MEMO

TO: Resolution Copper – Vicky Peacey

FROM: WSP – Gustavo Meza-Cuadra, Chris Pantano, Doug Oliver

SUBJECT: Resolution Copper Groundwater Flow Model – Predictive Results

DATE: October 31, 2018

INTRODUCTION

This technical memorandum presents the predictive results from the Resolution Copper (RC) groundwater flow model developed by WSP in support of the EIS for the Resolution Copper Mine plan and land exchange. Preliminary results were presented at the U.S. Forest Service Groundwater Modeling Workgroup meeting in May 2018. This document details the final results of the base case predictive simulations, consistent with the direction from the Groundwater Modeling Workgroup.

A groundwater flow model was constructed and calibrated to historical conditions to assess future impacts of construction and operation of the Resolution Copper Mine. The conceptualization, construction and calibration of the model were detailed in the report submitted by WSP to Resolution Copper in October 2017 (to be revised and updated in November 2018). Chapter 4 of this report detailed the approach that would be followed in constructing the predictive Life of Mine (LoM) and Closure / Post-closure models. It detailed the approach to assess the impacts by running parallel predictive models: No Action (NA) and Proposed Action (PA) models. Impacts were defined as the Proposed Action model-predicted drawdown minus the No Action model-predicted drawdown.

This memo details the predictive model results for the base case (best calibrated model) and provides figures and hydrographs to visualize predicted impacts around the project area. Results are presented for all Groundwater Dependent Ecosystems (GDEs) and water supply wells that were deemed to be assessed by the groundwater model, as identified in Table 1 of *DRAFT Summary and Analysis of Groundwater Dependent Ecosystems* (Garrett, 2018).

Through the Groundwater Modeling Workgroup meetings, a consensus was reached regarding how the output of the groundwater models would be used and described in the EIS. Because groundwater models have limited accuracy, the Groundwater Modeling Workgroup agreed that any areas showing 10 ft of impact or more would be described as an area of "expected impact".

Results of sensitivity analysis modeling were submitted separately in memorandum *Resolution Copper Groundwater Flow Model – Sensitivity Analysis* (WSP, 2018).

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GROUNDWATER DEPENDENT ECOSYSTEMS LOCATIONS AND DISCUSSION

The Groundwater Dependent Ecosystems (GDEs) represent the sensitive ecological receptors in the modeled area, such as springs or continuously saturated stream reaches. A compilation of all GDEs was developed and agreed upon by the Groundwater Modeling Workgroup, as summarized in Table 1 of *DRAFT Summary and Analysis of Groundwater Dependent Ecosystems* (Garrett, 2018). Column 9 of this table is labeled *Method of Analysis for DEIS*; all GDEs deemed to be assessed by the GW Model were included in the analysis.

The GDEs that are believed to be connected to the regional groundwater system, are shown on Figure 1 and listed in Table 1 of this document. Although water supply wells are not related to ecological receptors (GDEs), certain wells/piezometers (screened in the regional groundwater system) were also included on the list of GDEs as a proxy for areas where groundwater is used for water supply. The three wells/piezometers are: HRES-06 representing wells in the Top of the World area (note that water supply wells at Top of the World are in perched alluvium and not necessarily tied to the regional groundwater system), DHRES-16_743 (198 ft bgs in Gila Conglomerate) representing wells in the Superior area, and Gallery Well representing wells in the Boyce Thompson Arboretum area.

PREDICTIVE MODEL RESULTS

NO ACTION MODEL

As described in the model construction and calibration report (WSP, 2017), the No Action model was built to assess the drawdown that would occur if the Resolution Copper Mine was not constructed. The model assumes that the current maintenance of the site infrastructure and assets, through ongoing dewatering of Shaft 9, 10 and the historical Magma workings, would continue for 52 years (same duration as Proposed Action Model - 12 years of permitting and construction and 40 years of mining). Therefore, additional drawdown associated with this dewatering would be expected.

The primary hydrogeologic units (HGUs) that experience drawdown from dewatering to date are in the deep bedrock system including: Cretaceous volcaniclastic sediments (Kvs), Paleozoic (Pz) and younger Pre-Cambrian (pCy). Most of the deep bedrock system is isolated from the GDEs, except to the south and west of the Apache Leap Tuff (Tal) where the Pz and pCy units outcrop at the ground surface.

After 52 years, the No Action model assumes that dewatering of Shafts 9 and 10 and the Magma workings is discontinued, allowing water levels to recover in the Closure / Post-closure.

DRAWDOWN AT END OF LIFE OF MINE PERIOD – NO ACTION

Figure 2 shows the No Action model-predicted drawdown at the end of the 52-year LoM model period, in which there was no mining, but dewatering of existing infrastructure was active. This drawdown is calculated from the beginning of the predictive model (current conditions) and represents loss in head at the regional water table (i.e., zero pressure) during the 52-year LoM model period. The drawdown contours are not in constant intervals, but rather are at 10, 20, 50, 100, 200, and 500 feet to allow for ease of visualization. The contours have also been smoothed.

The greatest drawdown is over 500 feet and is centered in the area of the old Magma Mine workings.

Note that the model predicts that there is no additional drawdown in the Apache Leap Tuff around Shaft 9 and 10 (the primary location of dewatering) during the No Action LoM period. This behavior is controlled by the Whitetail Conglomerate (Tw) aquitard that underlies the Apache Leap Tuff and impedes upward propagation of drawdown.

At the end of the LoM model period, drawdown has propagated west of the Resolution Copper Mine within the Pz, pCy, and Gila Conglomerate (QTg) HGUs. Hydrographs for all GDEs (to be evaluated with the groundwater model) and water supply wells are provided in Appendix A, and show model-predicted drawdown for the LoM period (infrastructure dewatering only) and Closure / Post-closure period to 200 years into the future. Based on review of the hydrographs, drawdown exceeds 10 feet at Bored Spring, Hidden Spring, and Walker Spring at the end of LoM (see Table 2).

DRAWDOWN AT 200 YEARS – NO ACTION

Figure 3 shows the No Action model-predicted drawdown at 200 years into the future, 148 years after infrastructure and asset maintenance dewatering is discontinued. The area covered by the 10-ft drawdown contour continued to expand, slightly further than at the end of LoM model period for the No Action model. However, at 200 years, water levels have rebounded over 500 feet around the old Magma mine workings.

Based on hydrographs provided in Appendix A, none of the GDEs within the Apache Leap Tuff show discernible drawdown for No Action at the end of the LoM period or after 200 years. The GDEs to the west of the Apache Leap Tuff show drawdown greater than 10 feet at five locations after 200 years: McGinnel and McGinnel Mine springs, in addition to Bored, Hidden, and Walker springs (see Table 2).

PROPOSED ACTION MODEL

The Proposed Action Life of Mine model schedule for infrastructure and mining was constructed as described in the General Plan of Operations (GPO). The block cave geotechnical properties and timing were directly imported from the subsidence model as reported in *Assessment of Surface Subsidence Associated with Caving, Resolution Copper Mine Plan of Operations* (ITASCA, 2017). Output from the 3-D subsidence model was translated into time-varying hydraulic properties (hydraulic conductivity [K] and specific yield [Sy]) as described in Chapter 4 of the WSP model construction and calibration report (WSP, 2017) and were integrated into the groundwater flow model. The LoM model runs for 52 years comprising 12 years of infrastructure construction followed by 40 years of mining. Similar to the No Action model, dewatering is terminated at the end of the 52-year LoM model period, which allows water levels within the hydrogeologic system to eventually recover in the post-closure period.

Drawdown at the water table for the Proposed Action at the end of LoM (52 years into the future) and 200 years into the future (148 years post closure) are provided in Figures 4 and 5, respectively. As with the No Action model, drawdown exceeds 10 feet at Bored Spring, Hidden Spring, and Walker Spring at the end of LoM (see Table 2). In addition to the three springs listed above, after 200 years, drawdown is predicted to exceed 10 feet at McGinnel and McGinnel Mine springs, as in the No Action model at 200 years, but also at Bitter Spring, DC 6.6W, Kane Spring, and piezometer DHRES-16_743 (see Table 2).

IMPACTS AT END OF LIFE OF MINE

Impacts associated with the Proposed Action at the end of LoM (52 years into the future) are shown on Figure 6, representing when mining is complete but right before the dewatering is terminated. Impacts associated with the Proposed Action model are defined as the additional drawdown beyond that predicted for No Action (calculated by subtracting the model-predicted drawdown for No Action from the model-predicted drawdown for the Proposed Action).

In Figure 6, as expected, the greatest impacts (e.g., > 1000 ft) are centered around the block cave as it is fully dewatered during the Proposed Action LoM model. Water levels in the Apache Leap Tuff are impacted in the area surrounding the mine as fractures propagate through the low hydraulic conductivity Whitetail Conglomerate and connect groundwater in the deep bedrock system (Kvs, pCy, Pz) with the shallow Apache Leap Tuff. There are no GDEs or water supply wells where impacts exceed 10 feet at the end of LoM (see Table 3). The 10-ft impact contour extends most in the northeast direction from the Resolution Copper Mine towards Top of the World, but also in the south-southwest direction.

IMPACTS AT 200 YEARS

At the end of LoM, dewatering of the Resolution Copper Mine is discontinued and groundwater can flow into the infrastructure and block cave. Similar to the LoM model, impacts from the Proposed Action Closure / Post-closure model are compared to the No Action model and defined as additional drawdown at the water table. Impacts associated with the Proposed Action at 200 years (148 years post closure) are shown on Figure 7.

During the Closure / Post-closure simulation, groundwater begins to refill the block cave mine. Impacts at 200 years (Figure 7) have continued to expand outward, in comparison to those at the end of LoM (Figure 6). As water level recovery within the block cave is slow, some areas show additional drawdown continuing to propagate outward after 200 years as steady state equilibrium conditions have not yet been re-established.

In the Apache Leap Tuff, the 10-ft impact contour extends northeast reaching Top of the World (HRES-06). Impacts at GDEs in Devils Canyon increase during closure relative to the end of LoM, but are still less than 10 ft.

West of the Resolution Copper Mine, impacts are greatest (>1000 ft) at the old Magma workings as these provide a high hydraulic conductivity path directly connected to the Resolution Copper Mine. South of the Magma workings the impacts propagate southward through the Pz and pCy HGUs, resulting in impacts of up to 500 feet. Further west, the lower hydraulic conductivity Gila Conglomerate results in less impact (<200 feet).

Six GDEs and water supply wells (Bored, Hidden, Kane, and Walker springs and piezometer/wells HRES-06, DHRES-16_743) have impacts that are predicted to exceed 10 feet at 200 years (see Table 3). However, all but Kane Spring had drawdown exceeding 10 ft under the No Action case at 200 years. Hydrographs of the GDEs are also useful for visualizing the difference and timing between the No Action and Proposed Action models, and in understanding the impacts. These are presented in Appendices A and B.

The predictive results were derived using the base case model (best calibration) upon which the No Action and Proposed Action conditions were imposed. A sensitivity analysis has also been completed to assess variability in results due to uncertainty in model parameters. This sensitivity analysis is presented in a separate memorandum (WSP, 2018).

REFERENCES

Garrett, C., 2018. *DRAFT Summary and Analysis of Groundwater Dependent Ecosystems, Process Memorandum to File*, Resolution Copper Project and Land Exchange, Environmental Impact Statement. USDA Forest Service, Tonto National Forest. September 10, 2018.

ITASCA Consulting Group, Inc., 2017. *Assessment of Surface Subsidence Associated with Caving Resolution Copper Mine Plan of Operations*. July 17, 2017.

WSP, 2017. Resolution Copper Groundwater Flow Model Report. October 2017.

WSP, 2018. *Memorandum: Resolution Copper Groundwater Flow Model – Sensitivity Analysis*, *Draft*, 31 August 2018.

TABLES

Table 1: Groundwater Dependent Ecosystem (GDE) Location List

Appendice #	GDE	Type	X (ft)	Y (ft)	Elevation (ft)
1	AC 4.54	Stream	938,228	824,437	2958
2	AC 12.49 / Blue Spring	Stream / Spring	953,648	811,557	2962 / 2950
3	Bitter Spring	Spring	953,877	852,140	3780
4	Bored Spring	Spring	951,056	826,537	2880
5	DC 4.1E	Spring	977,653	818,496	2720
6	DC 5.5C	Stream	974,405	820,865	2959
7	DC 6.1E	Spring	973,867	822,073	3160
8	DC 6.6W	Spring	971,652	823,166	3520
9	DC 8.1C	Stream	971,968	827,402	3520
10	DC 8.2W	Spring	971,883	827,471	3540
11	DC 8.8C	Stream	971,553	829,400	3579
12	DHRES-16_743[1]	Well	944,002	830,711	1734
13	Gallery Well[2]	Well	933,286	829,302	2439
14	Hidden Spring	Spring	951,494	821,460	3040
15	HRES-06[3]	Well	977,109	852,678	4429
16	Iberri Spring	Spring	949,440	851,674	3610
17	Kane Spring	Spring	957,394	817,537	3160
18	McGinnel Mine Spring	Spring	944,479	853,371	3930
19	McGinnel Spring	Spring	942,999	851,572	3920
20	Lower Mineral	Stream	984,174	816,174	2515
21	MC 6.9	Stream	989,174	823,284	2815
22	No Name Spring	Spring	933,932	846,060	2600
23	QC 17.39	Stream	940,939	828,800	2559
24	Rock Horizontal Spring	Spring	938,145	859,659	3060
25	TC 0.6	Stream	937,869	822,652	2616
26	Walker Spring	Spring	935,320	836,432	2565

Notes:
Coordinate System (X,Y): NAD83 / Arizona Central
[1]Proxy for Superior
[2]Proxy for Boyce Thompson Arboretum
[3]Proxy for Top of the World

Table 2: Drawdown at GDE & Water Supply Well Locations: No Action and Proposed Action Models at LoM and Post Closure

Location	No Action Drawdown (ft)		Proposed Action Drawdown (ft)	
	LoM	Post Closure	LoM	Post Closure
AC 4.54	<10	<10	<10	<10
AC 12.49 / Blue Spring	<10	<10	<10	<10
Bitter Spring	<10	<10	<10	**11**
Bored Spring	**38**	**105**	**41**	**181**
DC 4.1E	<10	<10	<10	<10
DC 5.5C	<10	<10	<10	<10
DC 6.1E	<10	<10	<10	<10
DC 6.6W	<10	<10	<10	**11**
DC 8.1C	<10	<10	<10	<10
DC 8.2W	<10	<10	<10	<10
DC 8.8C	<10	<10	<10	<10
DHRES-16_743	<10	<10	**10**	**22**
Gallery Well	<10	<10	<10	<10
Hidden Spring	**15**	**49**	**17**	**91**
HRES-06	<10	<10	<10	<10
Iberri Spring	<10	<10	<10	<10
Kane Spring	<10	<10	<10	**57**
McGinnel Mine Spring	<10	**18**	<10	**23**
McGinnel Spring	<10	**24**	<10	**28**
Lower Mineral	<10	<10	<10	<10
MC 6.9	<10	<10	<10	<10
No Name Spring	<10	<10	<10	<10
QC 17.39	<10	<10	<10	<10
Rock Horizontal Spring	<10	<10	<10	<10
TC 0.6	<10	<10	<10	<10
Walker Spring	**14**	**27**	**14**	**41**

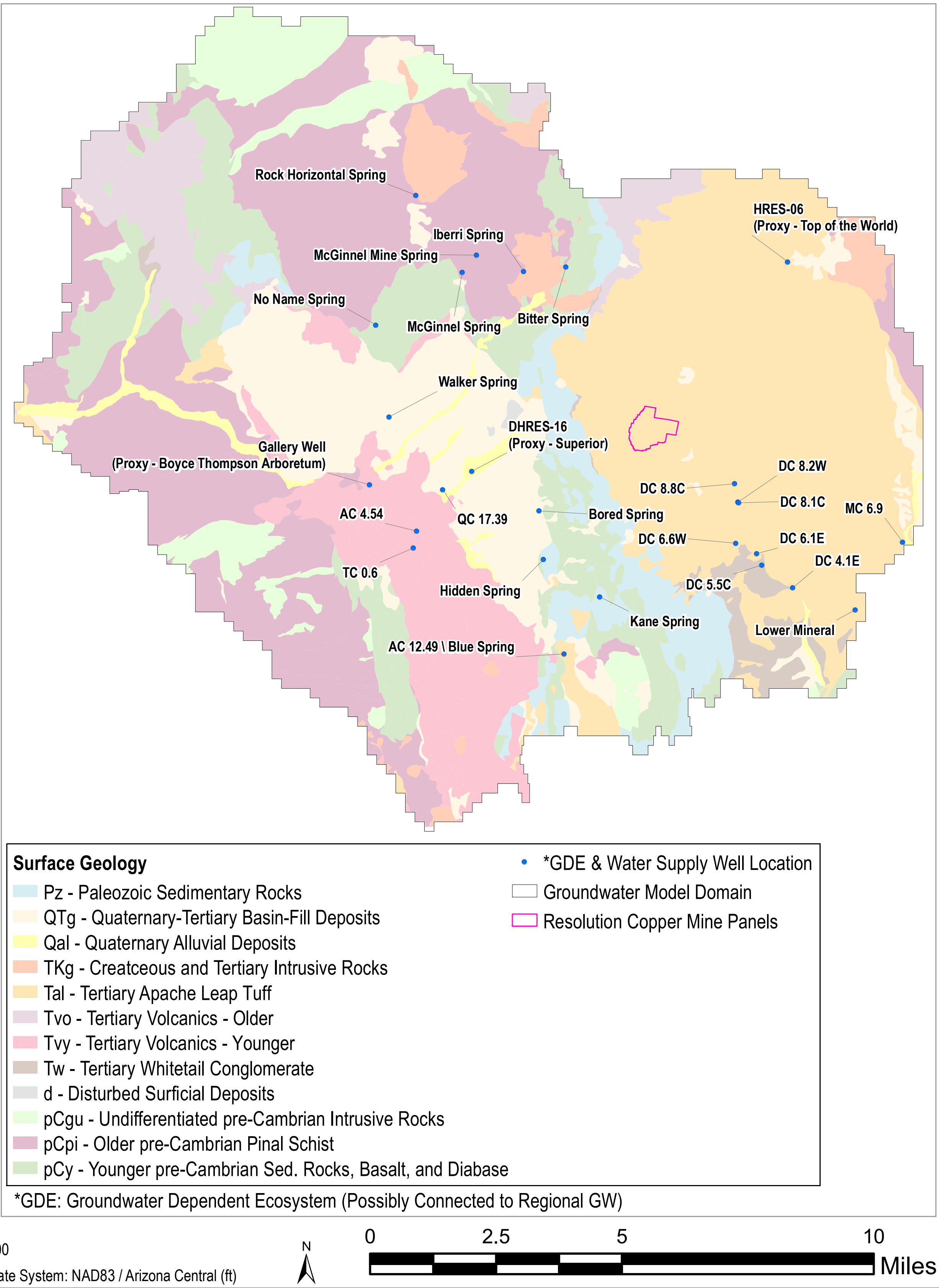
Notes:
LoM = 51.5 years into predictive model
Post Closure = 200 years into predictive model; 51.5 + 148.5
Bold # = Drawdown >10 ft

Table 3: Impact at GDE & Water Supply Well Locations: LoM and Post Closure

Location	LoM Impact (ft)	Post Closure Impact (ft)
AC 4.54	<10	<10
AC 12.49 / Blue Spring	<10	<10
Bitter Spring	<10	<10
Bored Spring	<10	**76**
DC 4.1E	<10	<10
DC 5.5C	<10	<10
DC 6.1E	<10	<10
DC 6.6W	<10	<10
DC 8.1C	<10	<10
DC 8.2W	<10	<10
DC 8.8C	<10	<10
DHRES-16_743	<10	**18**
Gallery Well	<10	<10
Hidden Spring	<10	**42**
HRES-06	<10	**10**
Iberri Spring	<10	<10
Kane Spring	<10	**49**
McGinnel Mine Spring	<10	<10
McGinnel Spring	<10	<10
Lower Mineral	<10	<10
MC 6.9	<10	<10
No Name Spring	<10	<10
QC 17.39	<10	<10
Rock Horizontal Spring	<10	<10
TC 0.6	<10	<10
Walker Spring	<10	**14**

Notes:
LoM = 51.5 years into predictive model
Post Closure = 200 years into predictive model; 51.5 + 148.5
Bold # = Impact >10 ft

FIGURES



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Coordinate System: NAD83 / Arizona Central (ft)

GDE & Water Supply Well Locations and Surface Geology

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DRAWN: CP	CHECKED: DO	DATE:	October 2018

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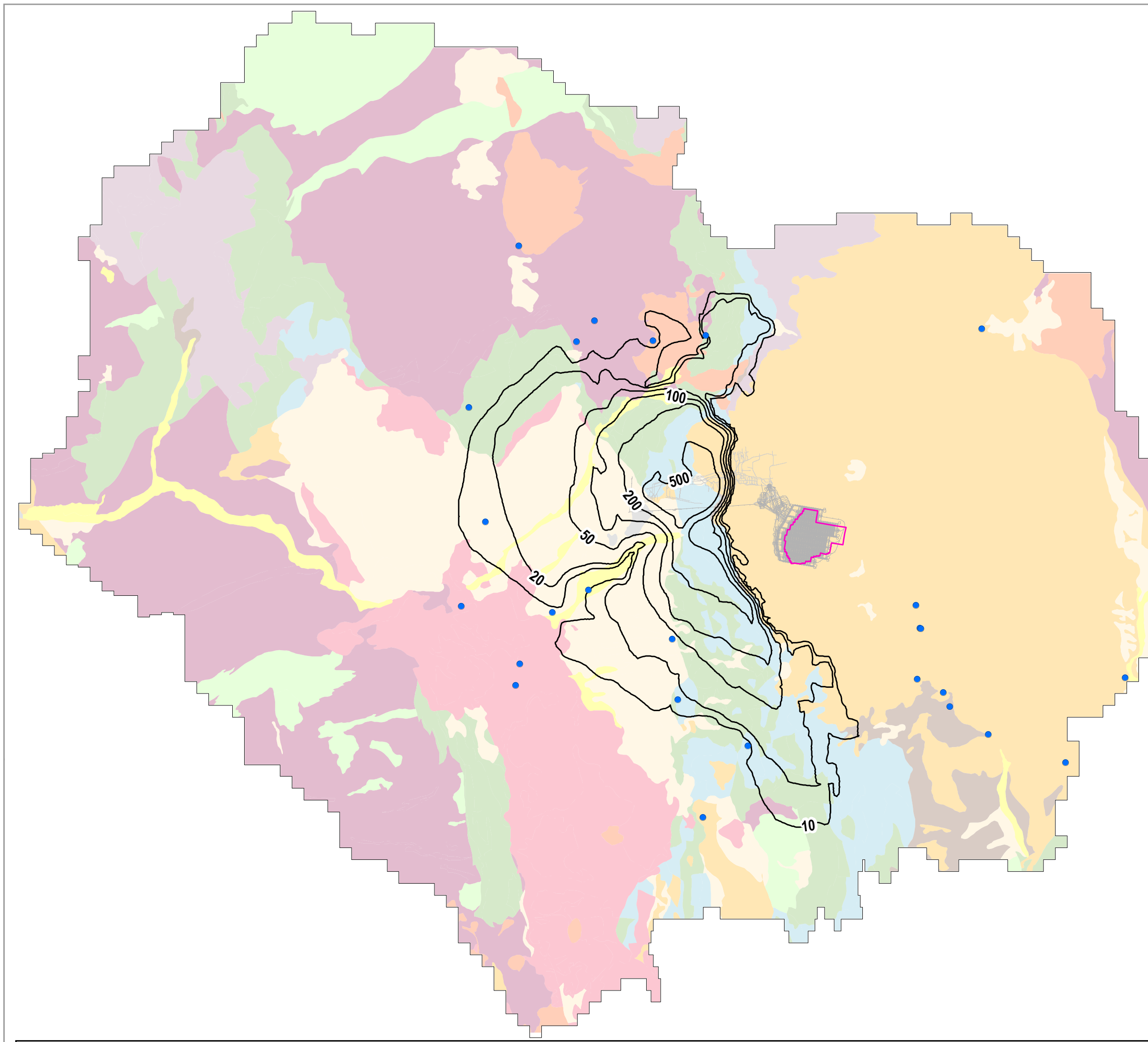

Surface Geology

- Pz - Paleozoic Sedimentary Rocks
- QTg - Quaternary-Tertiary Basin-Fill Deposits
- Qal - Quaternary Alluvial Deposits
- TKg - Createceous and Tertiary Intrusive Rocks
- Tal - Tertiary Apache Leap Tuff
- Tvo - Tertiary Volcanics - Older
- Tvy - Tertiary Volcanics - Younger
- Tw - Tertiary Whitetail Conglomerate
- d - Disturbed Surficial Deposits
- pCgu - Undifferentiated Precambrian Intrusive Rocks
- pCpi - Older Precambrian Pinal Schist
- pCy - Younger Precambrian Sedimentary Rocks, Basalt, and Diabase

- Drawdown Contour (feet)
- **GDE & Water Supply Well Location
- Groundwater Model Domain
- Resolution Copper Mine Panels
- Resolution Copper Underground Workings
- Magma Underground Workings

Model Results: RCM_LOM_NA_180730

**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

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Coordinate System: NAD83 / Arizona Central (ft)

N

0 2.5 5 10 Miles

Regional Groundwater Model Predicted Drawdown - No Action
End LoM (Year 52)

PROJECT:	3D Regional Groundwater Model	FIGURE #:	2
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DRAWN: CP	CHECKED: DO	DATE:	October 2018

