Prepared By:

Floodplain Analysis Report

Telfer Creek Square - 2275-16th Street East
Owen Sound, ON

GMBP File: 219112

March 2021

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA

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TELFER CREEK SQUARE - 2275-16TH STREET EAST
OWEN SOUND, ON

FLOODPLAIN ANALYSIS REPORT

MARCH 2021

GMBP FILE: 219112

1. INTRODUCTION

Exquisite Developers Inc. proposes to develop the property located at 2275 16th Street East, Owen Sound as Telfer Creek Square. The property is located south of 16th Street East and west of 28th Ave East. Refer to Figure 1 for general site location. Development is planned to include residential and commercial spaces.

Under existing conditions, the site is undeveloped and mainly treed. An existing un-named tributary of Bothwell's creek flows south to north through the southeastern portion of the site. Beyond the site's eastern limit, the creek passes through a box culvert under 16th Street East and flows north to join Bothwell's Creek. The Owen Sound Rail Trail and cycling route to the east of the site also passes under 16th Street East through a larger box culvert. The larger box culver also acts as an emergency overflow route during major storm events. Refer to Figure 2 for Site location details.

The area available for development on the site will be limited by the flood limit under the regional storm. Floodplain analysis is required by GSCA to determine the limit of flooding on the property under regional storm conditions prior to proceeding with development.

This Report is prepared to document the existing conditions flood limit under a Regional Storm to support development across the subject property.

2. EXISTING DRAINAGE CONDITIONS

Bothwell's Creek tributary drains south to north through the site. At the northeast corner of the site, the tributary creek crosses through a concrete box culvert under the Owen Sound Rail Trail and joins with another tributary from the east. The creek then flows through a 2000 x 2000 mm concrete box culvert to the north under 16th Street East. The invert elevation of the culvert is 226.63 MASL (meters above sea level).

The Rail Trail also crosses under 16th Street East via a 6050 x 4000 mm concrete box culvert. The culvert is partially filled with the trail base of approximately 1.5 meters thickness. The rail trail culvert opening invert elevation at the south (upstream) end is 228.40 MASL and is at 228.56 MASL at the north downstream end.

During large storm events, the floodline upstream, including on the subject property, would be controlled by flow through the small and large box culverts crossing under 16th Street East.

There have been two relevant previous floodplain analysis studies of the Bothwell's Creek tributary in proximity to the site. Previous floodplain analysis and floodline delination completed in 1988 by Henderson, Paddon, and Associates (HPA) titled "*Stormwater Study of Annexation and Industrial Park Areas*" determined that flows downstream of 8th Street East were limited by an existing culvert at 8th Street East. While this may be correct for current conditions, it is conceivable under large storm events that the culvert or roadway may fail, and flows may not be limited. It is also possible that the culvert may be replaced with a larger culvert in the future. Therefore, the floodline provided in the HPA report should not be relied upon until they are updated for the larger peak flow rate.

The *8th Street East Residential Development Functional Servicing and Stormwater Management Report* prepared by Crozier in 2015 estimated the floodline between 8th Street East and 16th Street East based on two cross-sections to input to their HEC-RAS model which was focused on determining flood levels south of 8th Street East. Generally, they found that the water levels between 8th Street East and 16th Street East did not impact the upstream water levels. The report noted that the estimated floodline elevations by HPA in the 1988 Report between 8th Street East and 16th Street East should not be relied upon.

Therefore, as requested by the Grey Sauble Conservation Authority, a new detailed HEC-RAS model is provided in this report to determine the floodline between 8th Street East and 16th Street East without any reduction in flow due to upstream conditions.

3. HYDROLOGY

The East Side Master Servicing Stormwater Management Study (ESMS SWM Study) completed by R.J. Burnside in 2008 calculated flow values at crossing locations of several creeks on the east side of Owen Sound based on catchment size, soil types, and development. The ESMS SWM Study is the master drainage study relied on by the City of Owen Sound for overall drainage planning.

The ESMS SWM Study calculated a flow rate of 22.69 m^3/s under the regional storm event (Timmins Storm) for the 16th Street East crossing.

Table 1 – Peak Flow Rate for 16th Street East Culvert Crossing from ESMS SWM Study

Node Description	Catchment Area (ha)	Upstream Catchment Areas (ha)	Total Contributing Area (ha)	**Peak Flow under Regional Storm (Timmins) (m^3/s)**
Culvert Crossing of 16th Street East	267	433	700	**22.69**

4. HYDRAULIC MODELLING

A new topographical survey was carried out by GMBP in December 2020 to provide elevations and cross-sections to be used in the HEC-RAS model. The locations of the cross-sections are shown on Figure 3.

Floodline modelling was prepared by Gamsby and Mannerow (now GMBP) in 2011 titled Surface Water Management Report, Andpet Industrial Park for the downstream reach of this watercourse north of 16th Street East and continuing approximately 420 meters downstream. Flood elevation directly north (downstream) of 16th Street East was found to be 227.84 meters above sea level.

Preliminary HEC-RAS modeling was completed for the Regional Storm flows as listed above in Section 3.

The regional storm event (Timmins Storm) water surface elevations for the existing conditions are summarized in Table 2 below for the various cross-sections.

Table 2 – HEC-RAS Floodplain Model Water Surface Elevations (m)

Cross-Section ID No.	Location Description of Station	Centerline Distance from Station 1 (m)	Flood Elevation under Existing Conditions (meters above sea level)
18	On Site	614	229.79
17		571	229.77
16		539	229.76
15		501	229.75
14		470	229.75
13		436	229.75
12		401	229.75
11		352	229.74
10		312	229.74
9		263	229.74
8		224	229.74
7		185	229.73
6		140	229.73
5	Immediately Upstream of 16th Street East	100	229.73
4	16th Street East Culvert	53	-
3	Downstream of 16th Street East	53	227.97
2		32	227.90
1		0	227.84

As shown in the above table, water surface elevations upstream of the 16th Street East, and within the study area, are in the range of 229.79 to 229.73 masl. Therefore, the water surface elevation is based on backup due to the 16th Street East culverts, not a restriction in the cross-sectional area across the subject property.

Sensitivity Analysis to the elevation downstream (Cross-section 1 through 3) was completed comparing the model with a set elevation at Cross-Section 1 of 227.84 compared to critical flow surface. Water surface elevations in Cross-Sections 5 through 18 did not change based on the downstream boundary conditions. As such, the water surface elevation across the subject property does not appear to be controlled by the downstream reach but is confirmed to be controlled by the 16th Street East culvert crossing.

5. PROPOSED CUT AND FILL

A fill of 40 m^3 is proposed to adjust the floodline horizontally in one location to straighten out the floodline in one area. To ensure the available flood volume is unchanged, a cut of 40 m^3 is proposed to be completed from the same elevation on the subject property at a nearby location just south of the fill area. The proposed cut and fill is minor in overall volume and will result in equal volumes and at the same elevation. As such, any changes to the flood elevation under various storms will be negligible. The floodlines have very little change in elevation across the subject property. This is because the floodline is controlled by the crossing under 16th Street East. Therefore, the overall volume of flooding has little impact on the floodlines. Regardless, balancing the cut and fill within the floodplain will result in no impact to the floodlines.

6. CONCLUSION

In conclusion, water surface elevations upstream of the 16th Street East, and within the study area, are in the range of 229.79 to 229.73 masl. The specific floodline elevations for each cross-section is shown on Figure 4.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

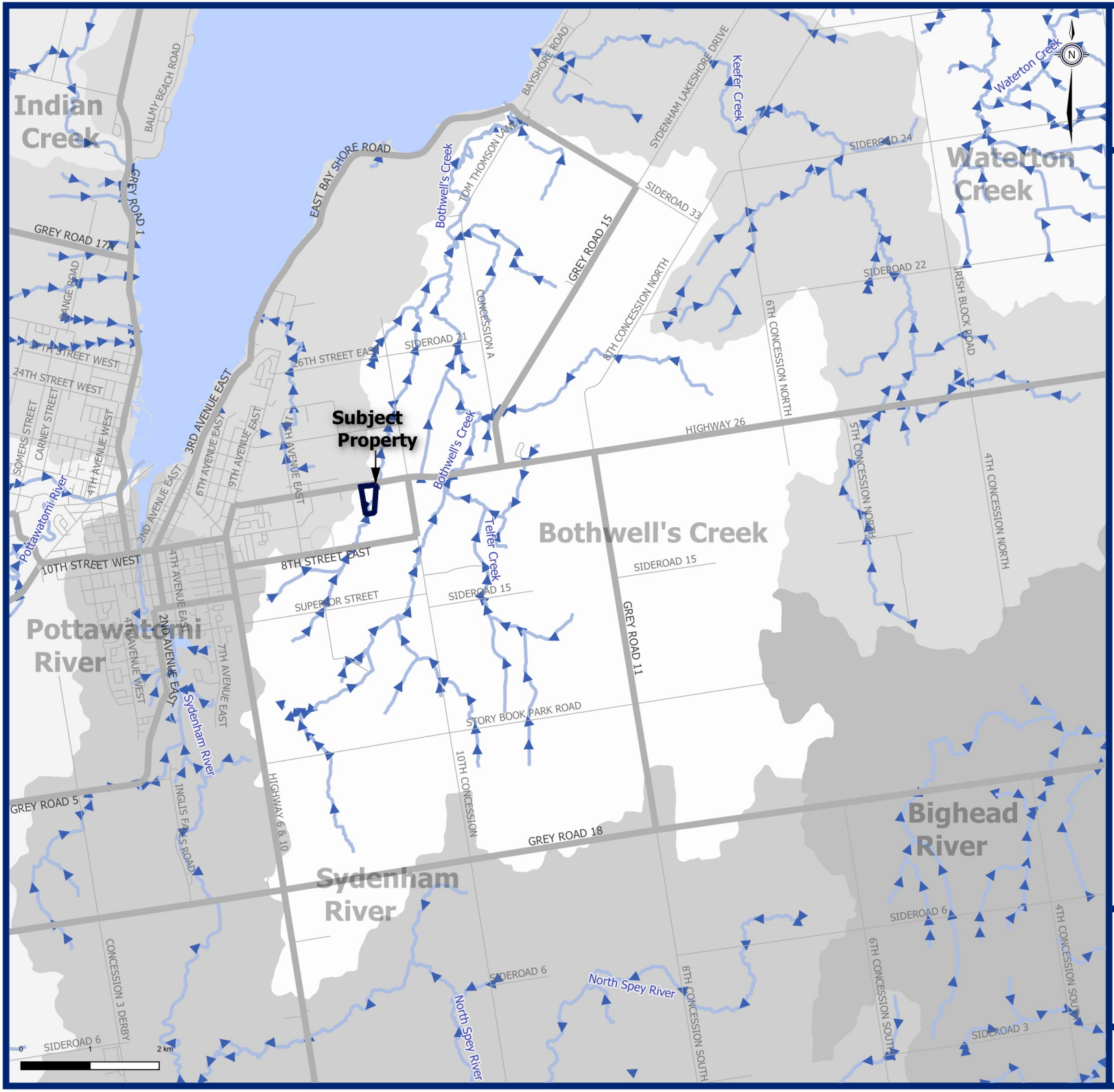
Prepared by:

Jennifer L Swiger, E.I.T.

Reviewed By:

Ian E. Eriksen, P.Eng.

FIGURES:



Telfer Creek Square
2275-16th Street East
Owen Sound

Site Location

- Site Boundary

Ontario Roadway

- Major Road
- Local Road
- Waterway
- Waterbody

Ontario Watershed

- Unidentified/Unnamed
- Waterton Creek
- Bothwell's Creek
- Pottawatomi River
- Indian Creek
- Bighead River
- Sydenham River

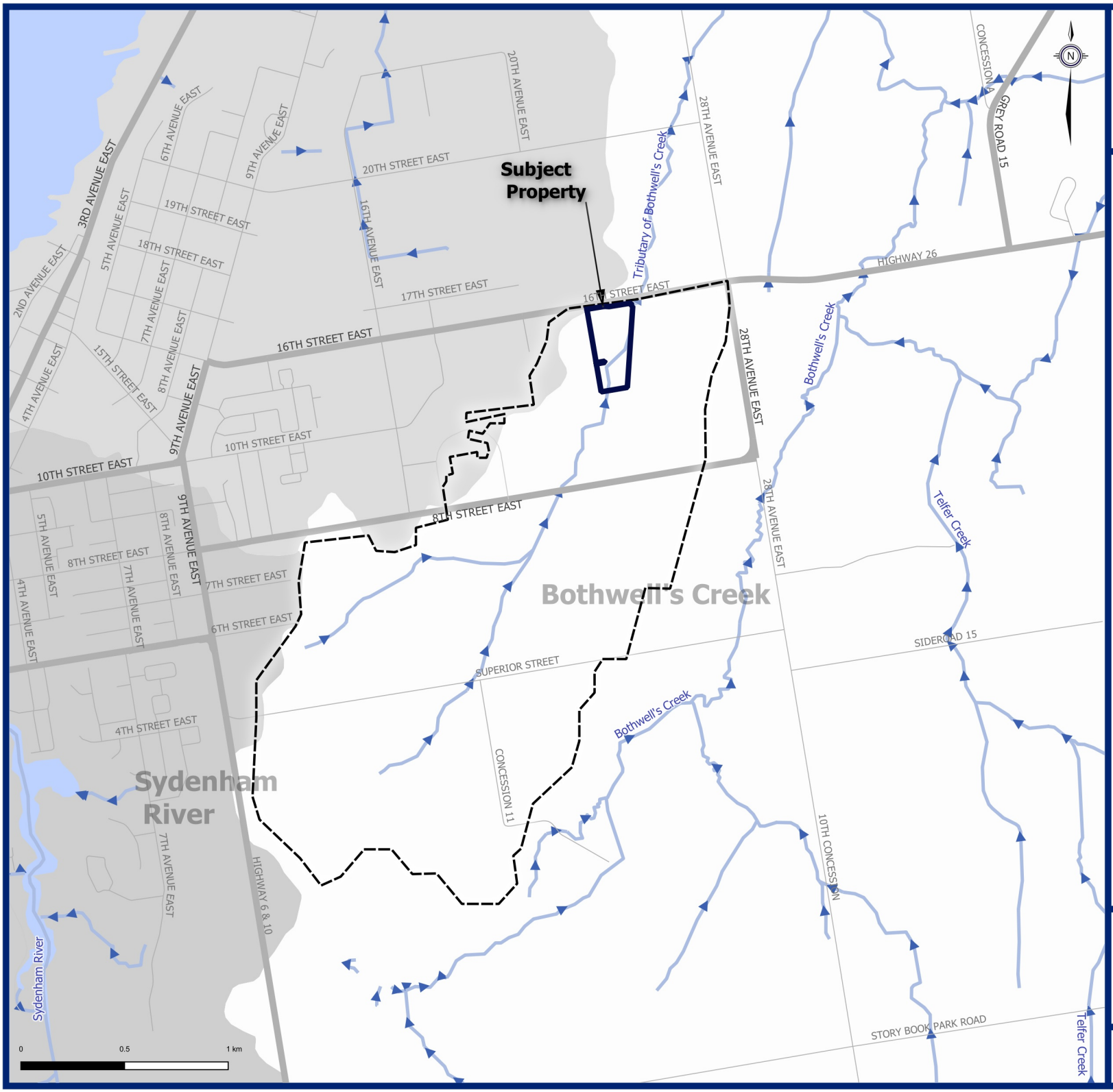
Figure 1

SITE LOCATION MAP

BluePlan ENGINEERING

April, 2021
219112
Projection EPSG:26917

Document Path: W:\OwenSound\Owen Sound\219-201912\19112 Site Plan - Telfer Creek Square - 2275-16th Street East, Owen Sound\GIS and Databases\Profile.qgz



