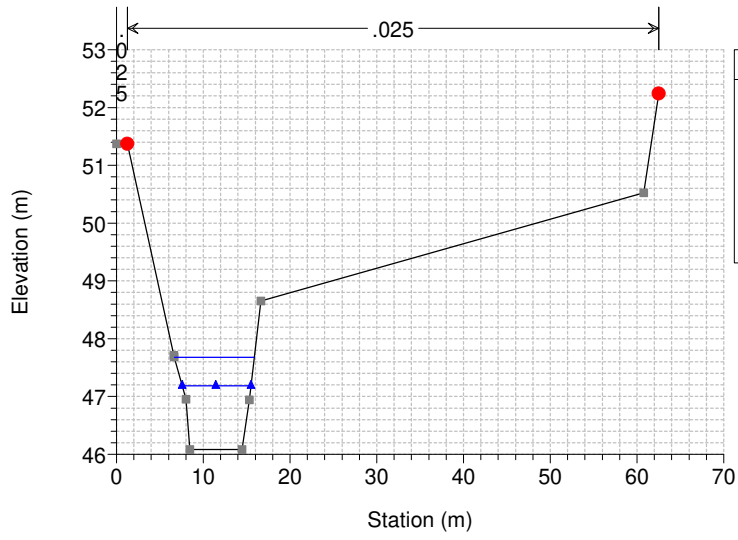
## **SEZIONI SISTEMA RIO MULERNA**



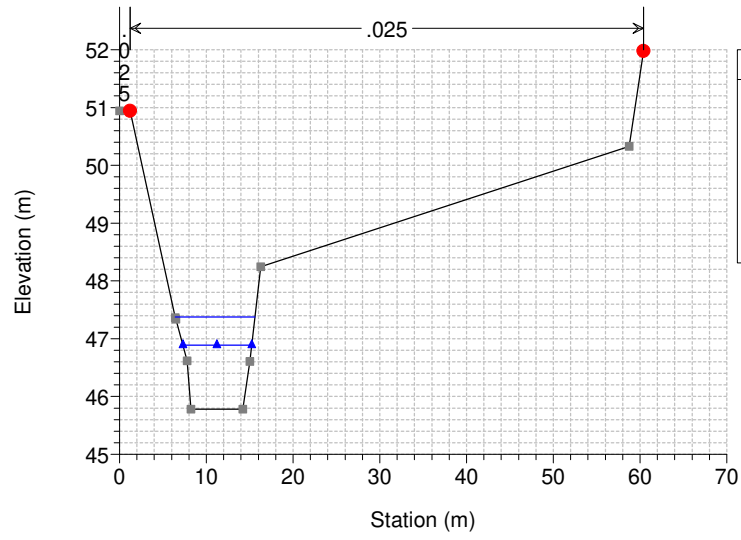




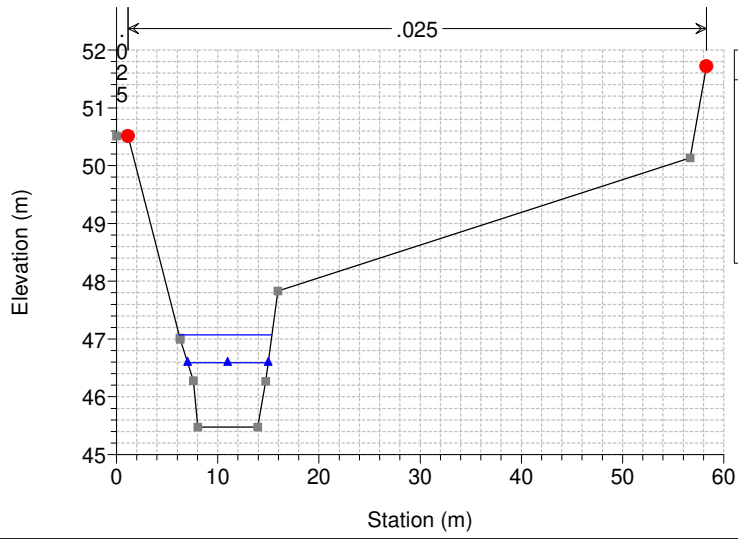
Mulerna Plan: Mulerna\_2010 7/1/2021



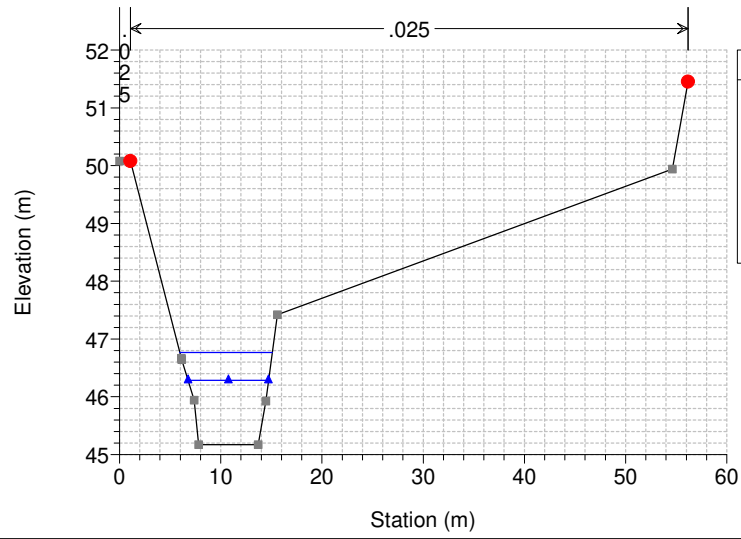
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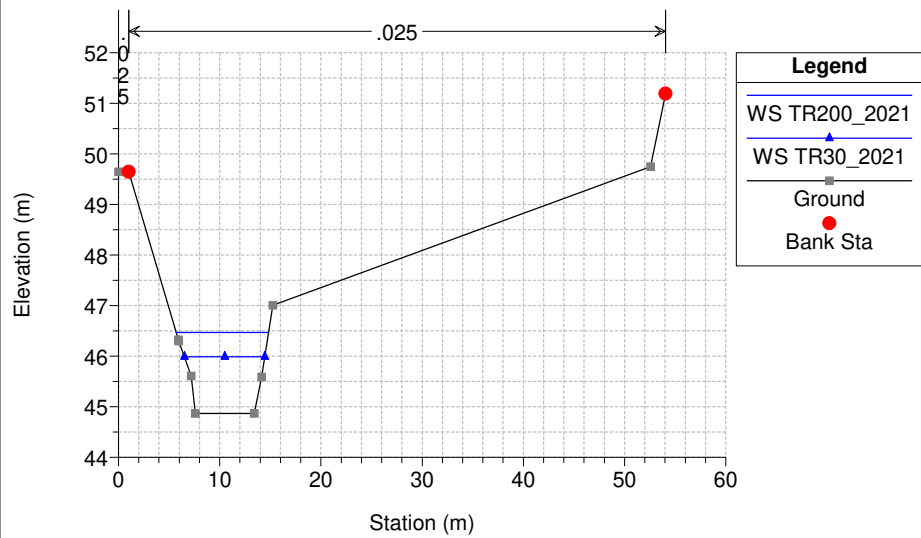
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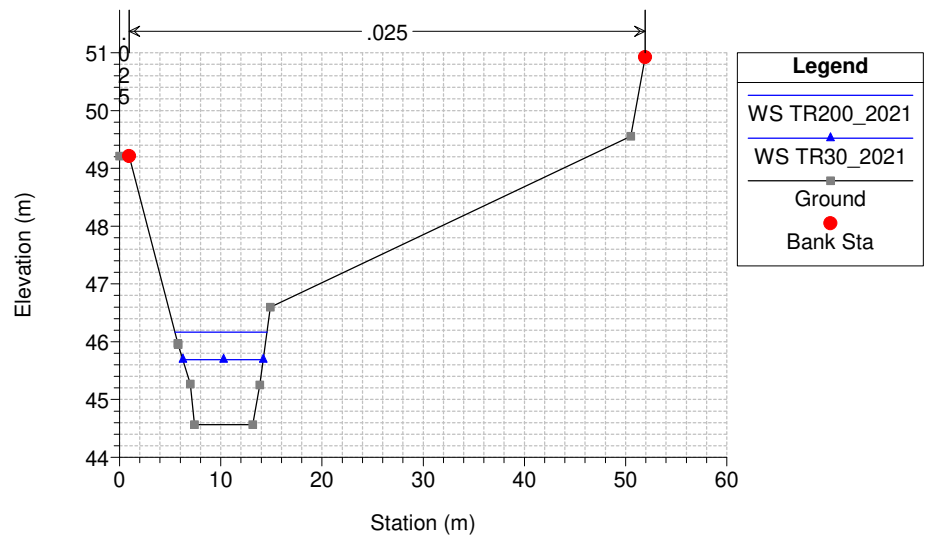
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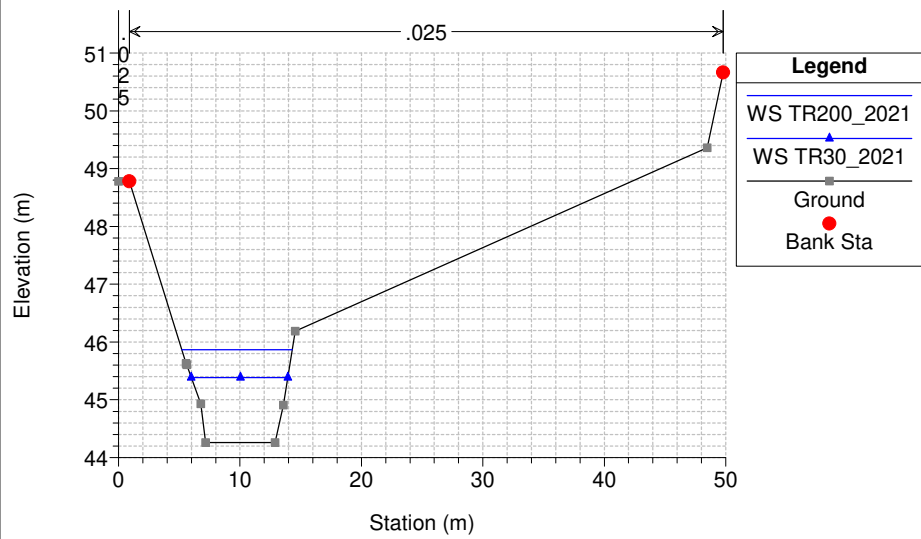
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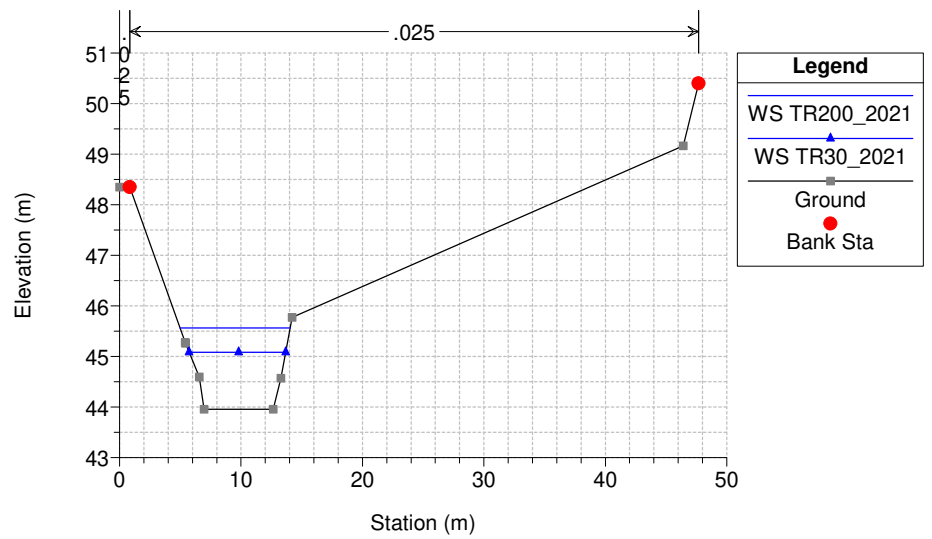
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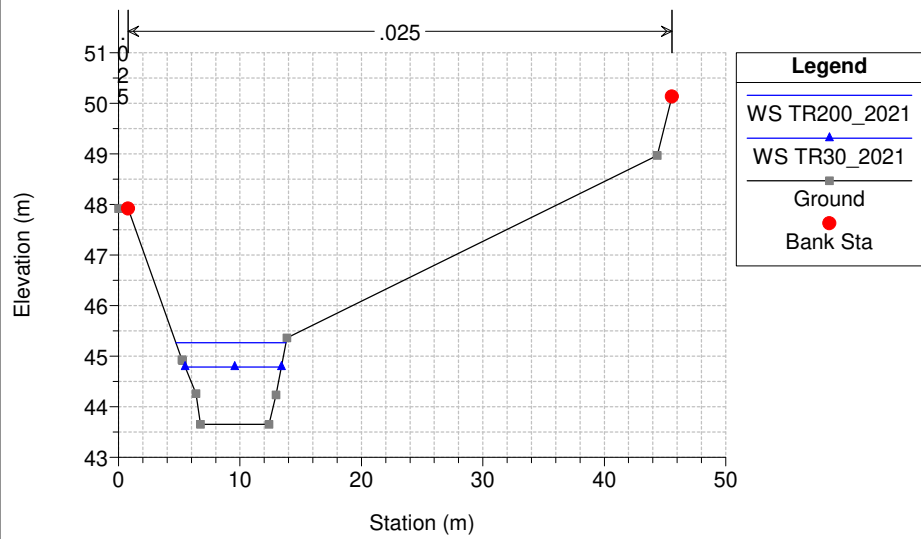
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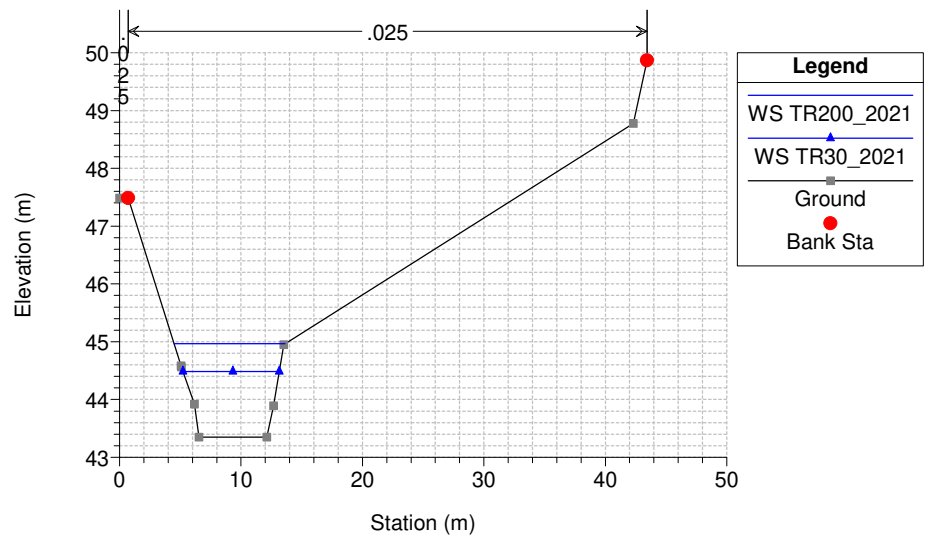
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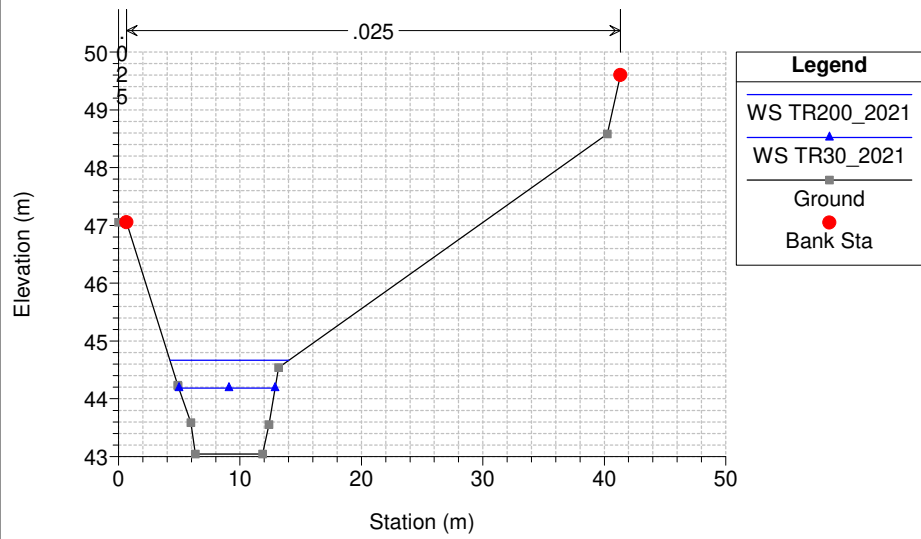
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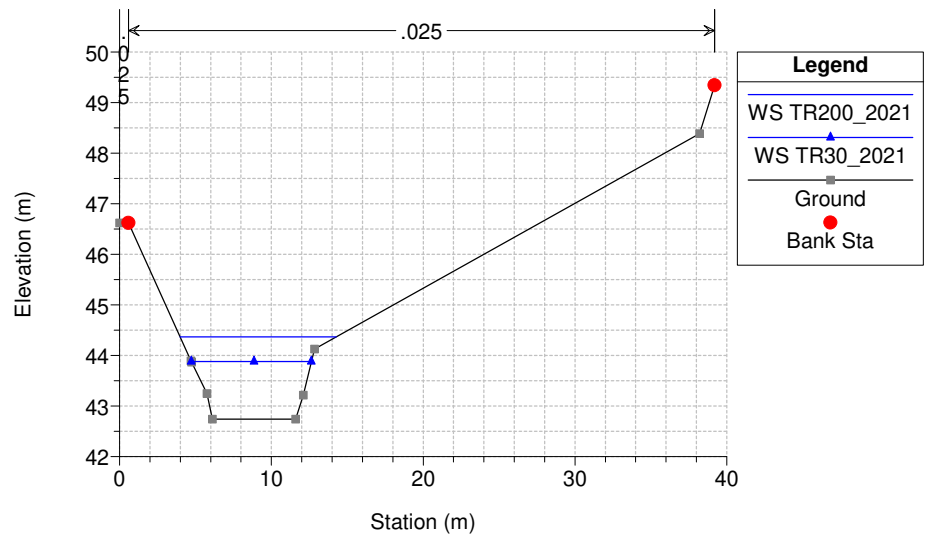
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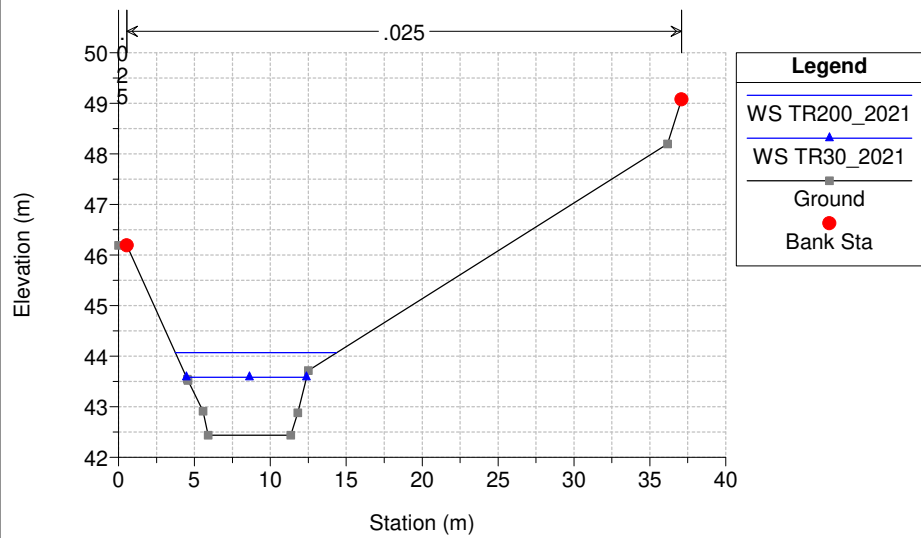
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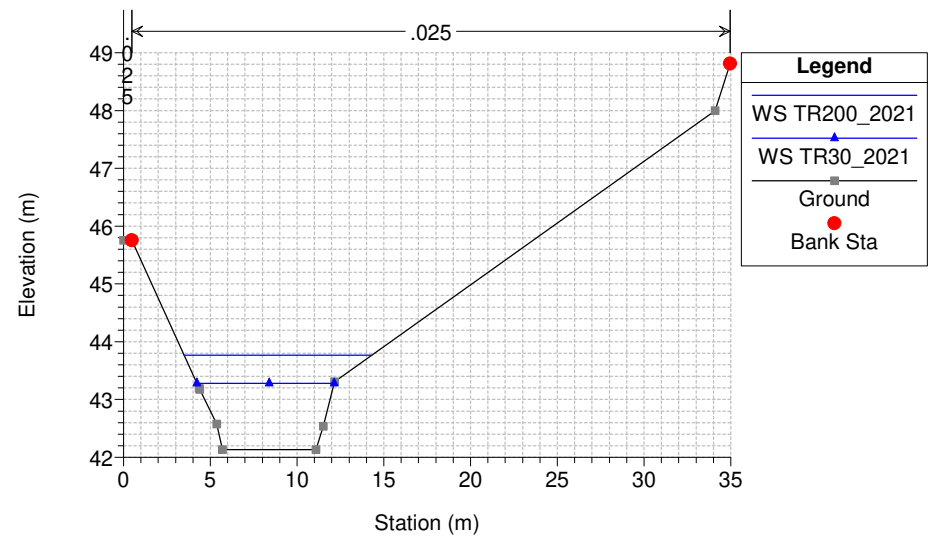
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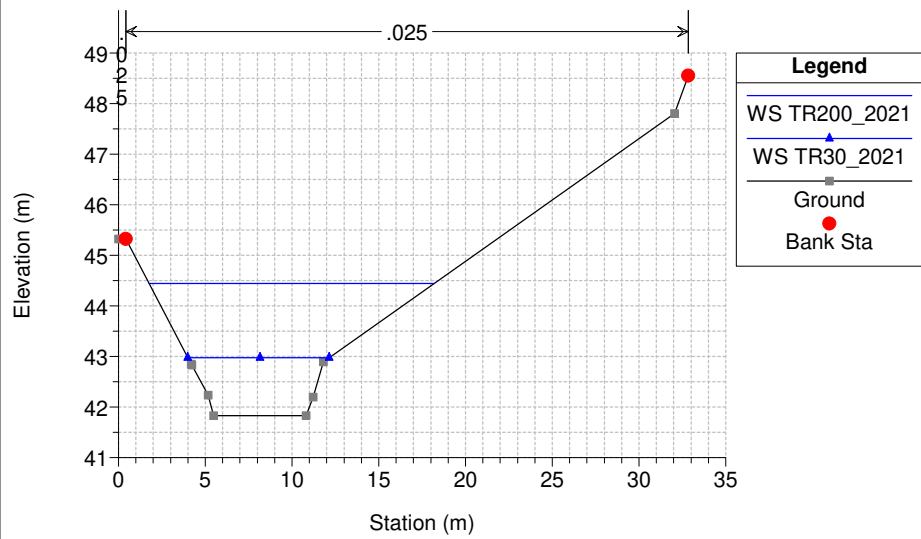
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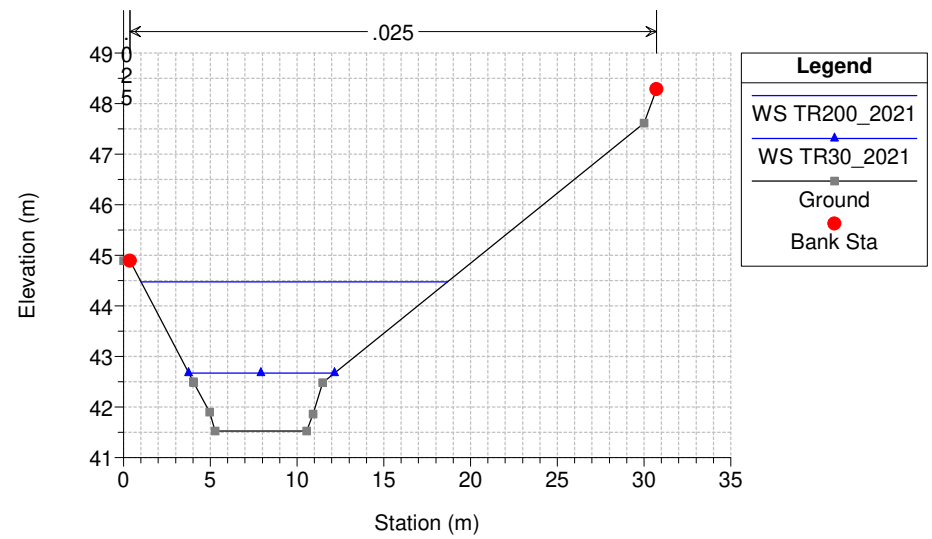
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Mulerna Plan: Mulerna\_2010 7/1/2021