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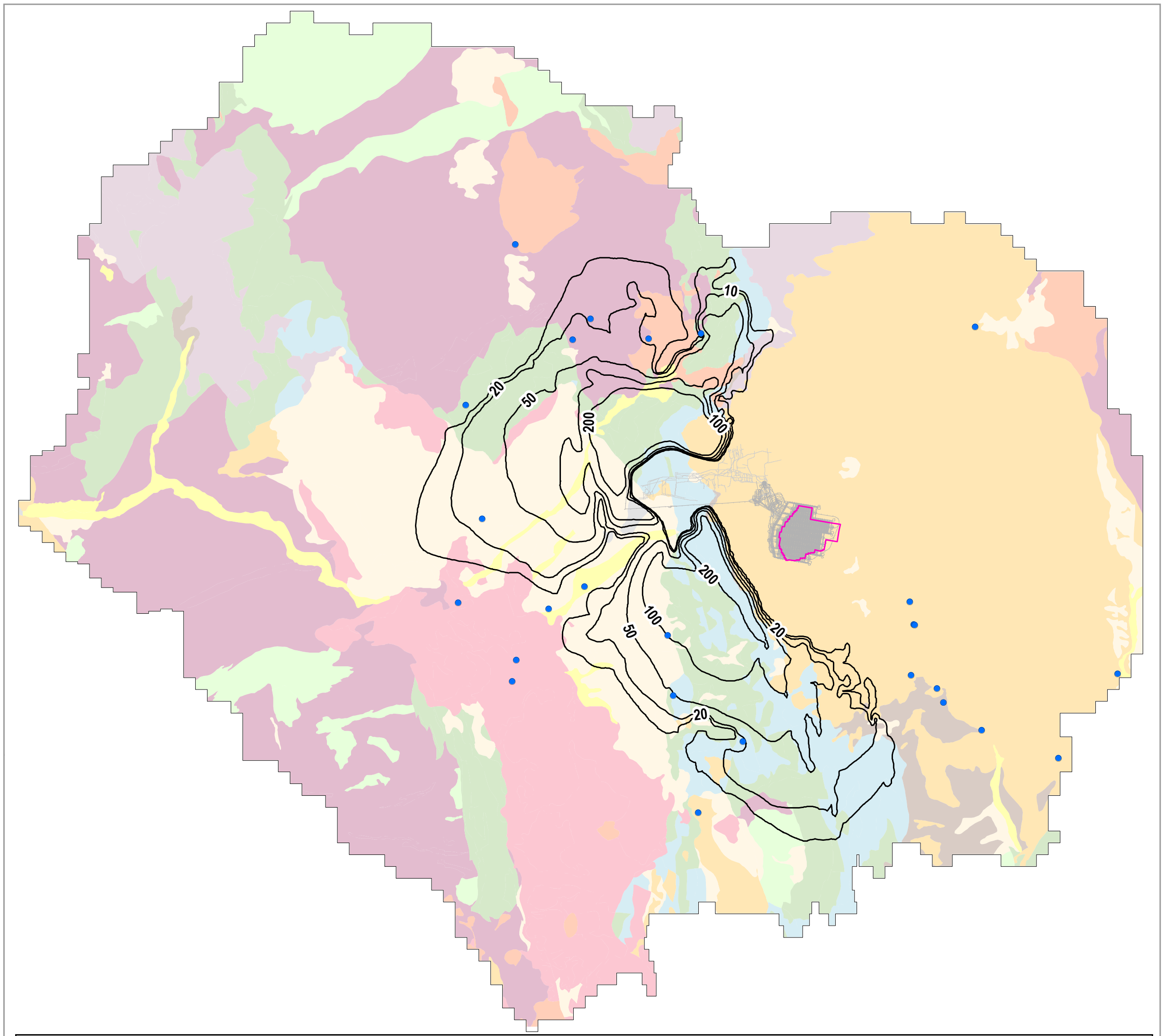

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- Drawdown Contour (feet)
- **GDE & Water Supply Well Location
- Groundwater Model Domain
- Resolution Copper Mine Panels
- Resolution Copper Underground Workings
- Magma Underground Workings

Model Results: RCM_LOM_NA_180730

**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

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Coordinate System: NAD83 / Arizona Central (ft)

N

0 2.5 5 10 Miles

wsp

Regional Groundwater Model Predicted Drawdown - No Action
Post Closure (Year 200)

PROJECT: 3D Regional Groundwater Model		FIGURE #:	3
CLIENT: Resolution Copper		PROJECT #:	31400968.001
DRAWN: CP	CHECKED: DO	DATE:	October 2018

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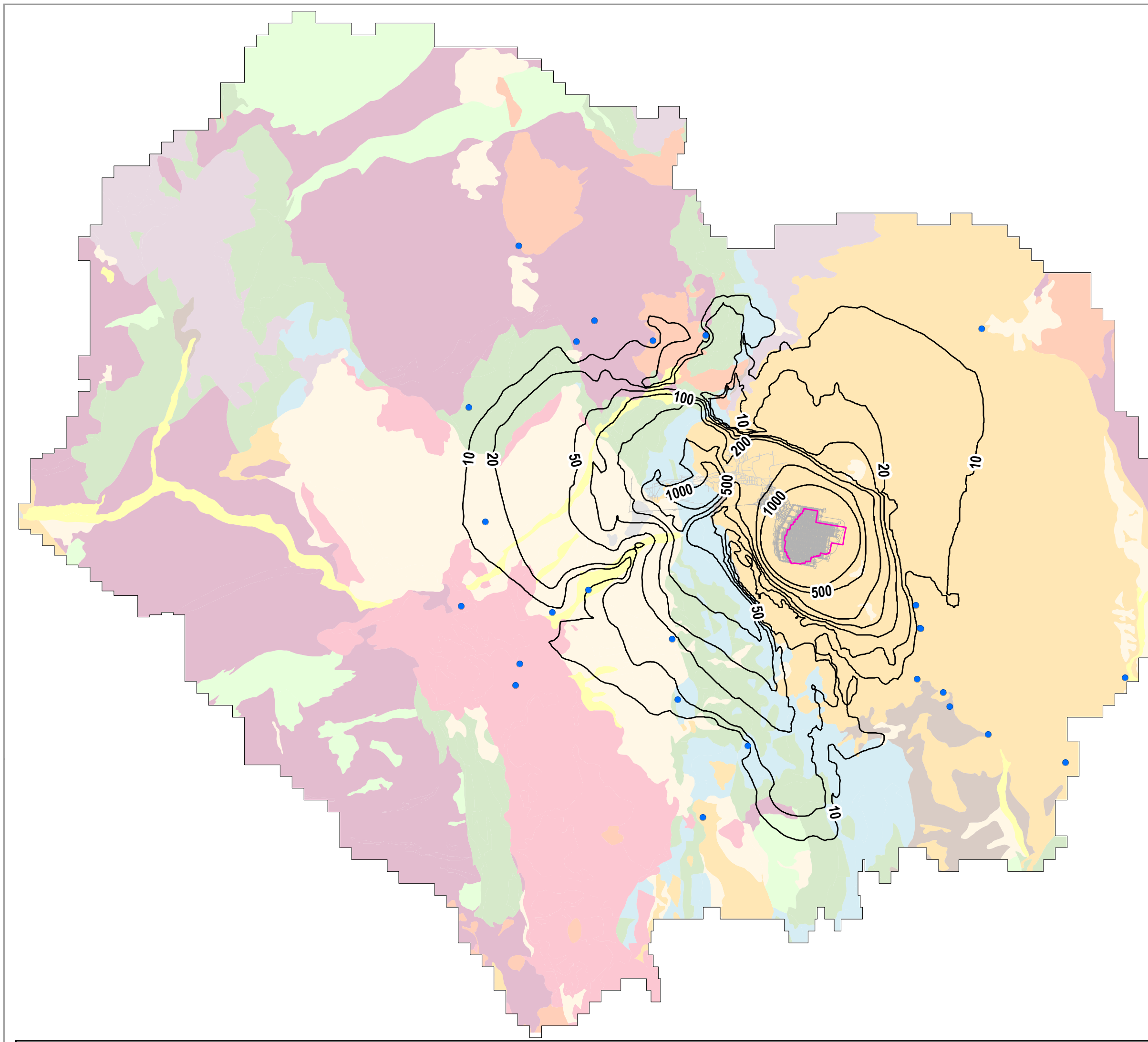

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- Drawdown Contour (feet)
- **GDE & Water Supply Well Location
- Groundwater Model Domain
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- Resolution Copper Underground Workings
- Magma Underground Workings

Model Results: RCM_LOM_PA_180730

**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

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Coordinate System: NAD83 / Arizona Central (ft)

N

0 2.5 5 10 Miles

wsp

Regional Groundwater Model Predicted Drawdown - Proposed Action End LoM (Year 52)

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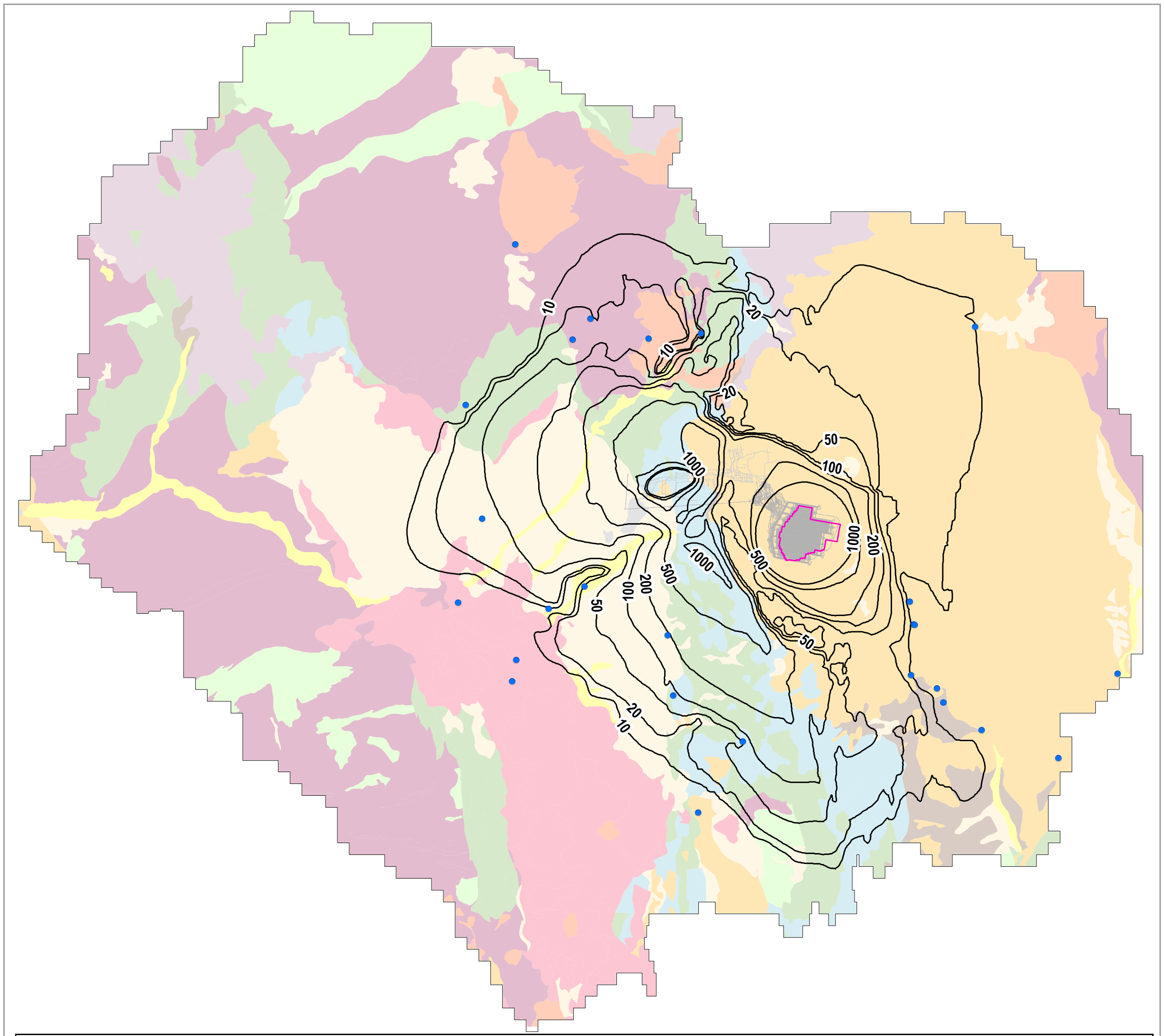

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- Drawdown Contour (feet)
- **GDE & Water Supply Well Location
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- Resolution Copper Mine Panels
- Resolution Copper Underground Workings
- Magma Underground Workings

Model Results: RCM_LOM_PA_180730

**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

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Coordinate System: NAD83 / Arizona Central (ft)

N

0 2.5 5 10 Miles

wsp

Regional Groundwater Model Predicted Drawdown - Proposed Action
Post Closure (Year 200)

PROJECT: 3D Regional Groundwater Model		FIGURE #:	5
CLIENT: Resolution Copper		PROJECT #:	31400968.001
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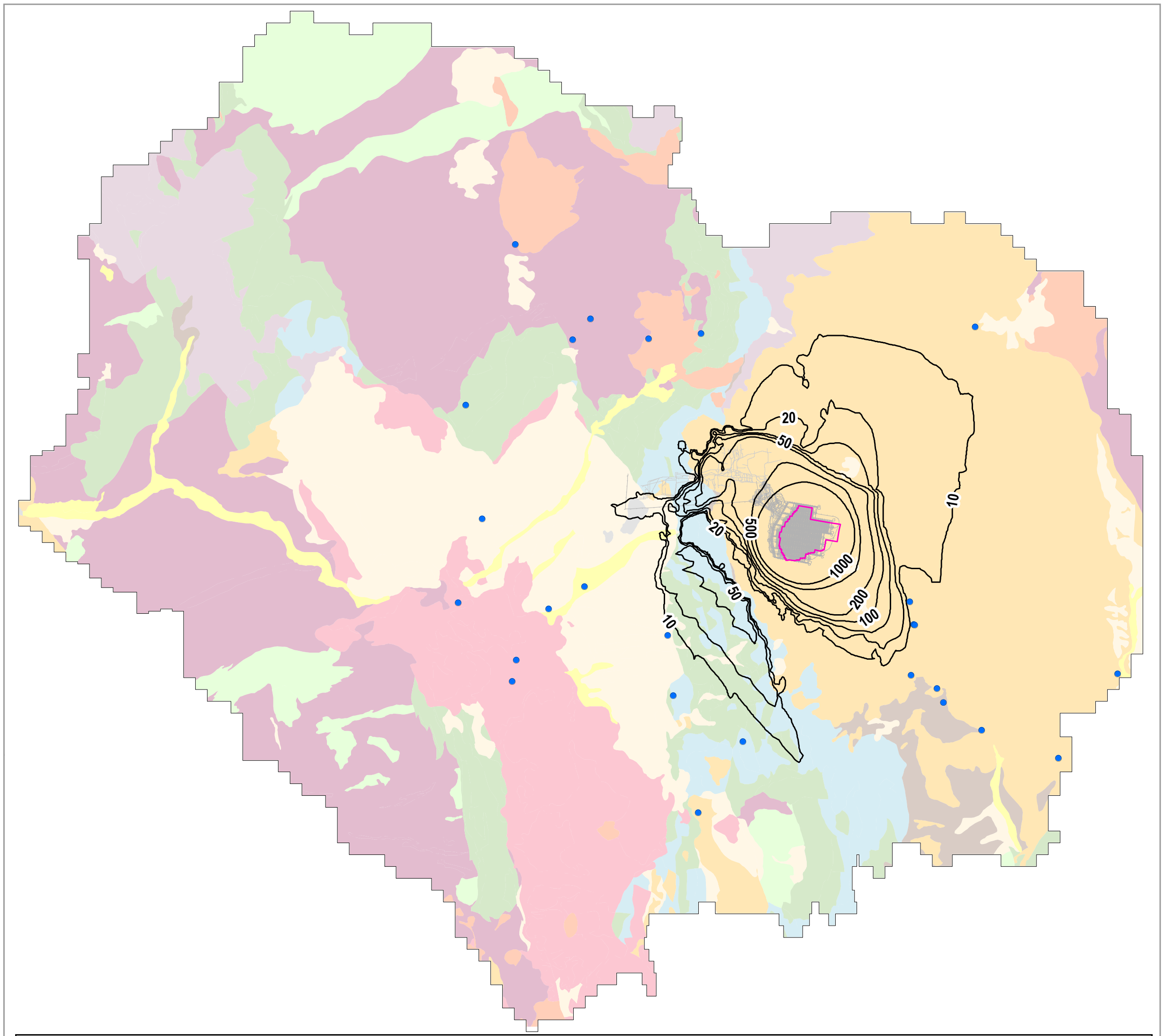

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- *Impact Contour (feet)
- **GDE & Water Supply Well Location
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- Magma Underground Workings

Model Results: RCM_LOM_NA_180730 & RCM_LOM_PA_180730

*Impact = Predicted No Action Head - Predicted Proposed Action Head / Equivalent to PA Drawdown - NA Drawdown
**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

1:185,000

Coordinate System: NAD83 / Arizona Central (ft)

N

0 2.5 5 10 Miles

Regional Groundwater Model Predicted Impact - End LoM (Year 52)

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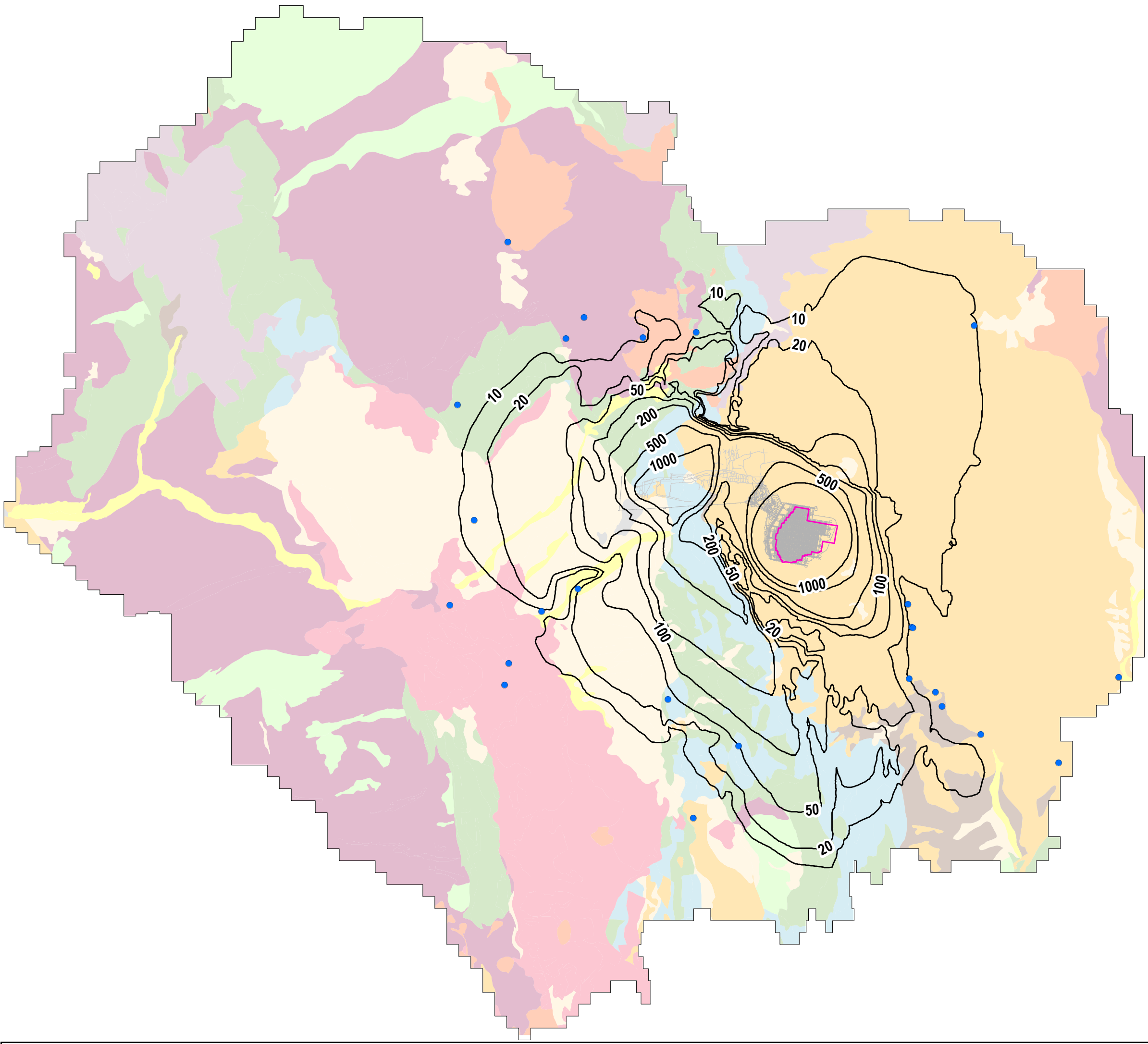

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- *Impact Contour (feet)
- **GDE & Water Supply Well Location
- Groundwater Model Domain
- Resolution Copper Mine Panels
- Resolution Copper Underground Workings
- Magma Underground Workings

Model Results: RCM_LOM_NA_180730
& RCM_LOM_PA_180730

*Impact = Predicted No Action Head - Predicted Proposed Action Head / Equivalent to PA Drawdown - NA Drawdown
**GDE = Groundwater Dependent Ecosystem (Possibly Connected to Regional GW)

1:185,000

Coordinate System: NAD83 / Arizona Central (ft)

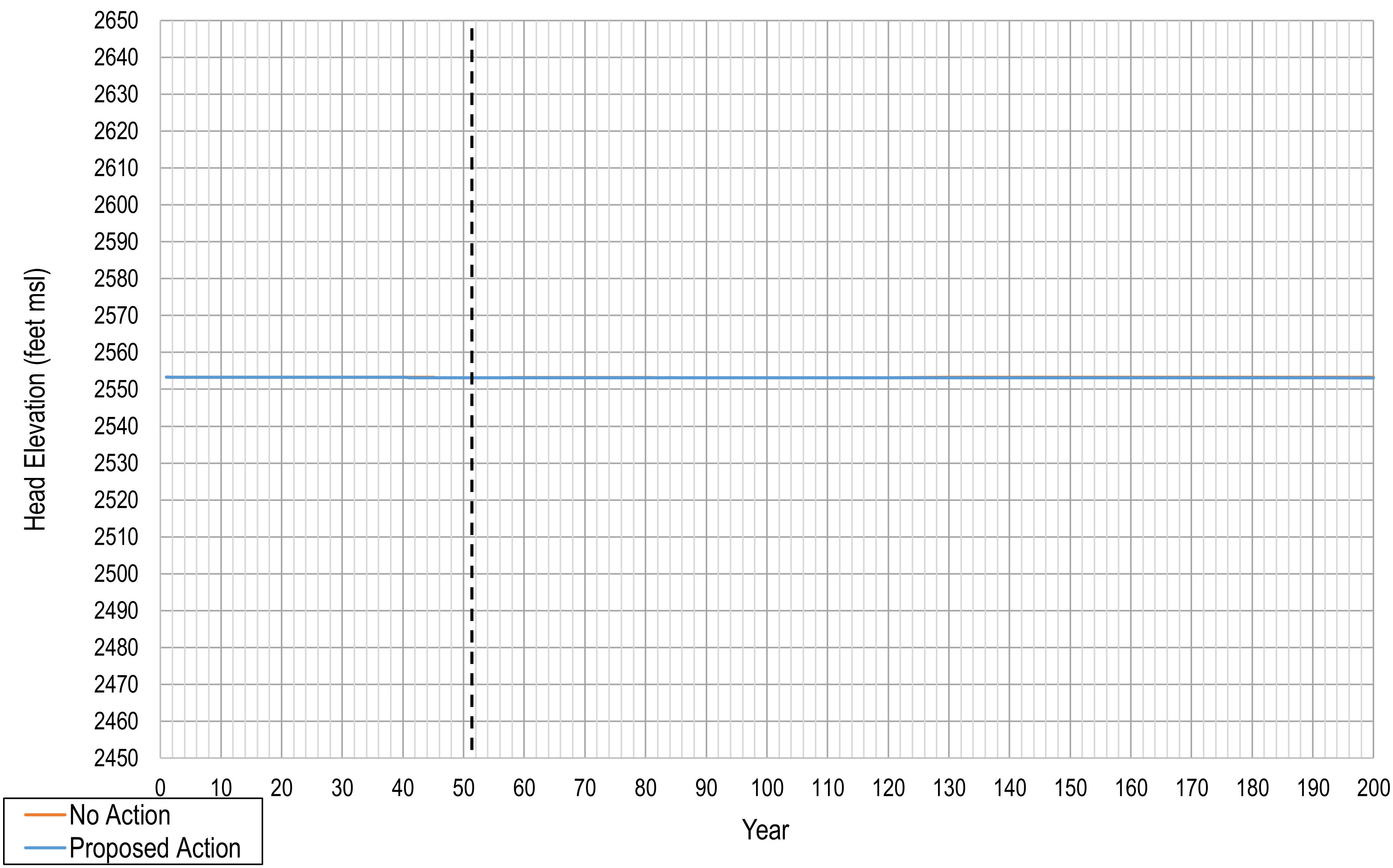
N

0 2.5 5 10 Miles

Regional Groundwater Model Predicted Impact - Post Closure (Year 200)