Telfer Creek Square
2275-16th Street East
Owen Sound

16th Street East Crossing Catchment Boundary

Site Location

- Site Boundary

Ontario Roadway

- Major Road
- Local Road
- Waterway
- Waterbody

Ontario Watershed

- Bothwell's Creek
- Other
- Sydenham River

Figure 2

STUDY WATERSHED AREA

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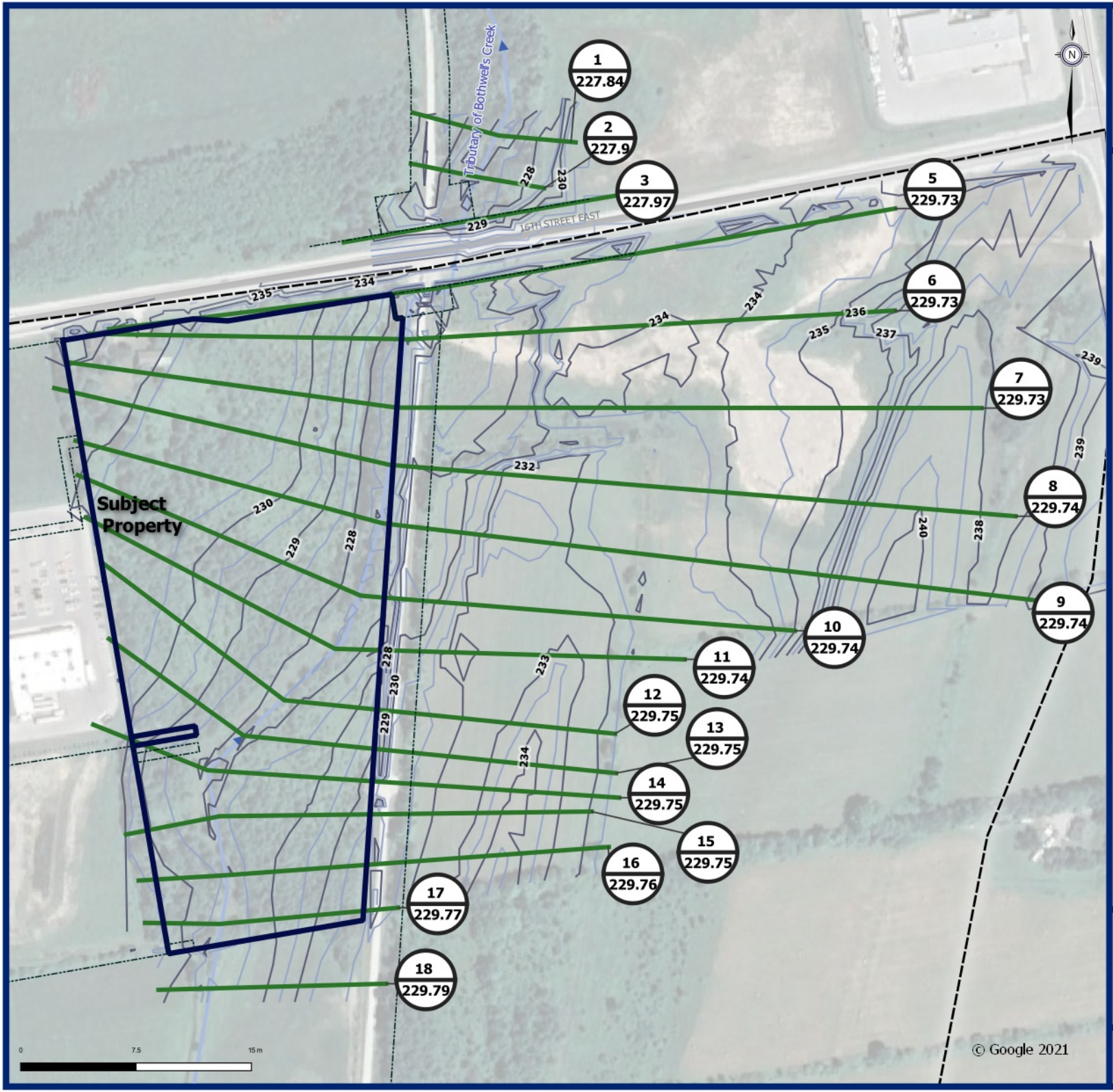

Telfer Creek Square
2275-16th Street East
Owen Sound

Cross-sections

Property Boundaries

Site

Other Properties

16th Street East Crossing Catchment Boundary

Waterway

Contours

Contour

Index Contour

Figure 3

FLOOD MODEL CROSS-SECTION LOCATION PLAN

BluePlan

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Projection EPSG:26917

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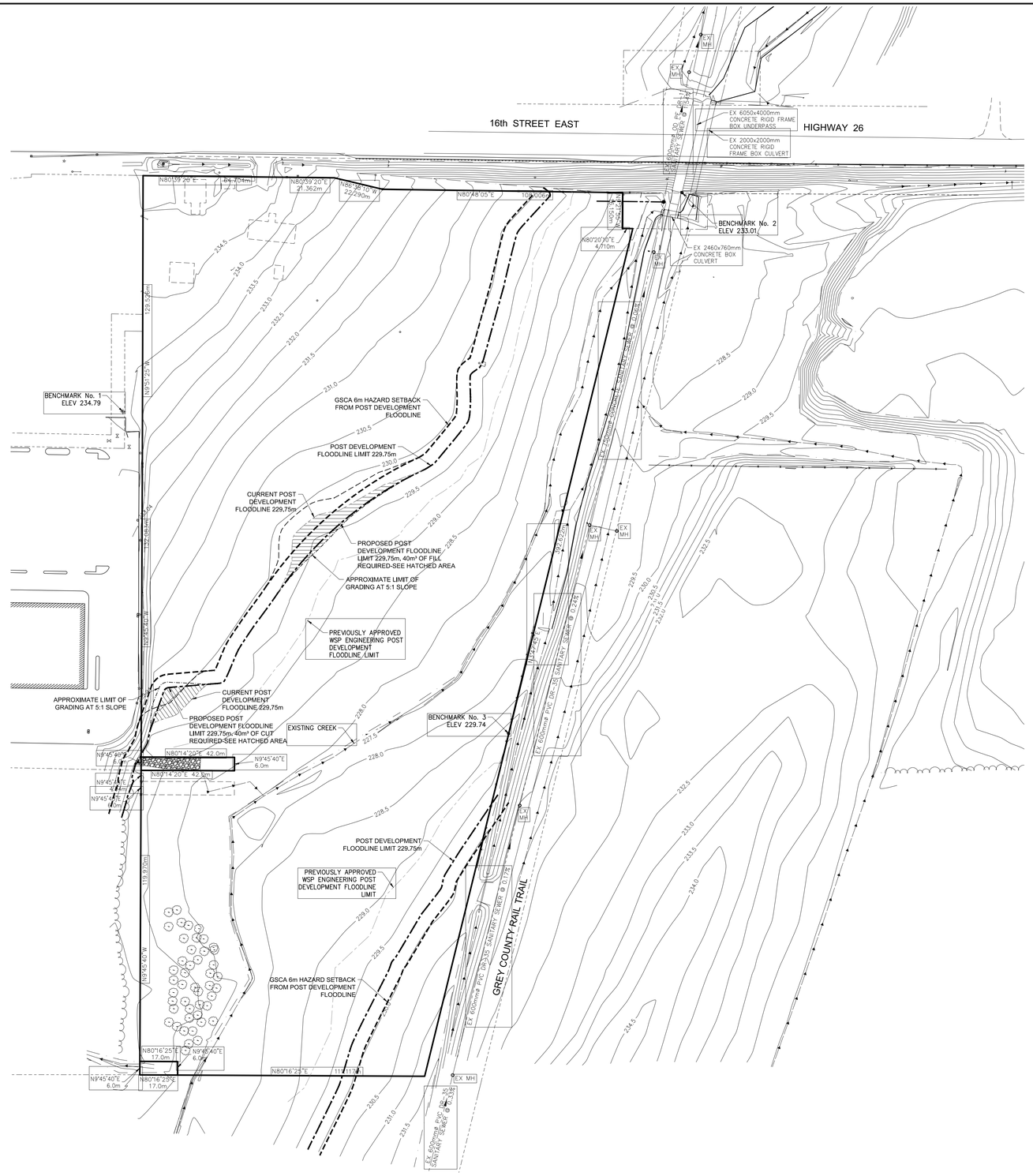

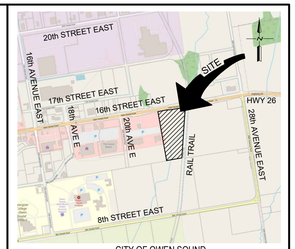

CITY OF OWEN SOUND

KEY PLAN

NOT TO SCALE

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRIC UNLESS OTHERWISE NOTED.
2. INFORMATION FOR LEGAL BOUNDARY WAS REFERENCED FROM OCTOBER 6th, 2011 SURVEY BY HEWETT AND MILNE LIMITED, PLAN 16R-10096.
3. TOPOGRAPHIC SURVEY COMPLETED ON DECEMBER 15th, 2020 BY GM BLUEPLAN ENGINEERING LTD.

BENCHMARKS :

BENCHMARK No. 1 - ELEVATION 234.79

TOP OF SPINDLE ON FIRE HYDRANT LOCATED AT THE NORTHEAST CORNER OF THE VALUE VILLAGE PARKING LOT WEST OF THE SUBJECT PROPERTY.

BENCHMARK No. 2 - ELEVATION 233.01

TOP OF CONCRETE ON THE SOUTHEAST CORNER OF THE 6050x4000mm BOX CULVERT UNDER 16th STREET EAST (HWY 26).

BENCHMARK No. 3 - ELEVATION 229.74

TOP OF NAIL IN FENCE POST ON THE WEST SIDE OF THE GREY COUNTY RAIL TRAIL APPROXIMATELY 250m SOUTH OF THE HIGHWAY 26 RIGHT OF WAY.

LICENSED PROFESSIONAL ENGINEER
I. E. ERIKSEN
100128824
March 31/21
PROVINCE OF ONTARIO

NO.	DATE	REVISION DESCRIPTION	CHKD
1	03/31/21	ISSUED FOR CITY AND GSCA APPROVAL	IEE

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TELFER CREEK SQUARE

EXQUISITE REAL ESTATE HOLDINGS LTD.

2275 16th STREET EAST, CITY OF OWEN SOUND

OVERALL SITE PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
K.B.	I.E.E.	219112	SP1
DESIGNED BY :	DATE :	SCALE :	
I.E.E.	DEC 2020	1:1,000	

APPENDIX A:
HYDROLOGY – ESMS SWM STUDY RELEVANT SECTION

3.3.1 East Bluffs Area Proposed Analysis and Methodology

The East Bluffs area consists of two (2) distinct existing storm sewer networks defined by the above mentioned perimeter boundaries and the halfway point between 23rd Street East and 25th Street East. The two existing storm sewer systems are referred to herein as the North and South Storm Sewer systems.

As-constructed storm sewer data consisting of invert elevations, pipe sizes and slopes have been provided by the City of Owen Sound to aid in the determination of the existing North and South Storm Sewer systems capacities. Based on the existing condition analysis of the North and South Storm Sewer systems, alternative solutions to provide servicing for the future infill developments within the area can be analyzed. Where as-constructed storm sewer information was not available, standard storm sewer design practices were implemented to complete the analysis for the unknown areas.

3.4 15th Street "B" East Storm Sewer

The hydrologic model OTTSWMM was utilized to assess the 15th Street B East area where a greater level of detail is required to isolate each storm sewer or road segment and understand how catchbasin density affects the peak flow within the storm sewer. The best available as-built information for the catchment area and consultant's drawings for adjacent under-construction or proposed developments were used to develop the catchment area parameters. A flow meter was installed to monitor storm sewer flow rates and compare them against measured rainfall volumes. Photos and reports from local residents helped to understand the extent of flooding and validate the model.

4 Telfer Creek Analysis

4.1 Existing Hydrology

4.1.1 General

The drainage limits for the Telfer Creek West Tributary have been determined based on field investigations, Ontario Base Mapping and GIS generated surface flow analysis calculations. In general, existing topographic features indicate that overland sheet flow occurs in a southwest to northeast direction. Three individual drainage areas of 263ha, 124ha and 57ha, Catchment Areas 3, 2 and 1 respectively, have been examined in this report. Flow nodes have been established at the following three key points located along the tributary: the first at the 8th Street East crossing, the second at a confluence point located approximately 200m north of 16th Street East and finally the third at the 28th Ave East crossing. These nodes are located at the northern limits of Catchments 1, 2 and 3, respectively. Refer to **Drawing SWM3** for existing catchment boundaries and aerial photography from 2006.

4.1.2 Soil Conditions

According to the Grey County Soils map, prepared for the Department of Agriculture in 1959, there is a general similarity of soil distribution between Catchment Areas. **Table 1**: Telfer Creek Soils Condition, illustrates soils located within the confines of the individual catchment boundaries along with their corresponding Ministry of Transportation (MTO) Hydrologic Soil Group classification.

Table 1: Telfer Creek Soils Condition

Catchment	Soil Code	Series	Hectares (ha)	Hyd Soil Group
3	Bc	Brookston	20.0	C
	Has	Harkaway	135.5	BC
	Ksc	Kemble	17.0	C
	Vsc	Vincent	90.0	C
2	Bc	Brookston	13.0	C
	Has	Harkaway	96.0	BC
	Ksc	Kemble	0.0	C
	Vsc	Vincent	15.0	C
1	Bc	Brookston	0.0	C
	Has	Harkaway	42.0	BC
	Ksc	Kemble	0.0	C
	Vsc	Vincent	2.0	C
	Wi	Wiarton	*13.0*	*B*

The Runoff Curve Number for the individual drainage areas have been computed by calculating weighted curve numbers based on the corresponding land use and soil type. A summary of these calculations for each drainage area is included in **Appendix A1.**

4.1.3 Land Use Patterns

Land use patterns of individual catchment areas have been determined by field investigations and aerial photography. As illustrated on **Drawing SWM3**, there is a single dominant land use pattern for the west tributary of Telfer Creek. Farmland/crop occupies a significant portion of each catchment area and has been solely used for calculations in this report. It is of note that small developed areas are present at the west limit of the watershed (i.e. hospital) and have been assumed as undeveloped for model simplicity. Farmland, escarpment protected and hazard lands occupy approximately 98% of the total watershed area.

4.1.4 Hydrologic Analysis and Results

By establishing watershed boundaries, soil conditions and land use patterns, pre-development flows have been determined using the SWMHYMO Hydrologic Model. Pre-development flows have been determined for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year and Regional storm events.