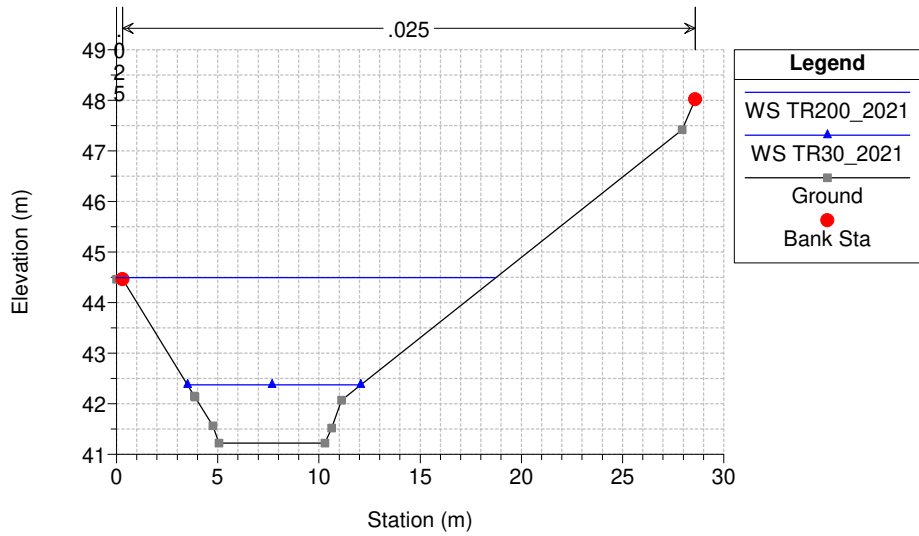


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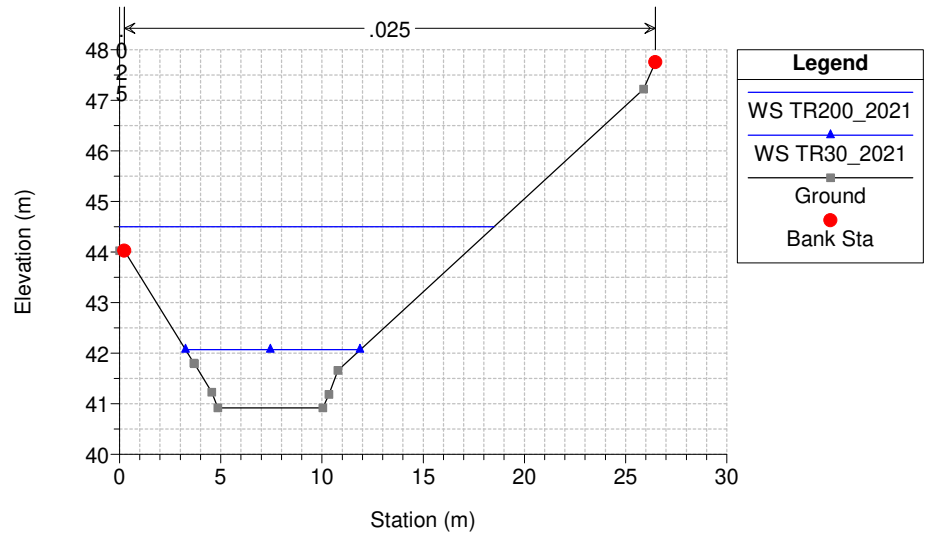