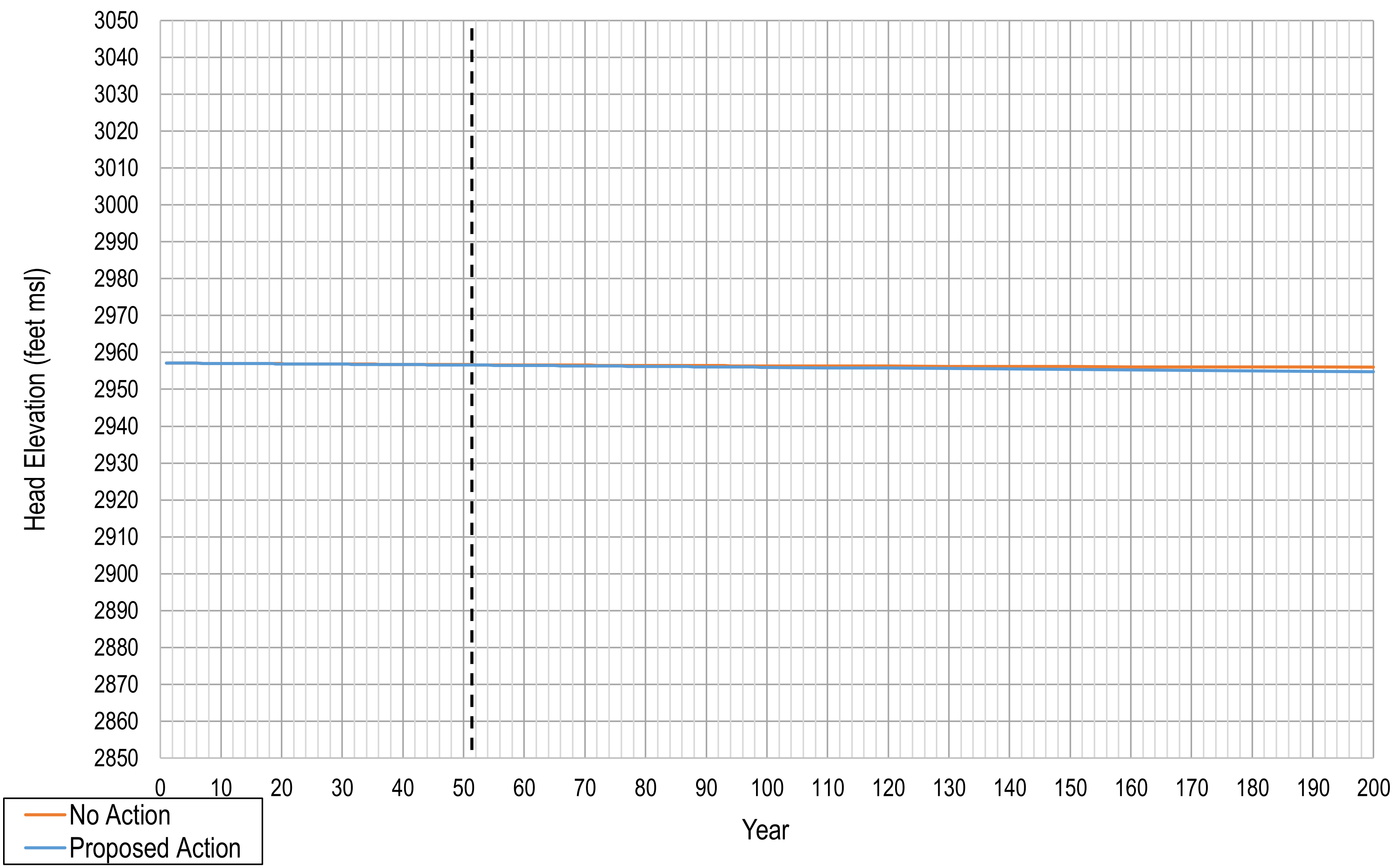
PROJECT: 3D Regional Groundwater Model		FIGURE #: 7	
CLIENT: Resolution Copper		PROJECT #: 31400968.001	
DRAWN: CP	CHECKED: DO	DATE: October 2018	

APPENDIX A: PREDICTIVE MODEL HYDROGRAPHS SHOWING DRAWDOWN (NO ACTION & PROPOSED ACTION MODELS)



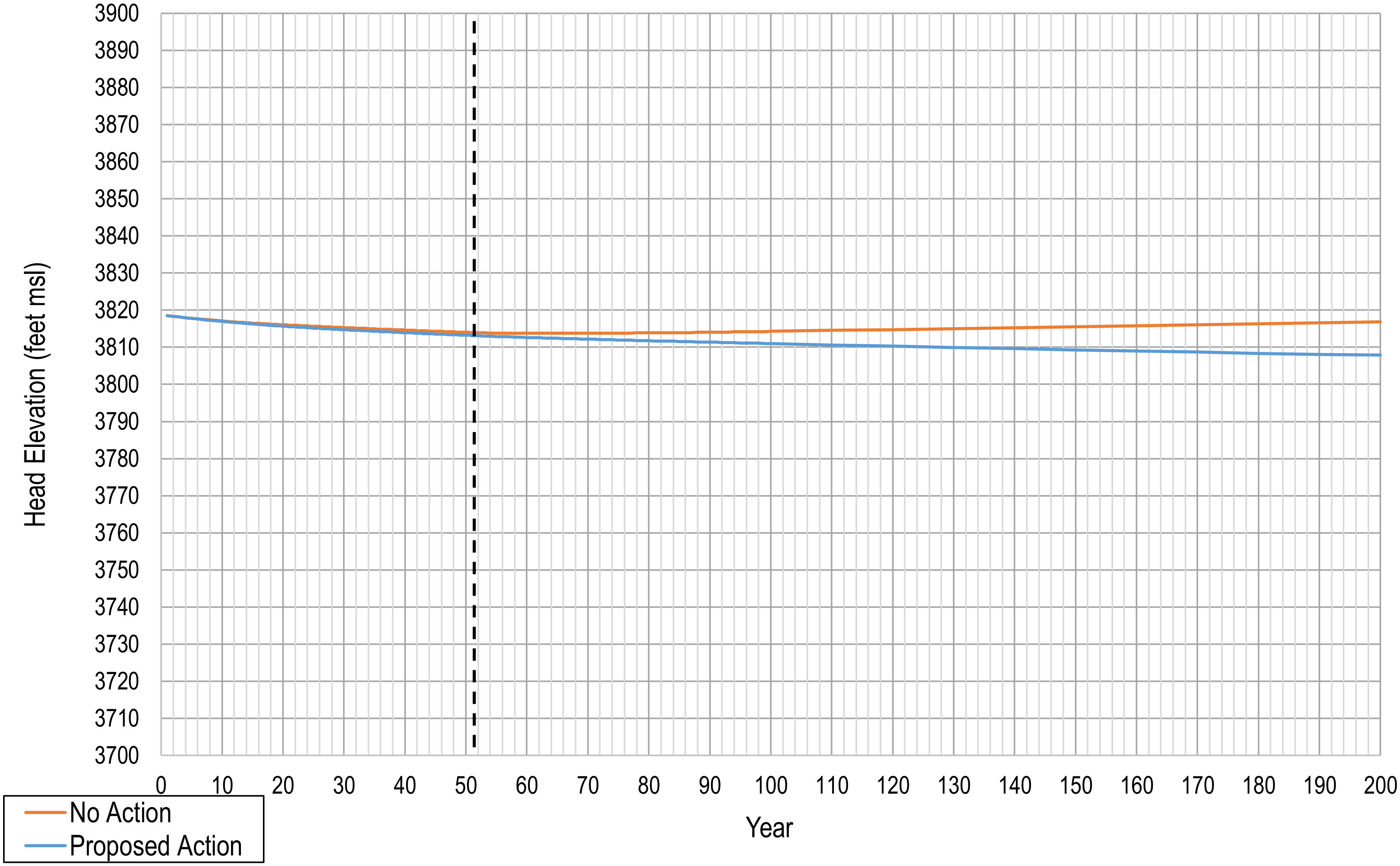
GDE Hydrograph – No Action and Proposed Action – Arnett Creek (AC) 4.54			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-1	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

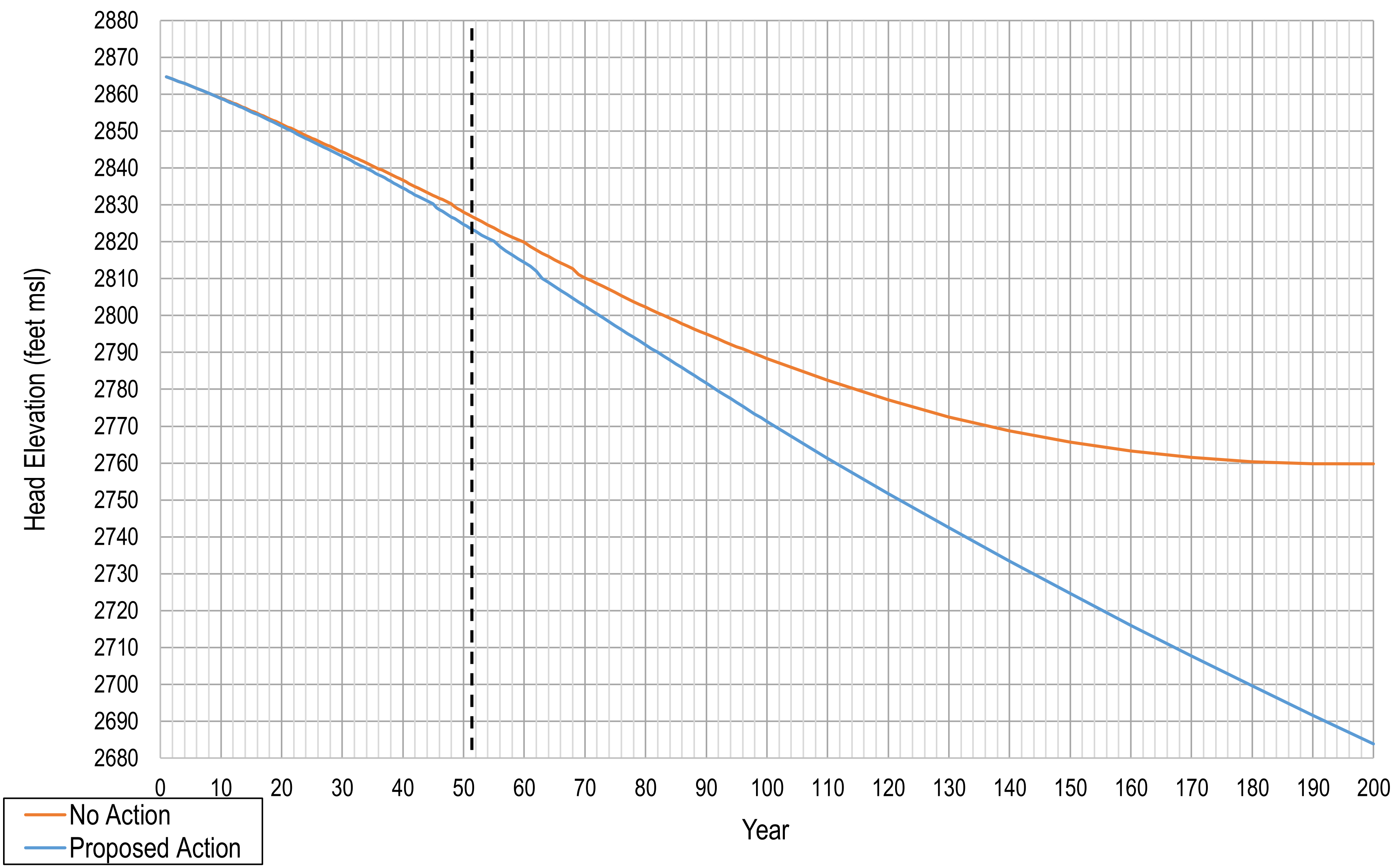


GDE Hydrograph – No Action and Proposed Action – Arnett Creek (AC) 12.49 / Blue Spring	
CLIENT: Resolution Copper	PROJECT: 3D Regional Groundwater Model
JOB: 31400968.001	DRAWN: CP CHECKED: DO
DATE: October 2018	FIGURE: A-2

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – Bitter Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-3	

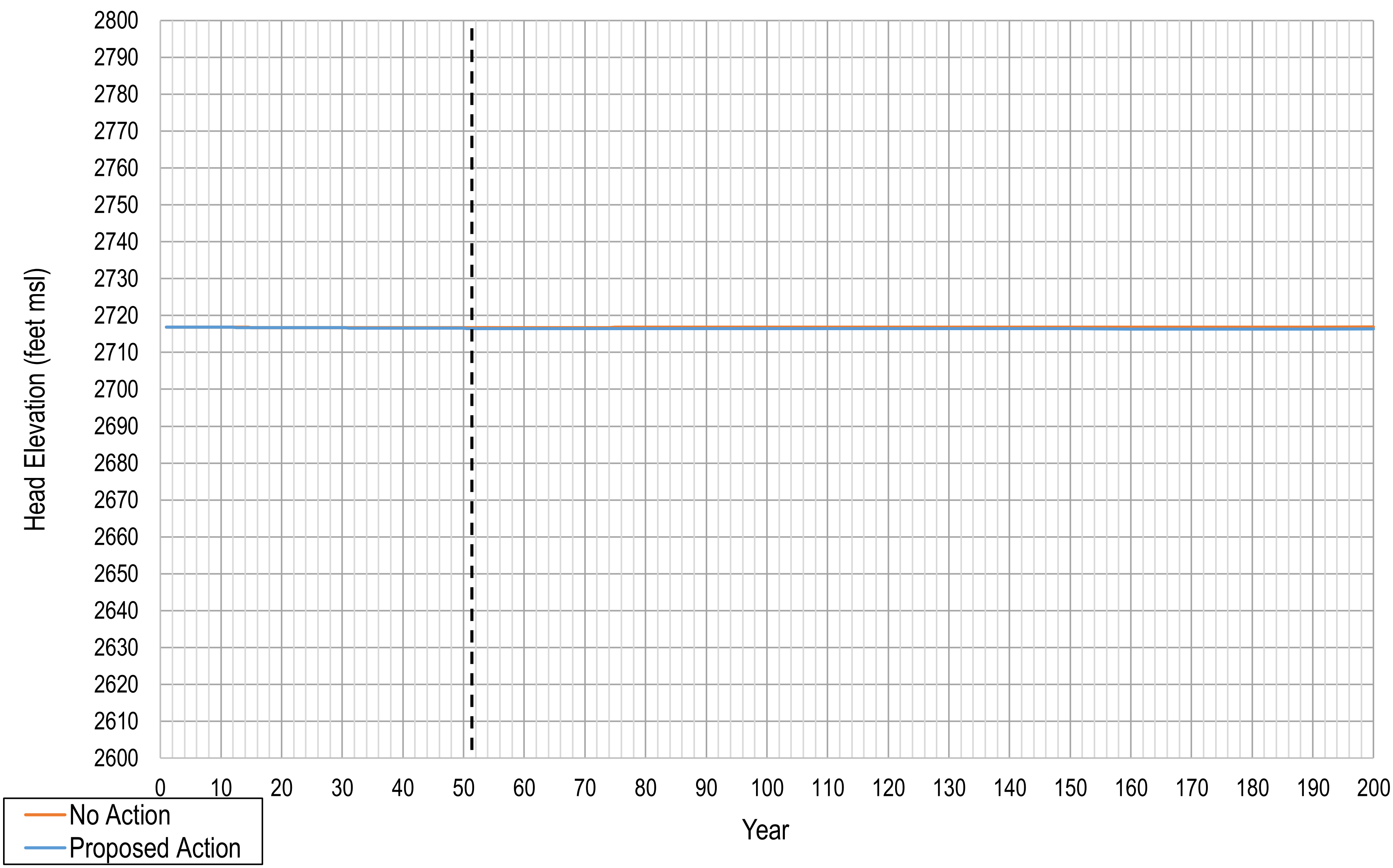


wsp

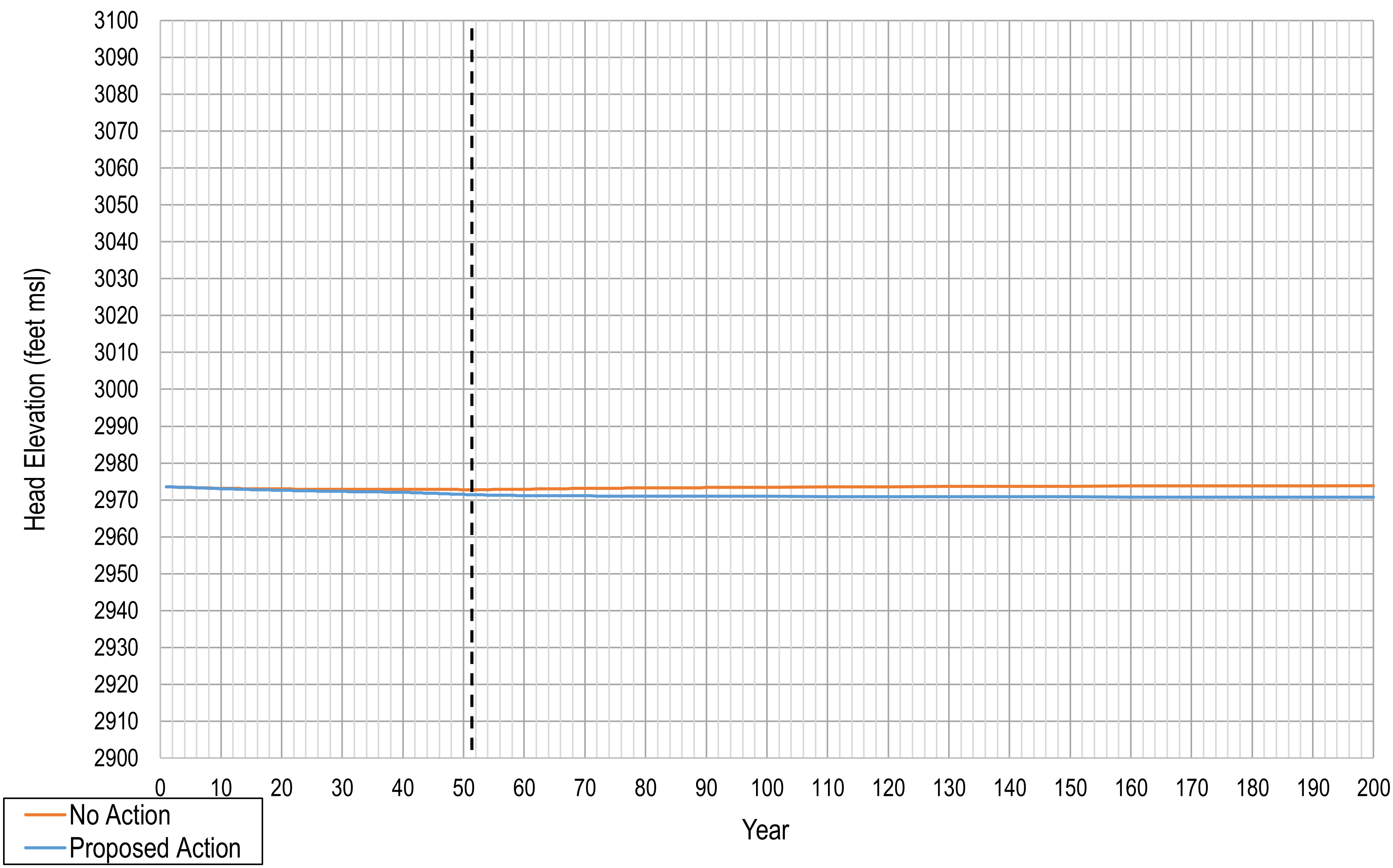
GDE Hydrograph – No Action and Proposed Action – Bored Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-4		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



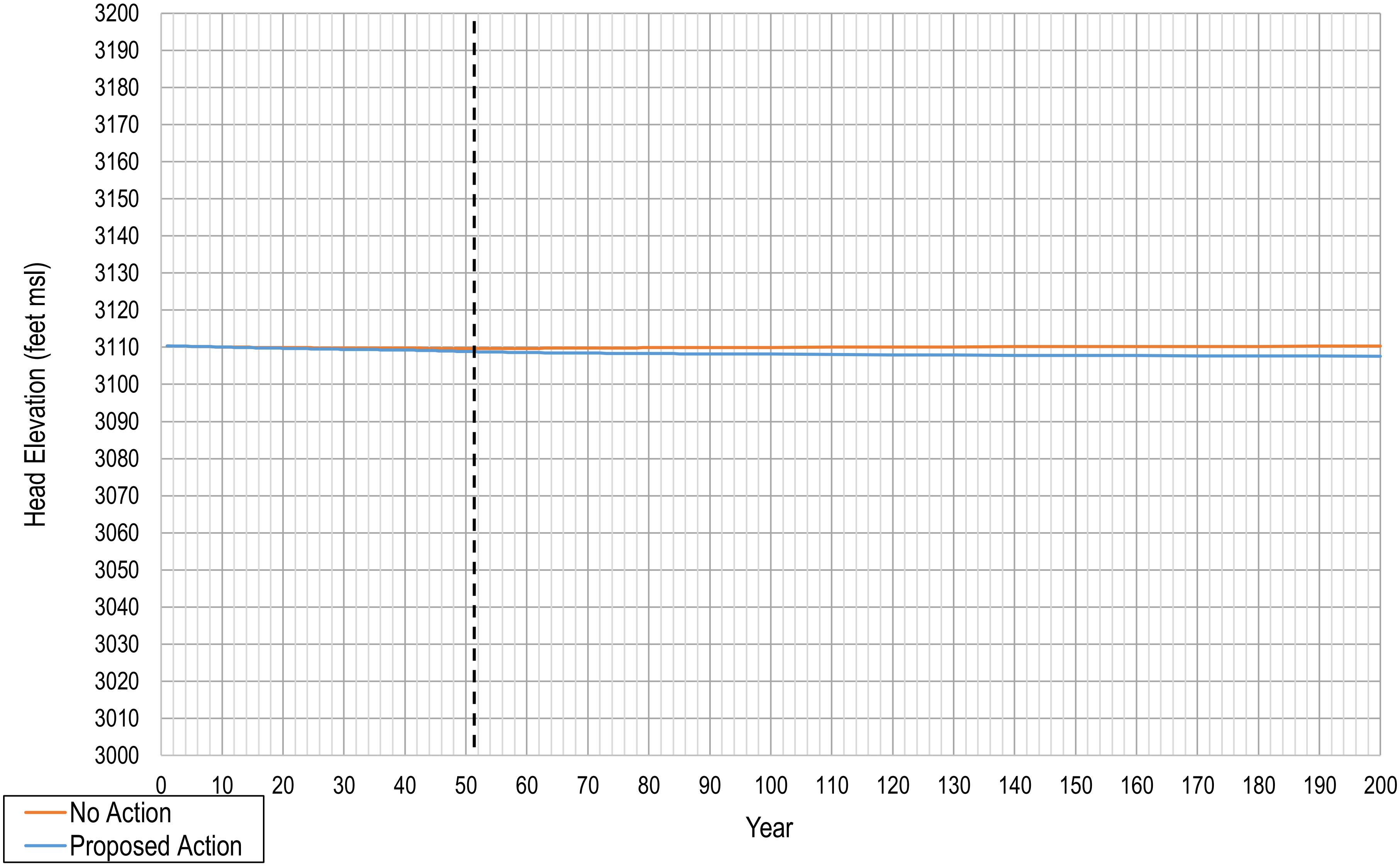
GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 4.1E				
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model		
JOB: 31400968.001		DRAWN: CP		CHECKED: DO
DATE: October 2018		FIGURE: A-5		



GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 5.5C

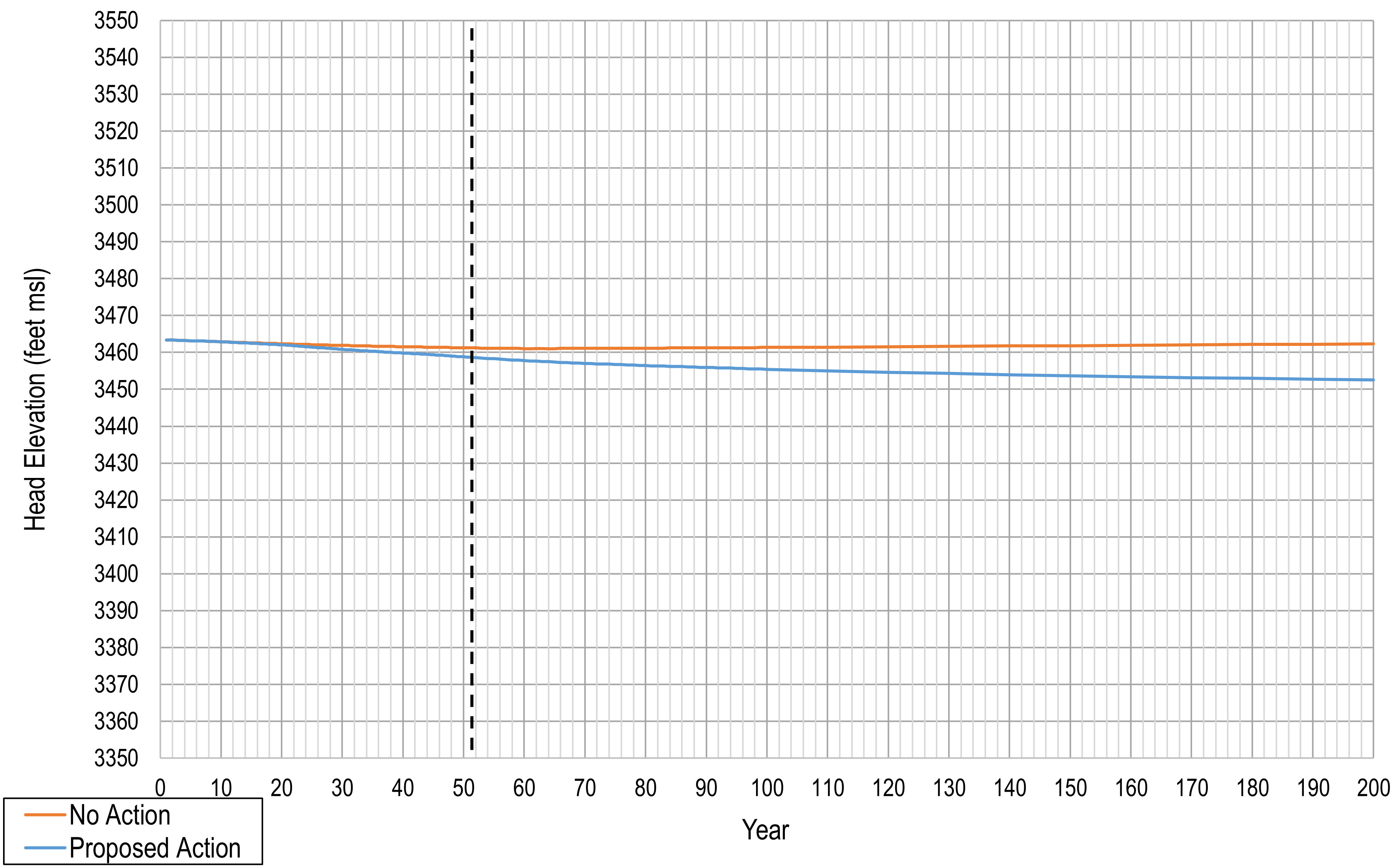
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-6		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