These flows are summarized at individual flow nodes illustrated in **Table 2** below. The SWMHYMO runs for the 6-hour SCS Type-II storm distributions are included as **Appendix A1**.

Table 2: Telfer Creek Pre-Development/Existing Condition Peak Flows

*Node	Total Area (ha)	Peak Flows to Flow Nodes (6-hour SCS Type-II Storm Distribution)						
		2 yr. m^3/s SCS	5 yr. m^3/s SCS	10 yr. m^3/s SCS	25 yr. m^3/s SCS	50 yr. m^3/s SCS	100 yr. m^3/s SCS	Regional m^3/s TIMMINS
3	245	2.26	3.85	5.04	6.66	7.92	9.21	15.76
2	267	2.89	4.89	6.38	8.39	7.92	11.58	22.69
1	433	3.18	5.37	7.00	9.21	10.93	12.69	26.07

***Flow node locations are illustrated on Drawing SWM3**

Calculated peak flows to Node 1 represent a total net flow for the 433 ha watershed area of the west tributary of Telfer Creek.

Pre-development flow rates to Flow Node 1, illustrated in Table 2 have been divided by a total drainage area of 432.6 ha to determine unit flow rates as illustrated in **Table 3** below and **Table 1 in Appendix A2**. These unit flow rates will be used in the preceding proposed hydrology calculations.

Table 3: Telfer Creek Unit Flow Rates

*Node	Total Area (ha)	Peak Flows to Flow Nodes (6-hour SCS Type-II Storm Distribution)						
		2 yr. m^3/s SCS	5 yr. m^3/s SCS	10 yr. m^3/s SCS	25 yr. m^3/s SCS	50 yr. m^3/s SCS	100 yr. m^3/s SCS	Regional m^3/s TIMMINS
All	433	0.0074	0.012	0.016	0.021	0.025	0.029	0.060

***Flow node locations are illustrated on Drawing SWM3**

4.2 Proposed Hydrology

4.2.1 General

Proposed land use patterns have been derived from the City of Owen Sound Official Plan, as illustrated on **Drawing SWM1.** Proposed land use patterns within the confines of this watershed are residential, commercial, industrial, and institutional lands. Each of these land use patterns have been examined individually in this report. Hazard lands, escarpment protected lands, rural areas and open space areas have been grouped together for simplicity. As shown on **Drawing SWM1,** the southern portion of Catchment 3 does not fall within the City of Owen Sound Official Plan; as such it has been assumed that these lands will remain undeveloped.

4.2.2 Post-Development Drainage (Application of this Approach)

The basis for examining the post development drainage has been outlined in Section 3.1.1 by developing unit flow rates for Telfer Creek. Analysis of post-development hydrology at this point has been completed to illustrate how this approach will work. This example helps the City and proponent's consultants to understand the methodology and potential Stormwater management volume requirements.

The example continues in the analysis as outlined in **Table 2 Appendix A2.** Table 2: Allowable Release Rates for Each Land Use based on Pre-Development Unit Flow Rates, illustrates the individual land uses patterns derived from the City of Owen Sound's Proposed Land Use Map and associated allowable release rates. The size of each individual land use area (i.e. residential, industrial, commercial, etc.) has been calculated within the individual catchments using GIS and AutoCAD techniques. The land use areas represented in the **Table 2 Appendix A2** represent a summation of like land uses within the total catchment area of approximately 433 ha. This has been done to illustrate the example of required SWM pond volumes. Having the areas of each individual land use, the allowable release rates for each individual land use could then be calculated for each return period by multiplying the Unit flow rates (shown in **Table 1 in Appendix A2**) by the individual land use areas. By multiplying the individual land use areas by the target unit flow rates, post-development flows will not exceed pre-development flows because the summation of the parts (peak flows) cannot be greater than the whole (total peak flow at the outlet).

Finally, the target release rates have been used to calculate storage volume requirements for each land use. Table 3: Required Storage Volumes for Each Land Use based on Pre-Development Unit Flow Rates, illustrates approximate required storage volumes for each land use to attenuate post-development flows to pre-development rates. Target release rates in **Table 2** have been used in conjunction with the SWMHYMO Hydrologic Model to determine post-development storage volumes.

The required storage volumes for each land use illustrated in **Table 3, Appendix A2** are used to calculate the unit rate storage volumes shown in **Table 4**: Required Unit Rate Storage Volumes for Each Land Use Based on Storage Volume/Land Use Drainage Area. By dividing the storage volumes in Table 3, **Appendix A2** by their respective land use area, the required unit storage volumes can then be determined. This table provides an estimate of the storage volume requirements. By multiplying a unit rate by the proponent's development area, allowable release rates and appropriate storage volumes can be determined to assist the proponent's consultant or to review the consultant's submission. It must be noted again, that reference to Tables 1, 2, 3 and 4 in Appendix A2 illustrates the approach of unit flow rates. **Table 3: Telfer Creek Unit Flow Rates** above provides a summary of the recommended target unit flow rates provided to maintain the post-development peak flows at the pre-development target rates.

4.3 Erosion Threshold Analysis

Aqualogic was retained to assist in determining the erosion thresholds of Telfer Creek. Refer to **Appendix C** for complete details of the Erosion Threshold Analysis.

Extended detention provides a means of holding back urban runoff to allow release of the first flush (1 in 1.5 year to 2 year storm) over a longer period of time to reduce the impact of runoff volume increases following development. Erosion thresholds are determined at critical locations along the watercourse where increases in the frequency and duration by which the threshold is exceeded increases the potential erosion following development. This can be mitigated by extending the period of time to release the first flush through SWM facilities being incorporated with a special extended detention control structure, typically a small orifice plate (greater than 75mm diameter). With this method the number of times the erosion threshold is exceeded remains the same as existing conditions even though the runoff volume in total has increased with development. Preliminary locations for SWM ponds are illustrated on **Drawing SWM4.**

The MOE Stormwater Management Planning and Design Manual dated March 2003, recommends the greater of site specific requirements or $40m^3$/ha over 24hrs minimum for extended detention in Stormwater management ponds. Based on the findings of the Erosion Threshold Analysis the minimum of $40m^3$/ha over 24hrs minimum is recommended for extended Stormwater control in future SWM ponds. It is recommended that existing vegetation be maintained along Telfer creek low flow channel to maintain its current stable characteristics. Should the low flow channel be disturbed the vegetation should be reinstated to equal or better.

4.4 Water Quality Control

It is recommended that water quality control follow the requirements of the Ministry of the Environment 2003 Stormwater Management Planning and Design Manual (SMPDM). Enhanced level of protection is recommended with volumes as noted in Table 3.2 of this document (SMPDM) as this watercourse feeds strong fishery communities downstream.

4.5 Conclusions and Recommendations Telfer Creek

With the headwater portion of Telfer Creek being un-developed, there is an opportunity to establish sound stormwater management practices to prevent flooding and erosion issues as witnessed within Kenny Drain. Pre-development target flow rates and attenuation volumes established in this report will allow consultants to use various models or methods for post-development flows/storage volumes while removing the variation of pre-development targets that can be developed with different models. This will ensure that there is no peak flow and flooding increase in Telfer Creek. The general layout of the Tables provided in **Appendix A2** provides an excellent management and implementation tool by reducing review time by the City staff and improving response back to the proponent.

It is recommended that the water quality and erosion control follow the requirements of the Ministry of Environment 2003 Stormwater Management Planning and Design Manual. Enhanced level of protection is recommended with volumes as noted in Table 3.2 (SMPDM).

It is recommended that the landowners work together with the City to finalize centralized locations of stormwater management facilities, where possible, at low points in the local topography to service more than one development thereby increasing available development land (the net land area for a single facility is less than multiple facilities servicing the same drainage area due to grading/access

requirements) and minimizing the need for the City to maintain multiple smaller SWM facilities. Preliminary SWM pond locations have been identified throughout the watershed within the City's limits and are illustrated on **Drawing SWM 4.**

5 Kenny Drain Analysis

5.1 Existing Hydrology

5.1.1 General

Kenny Drain is the most centrally located watershed analyzed in this report and provides drainage for approximately 400ha. Kenny Drain is generally bound to the south by 8th Street East, to the east by the former CP Rail line to the west by 9th Avenue East and finally to the north by 32nd Street East. Under existing conditions the majority of the southern portion of Kenny Drain is a developed region consisting of various commercial, industrial and institutional facilities. The northern portion of Kenny Drain contains scattered industrial and commercial facilities with large portions of un-developed lands. Refer to **Drawing SWM5** for an illustration. There is an opportunity for growth and development in this area.

Generally speaking, drainage is provided in a south to north manner. The storm sewer located on 8th Street East, at the most upstream portion of the Kenny Drain watershed, provides conveyance to a trunk storm sewer located on 16th Avenue East. The 16th Avenue East trunk sewer proceeds north of 8th Street East to 17th Street East providing conveyance for the following:

- approximately 1900m of 10th Street East, including drainage from the Grey Bruce Health Services Complex
- approximately 4.4km of existing development fronting 16th Street East
- approximately 2.0km of existing development fronting 16th Avenue East

Stormwater conveyance is provided by two means: north of the 17th Street East; and within the 16th Avenue East right of way. The first is a trunk storm sewer located beneath 16th Avenue East and the second is a channel located on the east limit of the 16th Avenue East right of way. This configuration provides conveyance for approximately 2.0km of existing development fronting 16th Avenue East including the Heritage Place Shopping Centre, Tennaco and P.P.G Industries.

Drainage is maintained through road side ditches and a well defined channel north of 20th Street East to 26th Street East. Further north of 26th Street East stormwater travels in the form of overland sheet and channelized flow to the former CP Rail corridor. North of the CP rail corridor drainage is once again conveyed through a well-defined man-made channel and ultimately discharging to Owen Sound Bay.

5.1.2 Soils Conditions

According to the Grey County soil map, prepared for the Department of Agriculture in 1959, Kenny Drain is mainly comprised of soils in the Hydrologic Soil Group C as illustrated in **Table 4.**

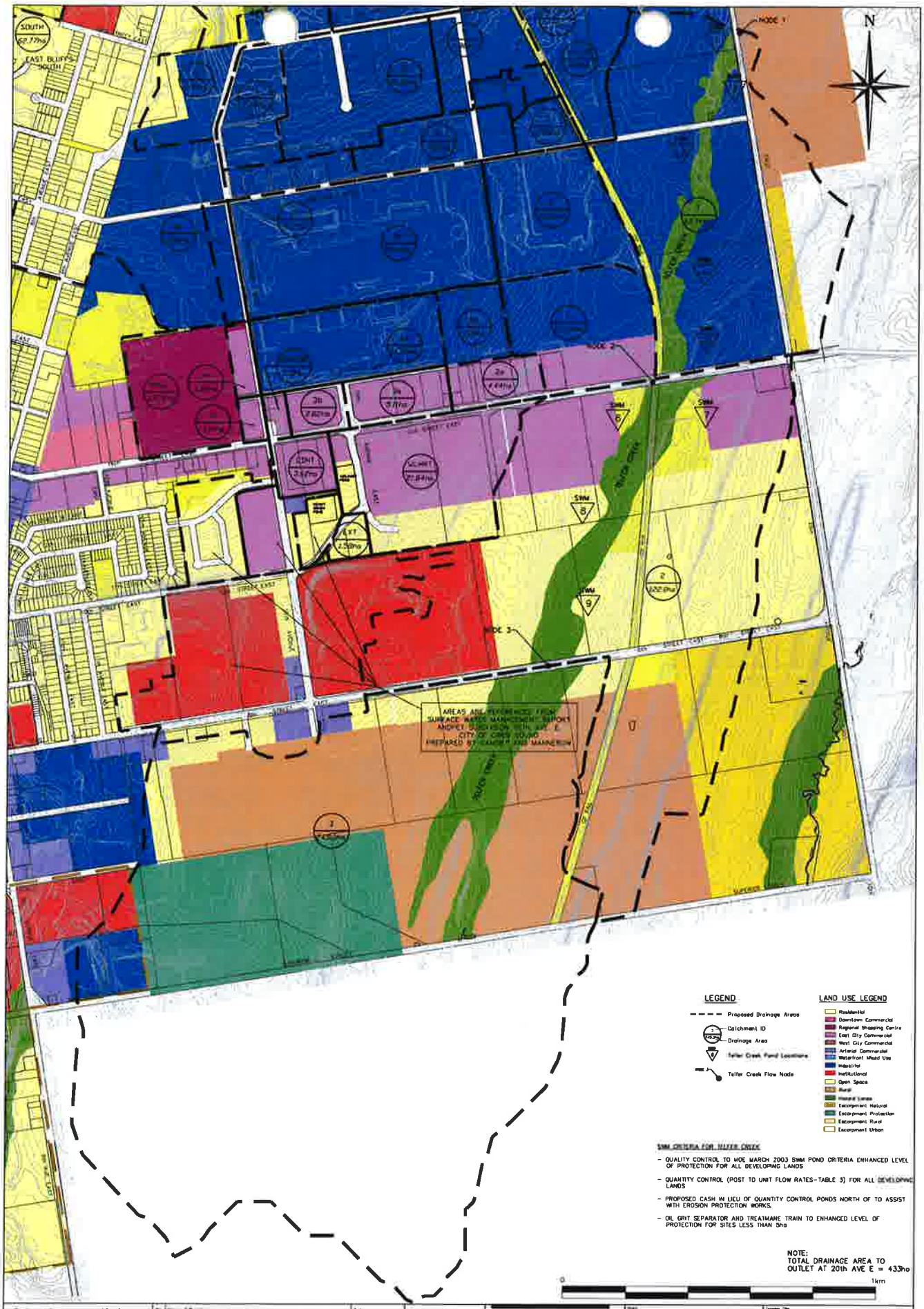
No.	Issue / Revision	Date
1.	Draft Submission	October 15, 2007
2.	Final Submission	January 2008

BURNSIDE
R. J. Burnside & Associates Limited

CITY OF OWEN SOUND
808 SECOND AVENUE E.
OWEN SOUND, ONTARIO

TELFER CREEK
EXISTING CONDITIONS PLAN

Scale: 1:5,000
Drawing No.: SWM3



No.	Issue / Revision	Date
1	Draft Submission	October 13, 2007
2	Final Submission	January 2008