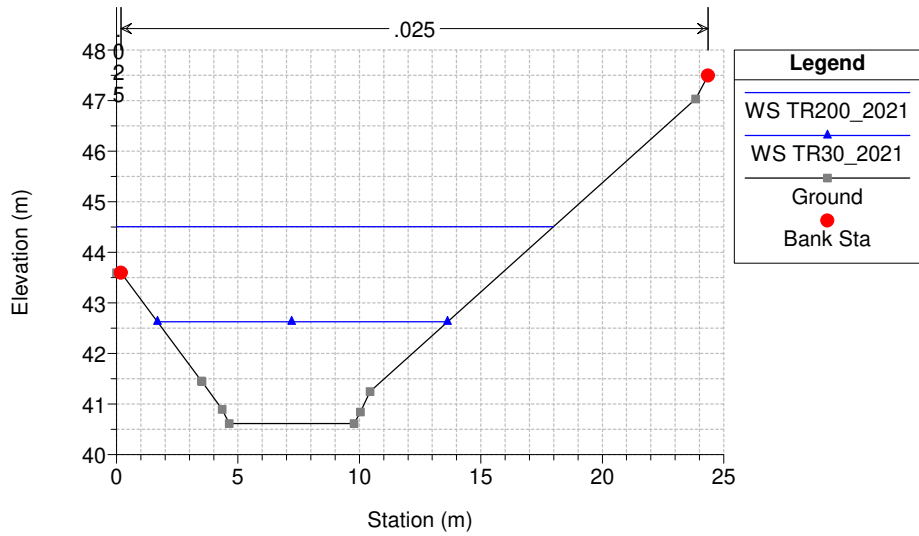
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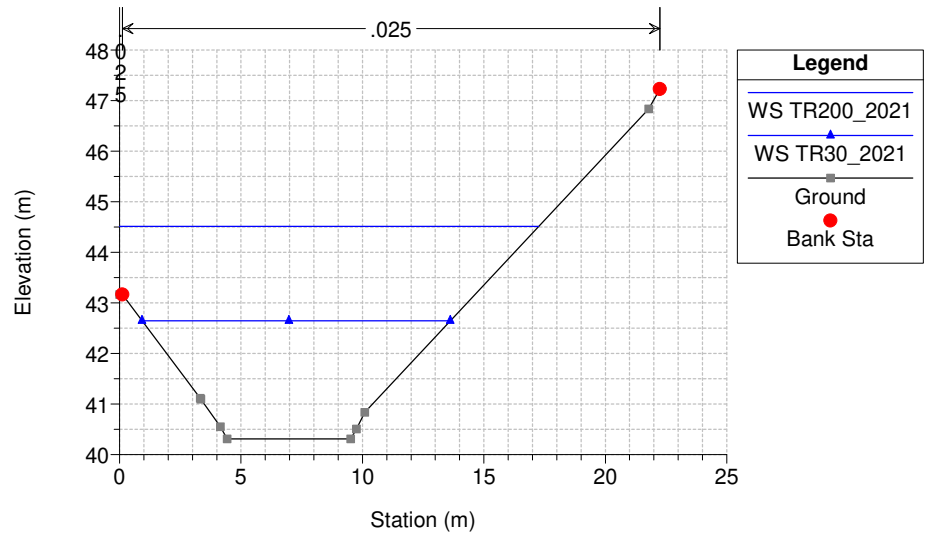
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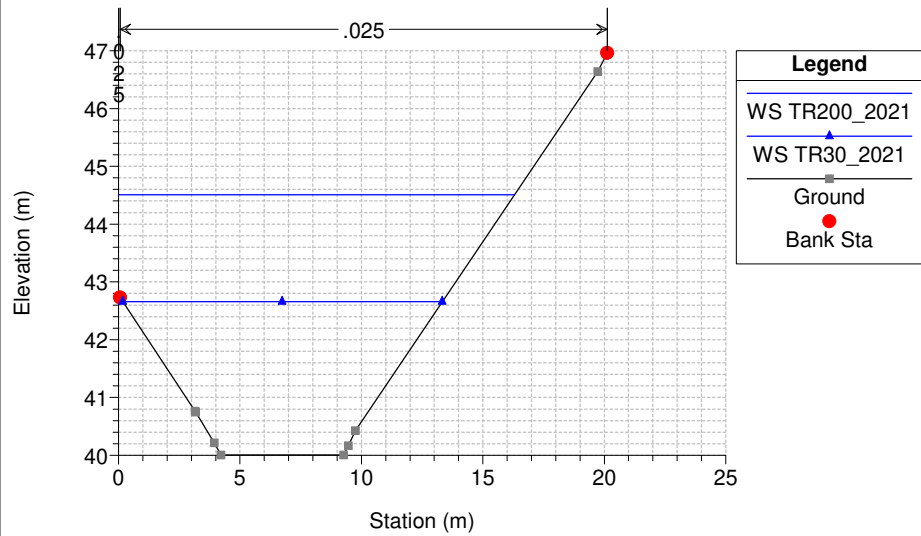
Mulerna Plan: Mulerna\_2010 7/1/2021



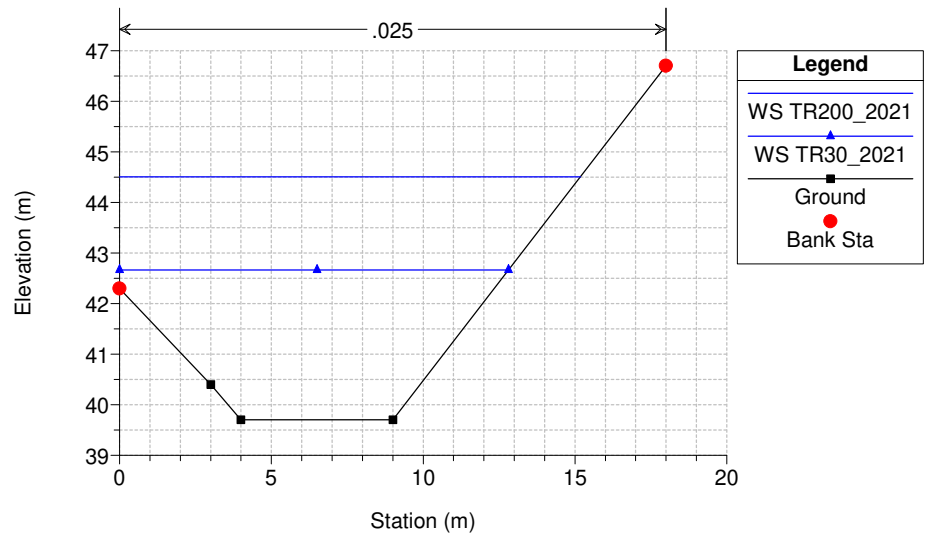
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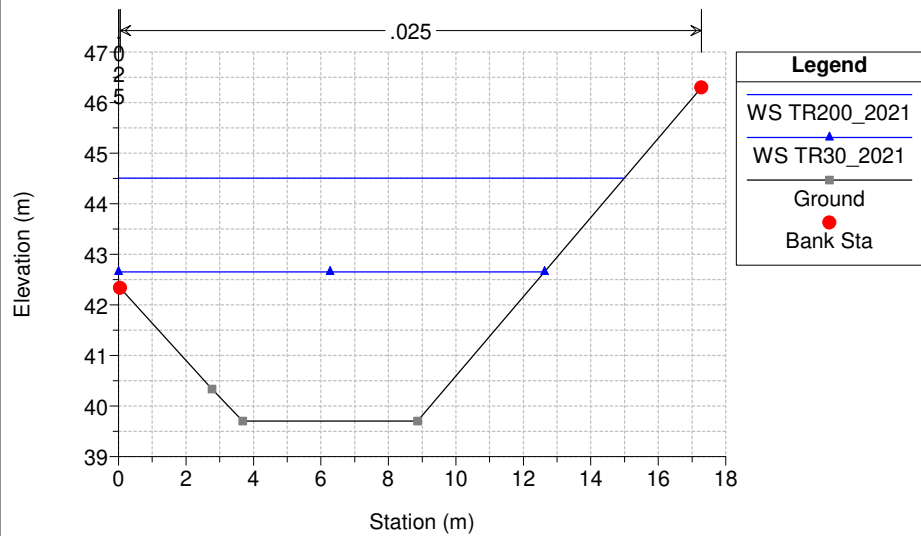
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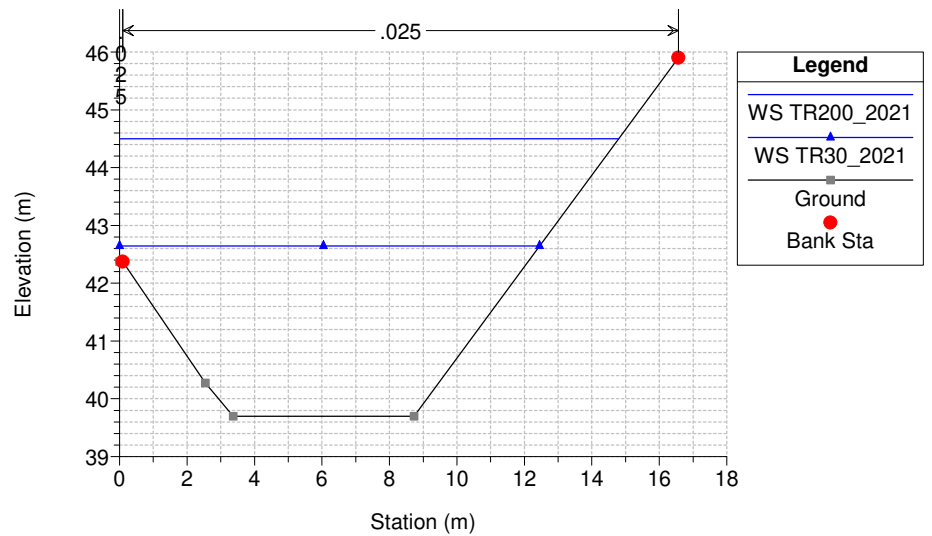
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S90