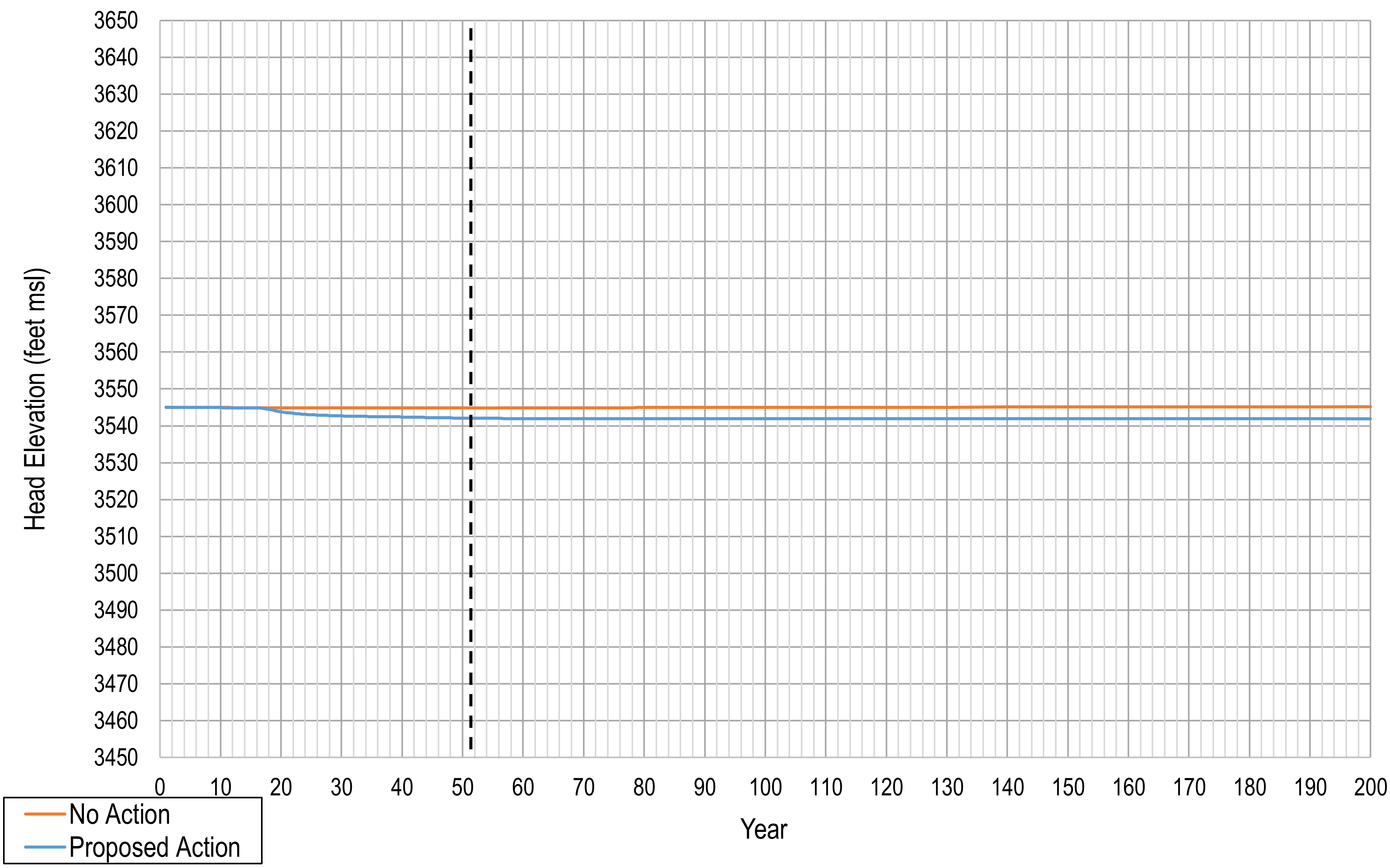
GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 6.1E			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-7	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



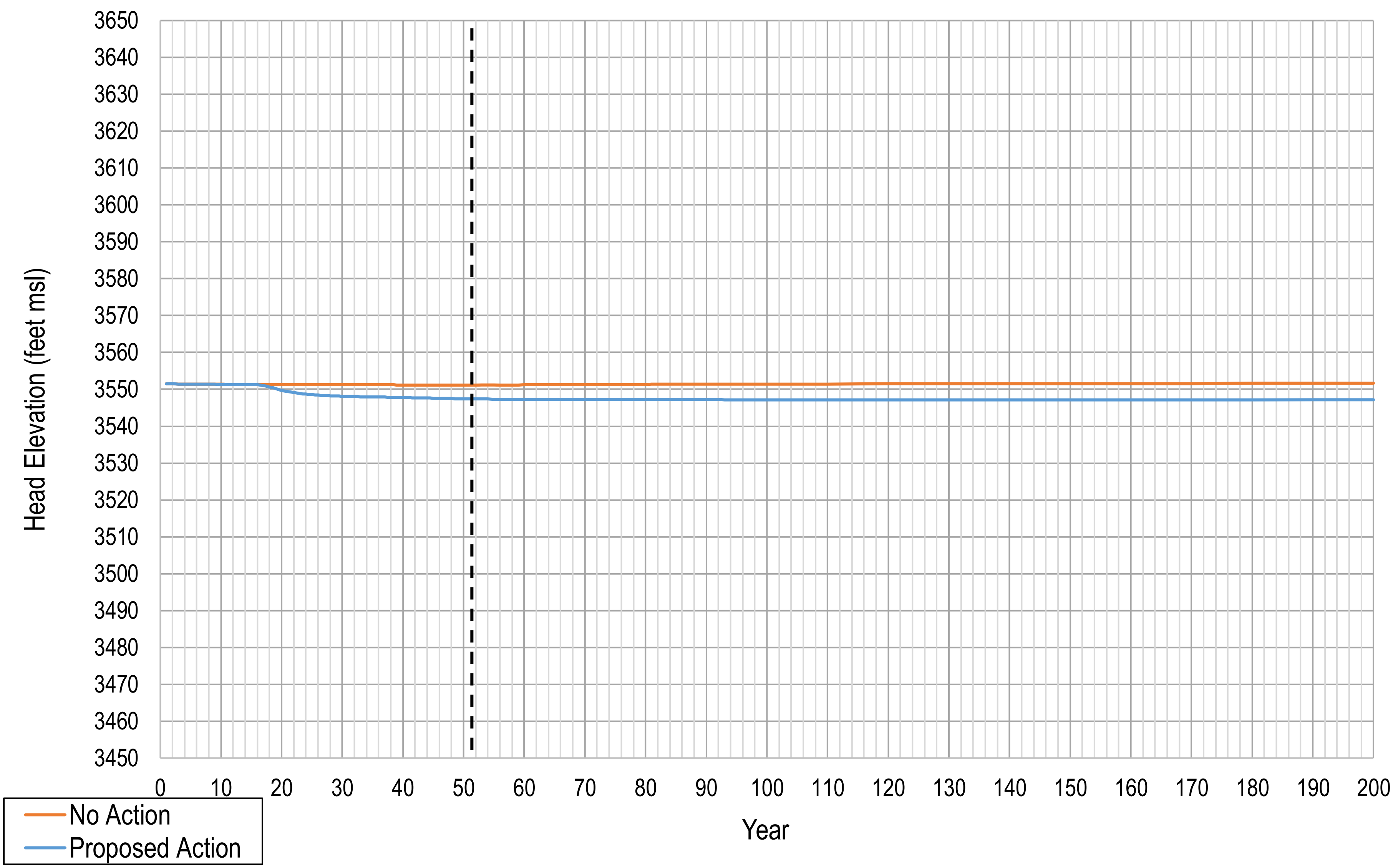
GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 6.6W

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN: CP	CHECKED: DO
DATE:	October 2018	FIGURE:	A-8



GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 8.1C			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-9	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 8.2W

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-10		

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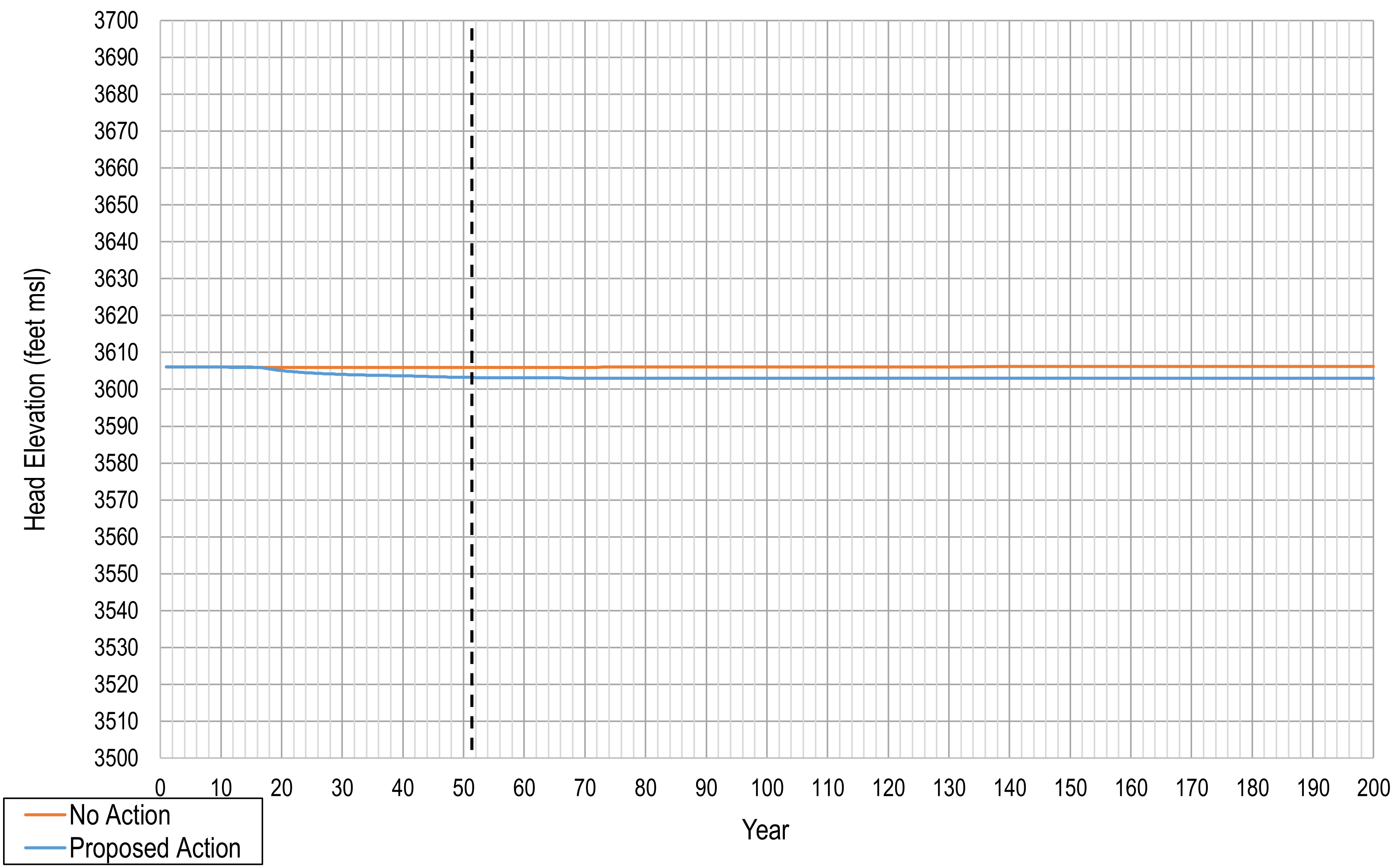
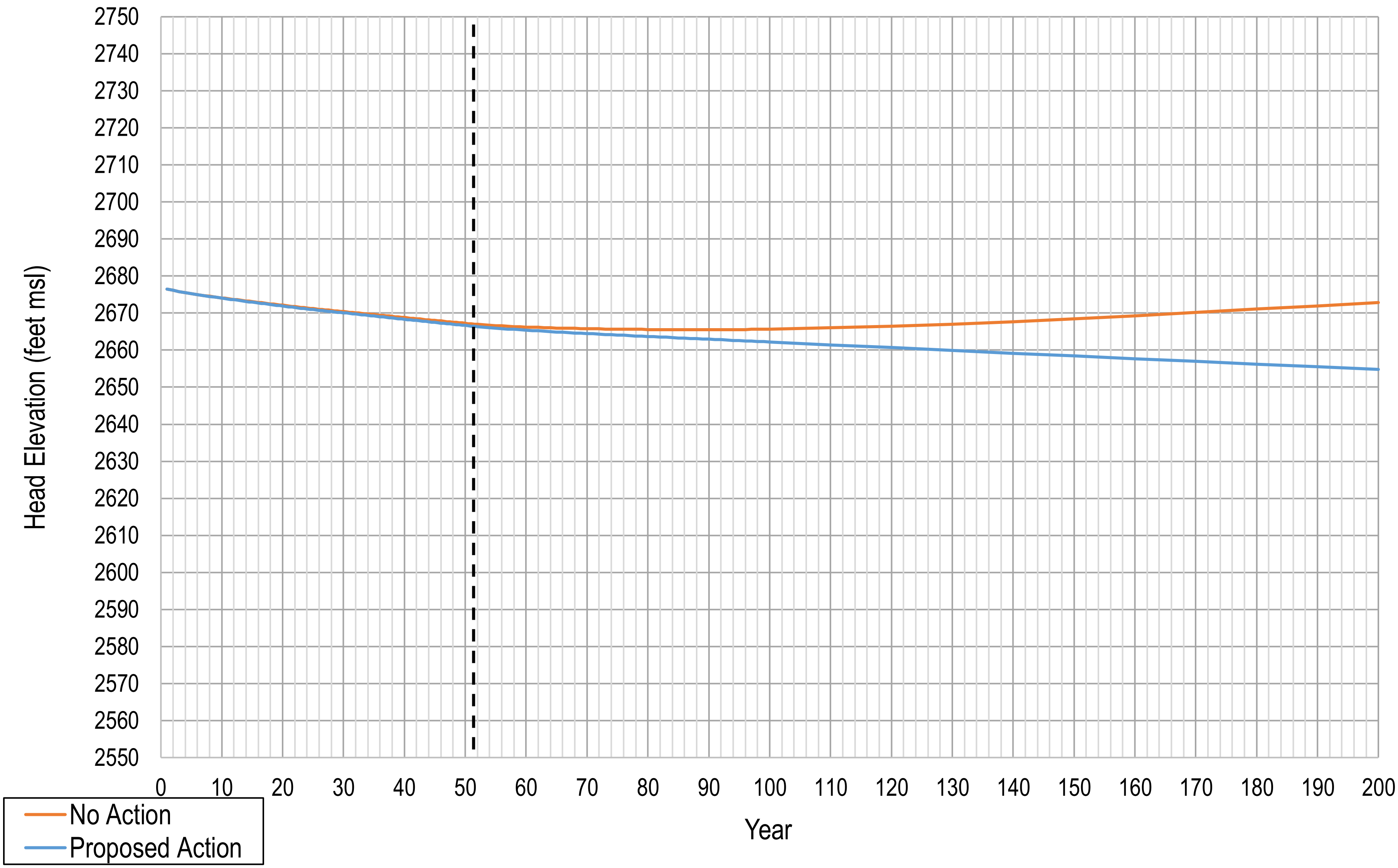


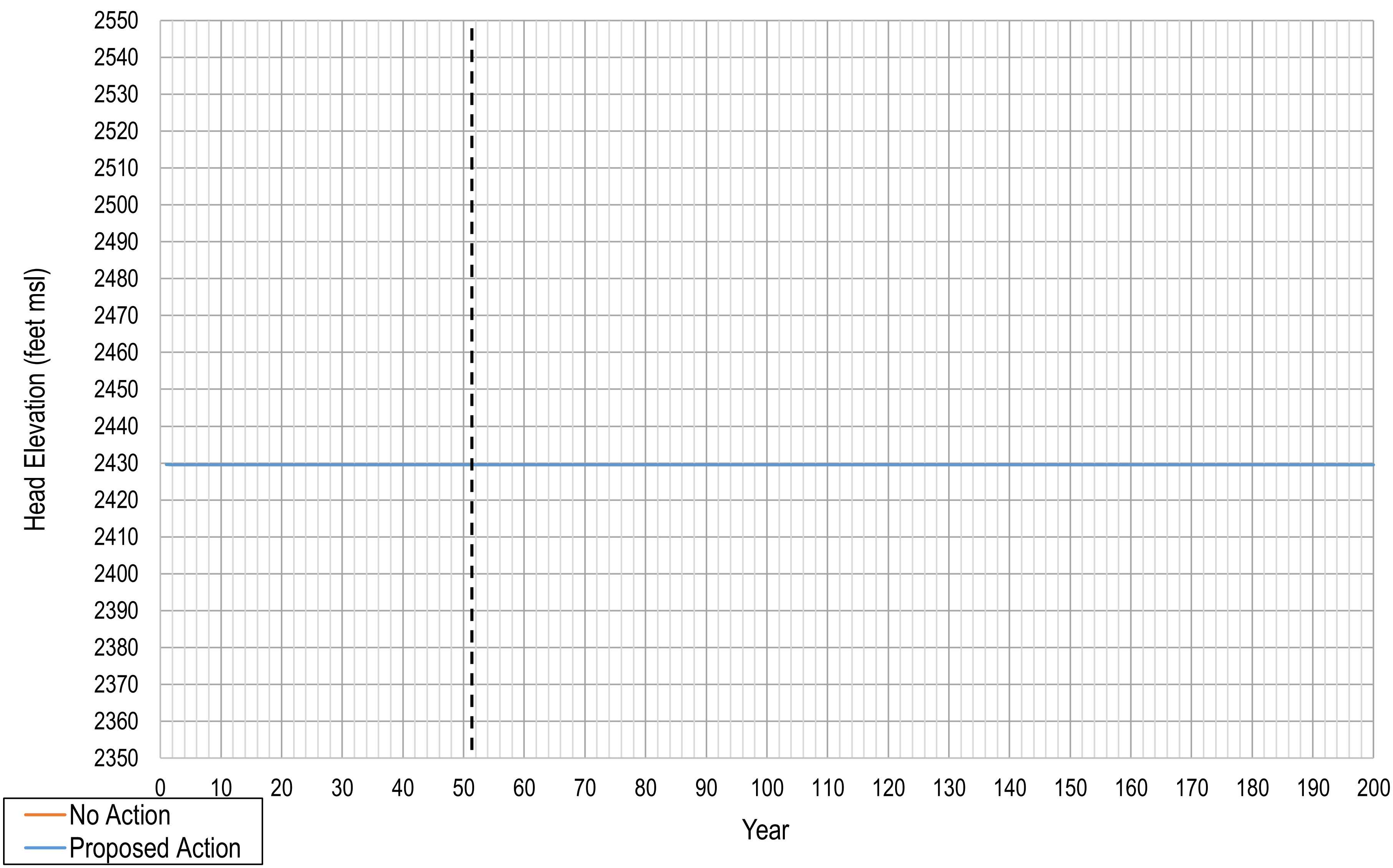
GDE Hydrograph – No Action and Proposed Action – Devils Canyon (DC) 8.8C			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-11	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

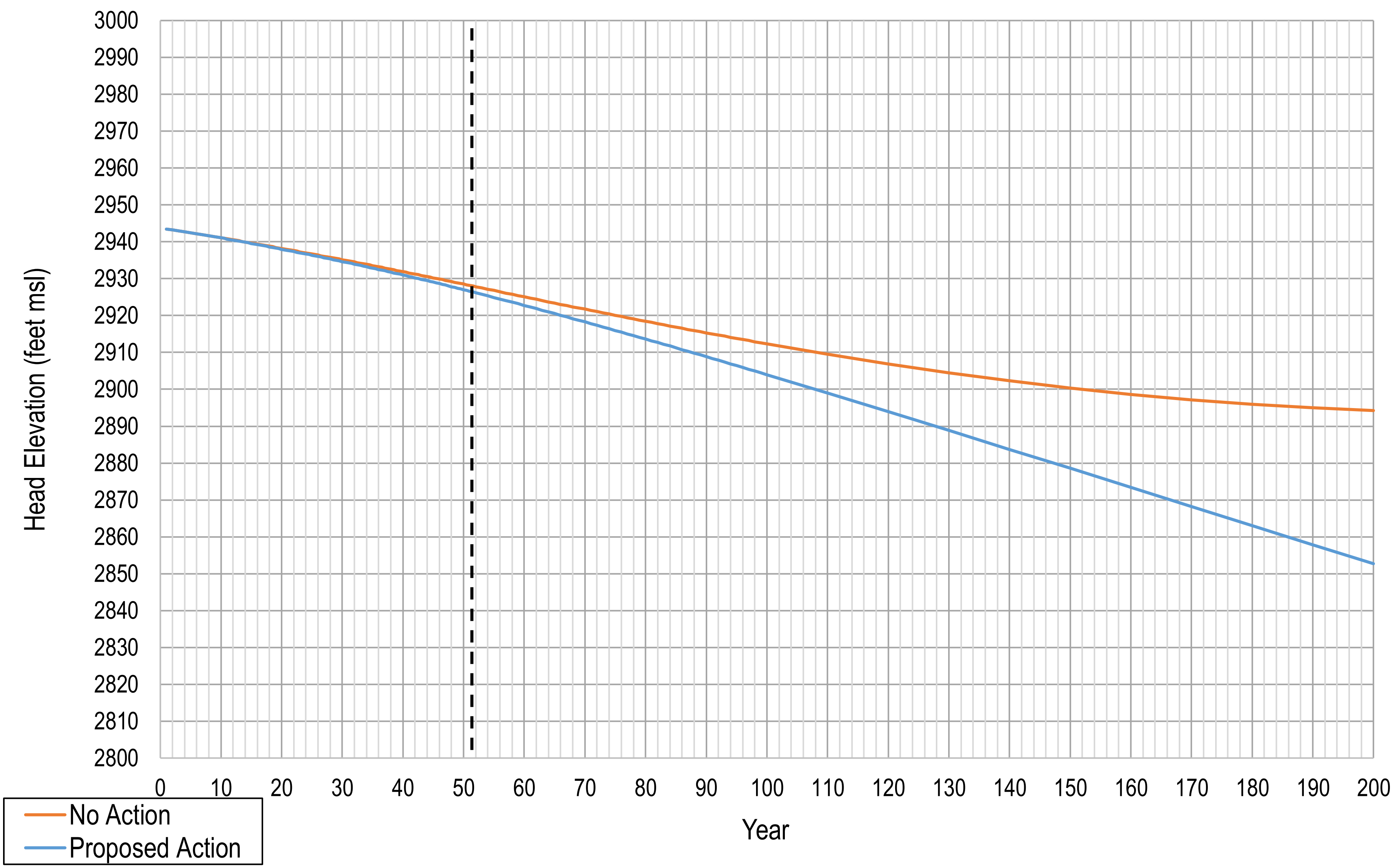


GDE Hydrograph – No Action and Proposed Action – DHRES-16_743

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN:	CP
		CHECKED:	DO
DATE:	October 2018	FIGURE:	A-12



GDE Hydrograph – No Action and Proposed Action – Gallery Well			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-13	



GDE Hydrograph – No Action and Proposed Action – Hidden Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-14		