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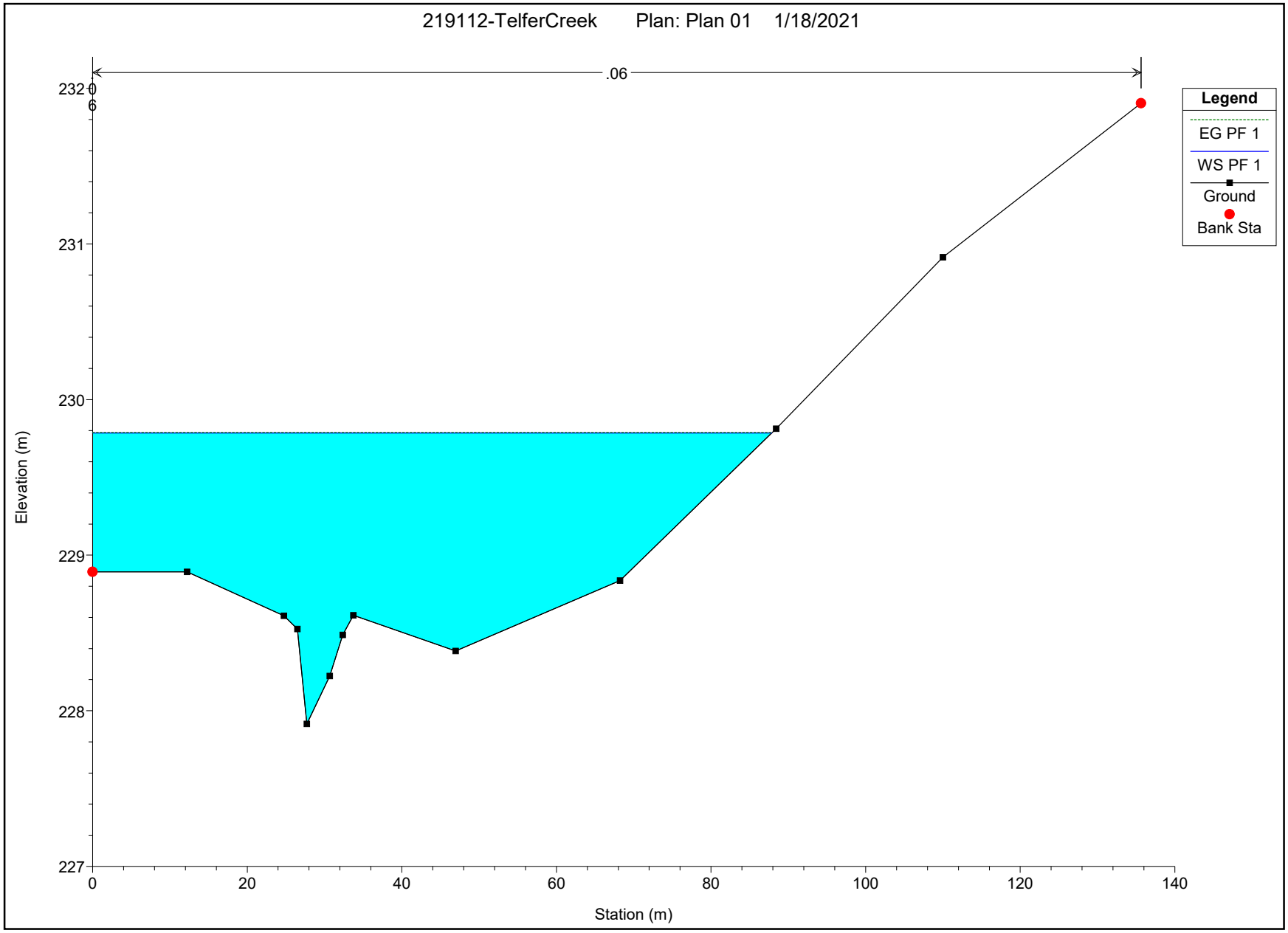
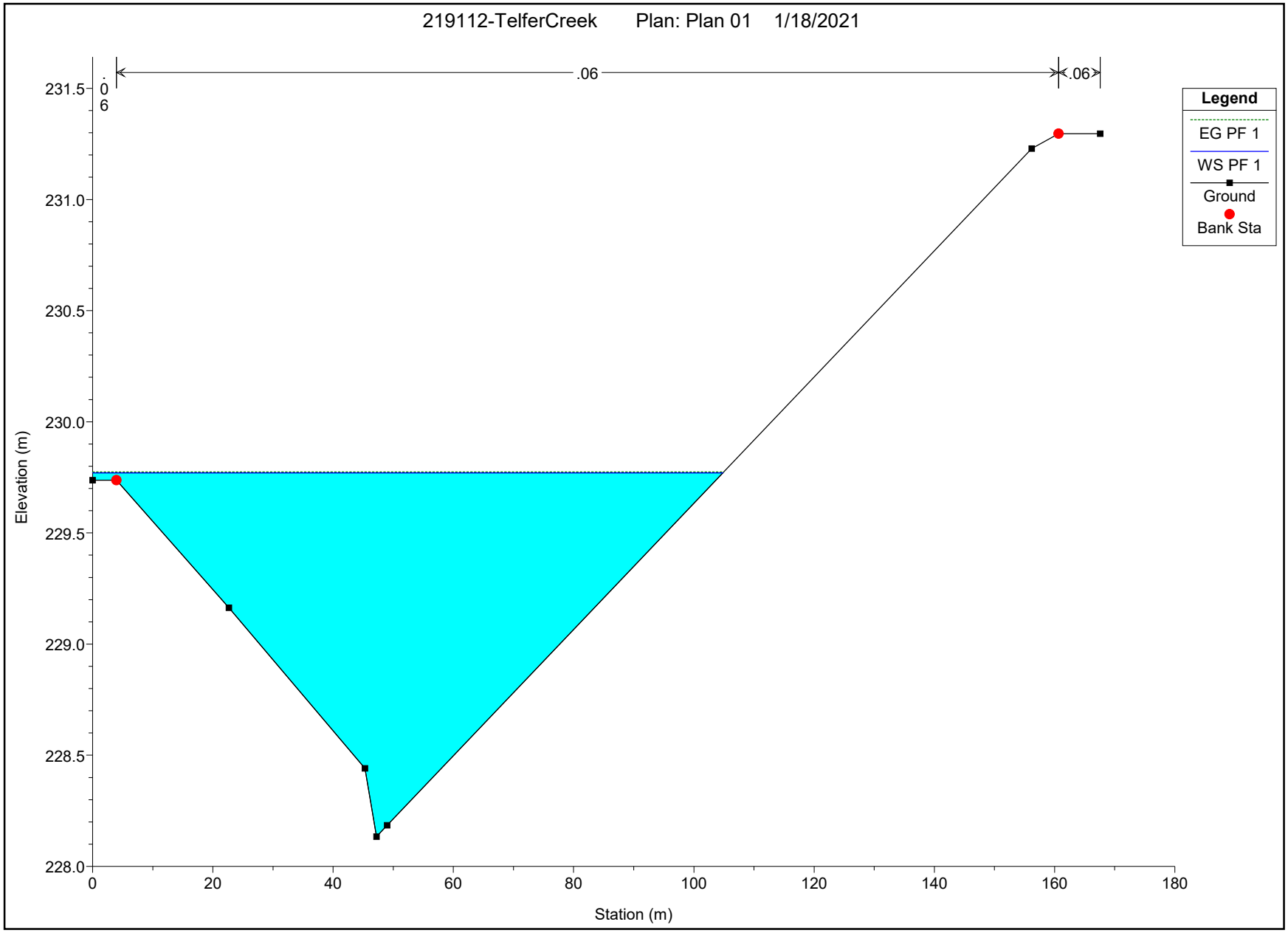
CITY OF OWEN SOUND
808 SECOND AVENUE E
OWEN SOUND, ONTARIO
N4K 2H4

TELFER CREEK
PROPOSED SWM PLAN

Drawn By	Checked By	Drawing No.
J.D.R.	D.M.	SWM4
Scale: 1:5,000	Project No.: MCO 106645	