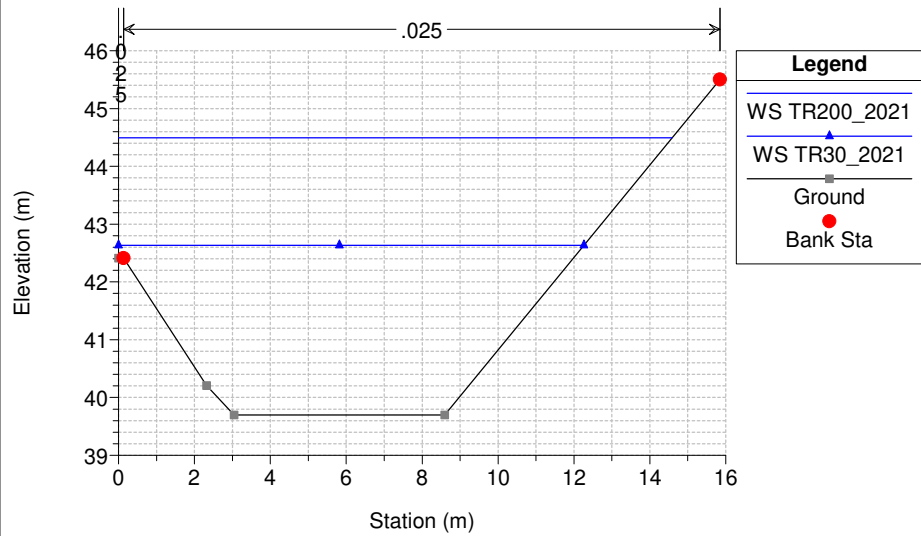
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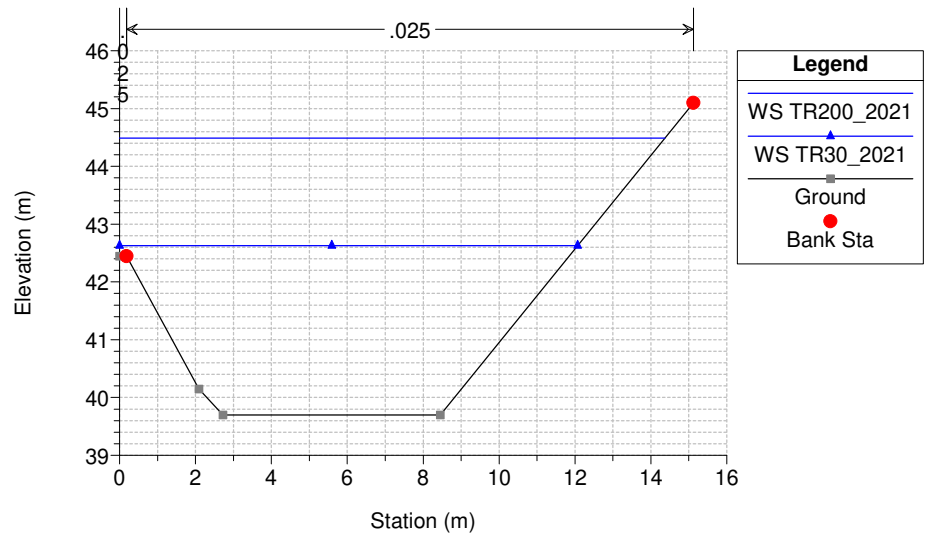
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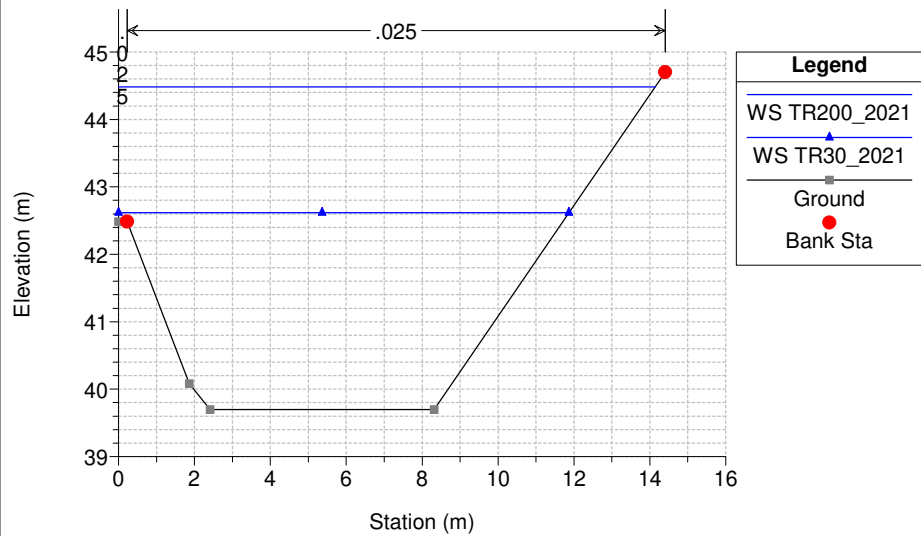
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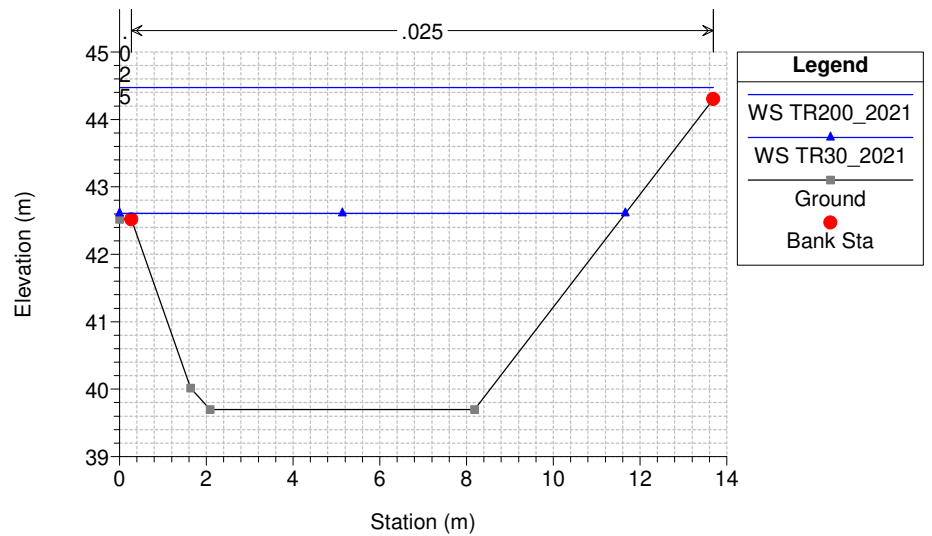
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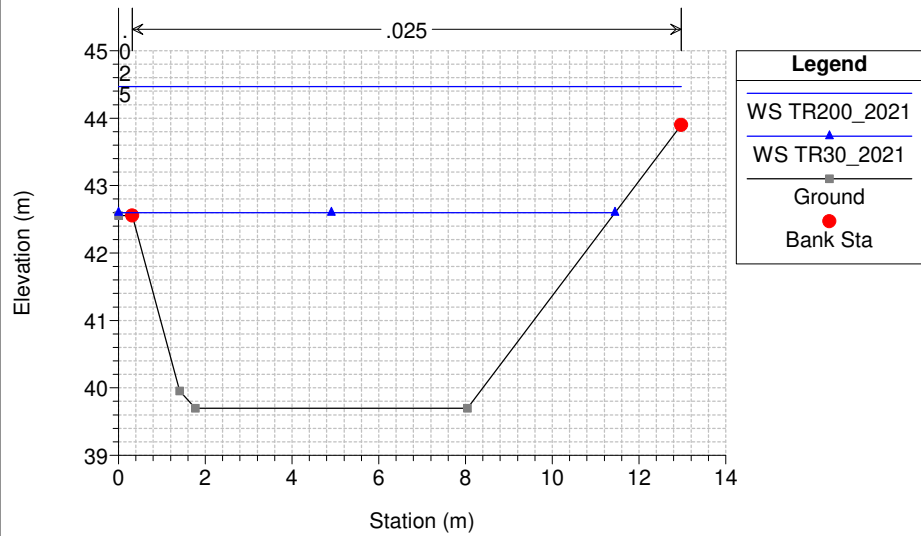
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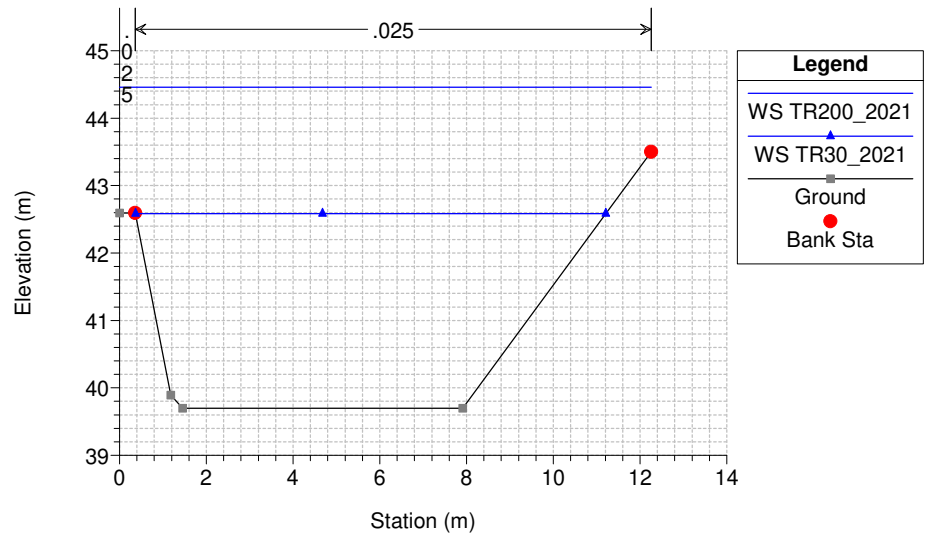
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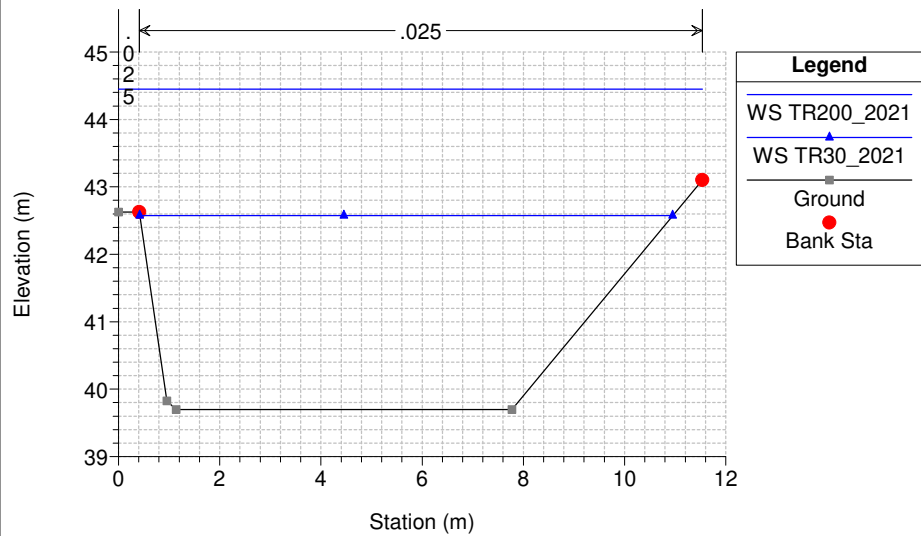
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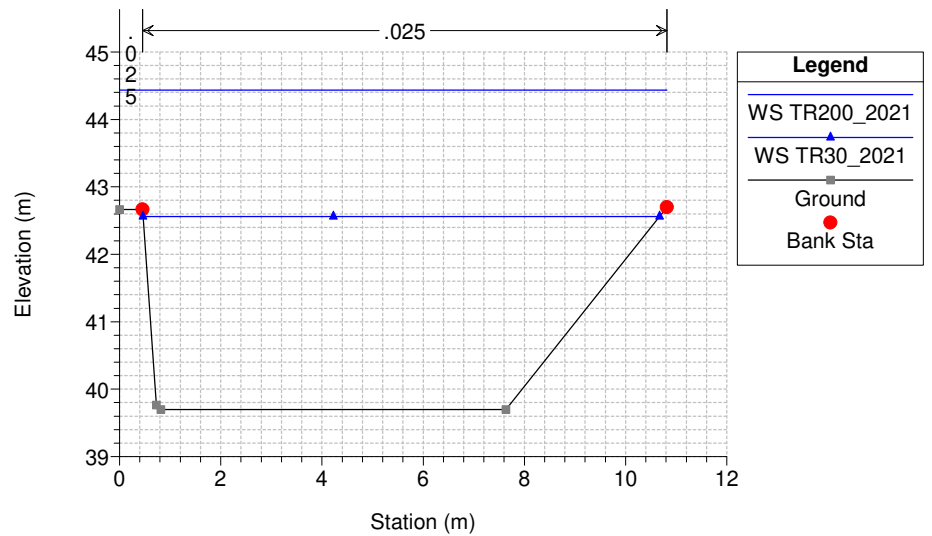
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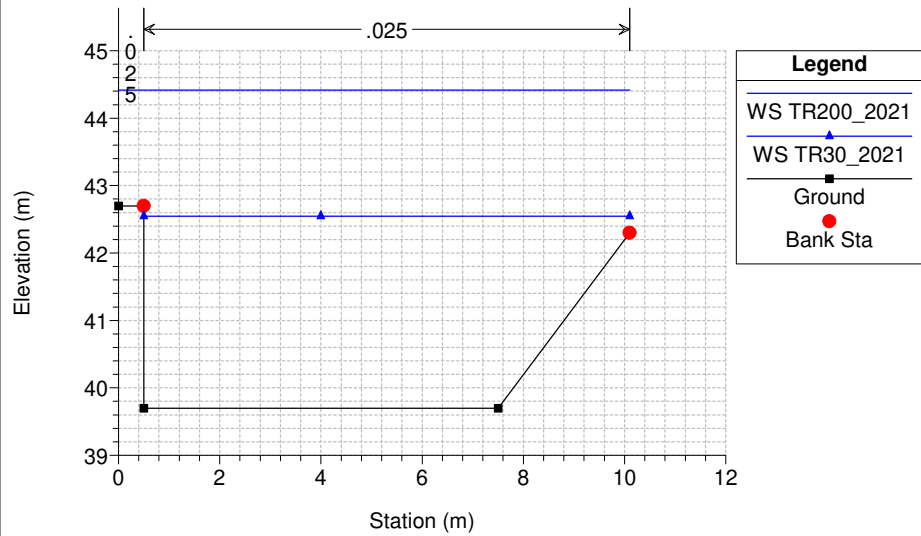
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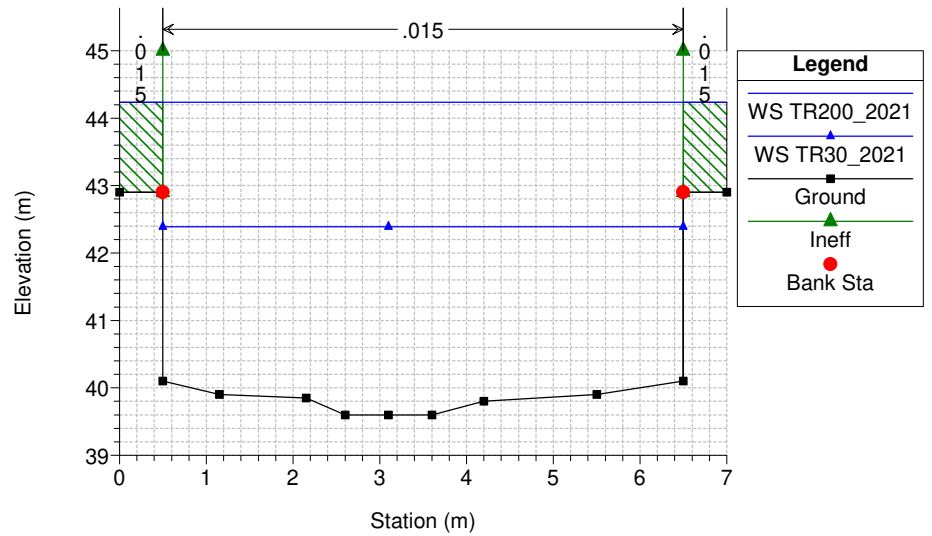
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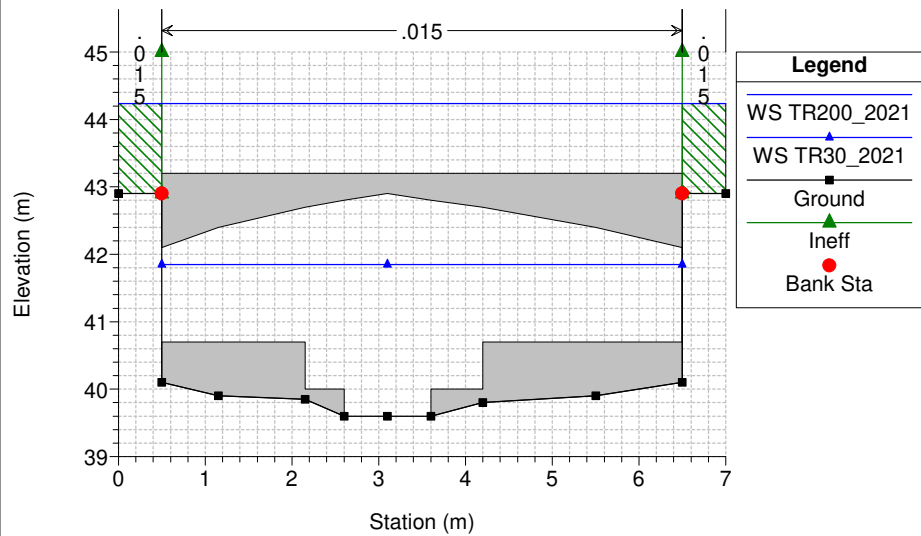
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S80



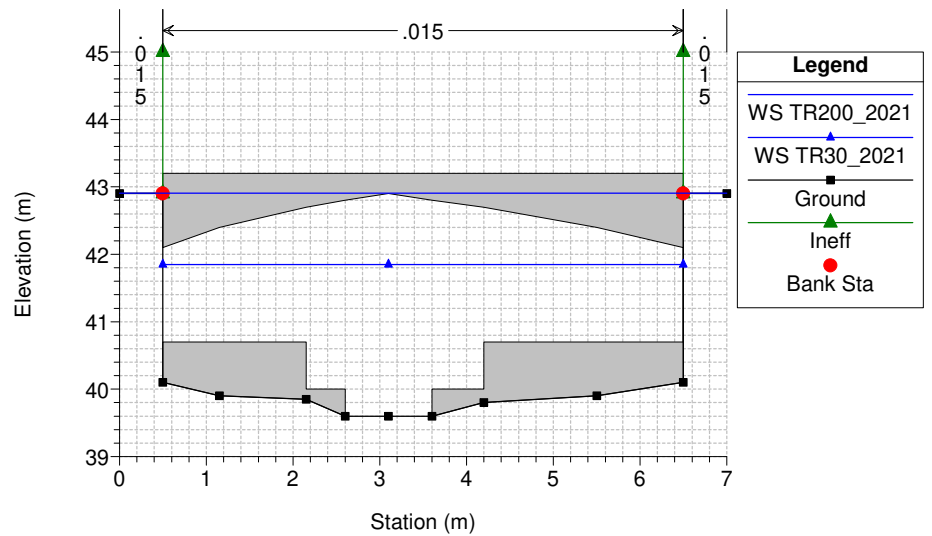
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S70M



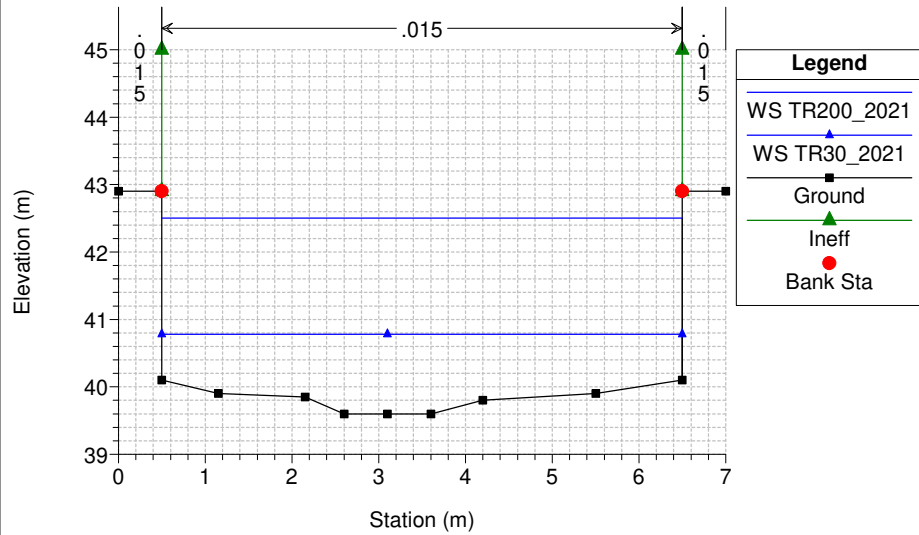
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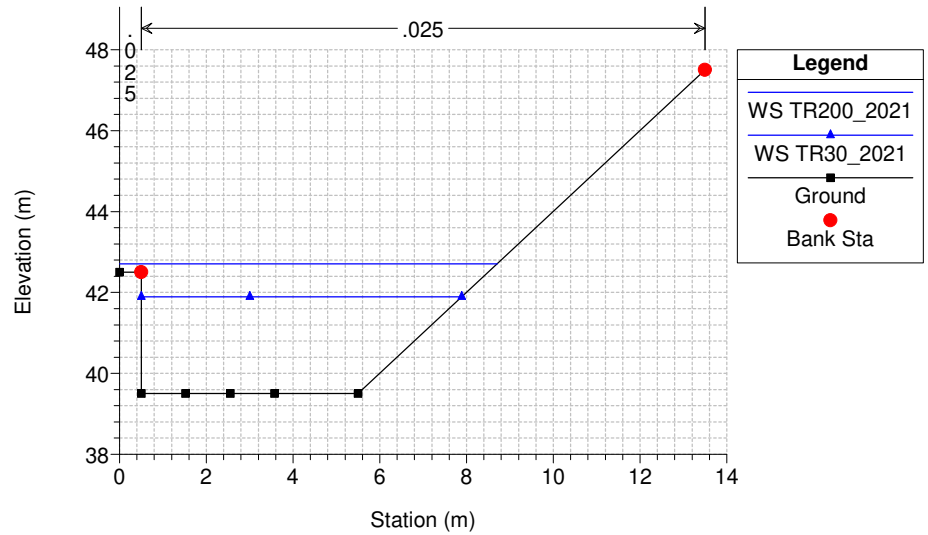
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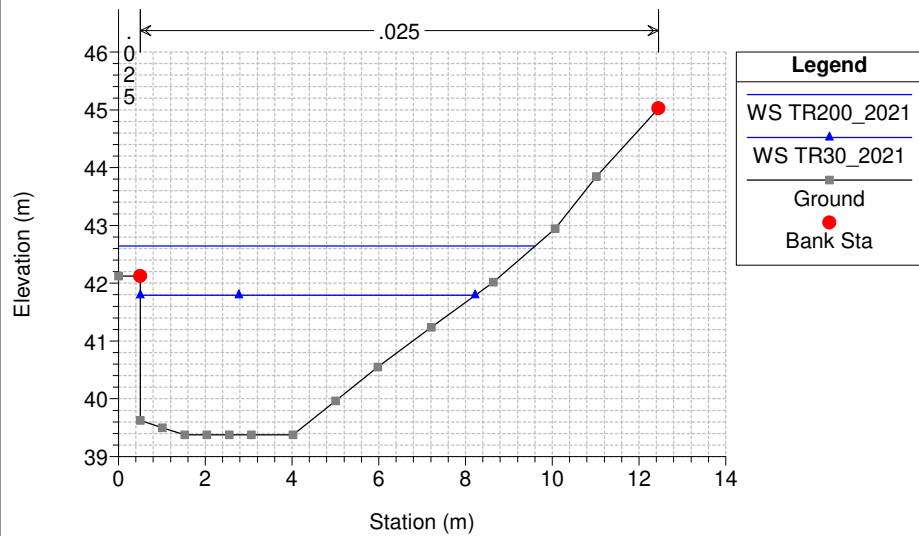
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S70V