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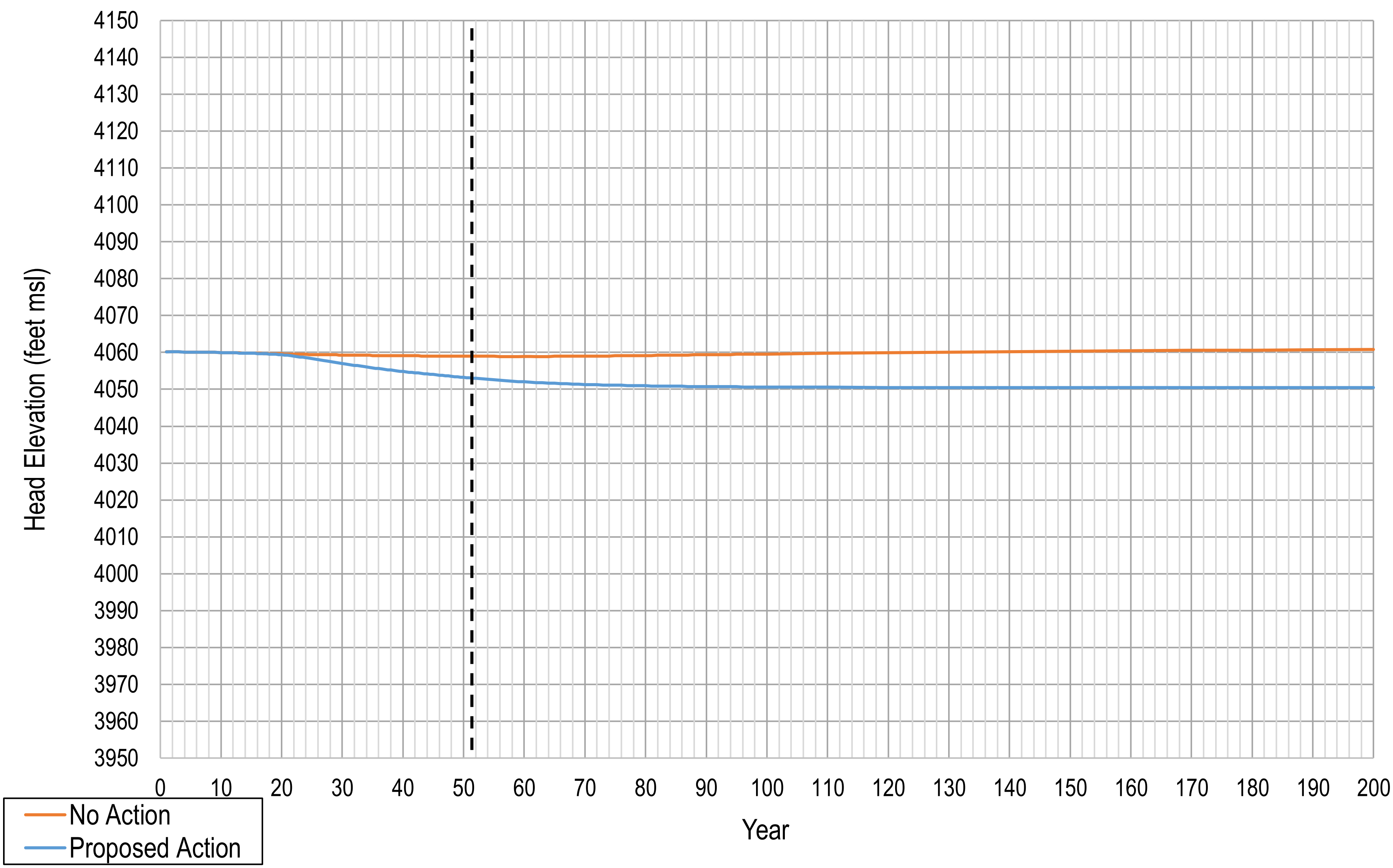

GDE Hydrograph – No Action and Proposed Action – HRES-06

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
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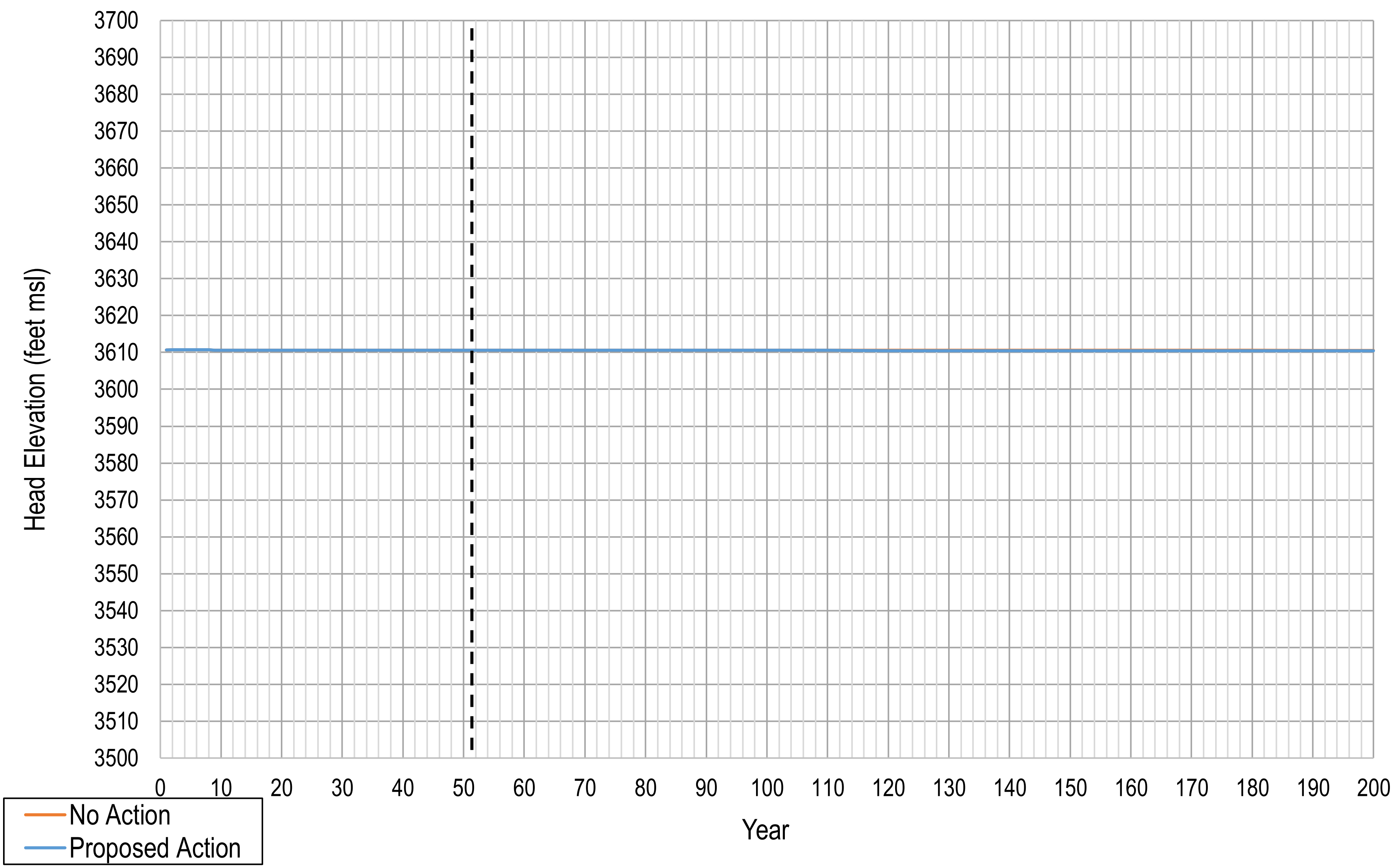
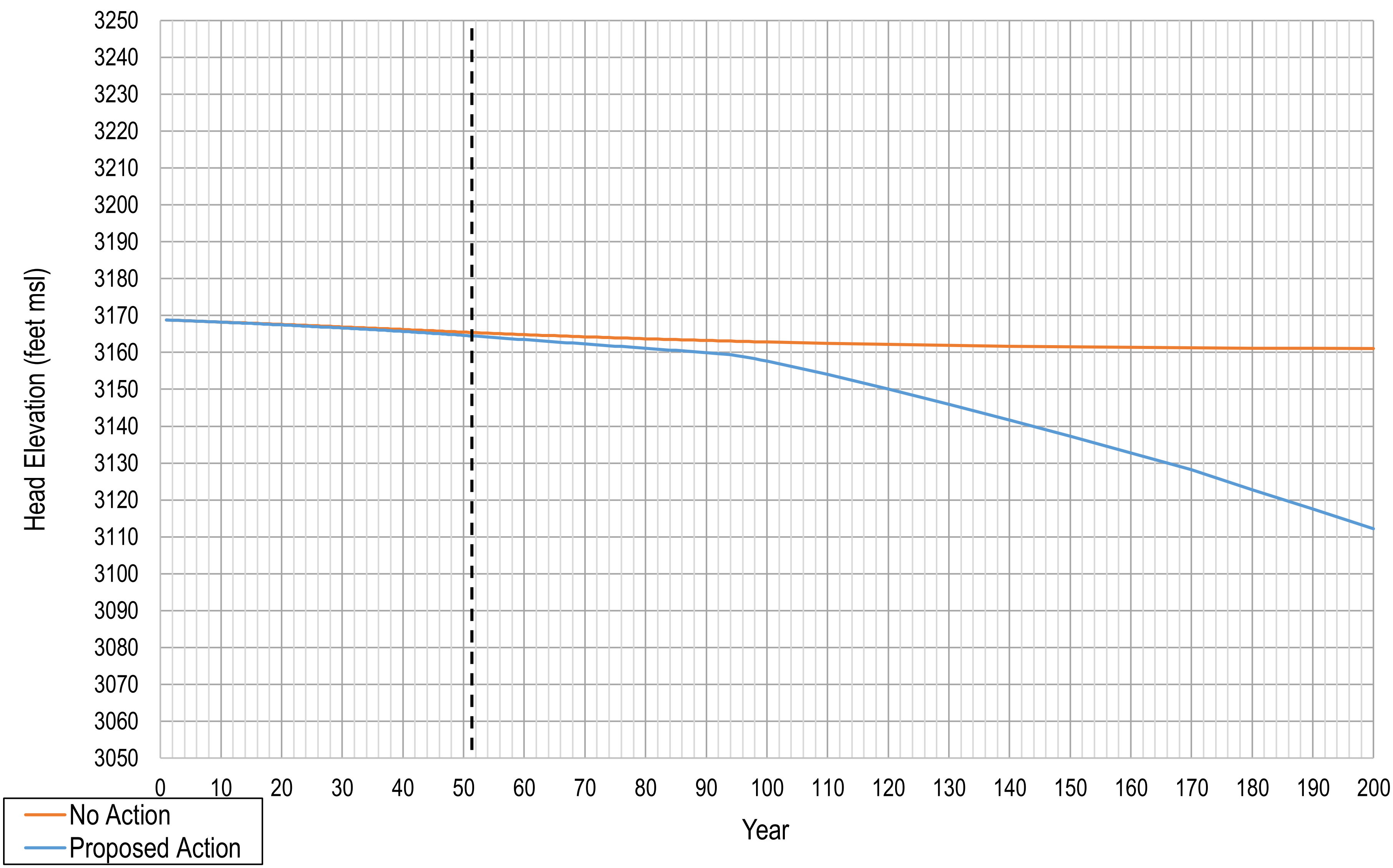
DATE:	October 2018	FIGURE:	A-15		



GDE Hydrograph – No Action and Proposed Action – Iberri Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-16		



GDE Hydrograph – No Action and Proposed Action – Kane Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-17	

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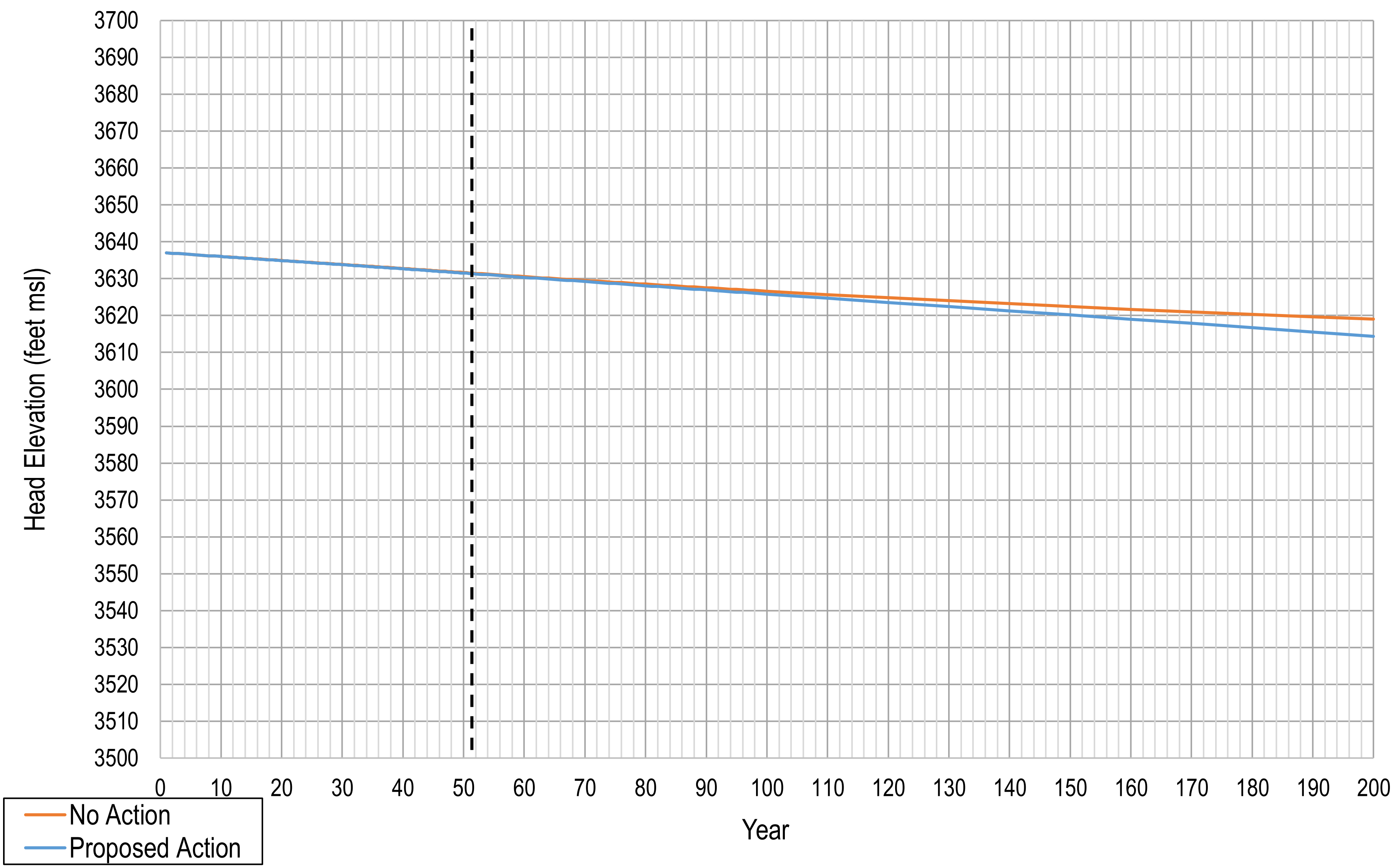
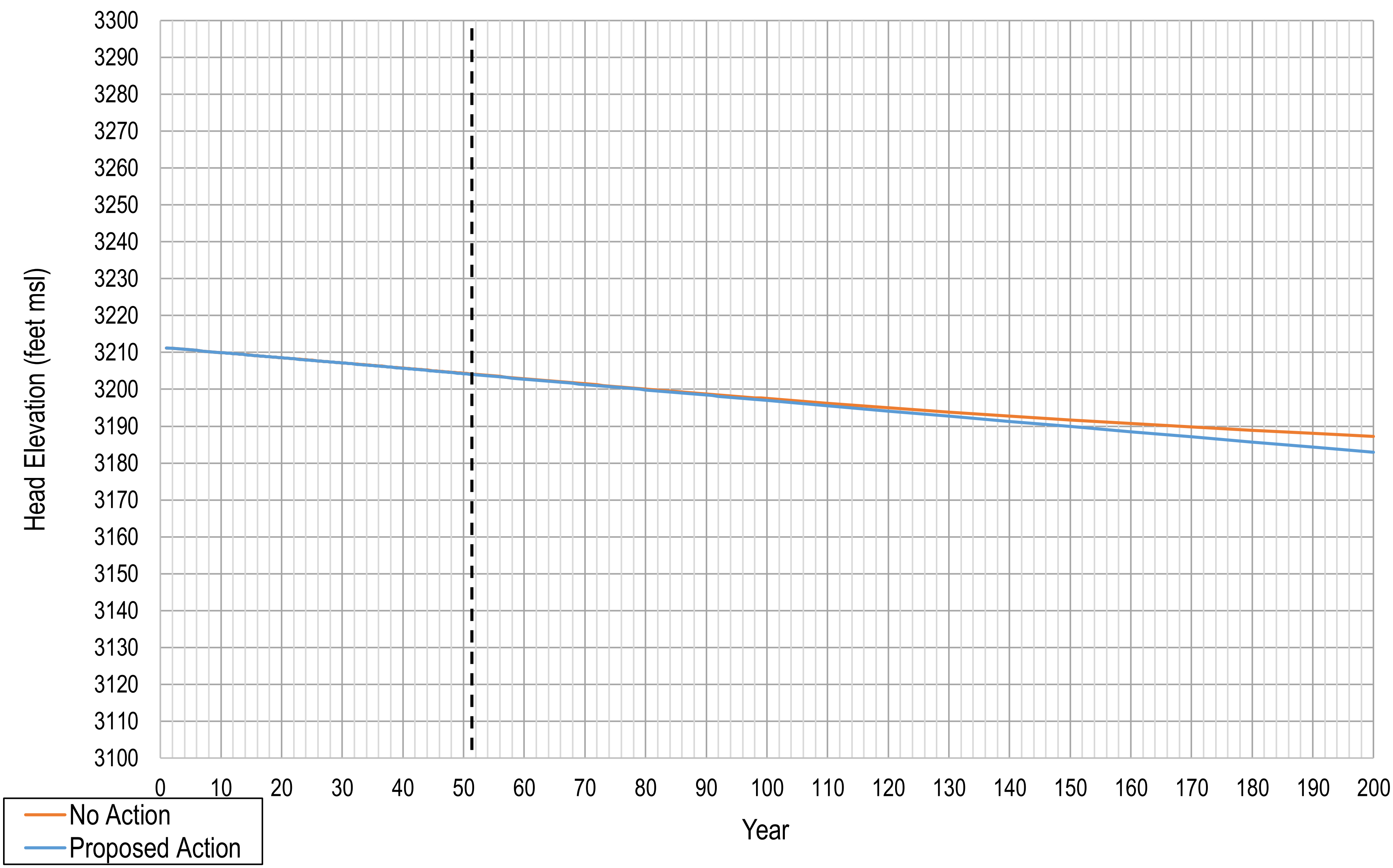
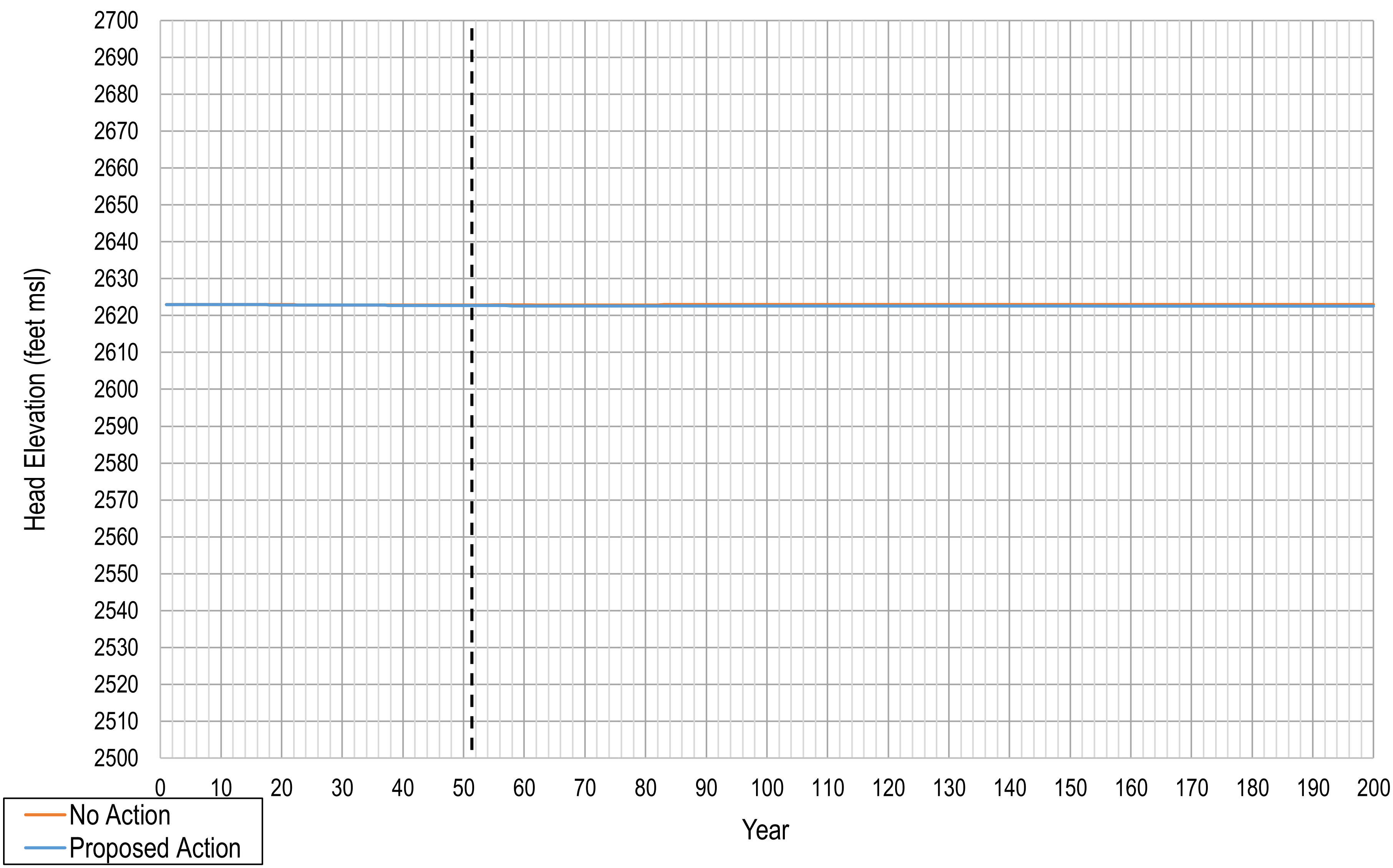


GDE Hydrograph – No Action and Proposed Action – McGinnel Mine Spring

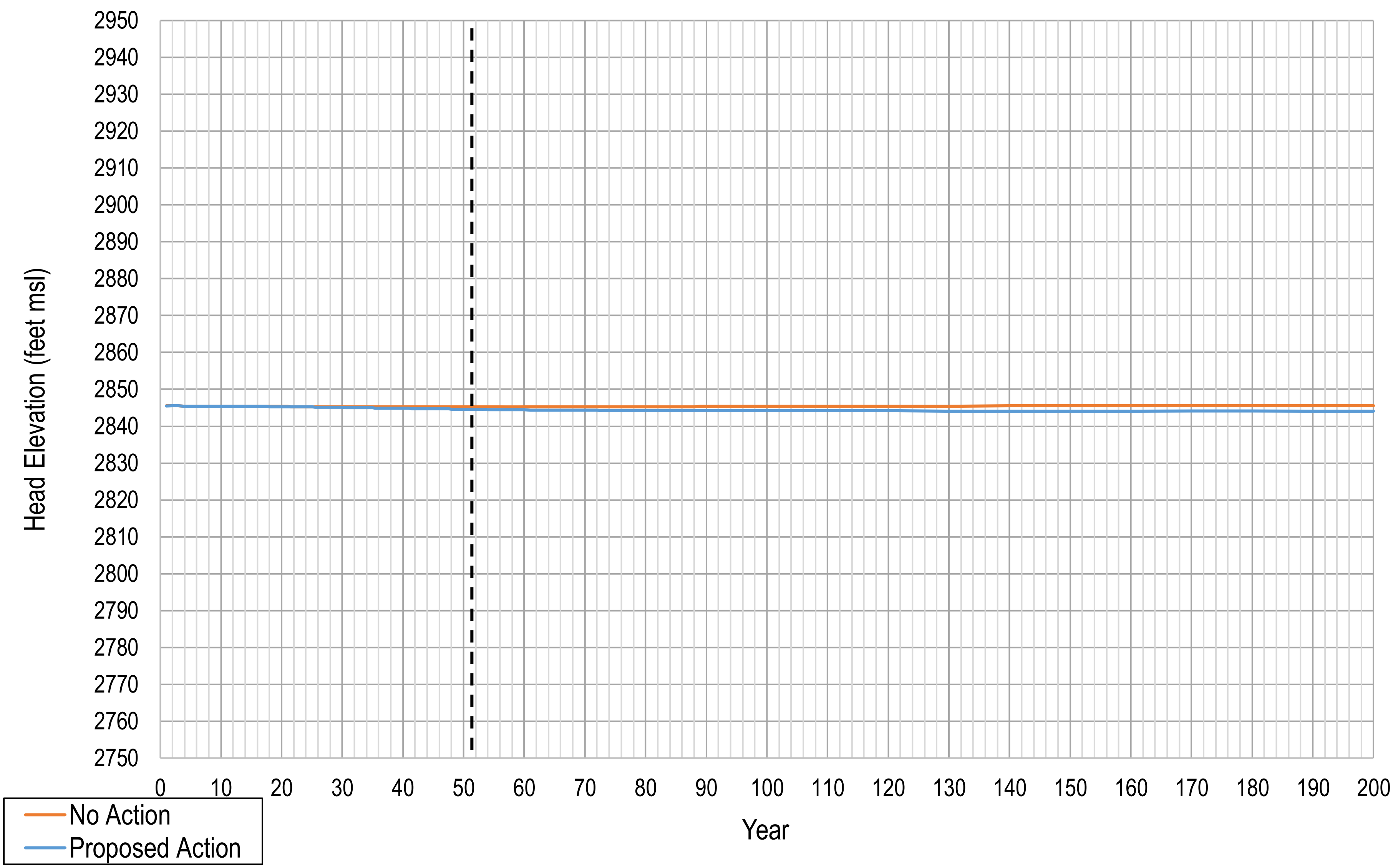
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN: CP	CHECKED: DO
DATE:	October 2018	FIGURE:	A-18