APPENDIX B:
HEC-RAS FLOODPLAIN MODELLING RESULTS


219112-TelferCreek Plan: Plan 01 1/18/2021
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
232
231
230
229
228
227
0
20
40
60
80
100
120
140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Legend
EG PF 1
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Ground
Bank Sta
Elevation (m)
231.5
231.0
230.5
230.0
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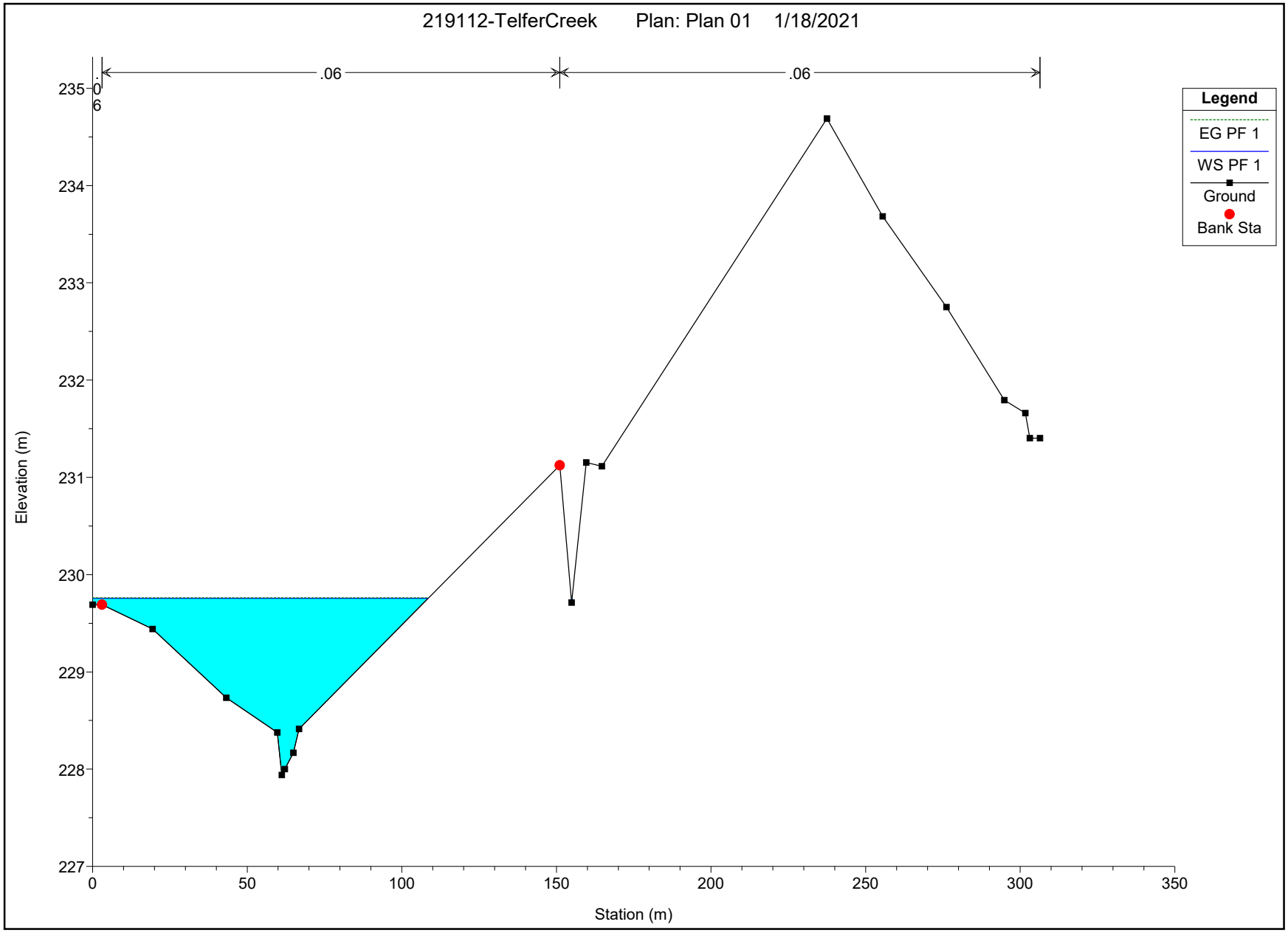
40
60
80
100
120
140
160
180
Station (m)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.06
.06
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
227
228
229
230
231
232
233
234
235
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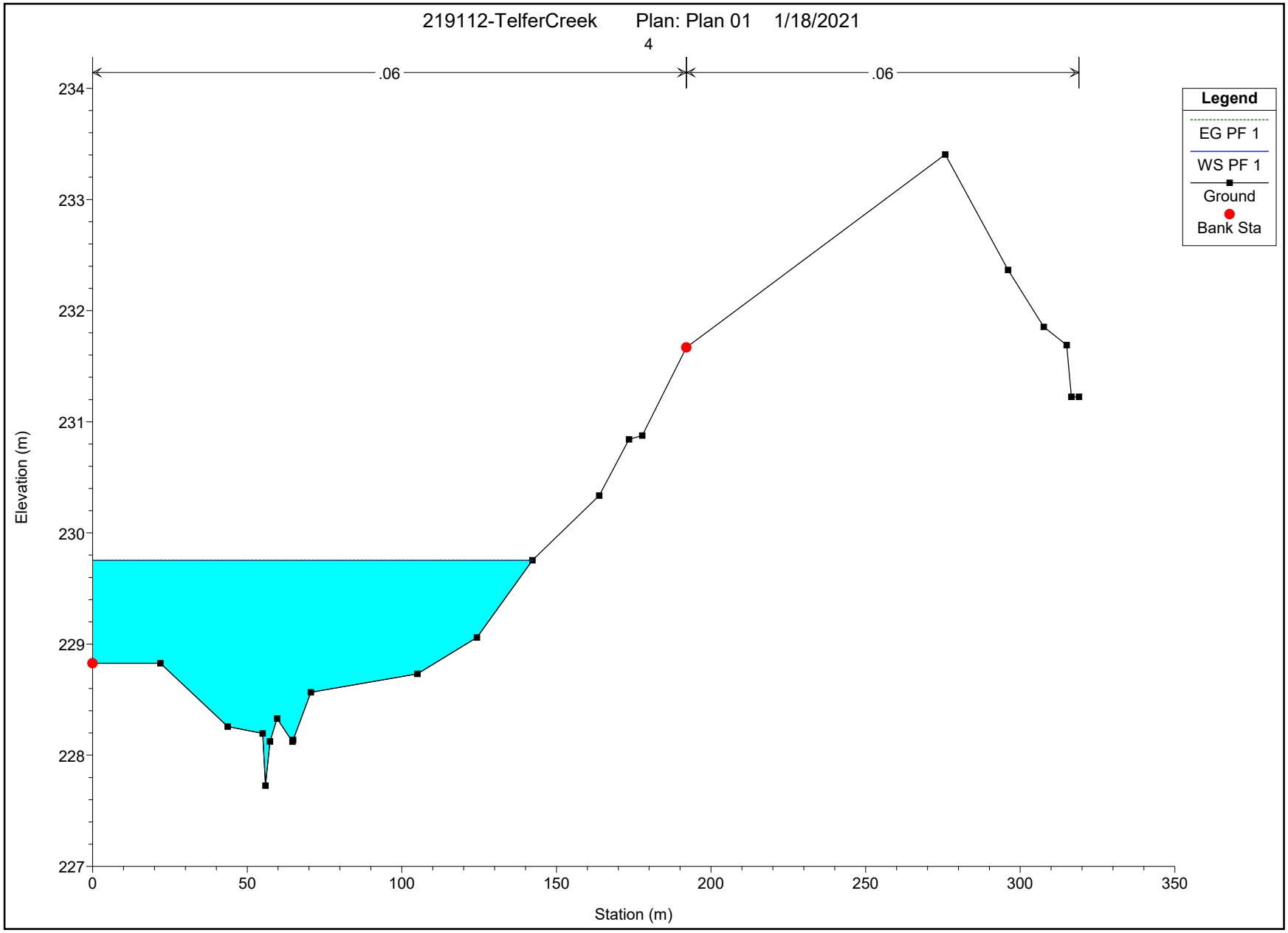
300
350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.06
.06
Legend
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WS PF 1
Ground
Bank Sta
Elevation (m)
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232
231
230
229
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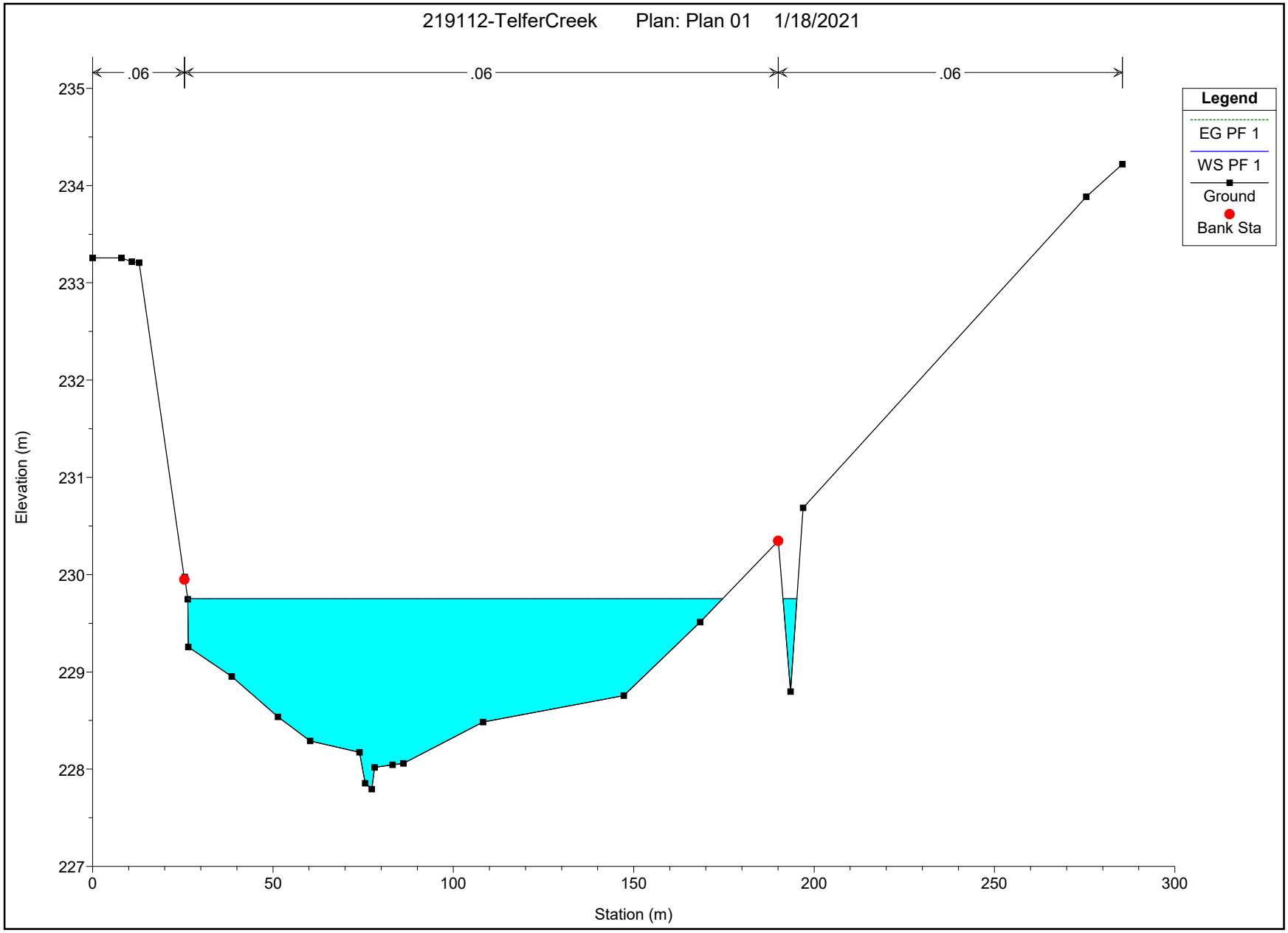
100
150
200
250
300
350
Station (m)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WS PF 1
Ground
Bank Sta
Elevation (m)
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233
232
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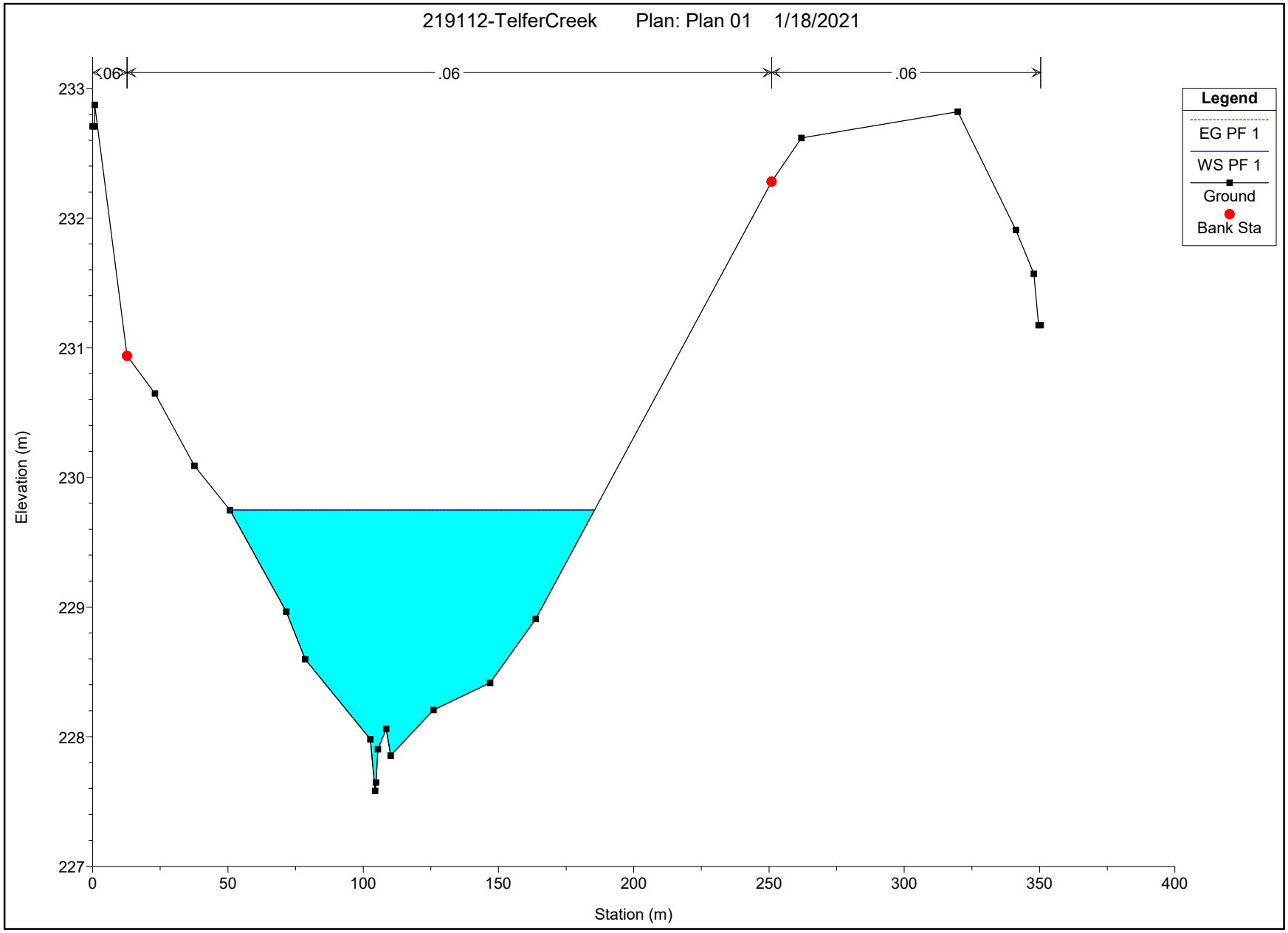
100
150
200
250
300
Station (m)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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
233