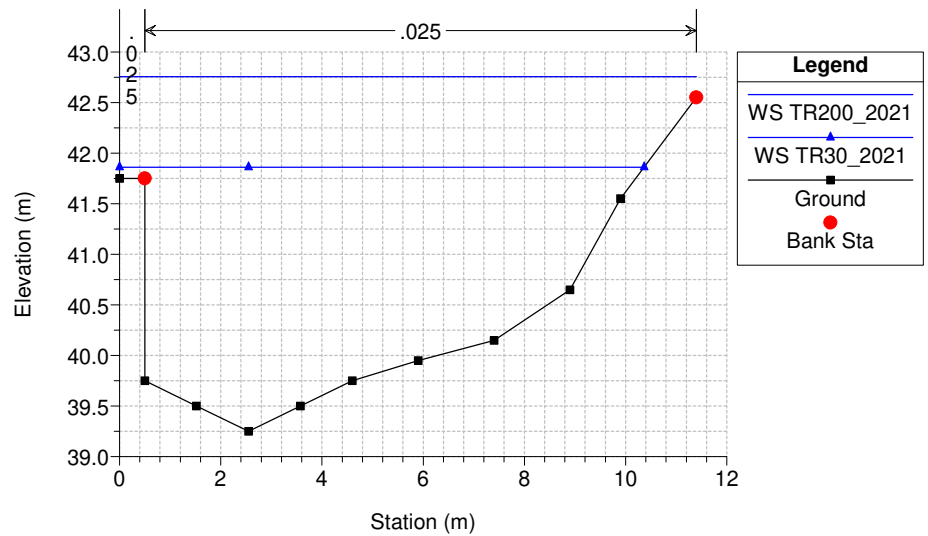
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S65



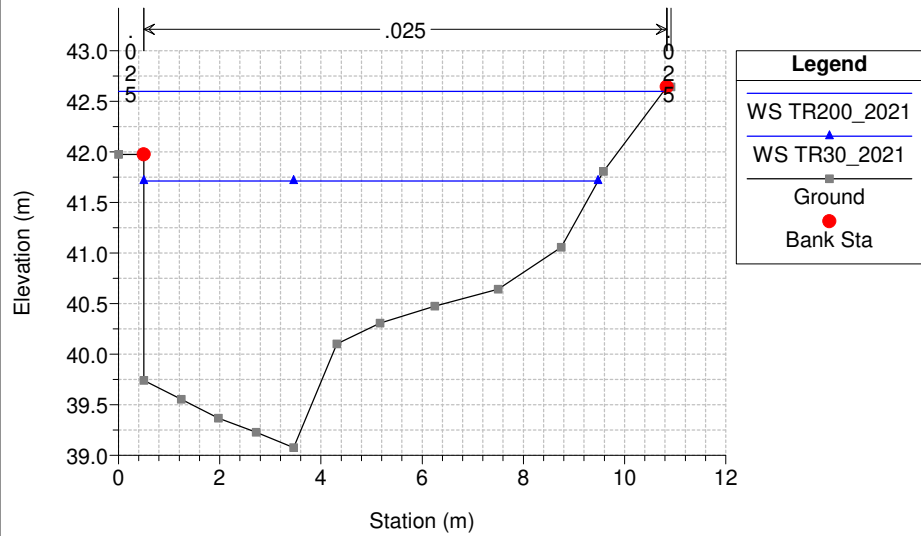
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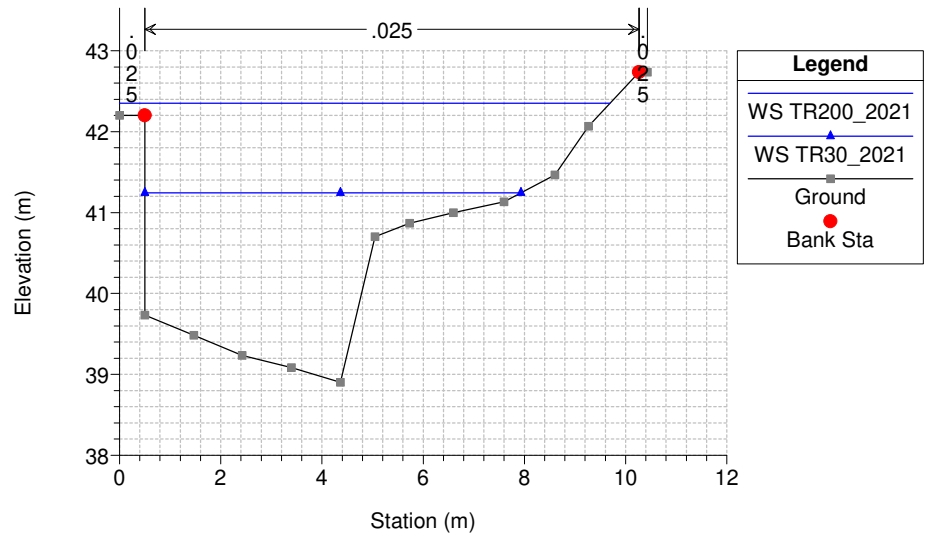
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S60



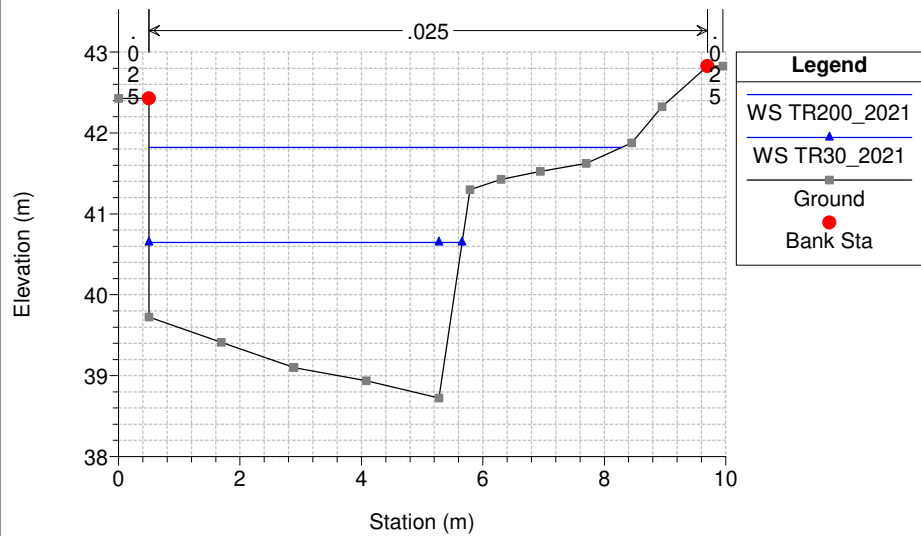
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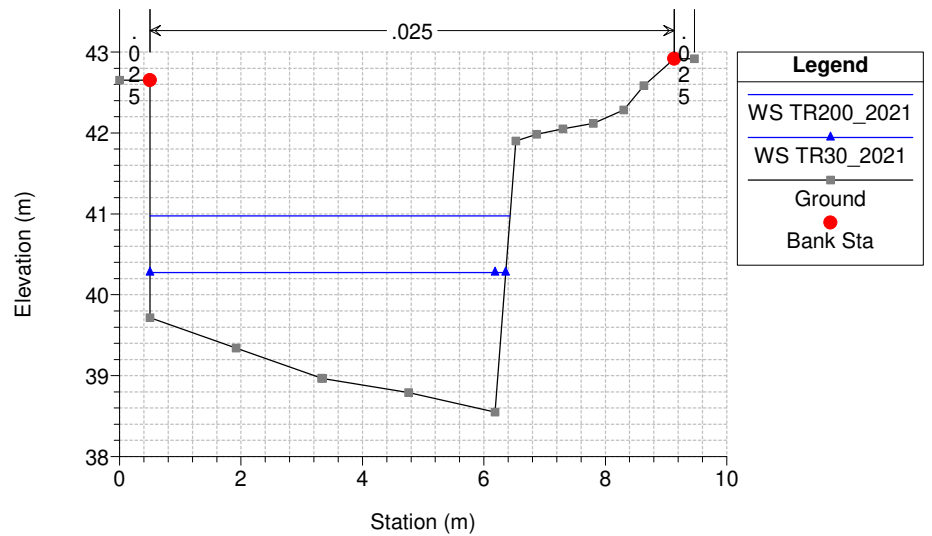
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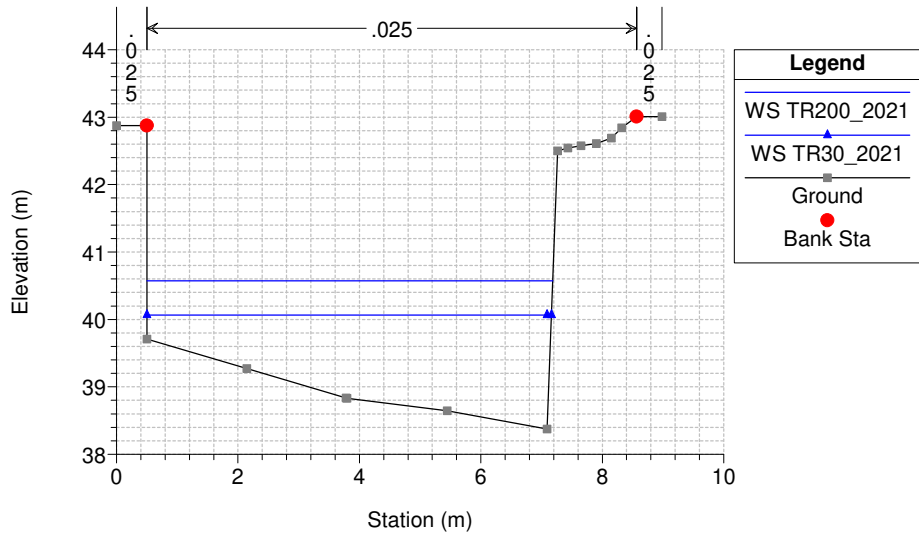
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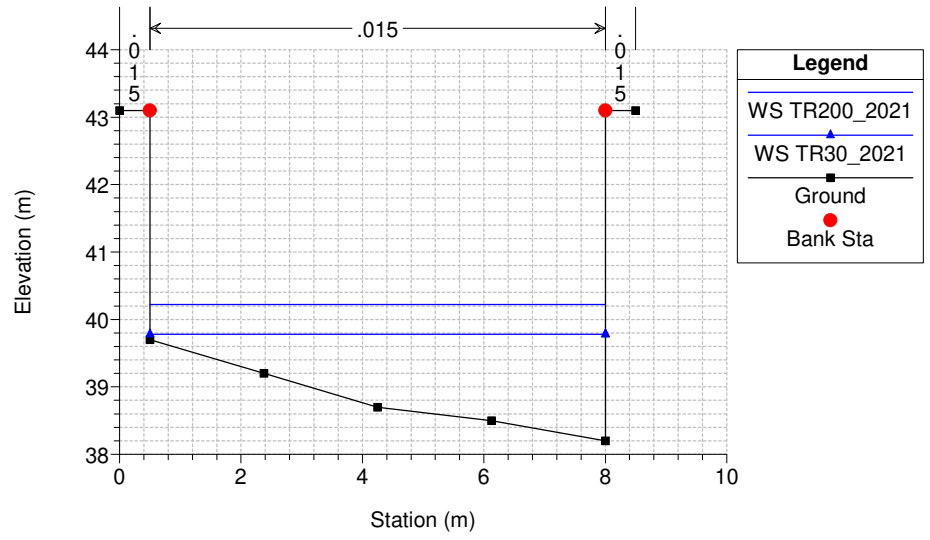
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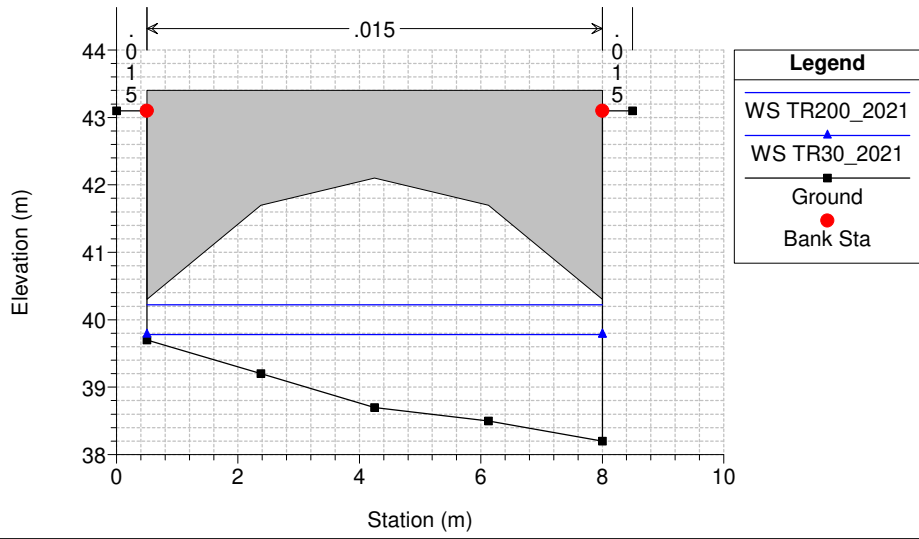
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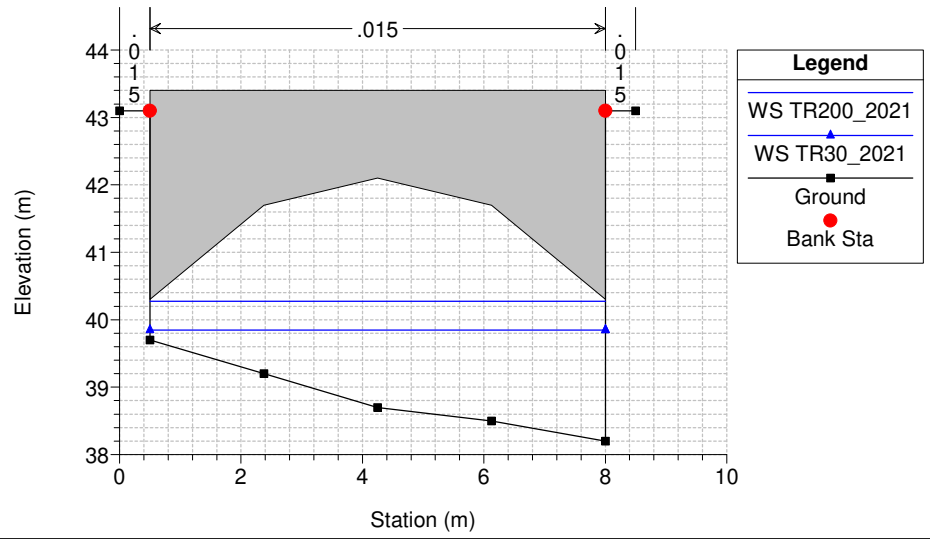
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Mulerna Plan: Mulerna\_2010 7/1/2021