GDE Hydrograph – No Action and Proposed Action – McGinnel Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-19	

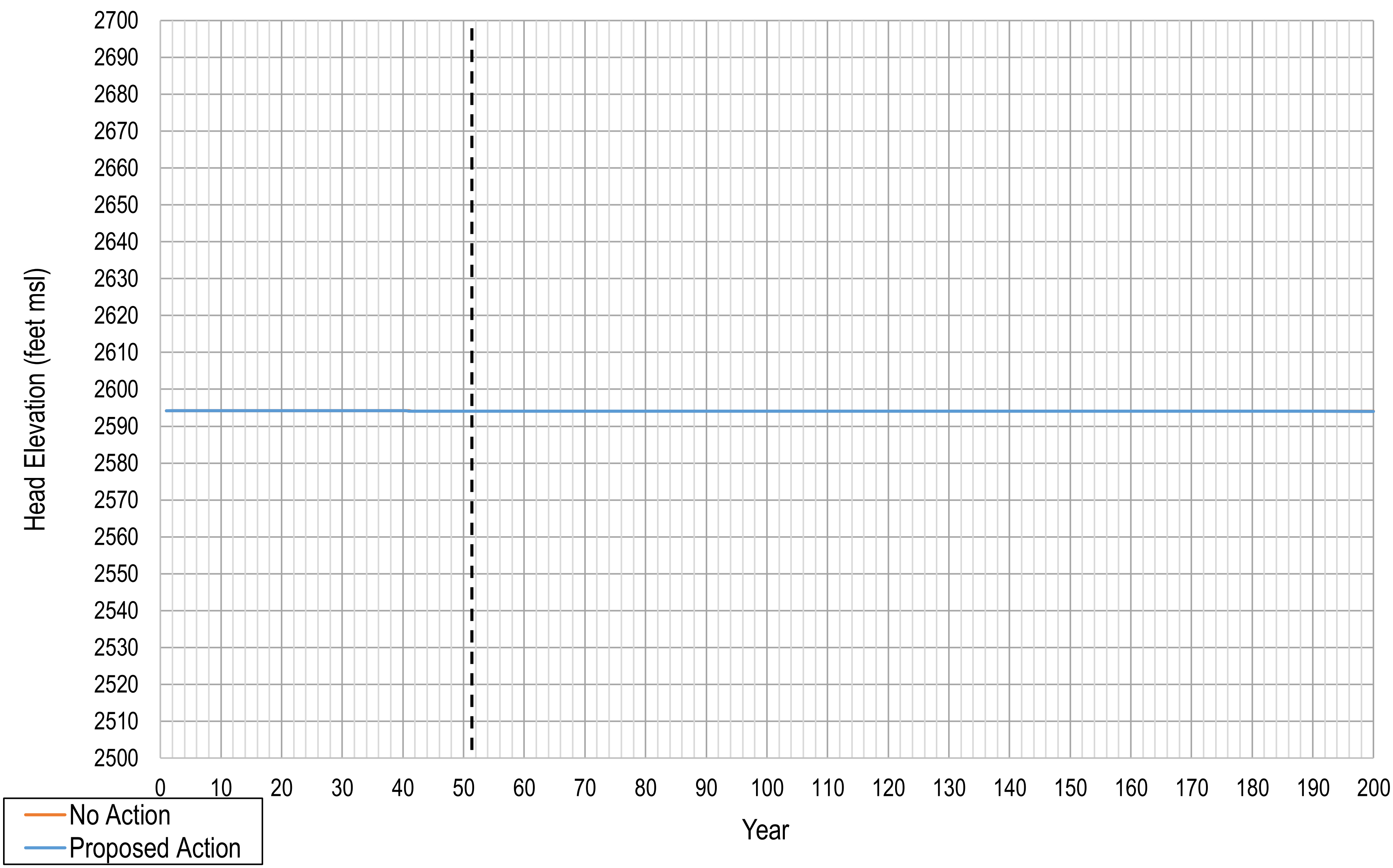


GDE Hydrograph – No Action and Proposed Action – Lower Mineral Creek			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-20	



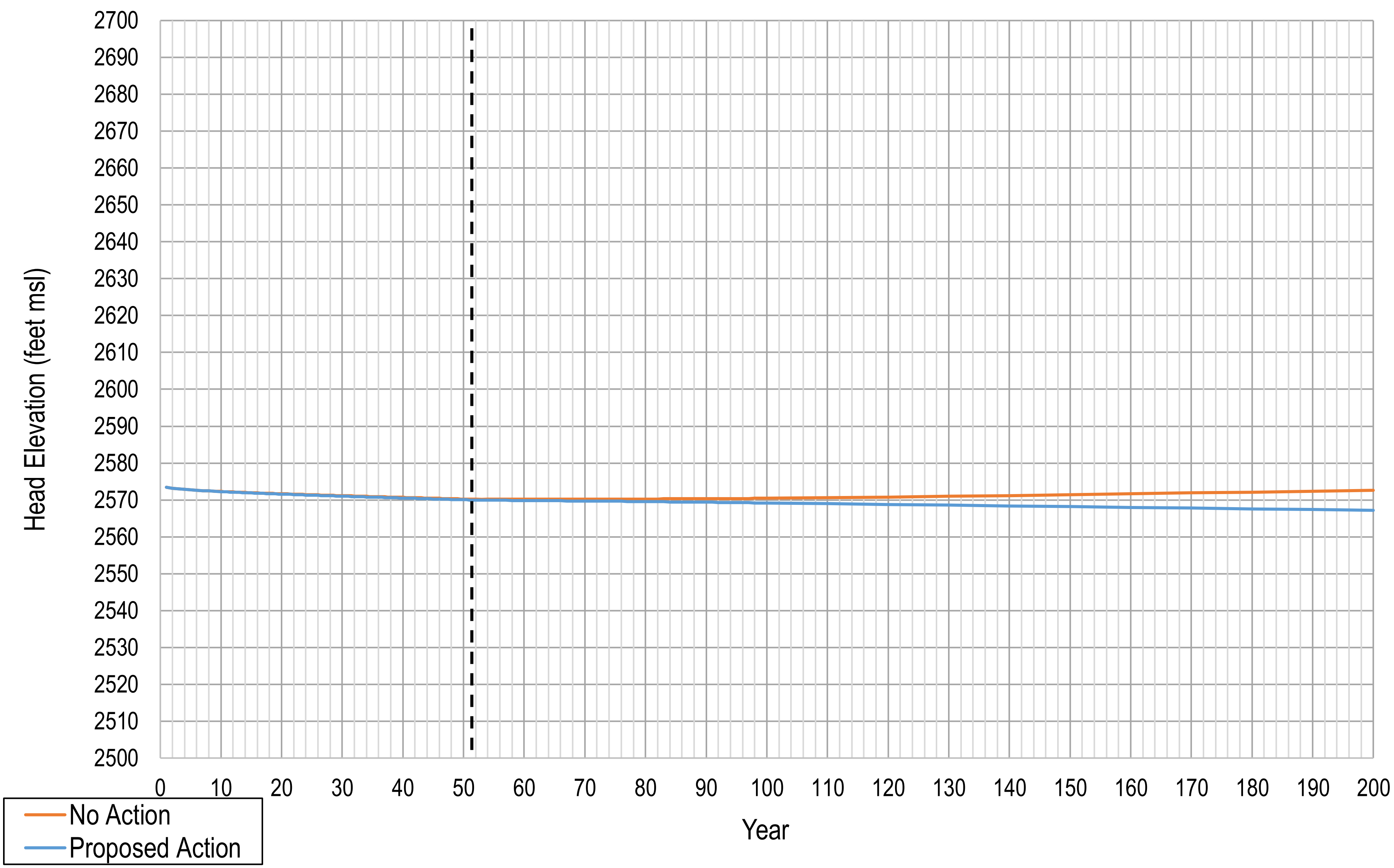
GDE Hydrograph – No Action and Proposed Action – Mineral Creek (MC) 6.9			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-21	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – No Name Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-22	

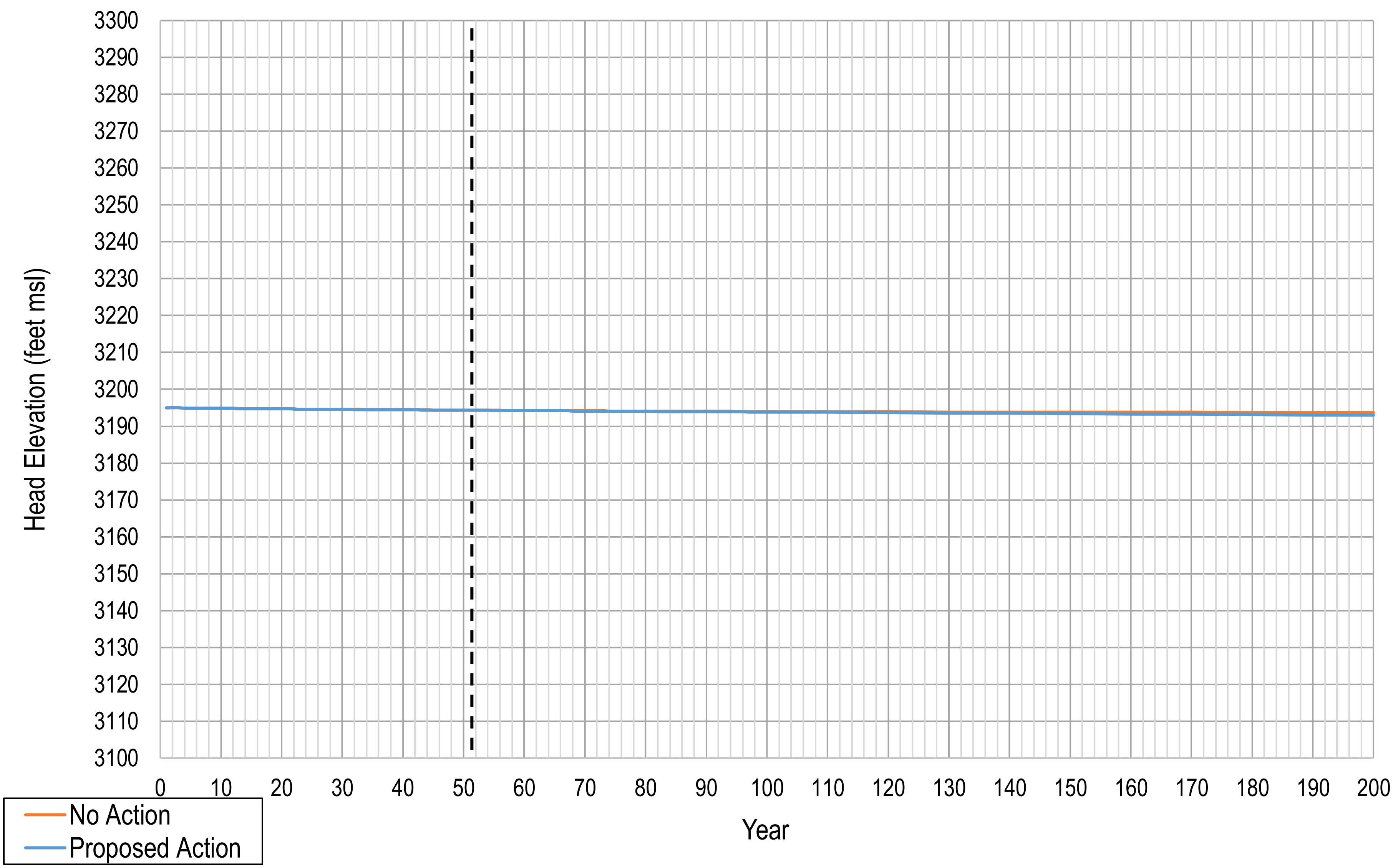
D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – Queen Creek (QC) 17.39

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-23		

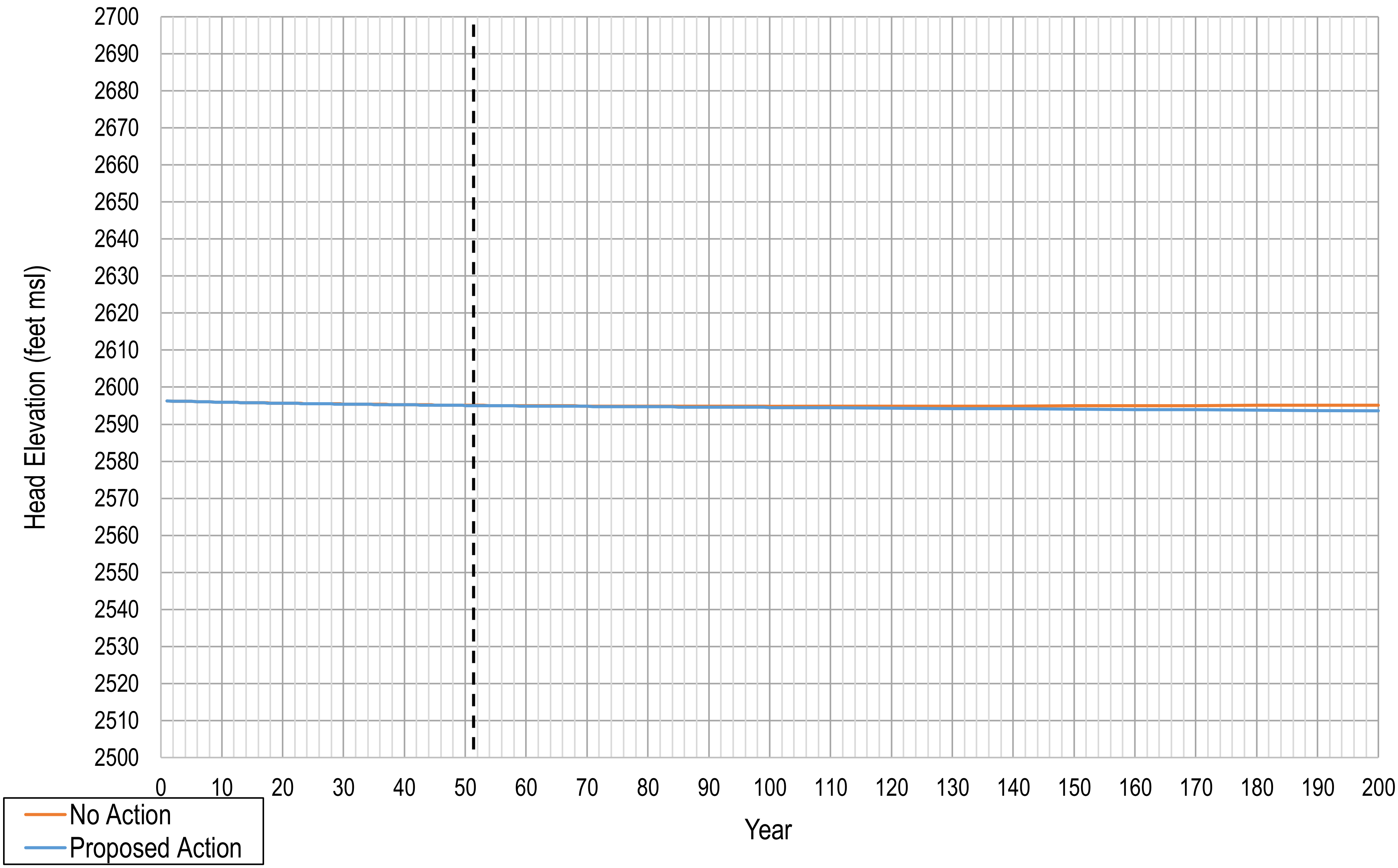
D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – Rock Horizontal Spring

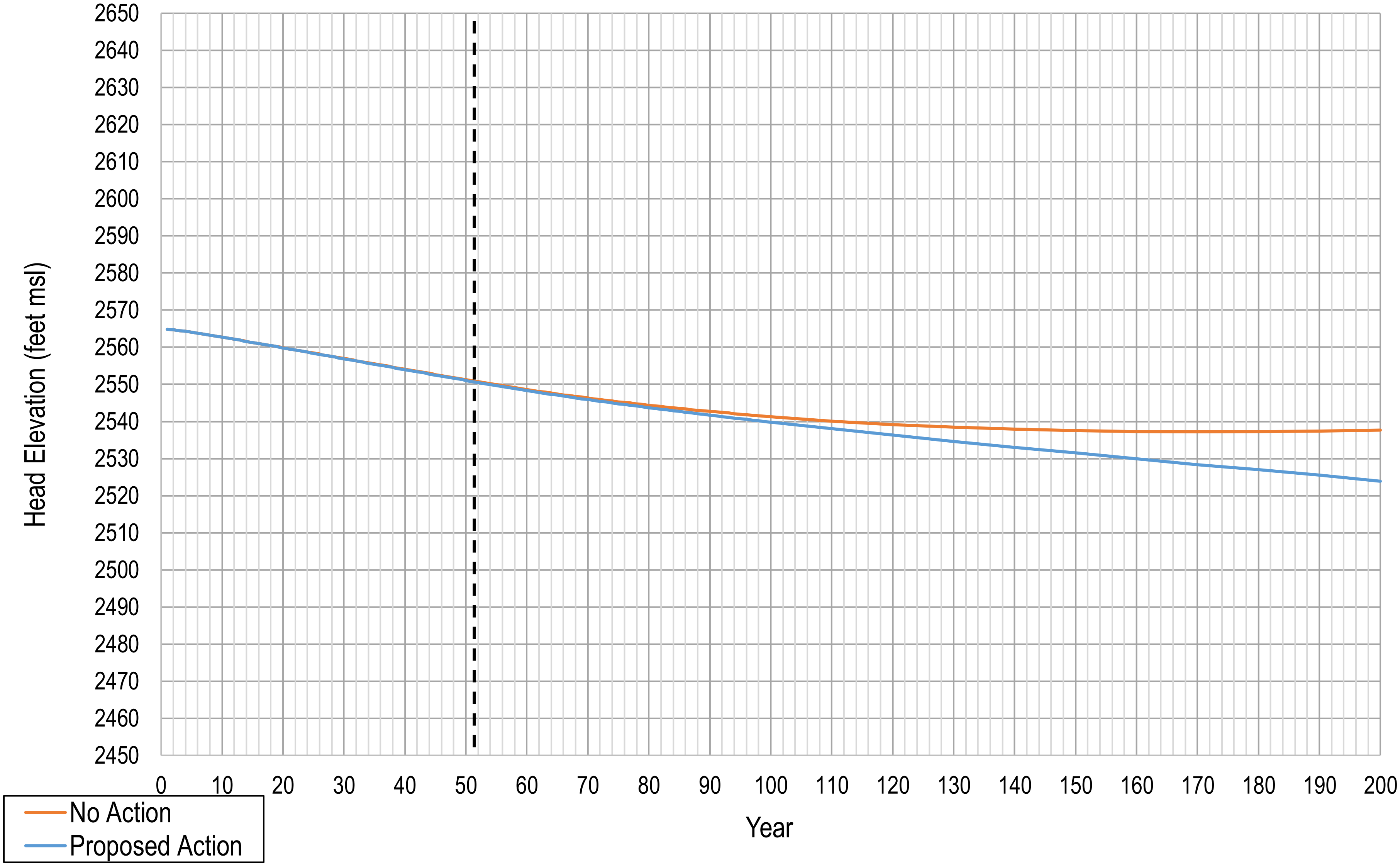
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	A-24		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – No Action and Proposed Action – Telegraph Canyon (TC) 0.6			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-25	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

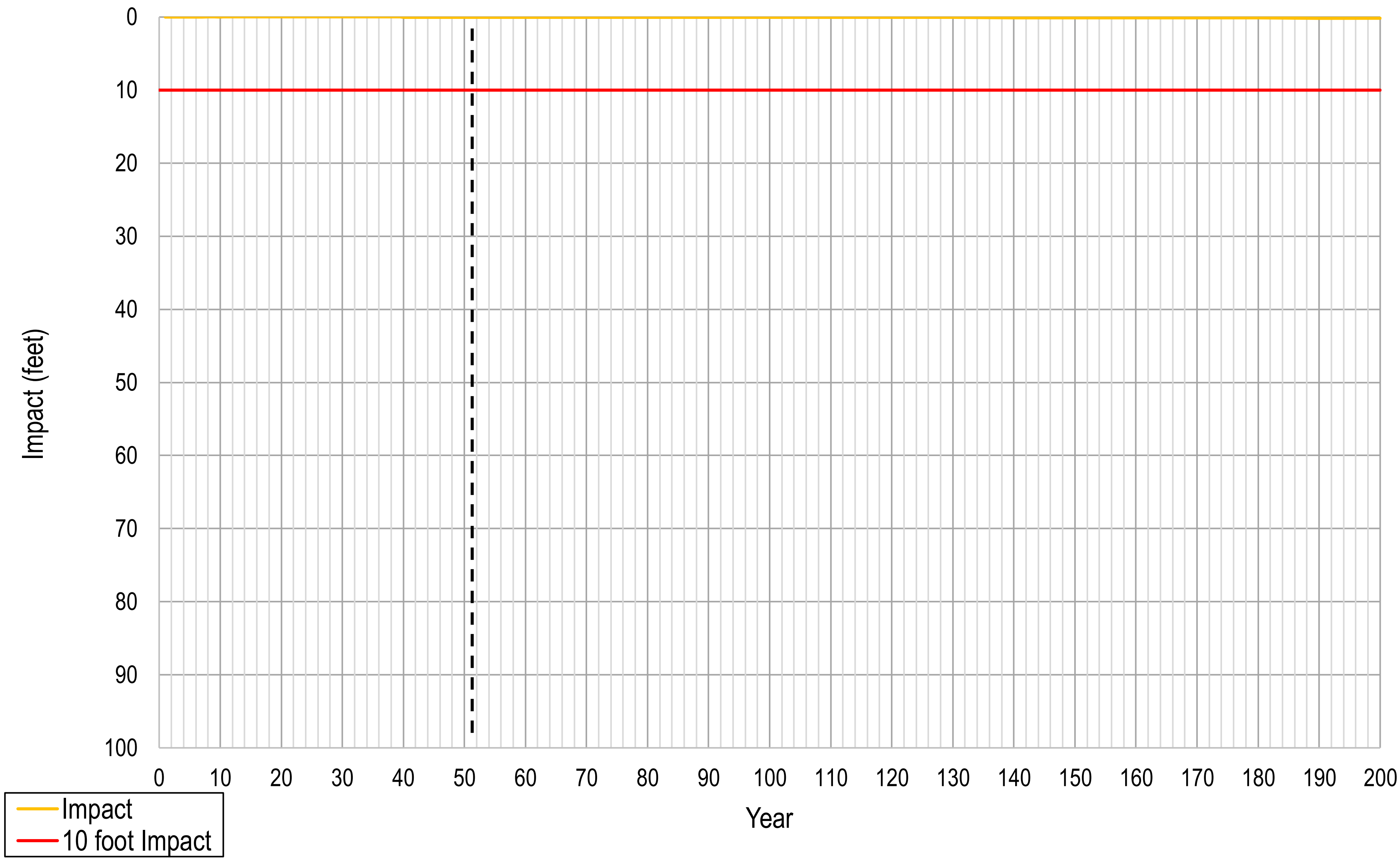


GDE Hydrograph – No Action and Proposed Action – Walker Spring

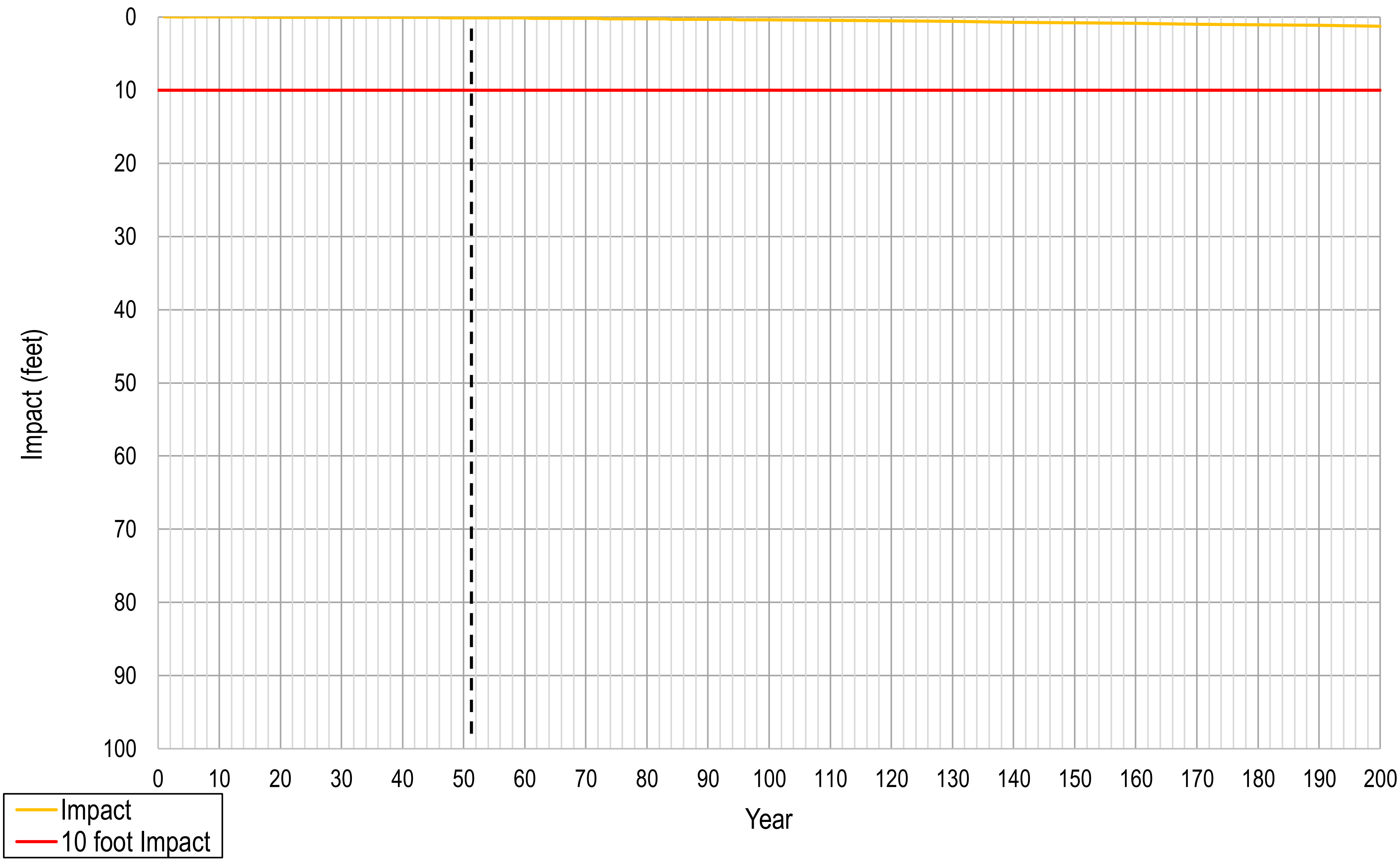
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: A-26	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