232
231
230
229
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0
50
100
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250
300
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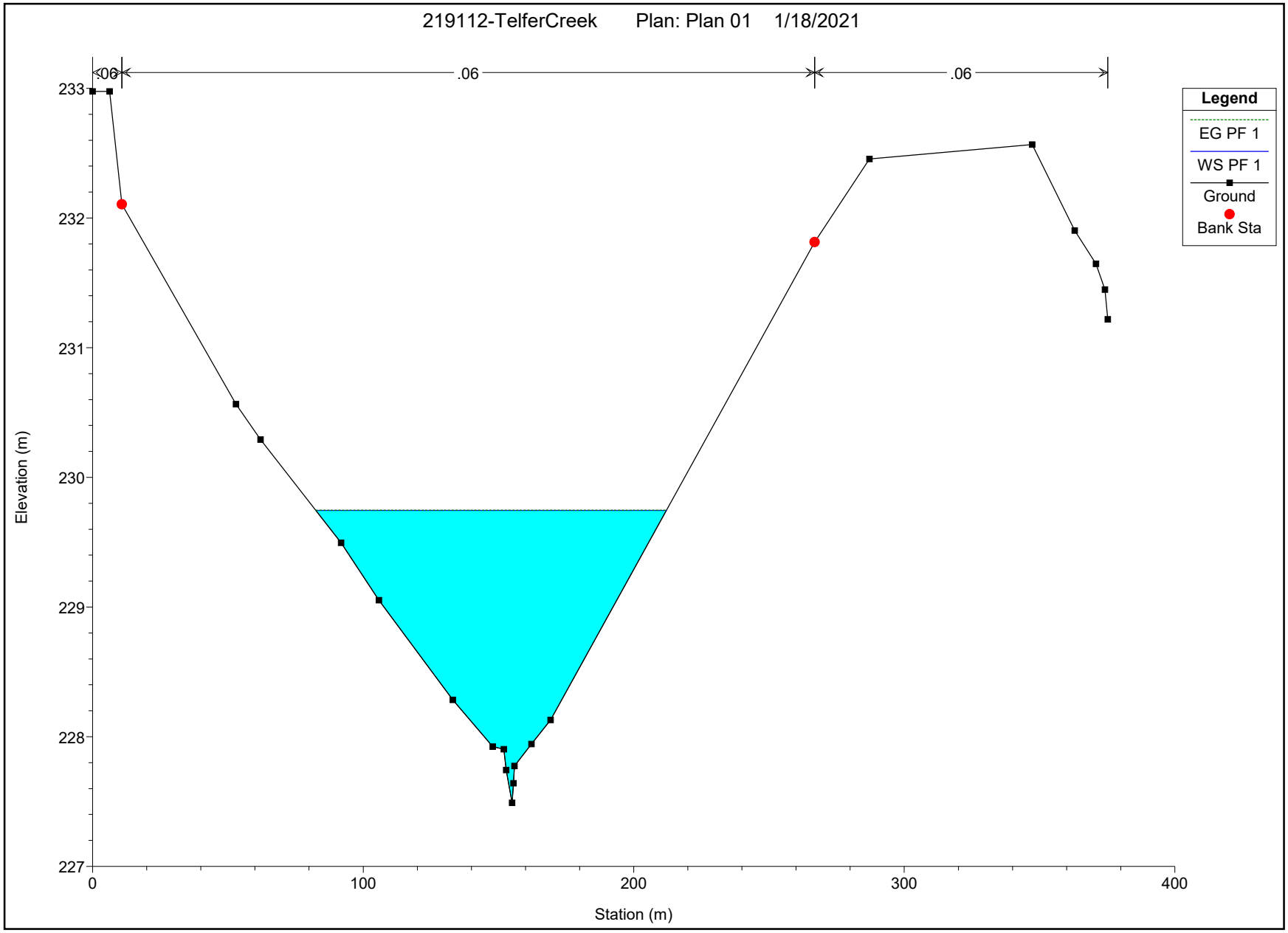
400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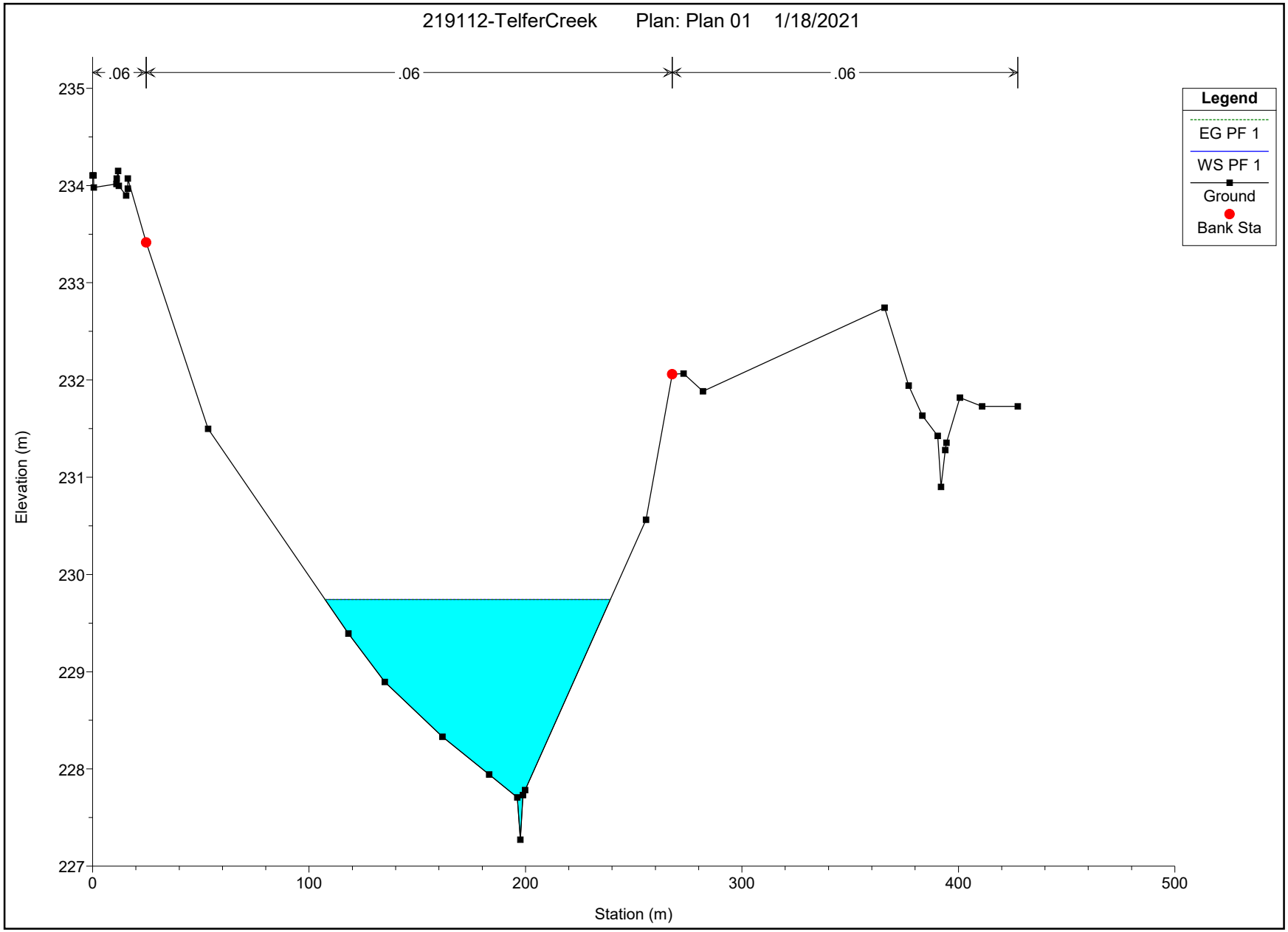
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
233
232
231
230
229
228
227
0
100
200
300
400
Station (m)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Ground
Bank Sta
Elevation (m)
Station (m)
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232
231
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400
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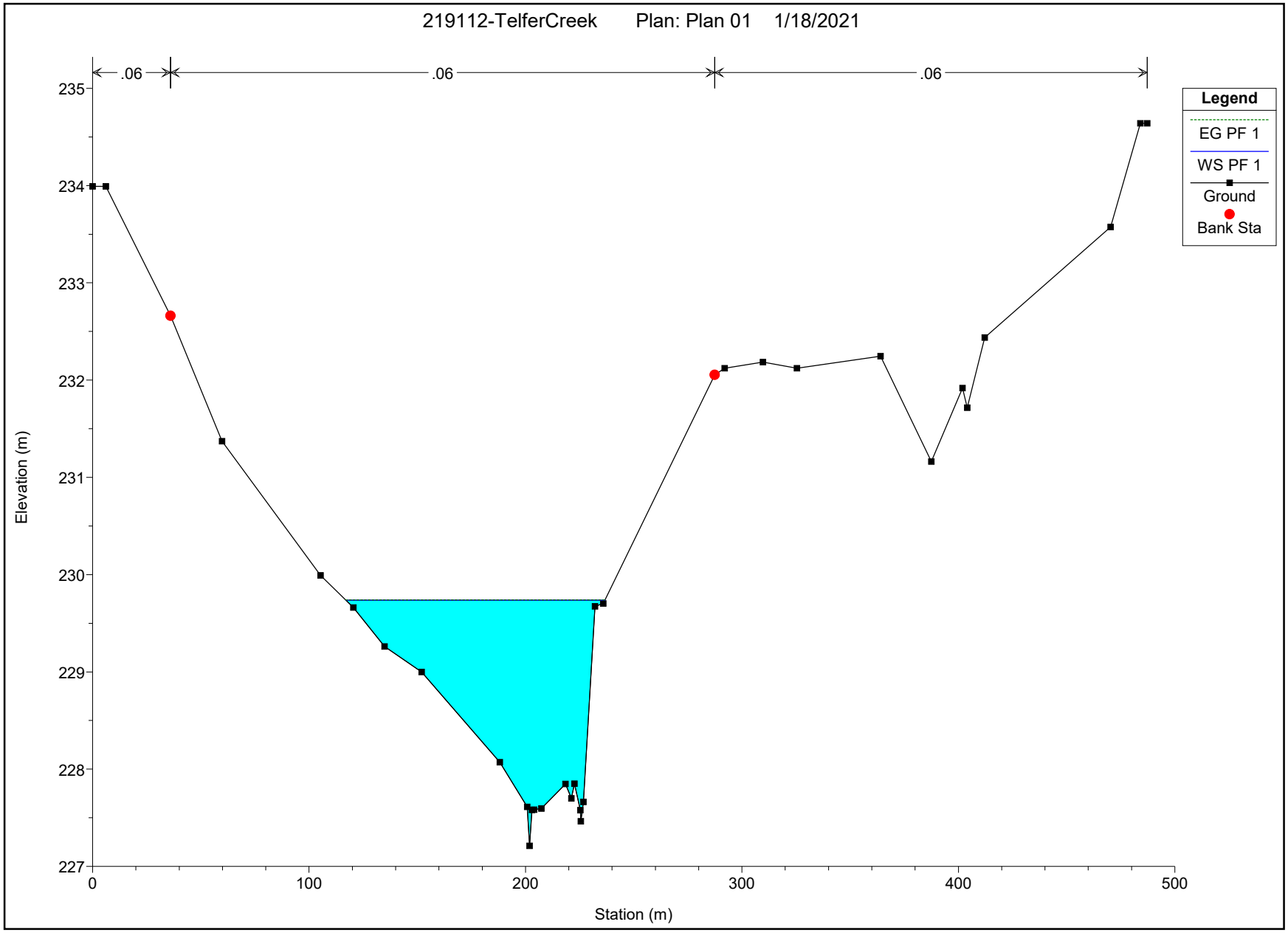
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
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227
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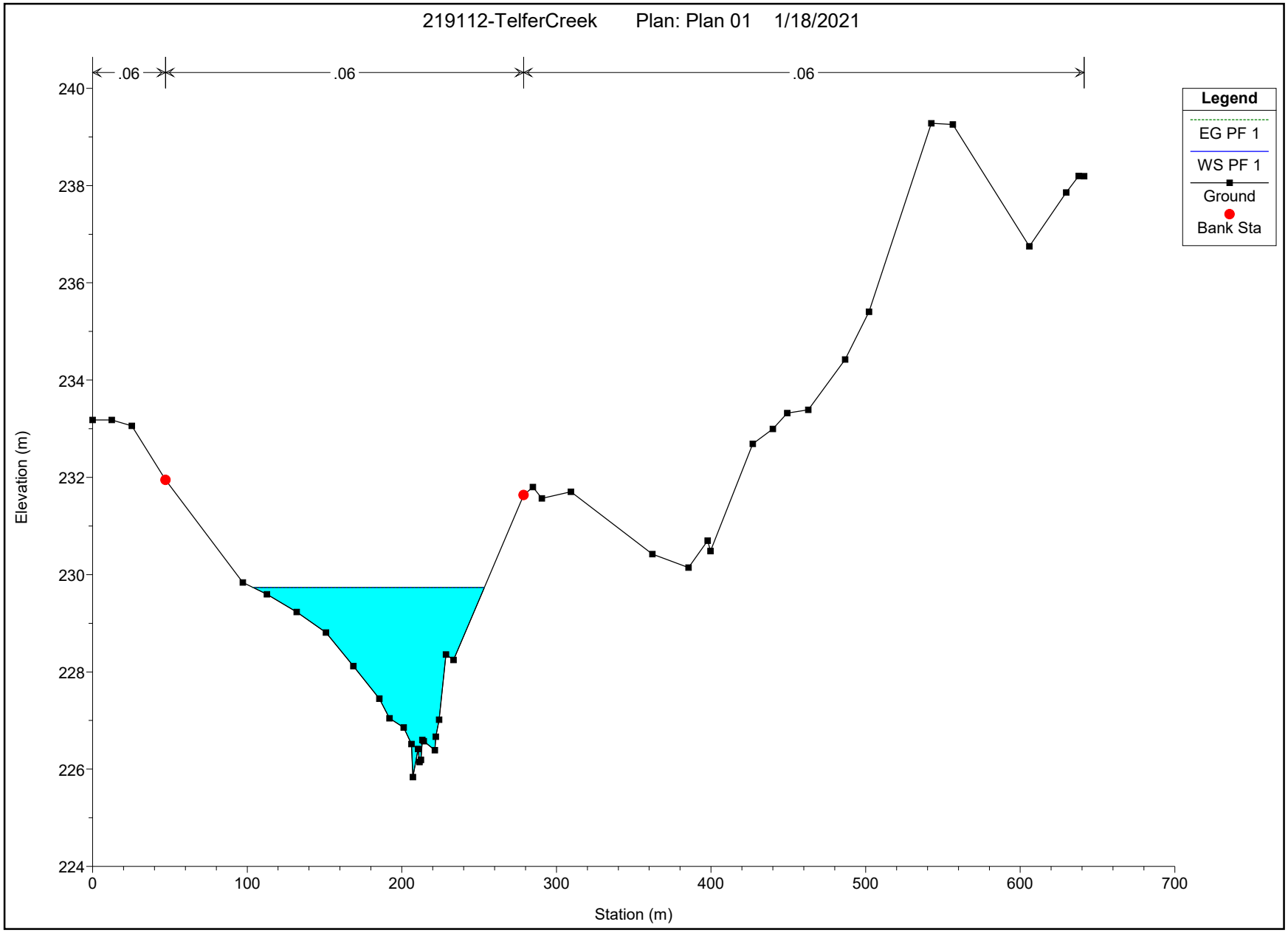
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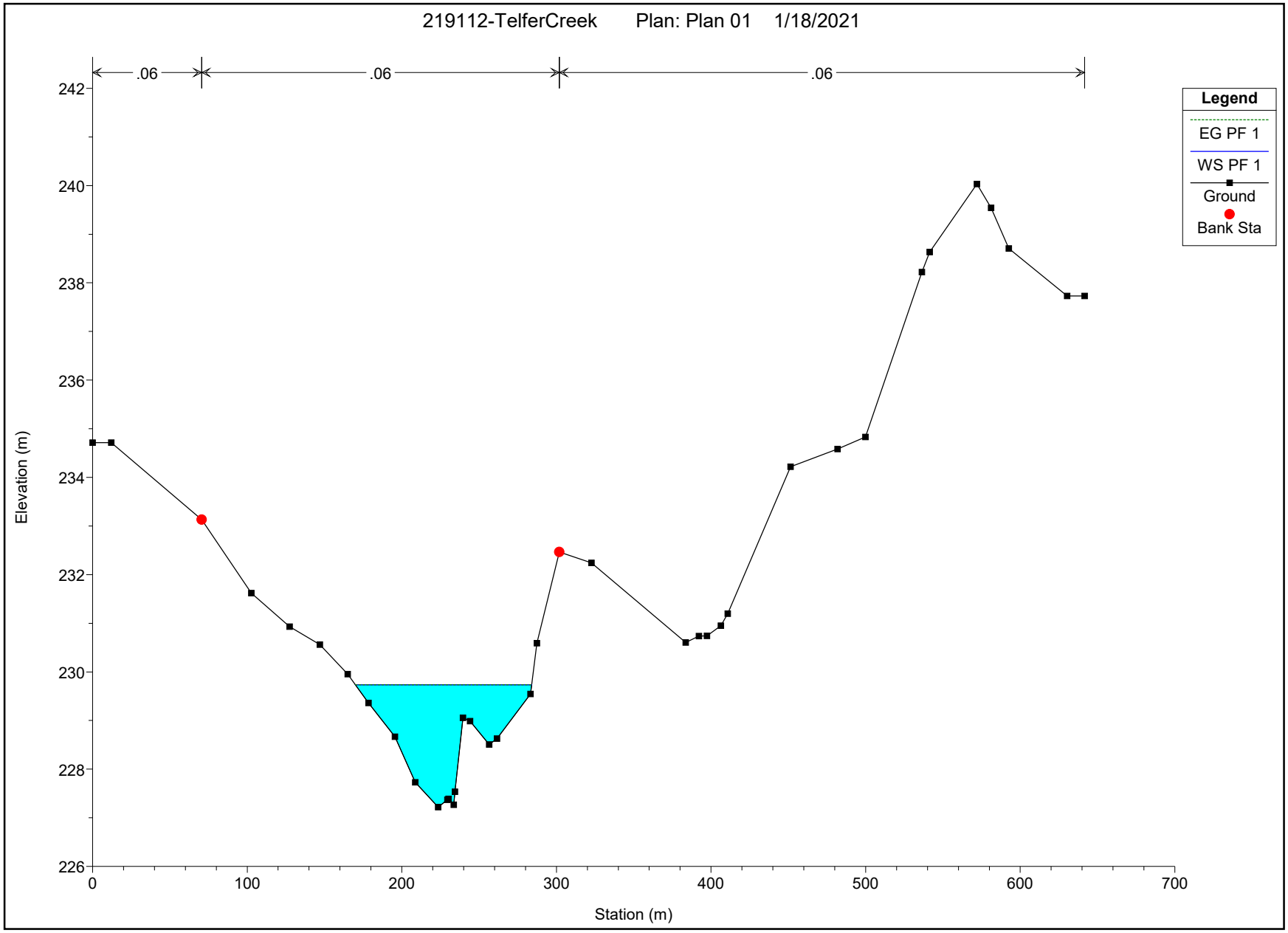
.06
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
240
238
236
234
232
230
228
226
224
0
100
200
300
400
500
600
700
Station (m)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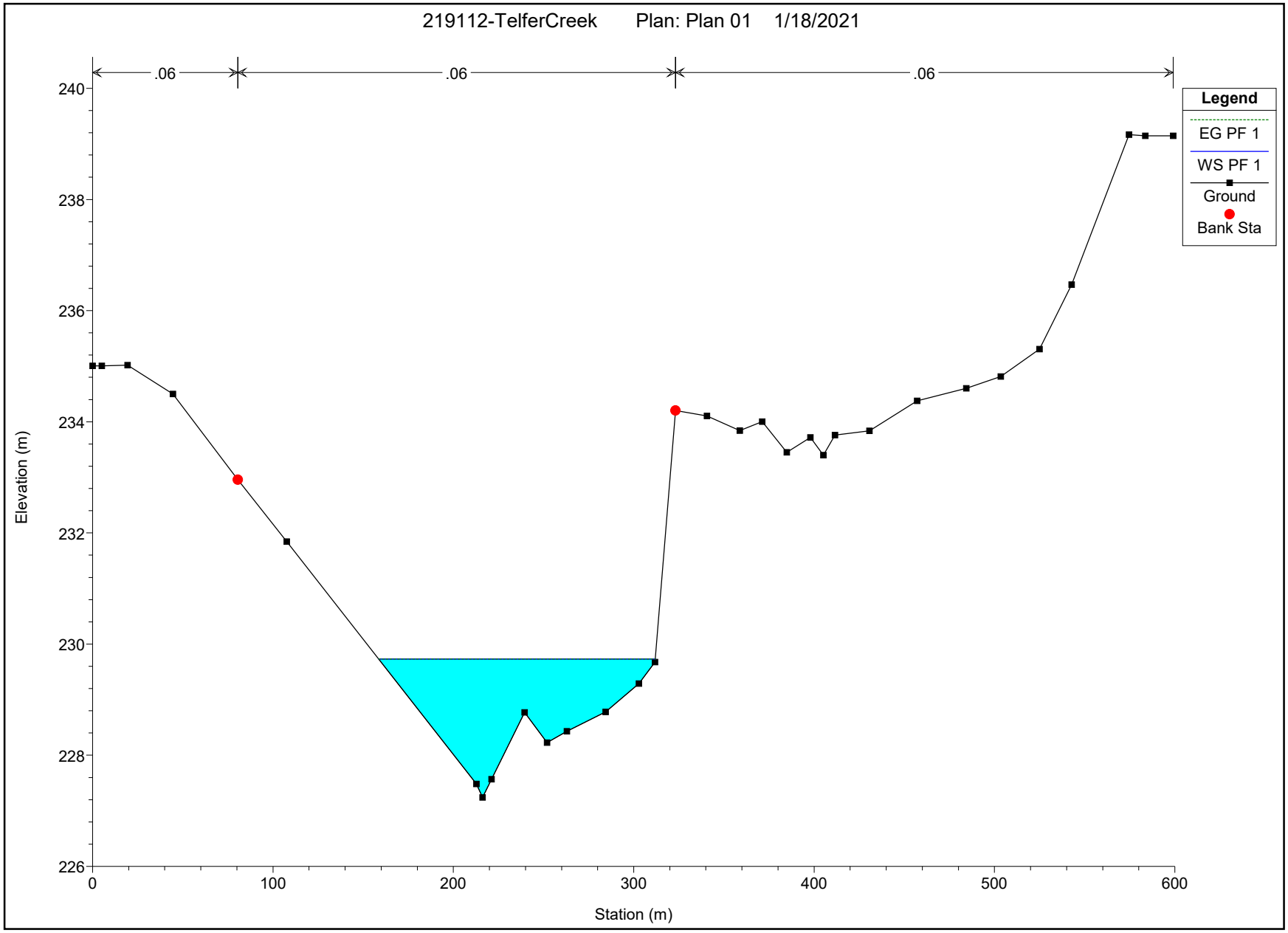
.06
.06
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
242
240
238
236
234
232
230
228
226
0
100
200
300
400
500
600
700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.06
.06