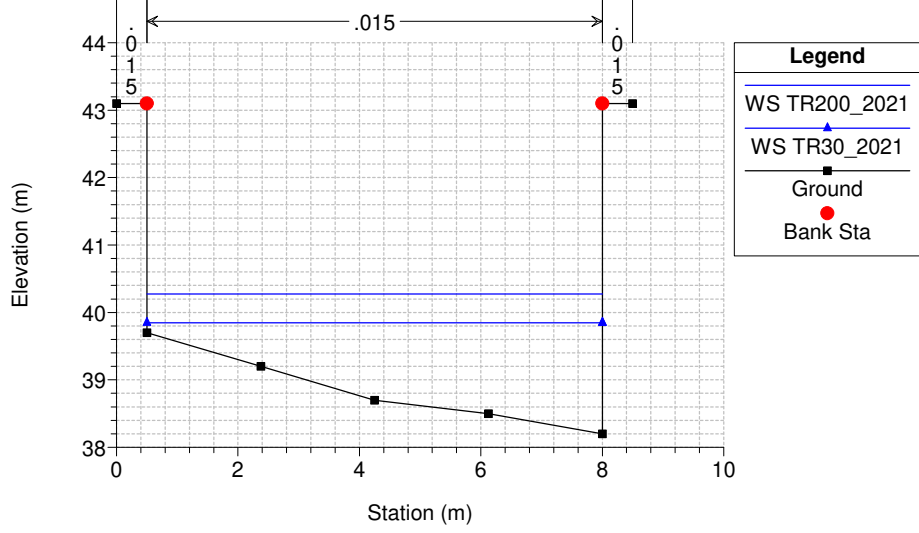


Mulerna Plan: Mulerna\_2010 7/1/2021

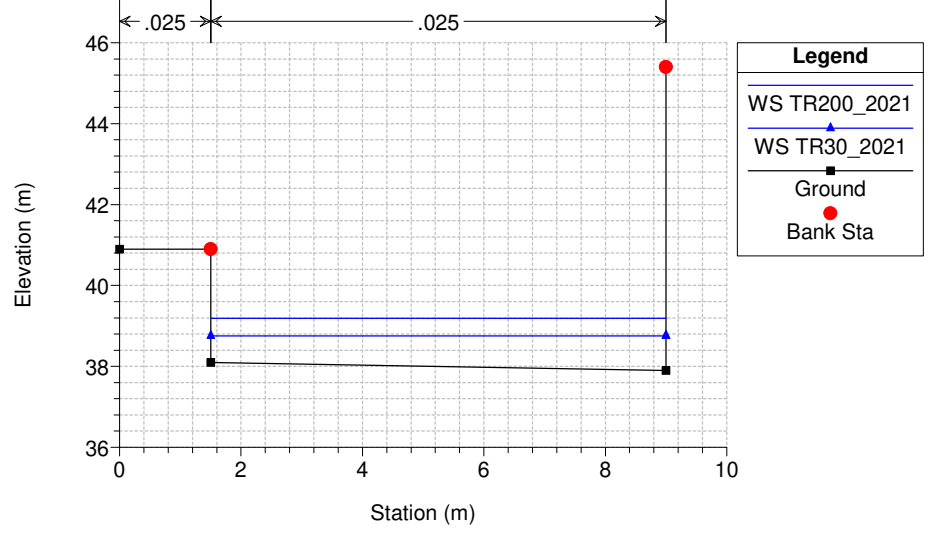




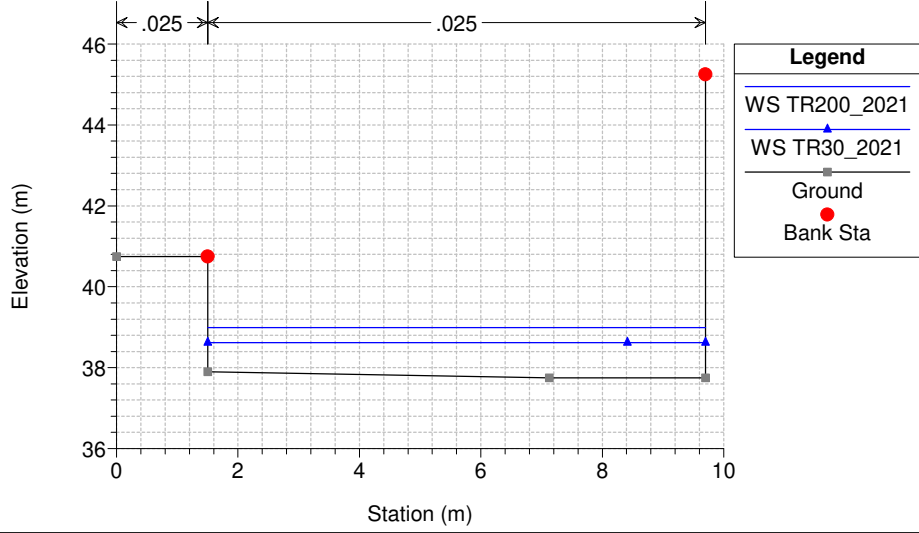
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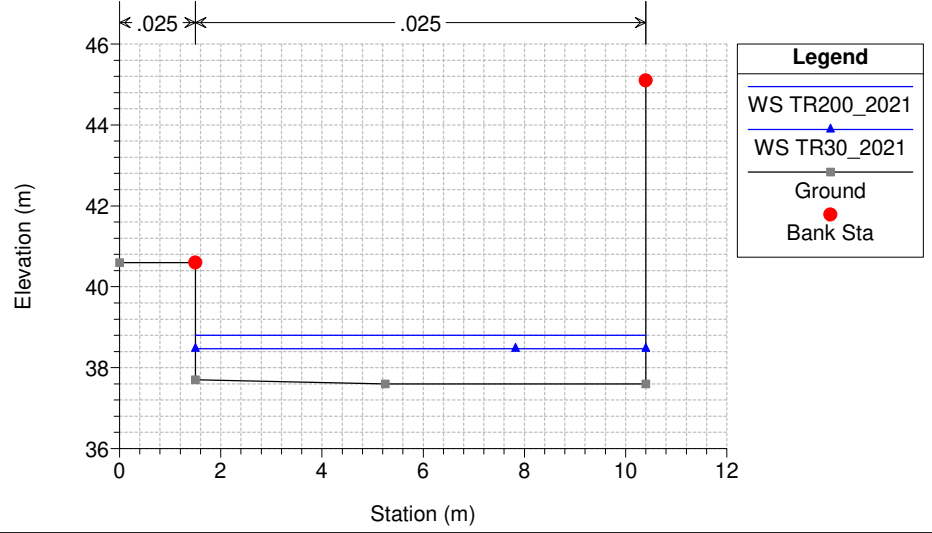
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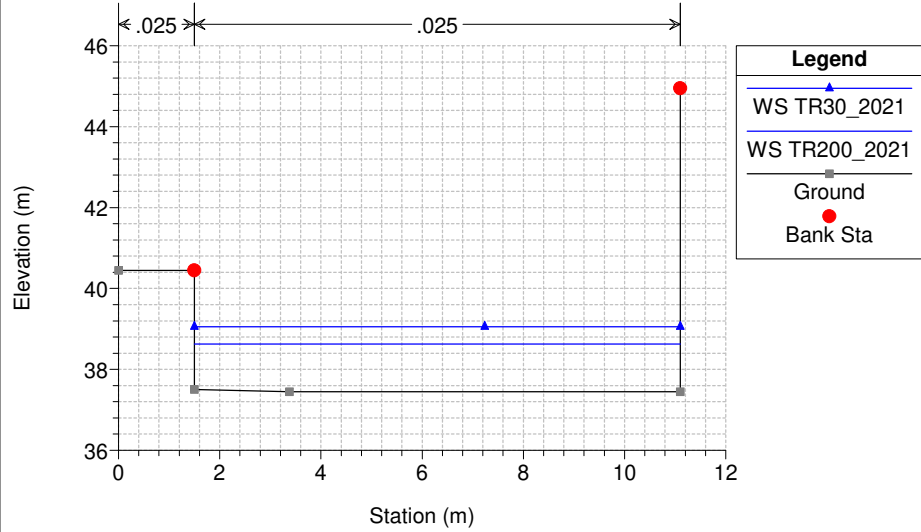
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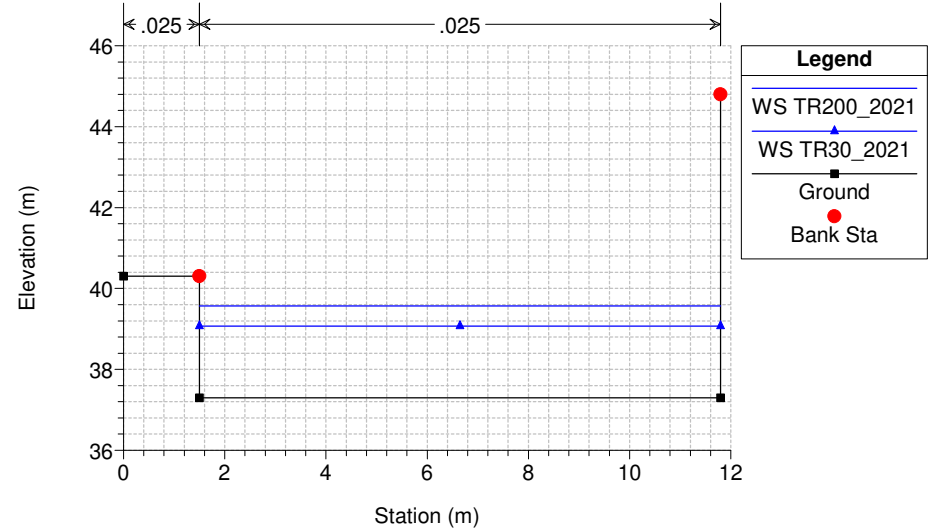
Mulerna Plan: Mulerna\_2010 7/1/2021



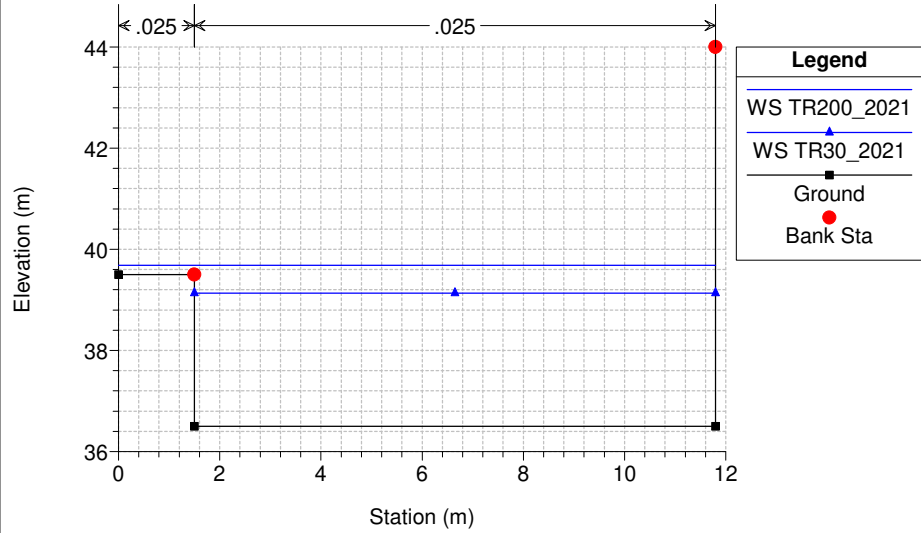
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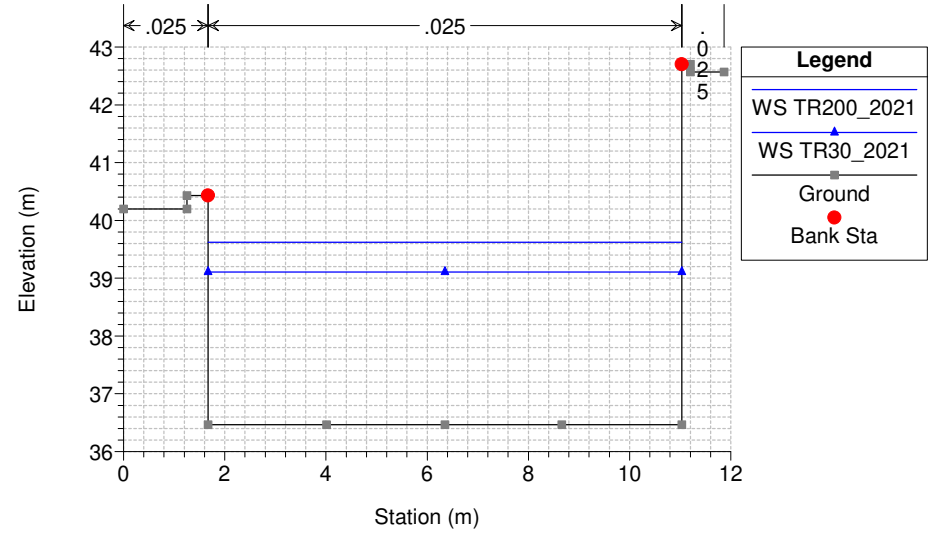
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30BIS



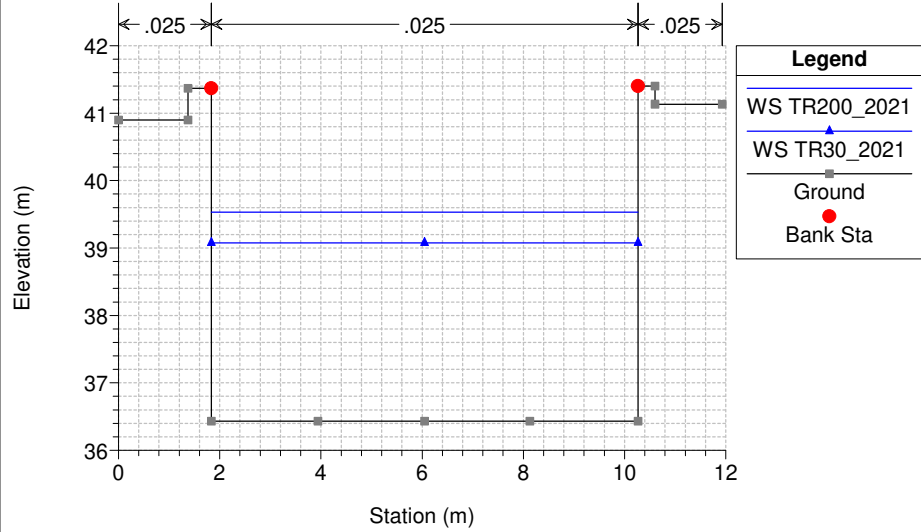
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S30