APPENDIX B: PREDICTIVE MODEL IMPACT HYDROGRAPHS

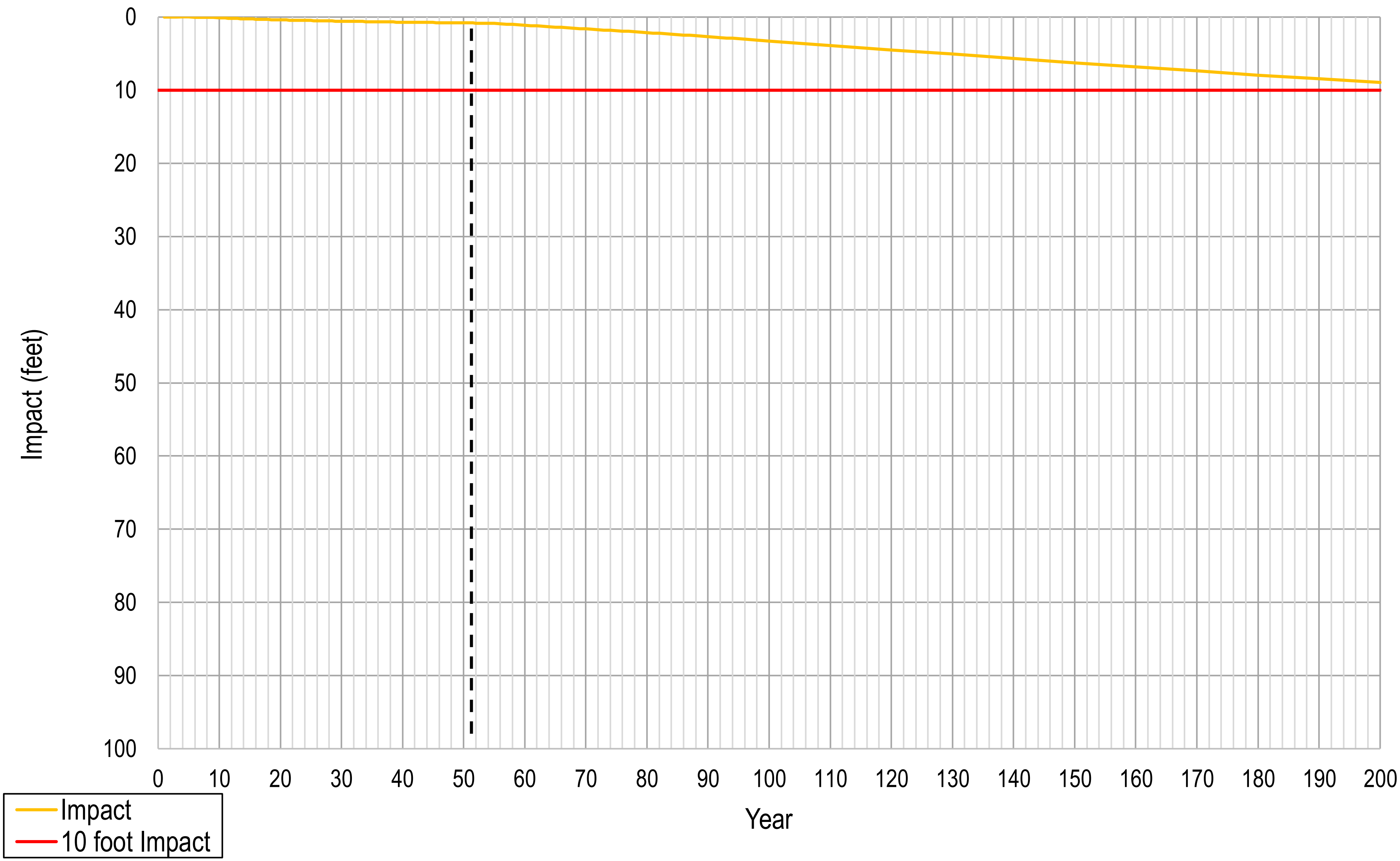


GDE Hydrograph – Water Level Impact – Arnett Creek (AC) 4.54	
CLIENT: Resolution Copper	PROJECT: 3D Regional Groundwater Model
JOB: 31400968.001	DRAWN: CP CHECKED: DO
DATE: October 2018	FIGURE: B-1



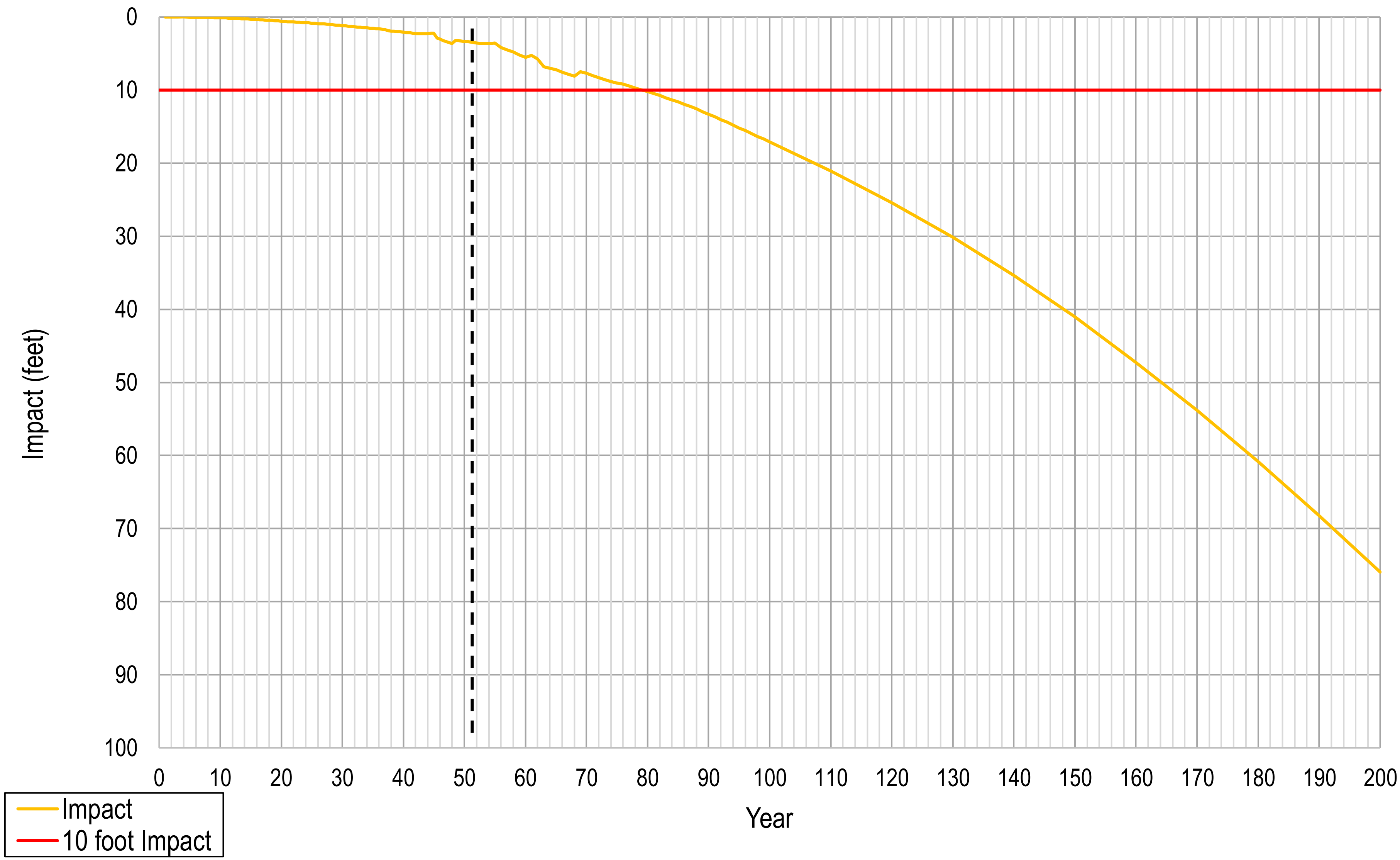
GDE Hydrograph – Water Level Impact – Arnett Creek (AC) 12.49 / Blue Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-2		



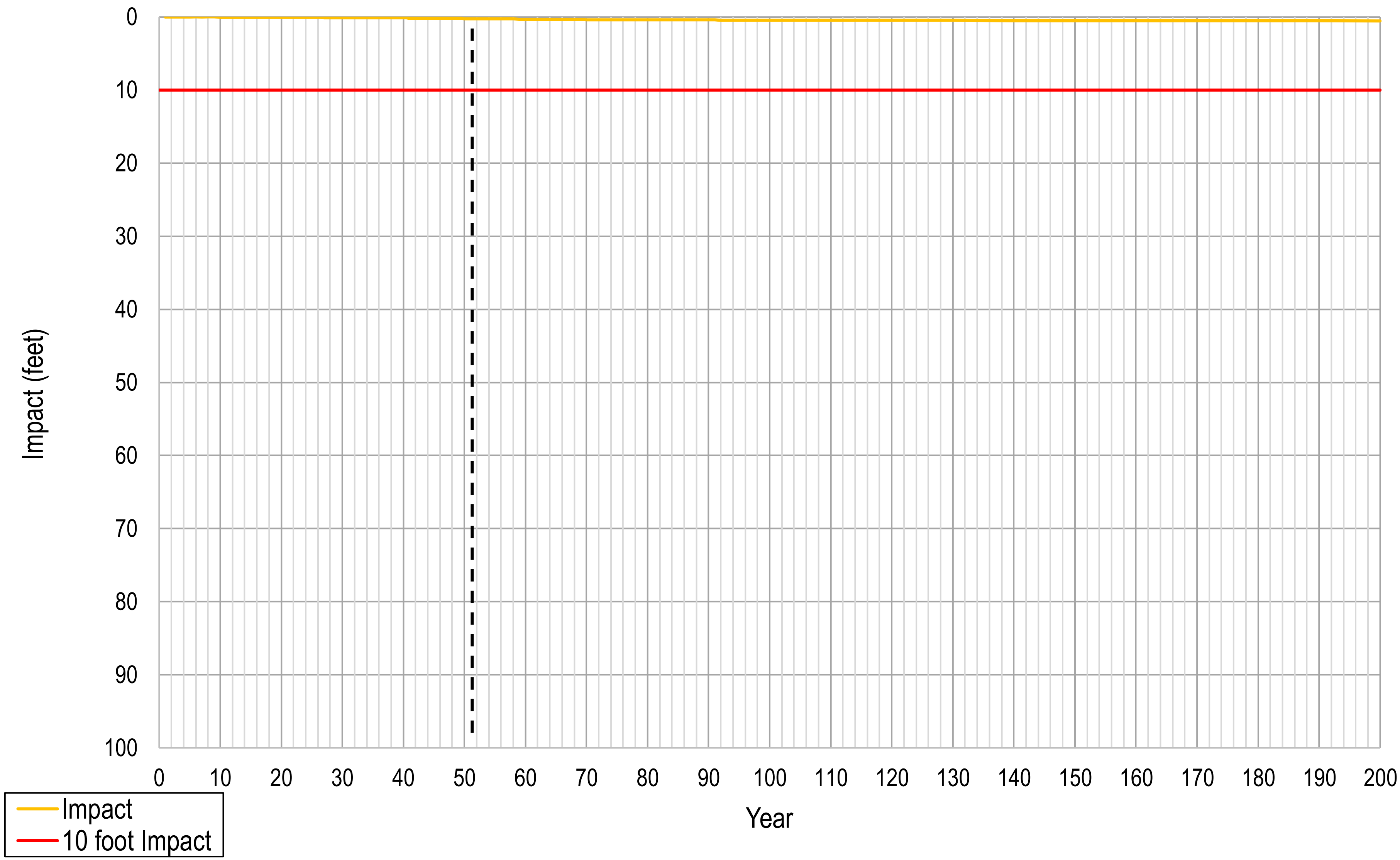
GDE Hydrograph – Water Level Impact – Bitter Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN: CP	CHECKED: DO
DATE:	October 2018	FIGURE:	B-3



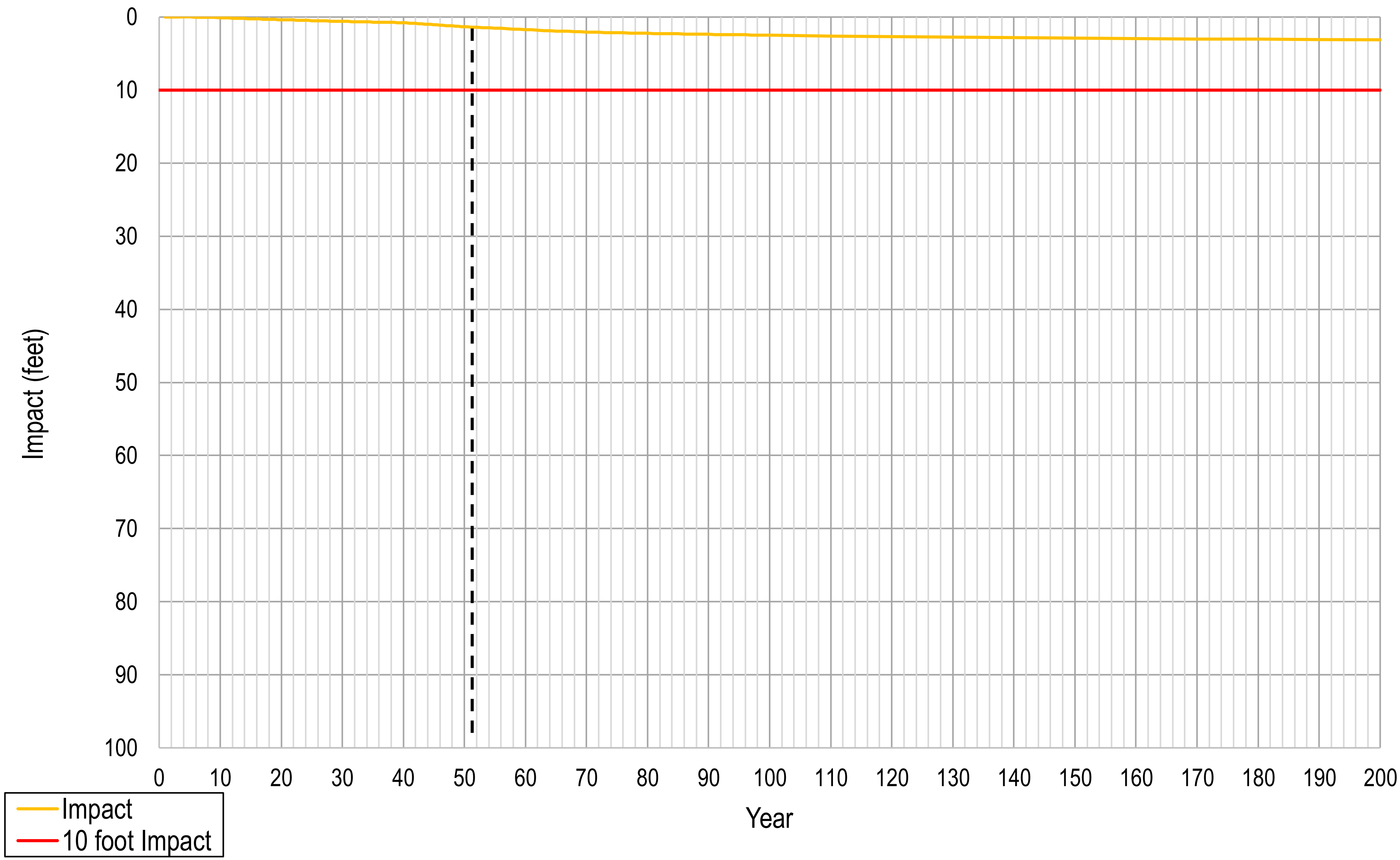
GDE Hydrograph – Water Level Impact – Bored Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-4	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

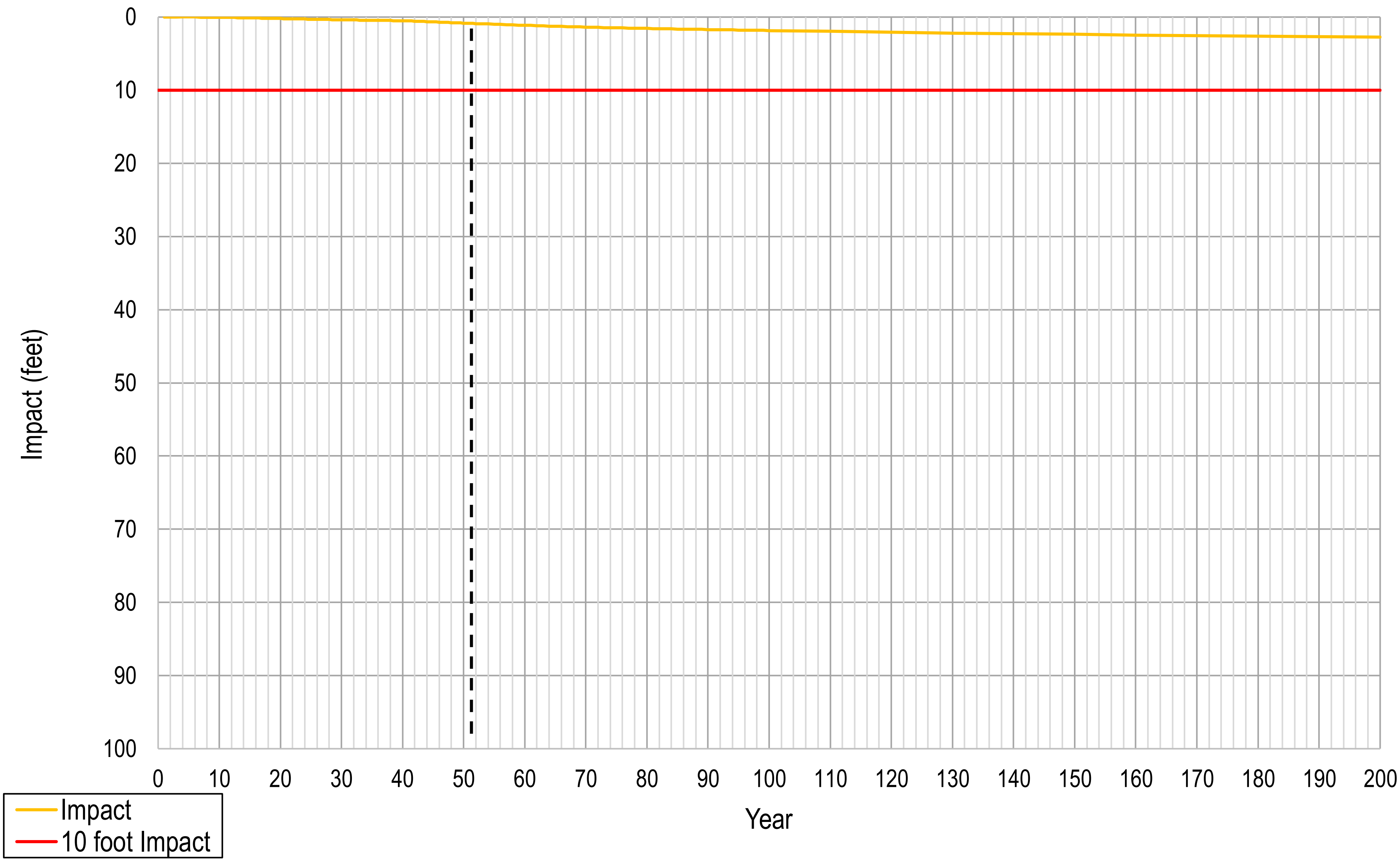


GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 4.1E

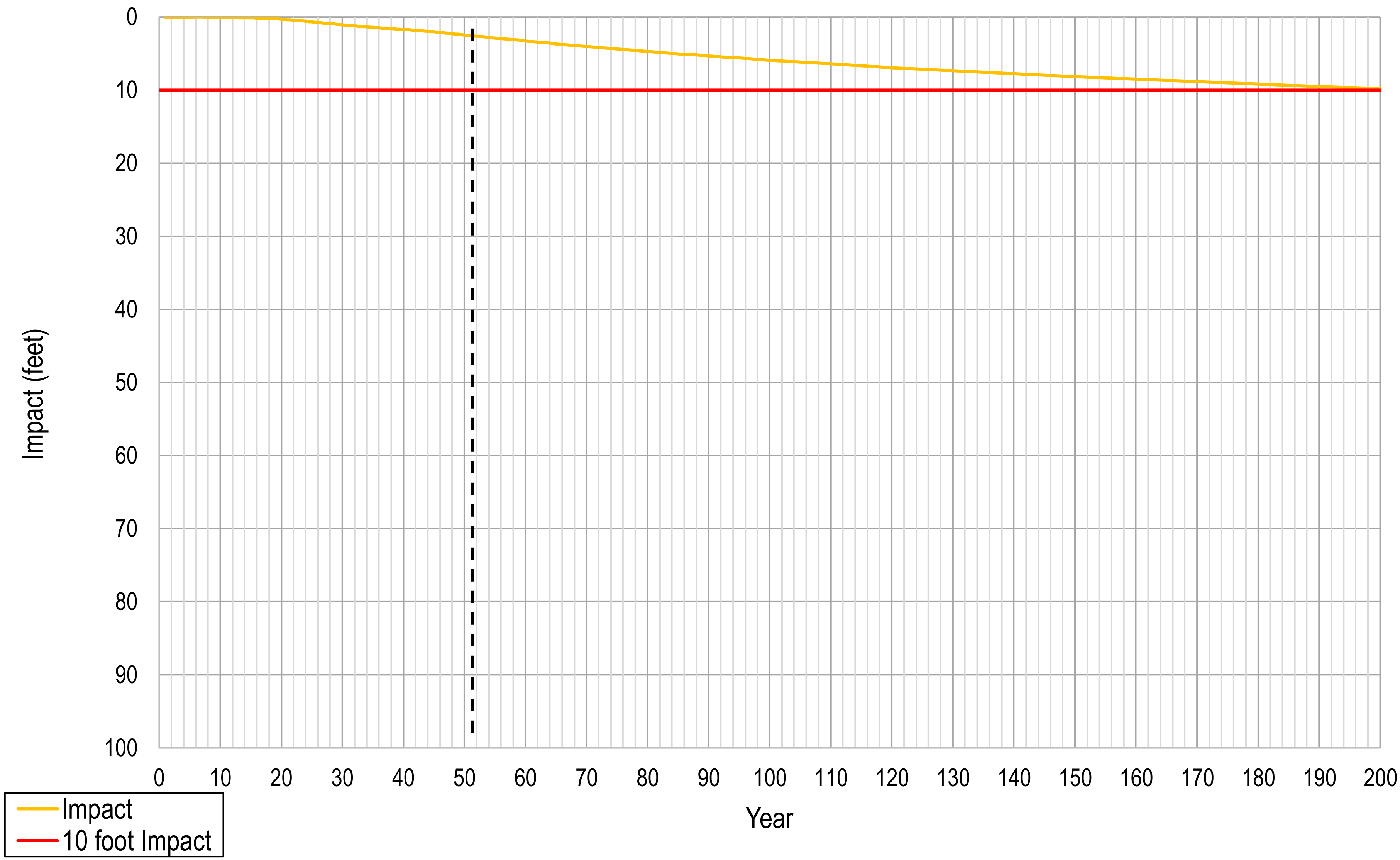
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-5		



GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 5.5C			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-6	