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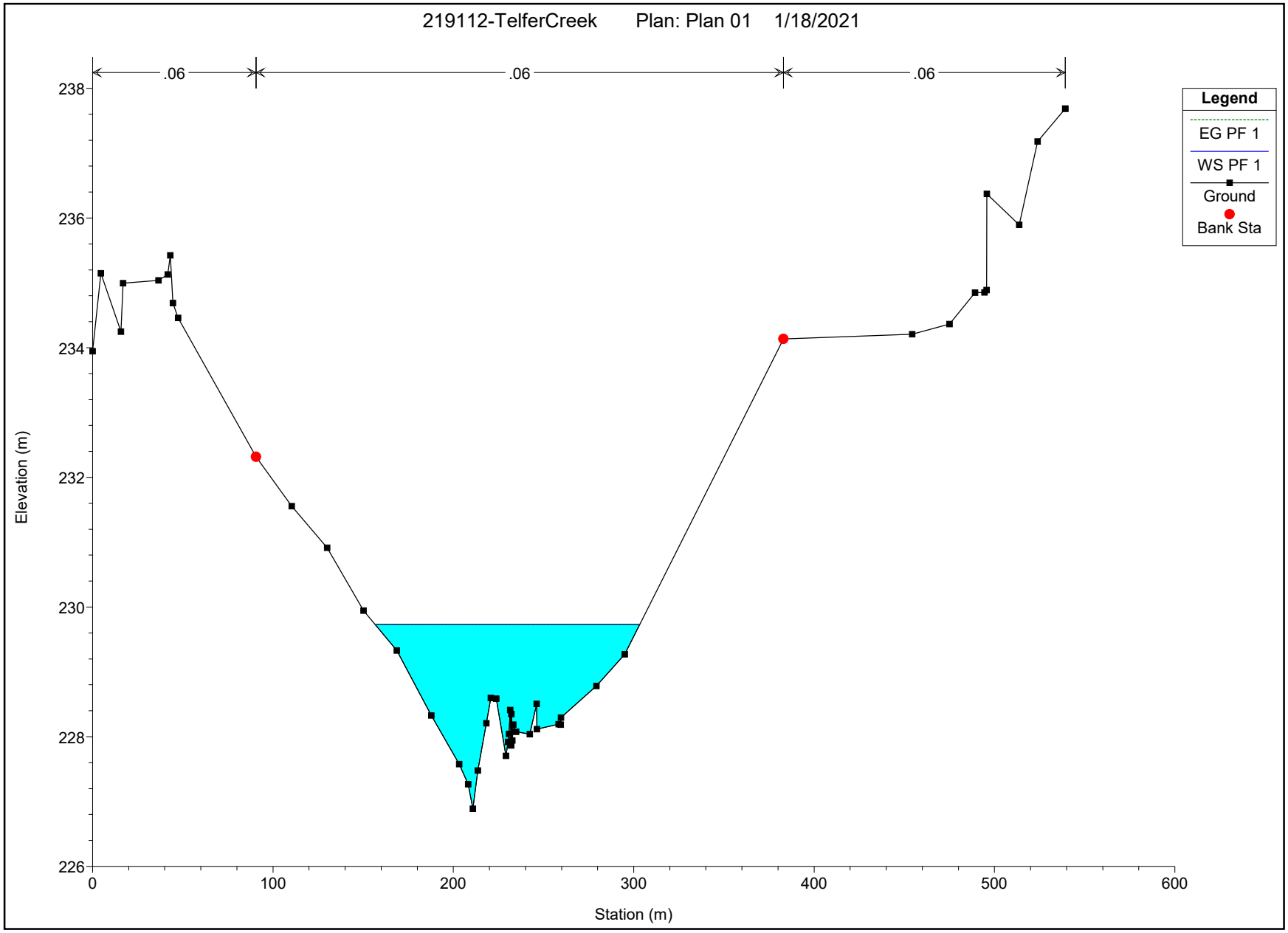
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
240
238
236
234
232
230
228
226
0
100
200
300
400
500
600
Station (m)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.06
.06
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
238
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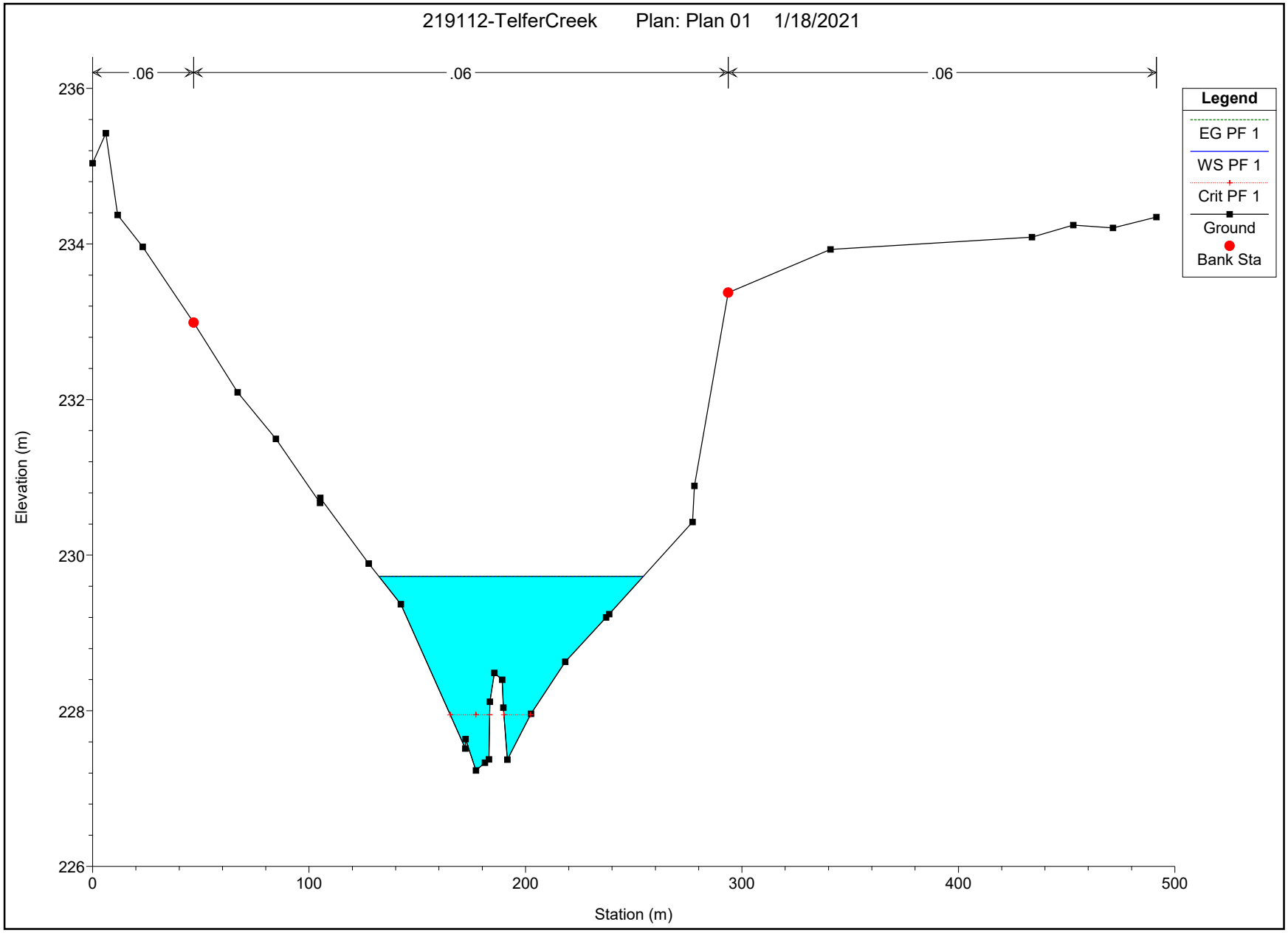
600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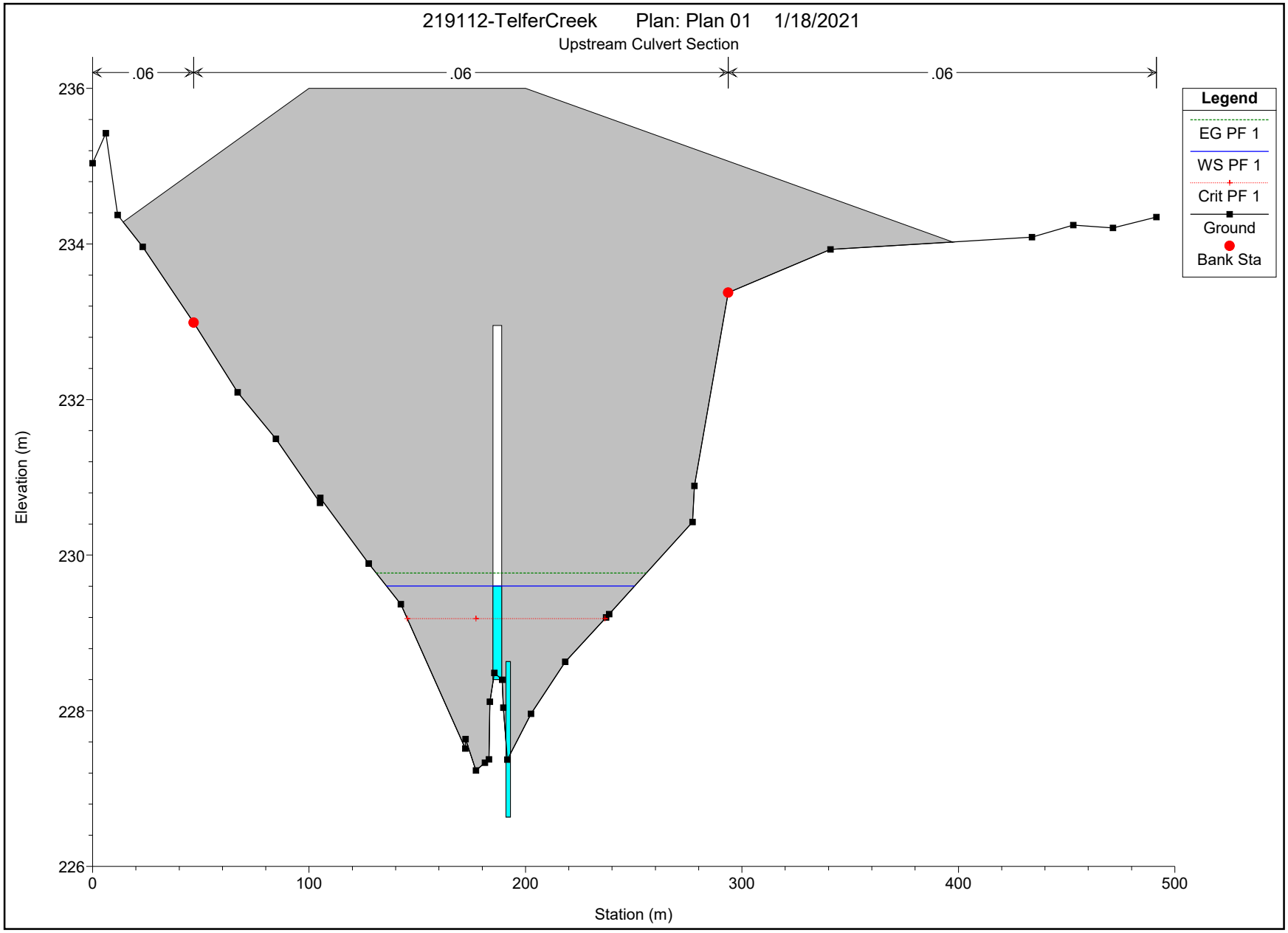
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
236
234
232
230
228
226
0
100
200
300
400
500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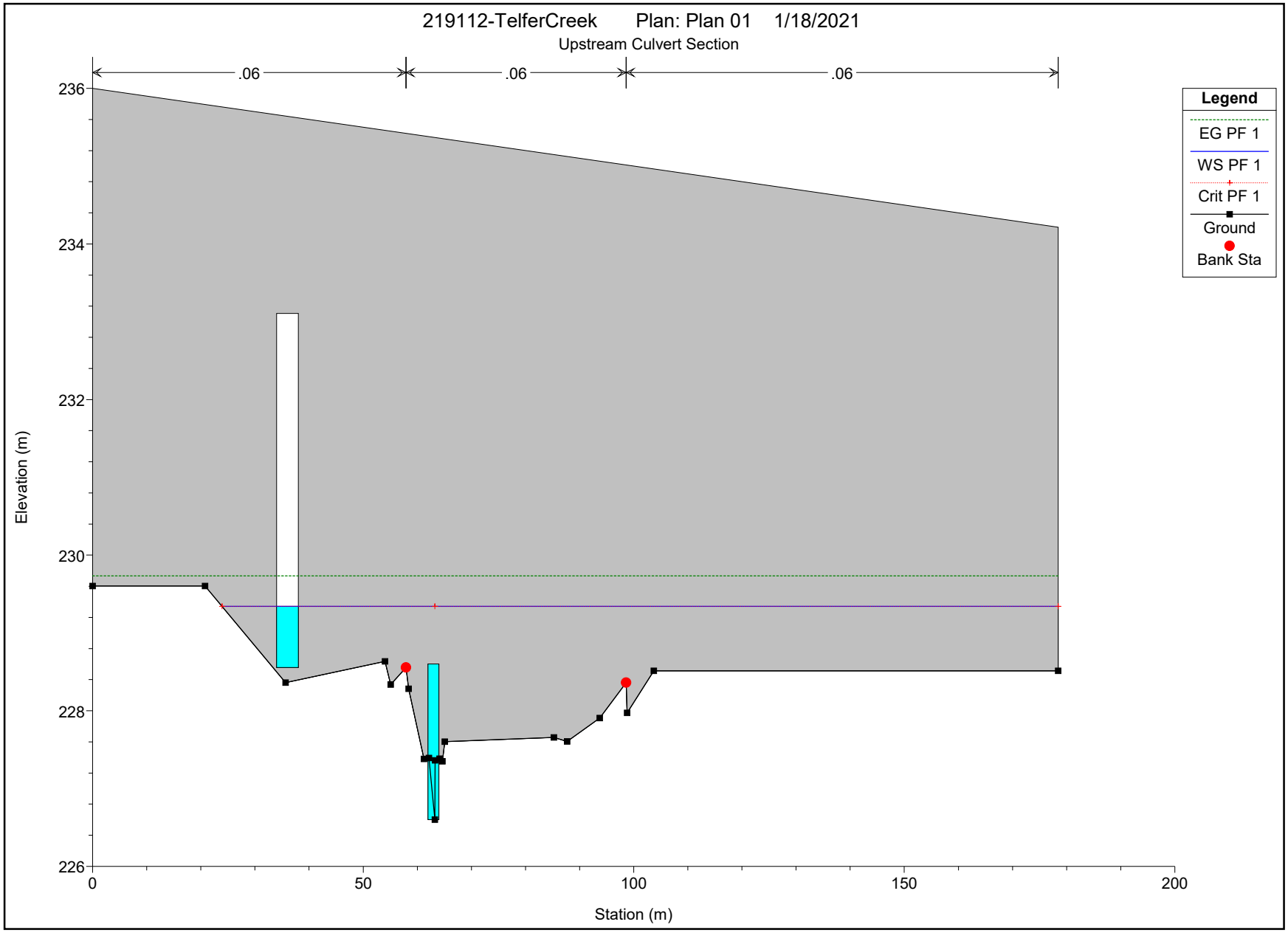
Upstream Culvert Section
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
236
234
232
230
228
226
0
100
200
300
400
500
Station (m)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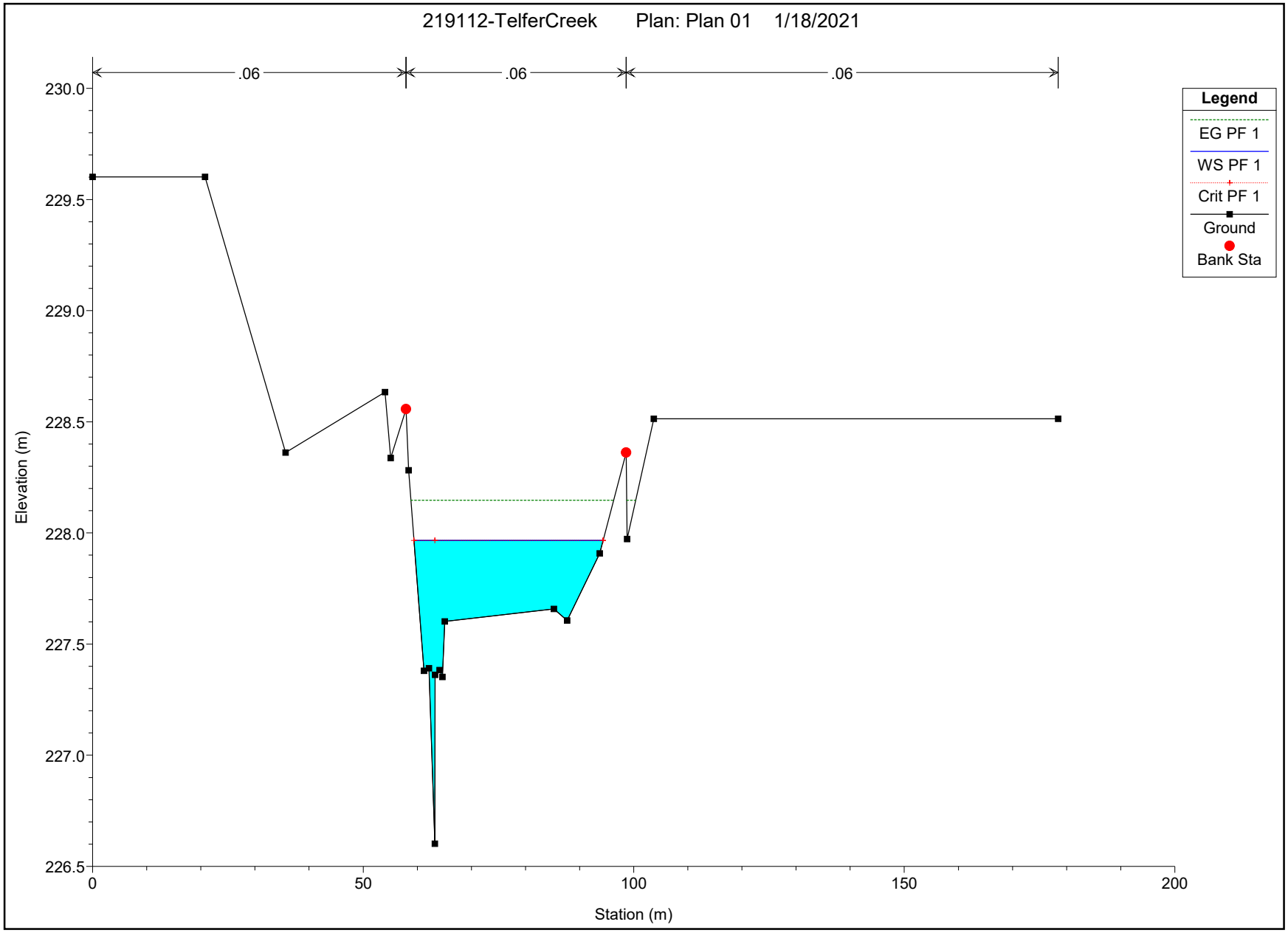
Upstream Culvert Section
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
236
234
232
230
228
226
0
50
100
150
200
Station (m)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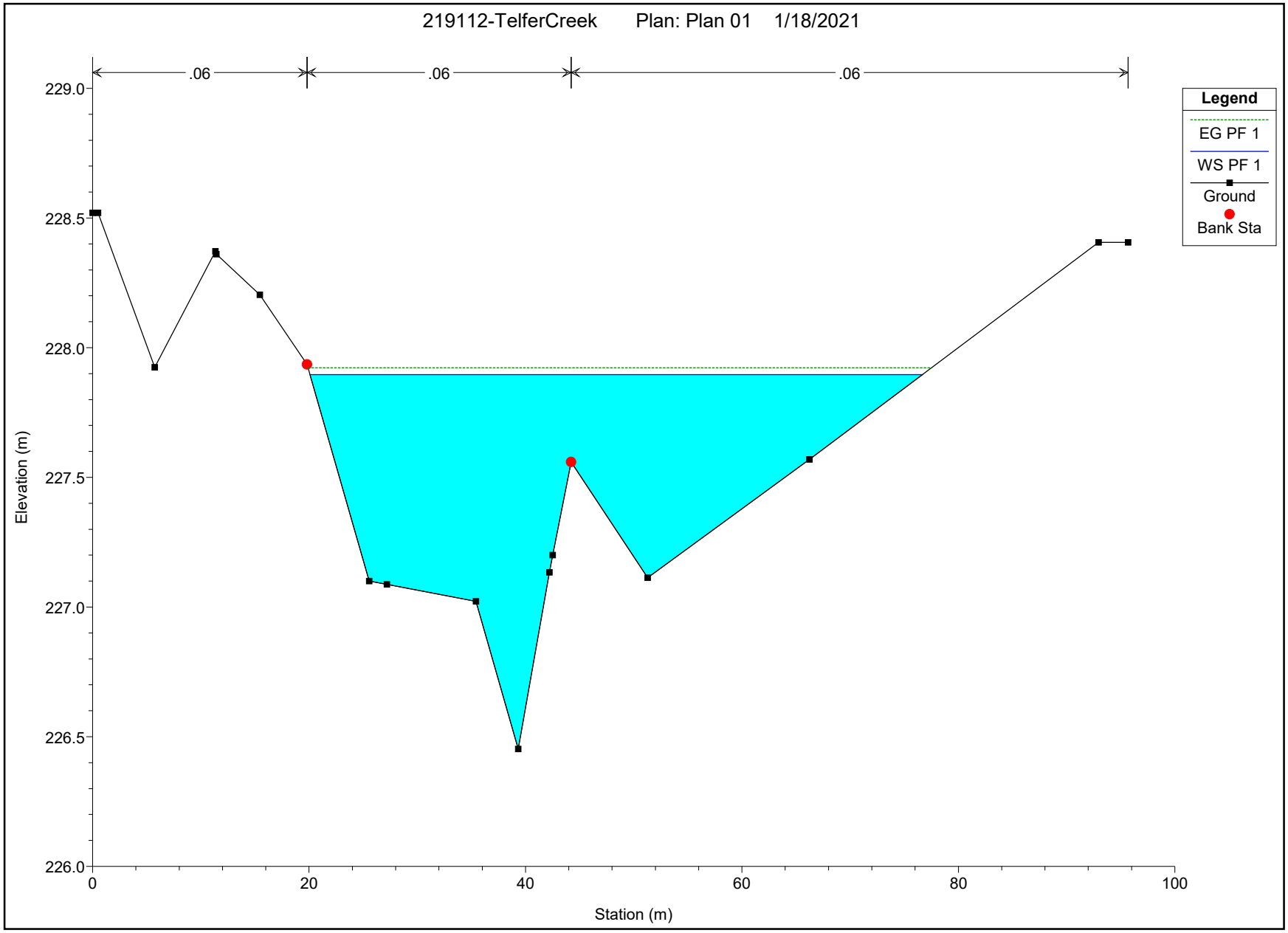
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
230.0
229.5
229.0
228.5
228.0
227.5
227.0
226.5
0
50
100
150
200
Station (m)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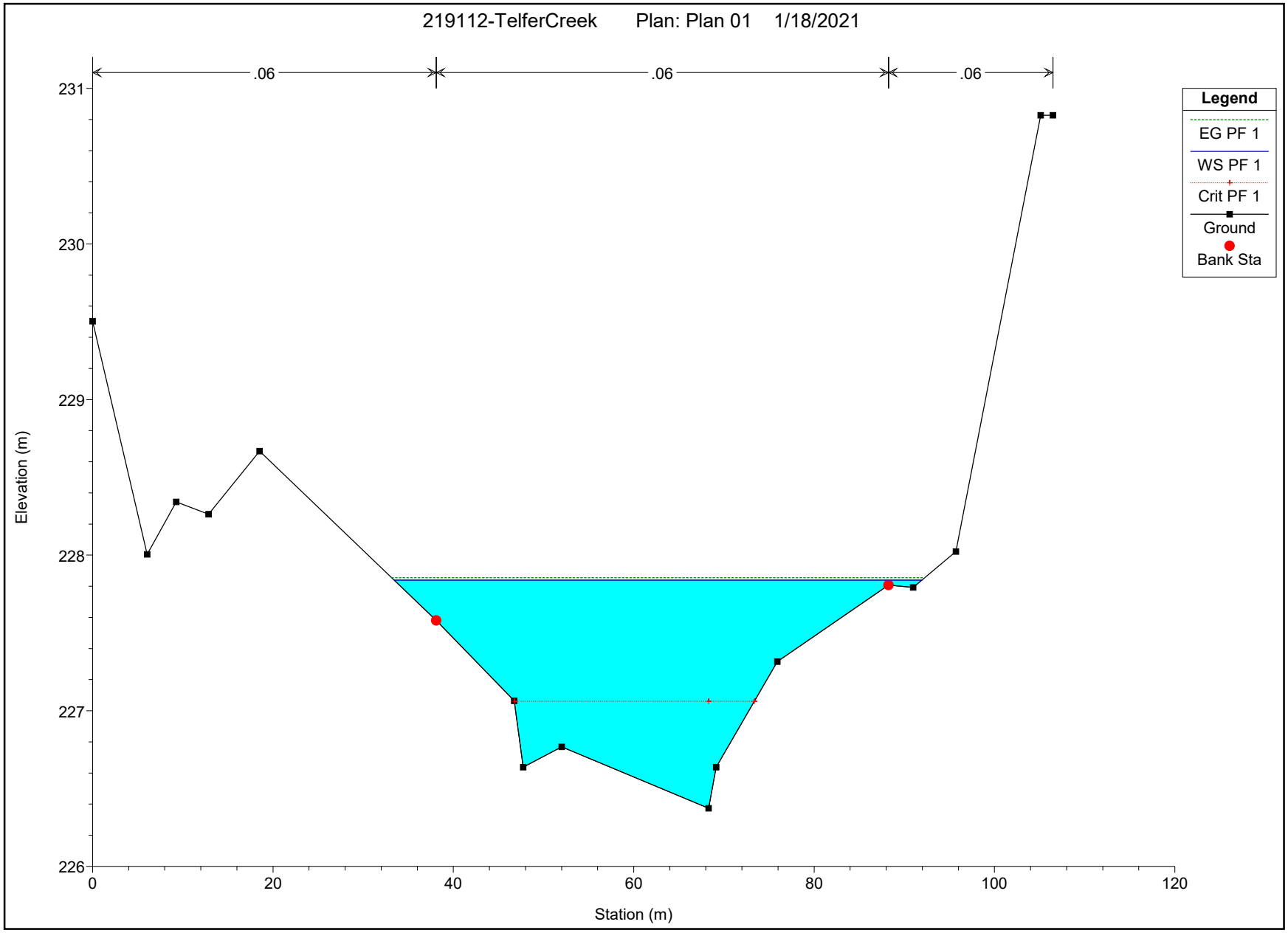
.06
.06
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (m)
229.0
228.5
228.0
227.5
227.0
226.5
226.0
0
20
40
60
80
100
Station (m)