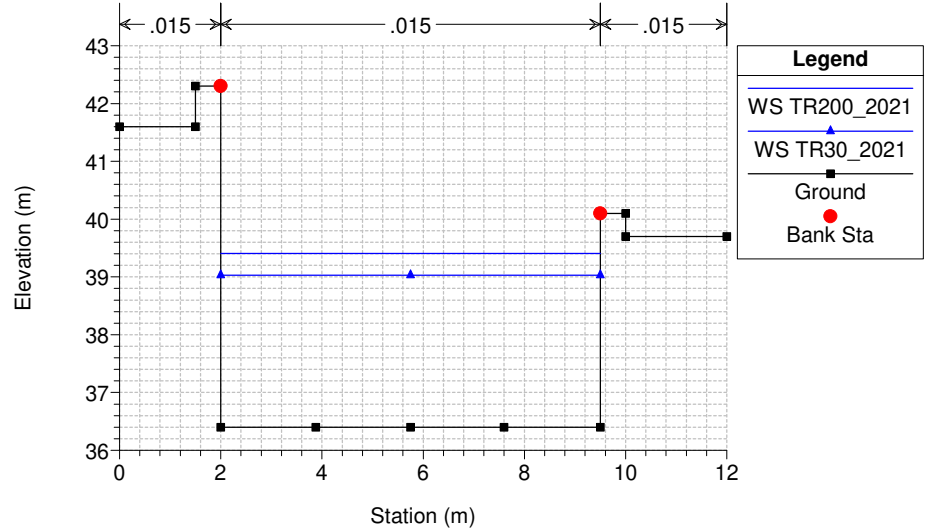
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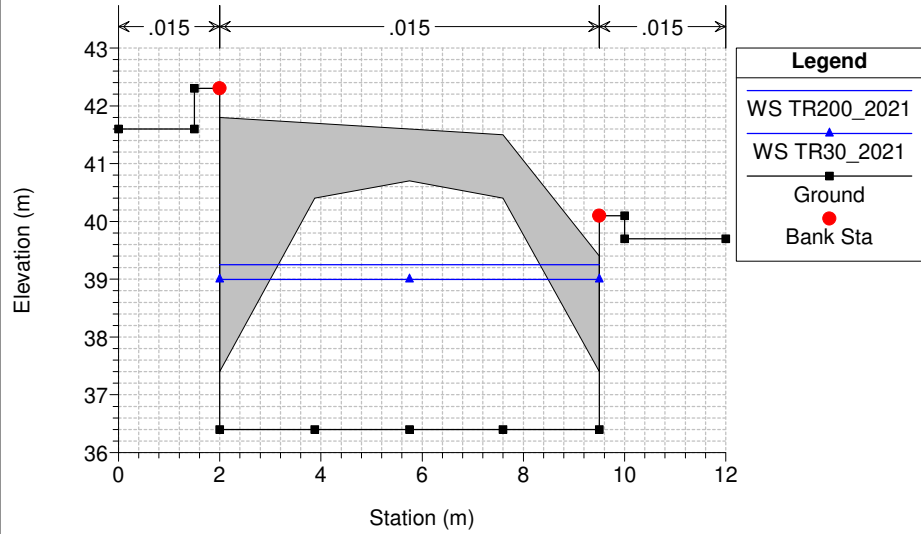
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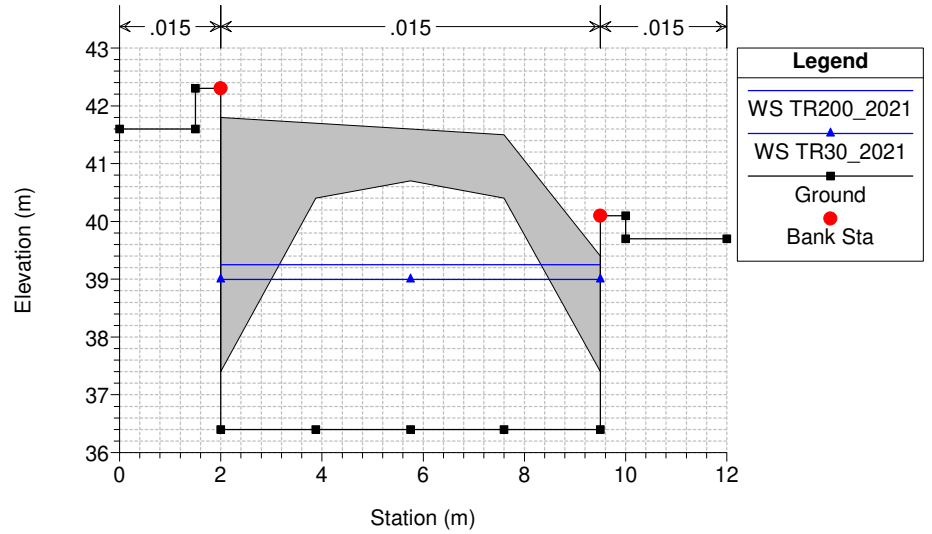
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S20

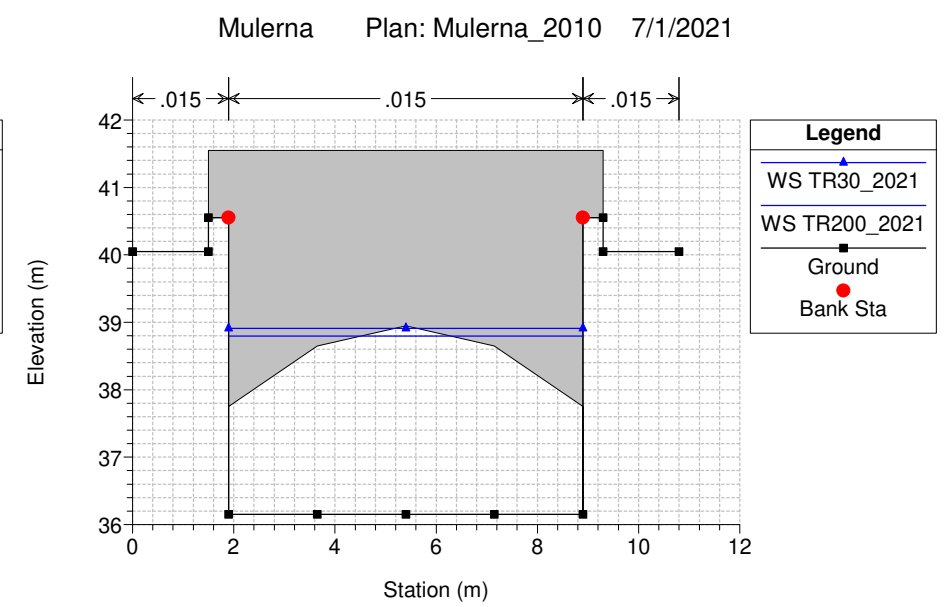
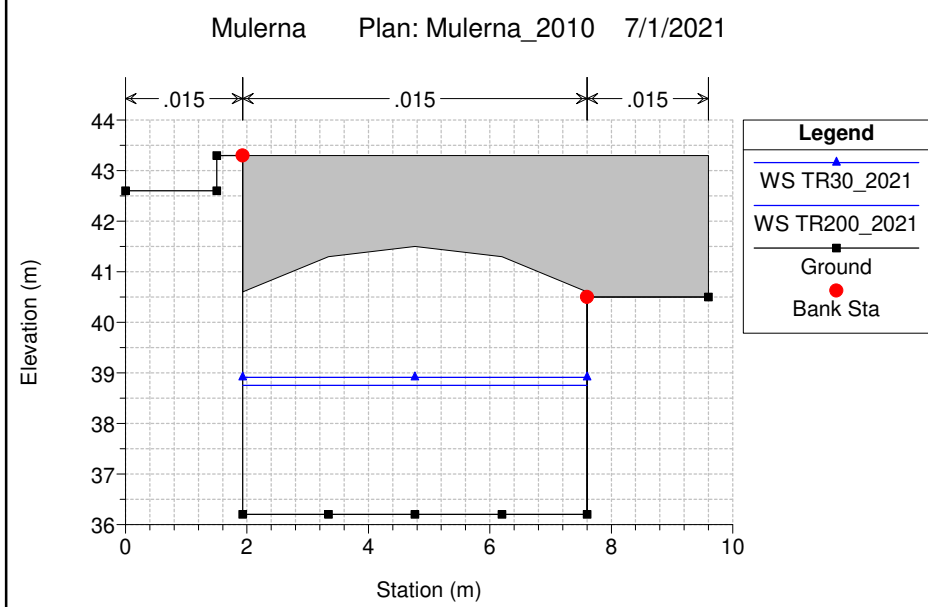
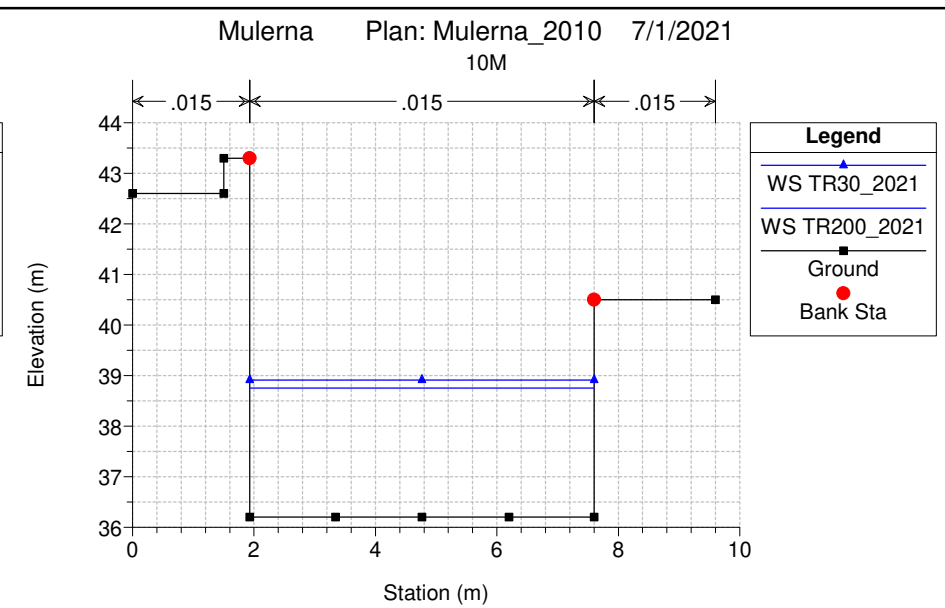
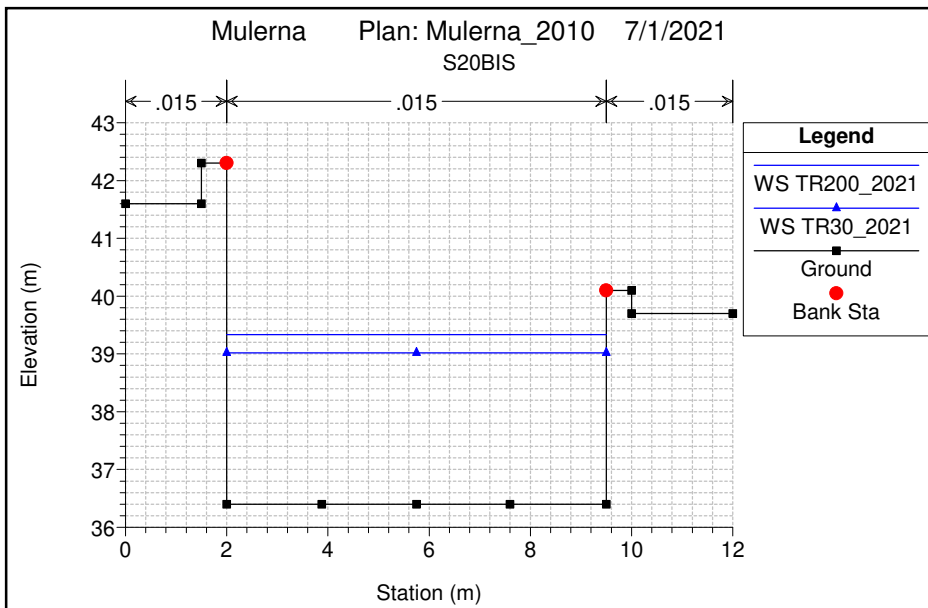


Mulerna Plan: Mulerna\_2010 7/1/2021

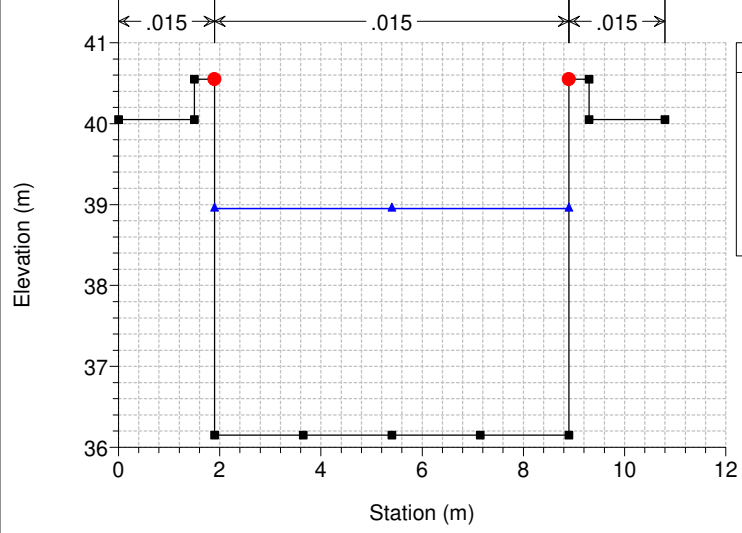


Mulerna Plan: Mulerna\_2010 7/1/2021





Mulerna Plan: Mulerna\_2010 7/1/2021  
S10V



**Legend**

- WS TR200\_2021
- WS TR30\_2021
- Ground
- Bank Sta



# **OUTPUT IDRAULICI RELATIVI AL SISTEMA RIO MULERNA**





HEC-RAS Plan: Mulerna\_2010 River: Mulerna Reach: Mulerna

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	LOB Elev	ROB Elev	L. Freeboard	R. Freeboard	Vel Chnl	Froude # Chl	Length Chnl
			(m3/s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/s)		(m)
Mulerna	110	TR200_2021	60.92	47.60	51.55	3.95	53.40	53.60	1.85	2.05	0.97	0.31	0.01
Mulerna	110	TR30_2021	32.96	47.60	50.63	3.03	53.40	53.60	2.77	2.97	1.19	0.27	0.01
Mulerna	109		Bridge										
Mulerna	108	TR200_2021	60.92	47.50	49.47	1.97	53.30	53.50	3.83	4.03	3.90	1.01	16.50
Mulerna	108	TR30_2021	32.96	47.50	48.85	1.35	53.30	53.50	4.45	4.65	3.36	1.01	16.50
Mulerna	100	TR200_2021	60.92	47.30	48.99	1.69	53.10	53.30	4.11	4.31	4.74	1.30	20.00
Mulerna	100	TR30_2021	32.96	47.30	48.42	1.12	53.10	53.30	4.68	4.88	4.18	1.35	20.00
Mulerna	99.6*	TR200_2021	60.92	47.00	48.63	1.63	52.67	53.04	4.04	4.41	4.95	1.38	20.00
Mulerna	99.6*	TR30_2021	32.96	47.00	48.10	1.10	52.67	53.04	4.57	4.94	4.27	1.39	20.00
Mulerna	99.2*	TR200_2021	60.92	46.69	48.30	1.61	52.24	52.77	3.93	4.47	5.06	1.42	20.00
Mulerna	99.2*	TR30_2021	32.96	46.69	47.79	1.10	52.24	52.77	4.44	4.98	4.31	1.40	20.00
Mulerna	98.8*	TR200_2021	60.92	46.39	47.99	1.60	51.80	52.51	3.82	4.52	5.12	1.44	20.00
Mulerna	98.8*	TR30_2021	32.96	46.39	47.49	1.10	51.80	52.51	4.32	5.02	4.34	1.42	20.00
Mulerna	98.4*	TR200_2021	60.92	46.08	47.68	1.59	51.37	52.24	3.69	4.57	5.16	1.46	20.00
Mulerna	98.4*	TR30_2021	32.96	46.08	47.19	1.10	51.37	52.24	4.18	5.06	4.34	1.42	20.00
Mulerna	98.*	TR200_2021	60.92	45.78	47.37	1.59	50.94	51.98	3.57	4.61	5.18	1.46	20.00
Mulerna	98.*	TR30_2021	32.96	45.78	46.89	1.11	50.94	51.98	4.05	5.09	4.34	1.42	20.00
Mulerna	97.6*	TR200_2021	60.92	45.48	47.07	1.59	50.51	51.72	3.44	4.65	5.20	1.47	20.00
Mulerna	97.6*	TR30_2021	32.96	45.48	46.59	1.11	50.51	51.72	3.92	5.13	4.35	1.42	20.00
Mulerna	97.2*	TR200_2021	60.92	45.17	46.77	1.60	50.08	51.45	3.31	4.68	5.21	1.47	20.00
Mulerna	97.2*	TR30_2021	32.96	45.17	46.29	1.12	50.08	51.45	3.79	5.16	4.35	1.42	20.00
Mulerna	96.8*	TR200_2021	60.92	44.87	46.47	1.60	49.64	51.19	3.18	4.72	5.21	1.47	20.00
Mulerna	96.8*	TR30_2021	32.96	44.87	45.99	1.12	49.64	51.19	3.66	5.20	4.35	1.42	20.00
Mulerna	96.4*	TR200_2021	60.92	44.56	46.17	1.60	49.21	50.92	3.04	4.76	5.22	1.47	20.00
Mulerna	96.4*	TR30_2021	32.96	44.56	45.69	1.12	49.21	50.92	3.53	5.24	4.36	1.43	20.00
Mulerna	96.*	TR200_2021	60.92	44.26	45.87	1.61	48.78	50.66	2.91	4.79	5.22	1.47	20.00
Mulerna	96.*	TR30_2021	32.96	44.26	45.38	1.12	48.78	50.66	3.40	5.28	4.37	1.43	20.00

HEC-RAS Plan: Mulerna\_2010 River: Mulerna Reach: Mulerna (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	LOB Elev	ROB Elev	L. Freeboard	R. Freeboard	Vel Chnl	Froude # Chl	Length Chnl
			(m3/s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/s)		(m)
Mulerna	95.6*	TR200_2021	60.92	43.96	45.57	1.61	48.35	50.40	2.78	4.83	5.23	1.47	20.00
Mulerna	95.6*	TR30_2021	32.96	43.96	45.08	1.13	48.35	50.40	3.26	5.31	4.37	1.43	20.00
Mulerna	95.2*	TR200_2021	60.92	43.65	45.27	1.61	47.92	50.13	2.65	4.87	5.23	1.48	20.00
Mulerna	95.2*	TR30_2021	32.96	43.65	44.78	1.13	47.92	50.13	3.13	5.35	4.38	1.44	20.00
Mulerna	94.8*	TR200_2021	60.92	43.35	44.97	1.62	47.48	49.87	2.52	4.90	5.24	1.48	20.00
Mulerna	94.8*	TR30_2021	32.96	43.35	44.48	1.13	47.48	49.87	3.00	5.39	4.38	1.43	20.00
Mulerna	94.4*	TR200_2021	60.92	43.04	44.66	1.62	47.05	49.60	2.39	4.94	5.22	1.52	20.00
Mulerna	94.4*	TR30_2021	32.96	43.04	44.18	1.14	47.05	49.60	2.87	5.42	4.37	1.43	20.00
Mulerna	94.*	TR200_2021	60.92	42.74	44.37	1.63	46.62	49.34	2.25	4.97	5.16	1.54	20.00
Mulerna	94.*	TR30_2021	32.96	42.74	43.88	1.14	46.62	49.34	2.74	5.46	4.38	1.43	20.00
Mulerna	93.6*	TR200_2021	60.92	42.44	44.07	1.63	46.19	49.08	2.12	5.01	5.10	1.54	20.00
Mulerna	93.6*	TR30_2021	32.96	42.44	43.58	1.14	46.19	49.08	2.61	5.50	4.38	1.43	20.00
Mulerna	93.2*	TR200_2021	60.92	42.13	43.76	1.63	45.76	48.81	1.99	5.05	5.06	1.53	20.00
Mulerna	93.2*	TR30_2021	32.96	42.13	43.28	1.15	45.76	48.81	2.48	5.53	4.39	1.44	20.00
Mulerna	92.8*	TR200_2021	60.92	41.83	44.44	2.62	45.32	48.55	0.88	4.10	2.38	0.61	20.00
Mulerna	92.8*	TR30_2021	32.96	41.83	42.98	1.15	45.32	48.55	2.35	5.57	4.38	1.46	20.00
Mulerna	92.4*	TR200_2021	60.92	41.52	44.48	2.95	44.89	48.28	0.41	3.81	1.96	0.47	20.00
Mulerna	92.4*	TR30_2021	32.96	41.52	42.67	1.15	44.89	48.28	2.22	5.61	4.37	1.47	20.00
Mulerna	92.*	TR200_2021	60.92	41.22	44.49	3.27	44.46	48.02	-0.03	3.53	1.68	0.38	20.00
Mulerna	92.*	TR30_2021	32.96	41.22	42.37	1.15	44.46	48.02	2.09	5.65	4.34	1.47	20.00
Mulerna	91.6*	TR200_2021	60.92	40.92	44.50	3.59	44.03	47.76	-0.47	3.25	1.48	0.32	20.00
Mulerna	91.6*	TR30_2021	32.96	40.92	42.07	1.15	44.03	47.76	1.96	5.69	4.32	1.47	20.00
Mulerna	91.2*	TR200_2021	60.92	40.61	44.51	3.90	43.60	47.49	-0.91	2.98	1.35	0.27	20.00
Mulerna	91.2*	TR30_2021	32.96	40.61	42.63	2.01	43.60	47.49	0.97	4.87	2.00	0.54	20.00
Mulerna	90.8*	TR200_2021	60.92	40.31	44.51	4.20	43.16	47.23	-1.35	2.72	1.25	0.24	20.00
Mulerna	90.8*	TR30_2021	32.96	40.31	42.65	2.34	43.16	47.23	0.52	4.58	1.63	0.41	20.00
Mulerna	90.4*	TR200_2021	60.92	40.00	44.51	4.51	42.73	46.96	-1.78	2.45	1.19	0.21	20.00
Mulerna	90.4*	TR30_2021	32.96	40.00	42.66	2.65	42.73	46.96	0.07	4.31	1.38	0.33	20.00



HEC-RAS Plan: Mulerna\_2010 River: Mulerna Reach: Mulerna (Continued)

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Max Chl Dpth (m)	LOB Elev (m)	ROB Elev (m)	L. Freeboard (m)	R. Freeboard (m)	Vel Chnl (m/s)	Froude # Chl	Length Chnl (m)
Mulerna	68	TR200_2021	60.92	39.60	42.50	2.90	42.90	42.90	0.40	0.40	3.80	0.74	6.50
Mulerna	68	TR30_2021	32.96	39.60	40.78	1.18	42.90	42.90	2.12	2.12	5.77	1.89	6.50
Mulerna	65	TR200_2021	60.92	39.50	42.71	3.21	42.50	47.50	-0.21	4.79	2.87	0.57	14.70
Mulerna	65	TR30_2021	32.96	39.50	41.89	2.39	42.50	47.50	0.61	5.61	2.23	0.50	14.70
Mulerna	62.5*	TR200_2021	60.92	39.37	42.64	3.27	42.12	45.03	-0.52	2.38	2.95	0.63	14.70
Mulerna	62.5*	TR30_2021	32.96	39.37	41.79	2.41	42.12	45.03	0.34	3.24	2.47	0.60	14.70
Mulerna	60	TR200_2021	60.92	39.25	42.76	3.51	41.75	42.55	-1.01	-0.20	2.21	0.44	17.67
Mulerna	60	TR30_2021	32.96	39.25	41.86	2.61	41.75	42.55	-0.11	0.69	1.83	0.43	17.67
Mulerna	58.3333*	TR200_2021	60.92	39.08	42.60	3.52	41.97	42.64	-0.62	0.04	2.68	0.57	17.67
Mulerna	58.3333*	TR30_2021	32.96	39.08	41.71	2.64	41.97	42.64	0.26	0.93	2.33	0.59	17.67
Mulerna	56.6666*	TR200_2021	60.92	38.90	42.35	3.45	42.20	42.73	-0.15	0.38	3.25	0.73	17.67
Mulerna	56.6666*	TR30_2021	32.96	38.90	41.24	2.34	42.20	42.73	0.96	1.49	3.52	1.00	17.67
Mulerna	55.*	TR200_2021	60.92	38.73	41.82	3.10	42.43	42.83	0.60	1.00	4.26	1.00	17.67
Mulerna	55.*	TR30_2021	32.96	38.73	40.65	1.92	42.43	42.83	1.78	2.18	4.44	1.18	17.67
Mulerna	53.3333*	TR200_2021	60.92	38.55	40.97	2.42	42.65	42.92	1.68	1.94	5.44	1.27	17.67
Mulerna	53.3333*	TR30_2021	32.96	38.55	40.27	1.72	42.65	42.92	2.38	2.64	4.67	1.36	17.67
Mulerna	51.6666*	TR200_2021	60.92	38.37	40.57	2.20	42.88	43.01	2.30	2.43	5.63	1.41	17.67
Mulerna	51.6666*	TR30_2021	32.96	38.37	40.06	1.69	42.88	43.01	2.81	2.94	4.45	1.35	17.67
Mulerna	50	TR200_2021	60.92	38.20	40.22	2.02	43.10	43.10	2.88	2.88	5.88	1.60	0.10
Mulerna	50	TR30_2021	32.96	38.20	39.78	1.58	43.10	43.10	3.32	3.32	4.65	1.53	0.10
Mulerna	49		Bridge										
Mulerna	48	TR200_2021	60.92	38.20	40.28	2.08	43.10	43.10	2.82	2.82	5.65	1.50	20.00
Mulerna	48	TR30_2021	32.96	38.20	39.85	1.65	43.10	43.10	3.25	3.25	4.35	1.38	20.00
Mulerna	40	TR200_2021	60.92	37.90	39.19	1.29	40.90	45.40	1.71	6.21	6.83	2.00	15.50
Mulerna	40	TR30_2021	32.96	37.90	38.75	0.85	40.90	45.40	2.15	6.65	5.84	2.15	15.50
Mulerna	37.5*	TR200_2021	60.92	37.75	38.99	1.24	40.75	45.25	1.76	6.26	6.26	1.84	15.50
Mulerna	37.5*	TR30_2021	32.96	37.75	38.62	0.86	40.75	45.25	2.13	6.63	4.94	1.75	15.50

HEC-RAS Plan: Mulerna\_2010 River: Mulerna Reach: Mulerna (Continued)

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Max Chl Dpth (m)	LOB Elev (m)	ROB Elev (m)	L. Freeboard (m)	R. Freeboard (m)	Vel Chnl (m/s)	Froude # Chl	Length Chnl (m)
Mulerna	35.*	TR200_2021	60.92	37.60	38.80	1.20	40.60	45.10	1.80	6.30	5.79	1.70	15.50
Mulerna	35.*	TR30_2021	32.96	37.60	38.47	0.87	40.60	45.10	2.13	6.63	4.37	1.52	15.50
Mulerna	32.5*	TR200_2021	60.92	37.45	38.63	1.18	40.45	44.95	1.82	6.32	5.41	1.59	15.50
Mulerna	32.5*	TR30_2021	32.96	37.45	39.05	1.60	40.45	44.95	1.40	5.90	2.15	0.54	15.50
Mulerna	30	TR200_2021	60.92	37.30	39.57	2.27	40.30	44.80	0.73	5.23	2.61	0.55	0.01
Mulerna	30	TR30_2021	32.96	37.30	39.07	1.77	40.30	44.80	1.23	5.73	1.81	0.43	0.01
Mulerna	29	TR200_2021	60.92	36.50	39.69	3.19	39.50	44.00	-0.19	4.31	1.85	0.33	18.33
Mulerna	29	TR30_2021	32.96	36.50	39.14	2.64	39.50	44.00	0.36	4.86	1.21	0.24	18.33
Mulerna	26.*	TR200_2021	60.92	36.47	39.62	3.16	40.43	42.70	0.81	3.08	2.06	0.37	18.33
Mulerna	26.*	TR30_2021	32.96	36.47	39.11	2.64	40.43	42.70	1.32	3.59	1.33	0.26	18.33
Mulerna	23.*	TR200_2021	60.92	36.43	39.53	3.10	41.37	41.40	1.84	1.87	2.33	0.42	18.33
Mulerna	23.*	TR30_2021	32.96	36.43	39.07	2.64	41.37	41.40	2.29	2.33	1.48	0.29	18.33
Mulerna	20	TR200_2021	60.92	36.40	39.41	3.01	42.30	40.10	2.89	0.69	2.70	0.50	0.01
Mulerna	20	TR30_2021	32.96	36.40	39.03	2.63	42.30	40.10	3.27	1.07	1.67	0.33	0.01
Mulerna	19		Bridge										
Mulerna	18	TR200_2021	60.92	36.40	39.33	2.93	42.30	40.10	2.97	0.77	2.77	0.52	13.00
Mulerna	18	TR30_2021	32.96	36.40	39.02	2.62	42.30	40.10	3.28	1.08	1.68	0.33	13.00
Mulerna	10	TR200_2021	60.92	36.20	38.75	2.55	43.30	40.50	4.55	1.75	4.21	0.84	0.10
Mulerna	10	TR30_2021	32.96	36.20	38.91	2.71	43.30	40.50	4.39	1.59	2.14	0.42	0.10
Mulerna	09		Bridge										
Mulerna	8	TR200_2021	60.92	36.15	38.95	2.80	40.55	40.55	1.60	1.60	3.11	0.59	
Mulerna	8	TR30_2021	32.96	36.15	38.95	2.80	40.55	40.55	1.60	1.60	1.68	0.32	