219112-TelferCreek Plan: Plan 01 1/18/2021
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (m)
231
230
229
228
227
226
0
20
40
60
80
100
120
Station (m)

HEC-RAS River: Bothwell's Creek Profile: Regional Storm

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Main	18	PF 1	22.69	227.92	229.79		229.79	0.000236	0.26	88.35	87.84	0.08
Main	17	PF 1	22.69	228.13	229.77		229.77	0.000432	0.29	78.01	104.84	0.11
Main	16	PF 1	22.69	227.94	229.76		229.76	0.00045	0.29	78.49	108.76	0.11
Main	15	PF 1	22.69	227.73	229.75		229.75	0.00008	0.15	148.37	142.21	0.05
Main	14	PF 1	22.69	227.79	229.75		229.75	0.000058	0.14	167.16	152.09	0.04
Main	13	PF 1	22.69	227.58	229.75		229.75	0.000074	0.15	148.74	134.8	0.05
Main	12	PF 1	22.69	227.49	229.75		229.75	0.000095	0.17	135.46	129.51	0.05
Main	11	PF 1	22.69	227.27	229.74		229.74	0.000073	0.15	148.02	131.82	0.05
Main	10	PF 1	22.69	227.21	229.74		229.74	0.000075	0.16	141.53	119.72	0.05
Main	9	PF 1	22.69	225.83	229.74		229.74	0.000022	0.1	223.33	149.66	0.03
Main	8	PF 1	22.69	227.22	229.73		229.74	0.000078	0.17	136.92	114.02	0.05
Main	7	PF 1	22.69	227.24	229.73		229.73	0.000047	0.13	179.27	153.42	0.04
Main	6	PF 1	22.69	226.89	229.73		229.73	0.000043	0.12	181.99	146.71	0.04
Main	5	PF 1	22.69	227.23	229.73	227.95	229.73	0.000072	0.16	144.03	122.18	0.05
Main	4		Culvert									
Main	3	PF 1	22.69	226.6	227.97	227.97	228.15	0.054843	1.88	12.07	34.96	1.02
Main	2	PF 1	22.69	226.45	227.9		227.92	0.003119	0.79	33.2	56.61	0.28
Main	1	PF 1	22.69	226.37	227.84	227.06	227.86	0.001391	0.55	42.14	58.52	0.19