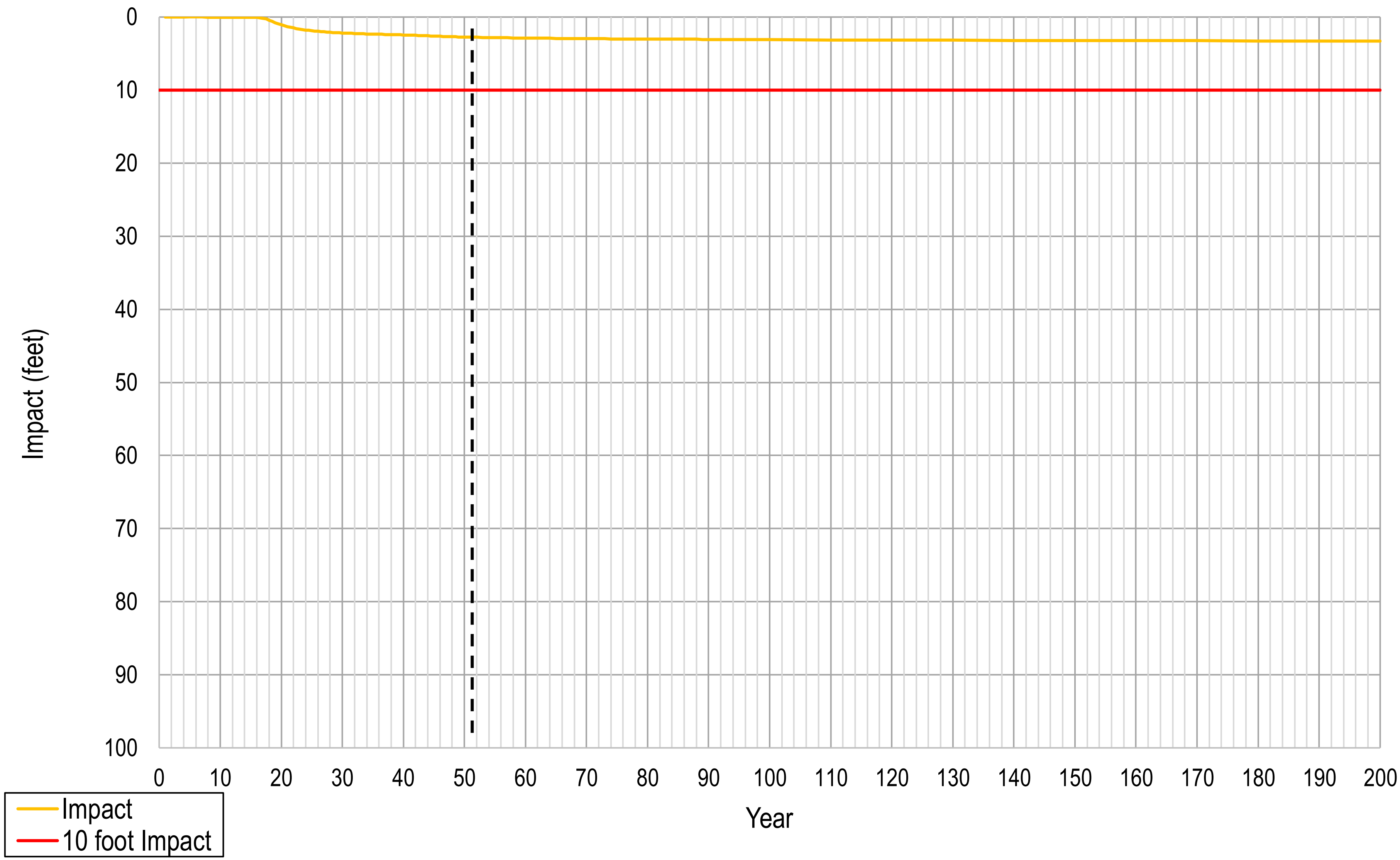
GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 6.1E			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-7	



GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 6.6W

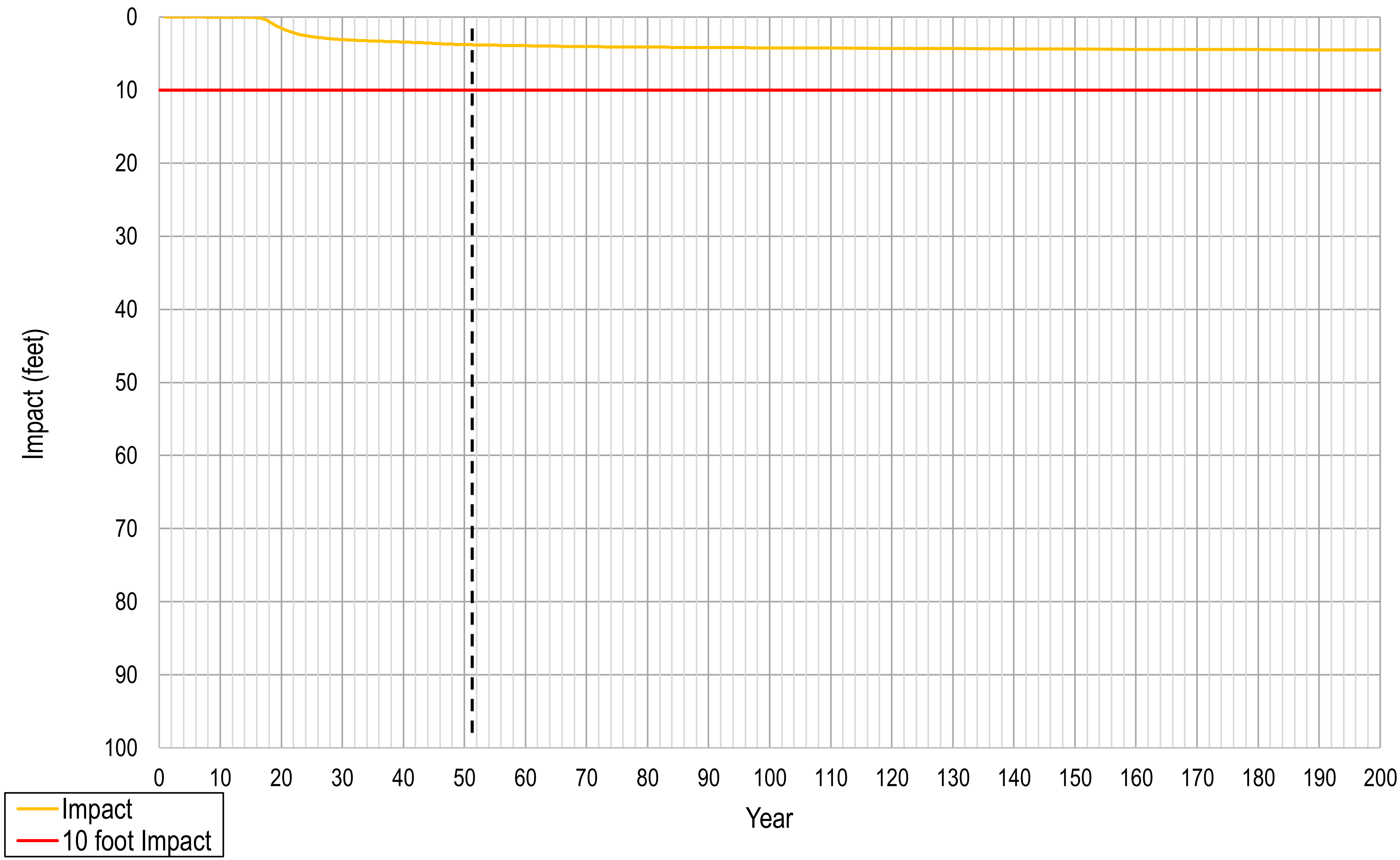
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-8		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



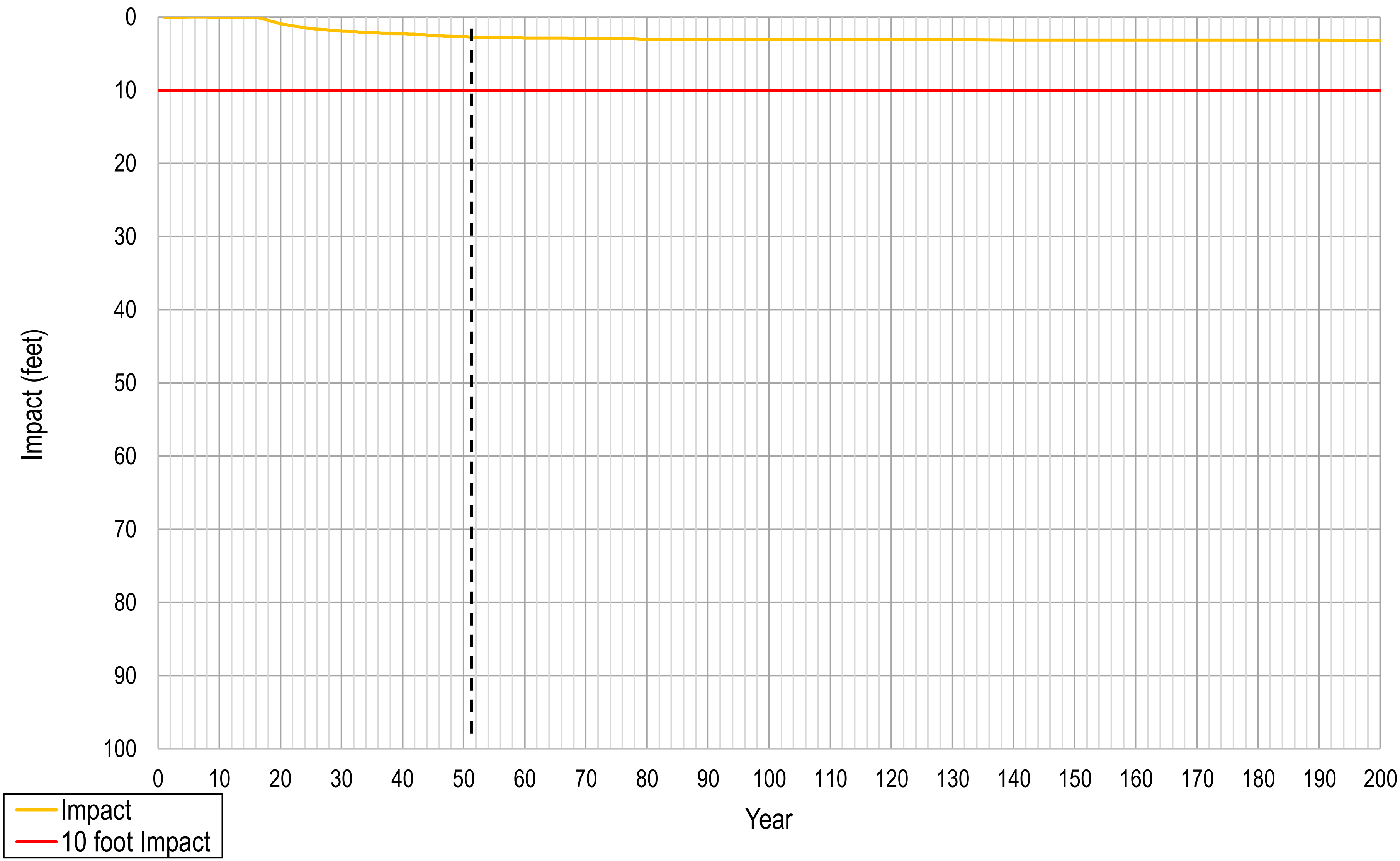
GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 8.1C

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-9		



GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 8.2W

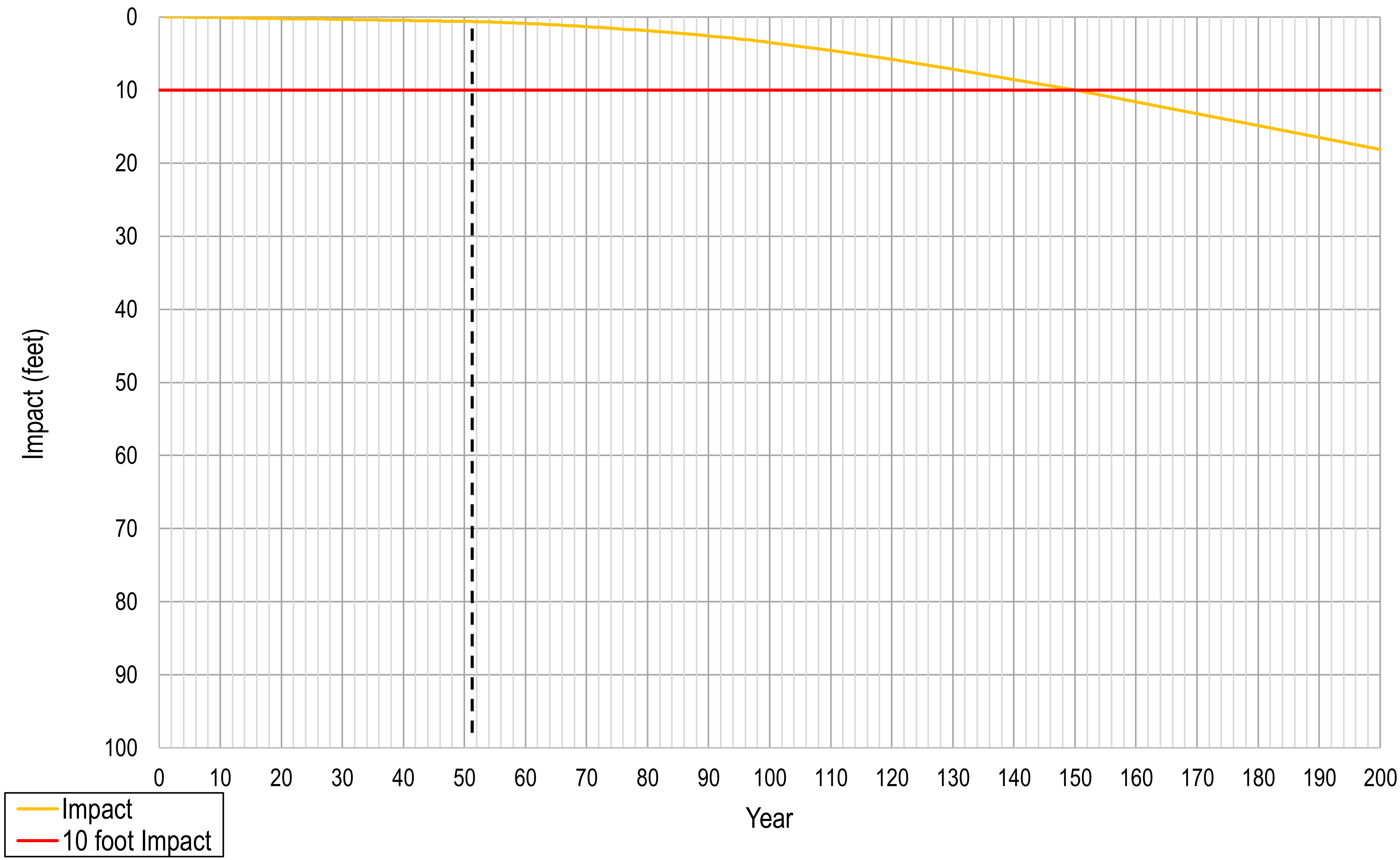
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-10		



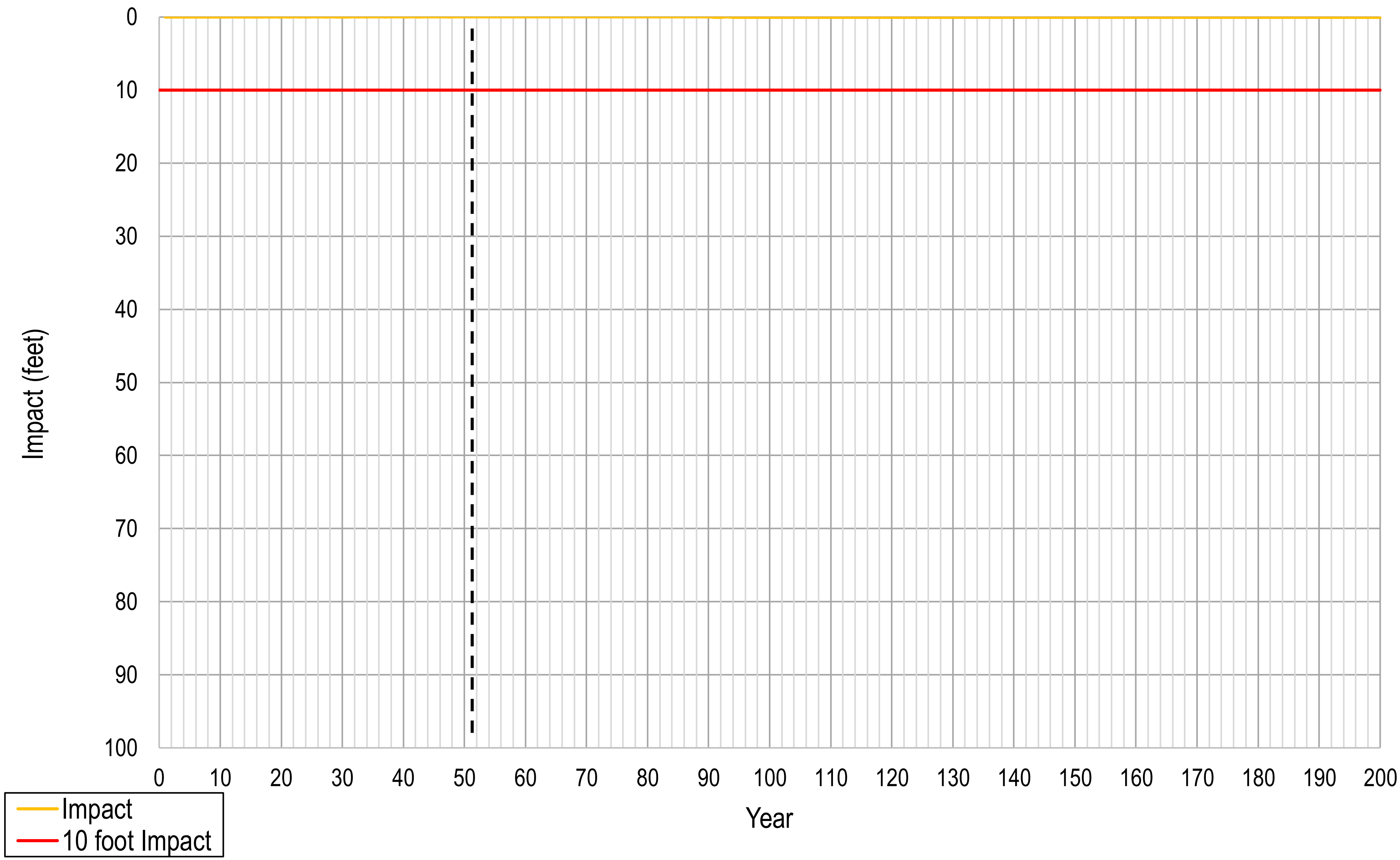
GDE Hydrograph – Water Level Impact – Devils Canyon (DC) 8.8C

CLIENT: Resolution Copper	PROJECT: 3D Regional Groundwater Model		
JOB: 31400968.001	DRAWN: CP	CHECKED: DO	
DATE: October 2018	FIGURE: B-11		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx

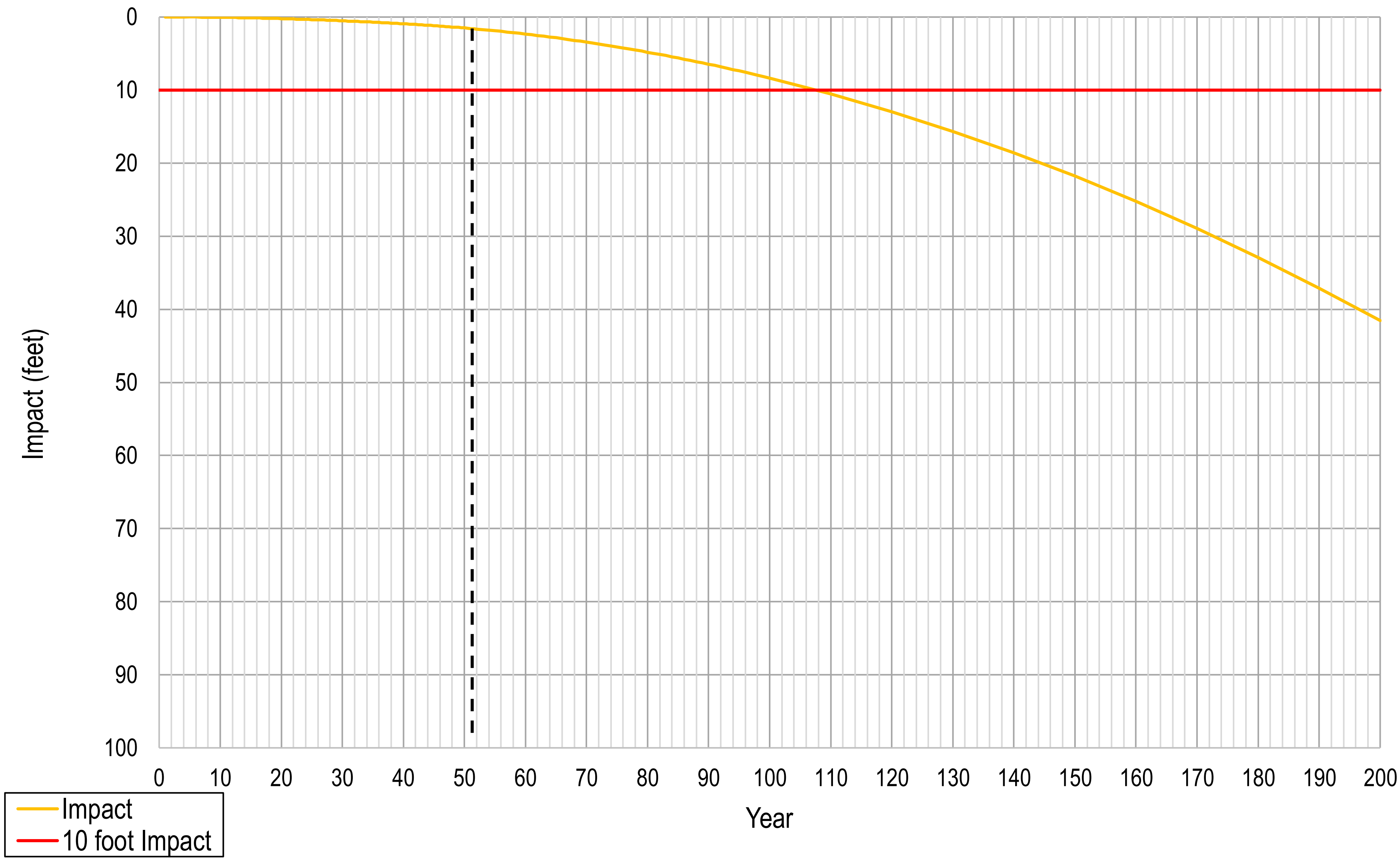


GDE Hydrograph – Water Level Impact – DHRES16_743			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-12	



GDE Hydrograph – Water Level Impact – Gallery Well

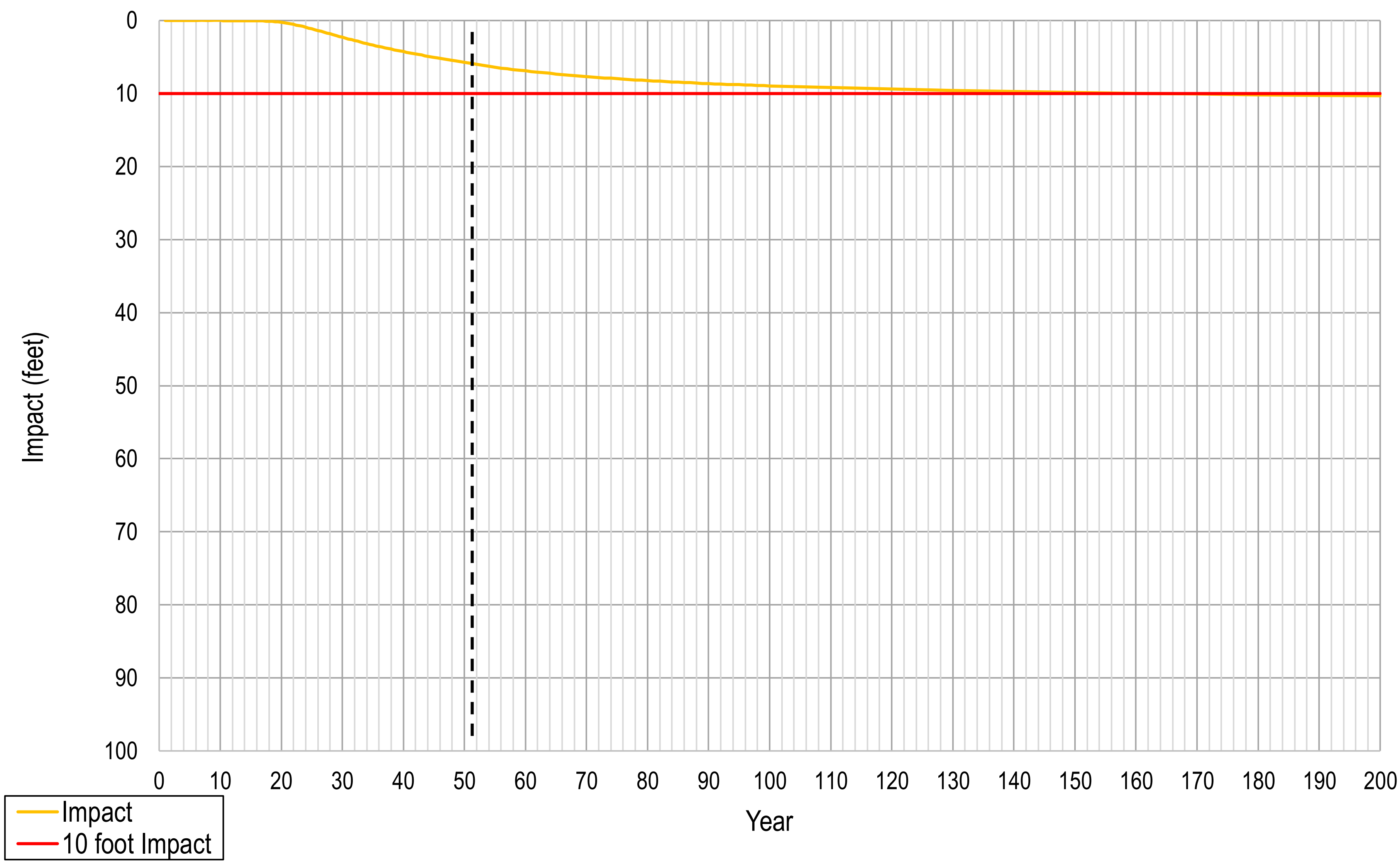
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-13		



wsp

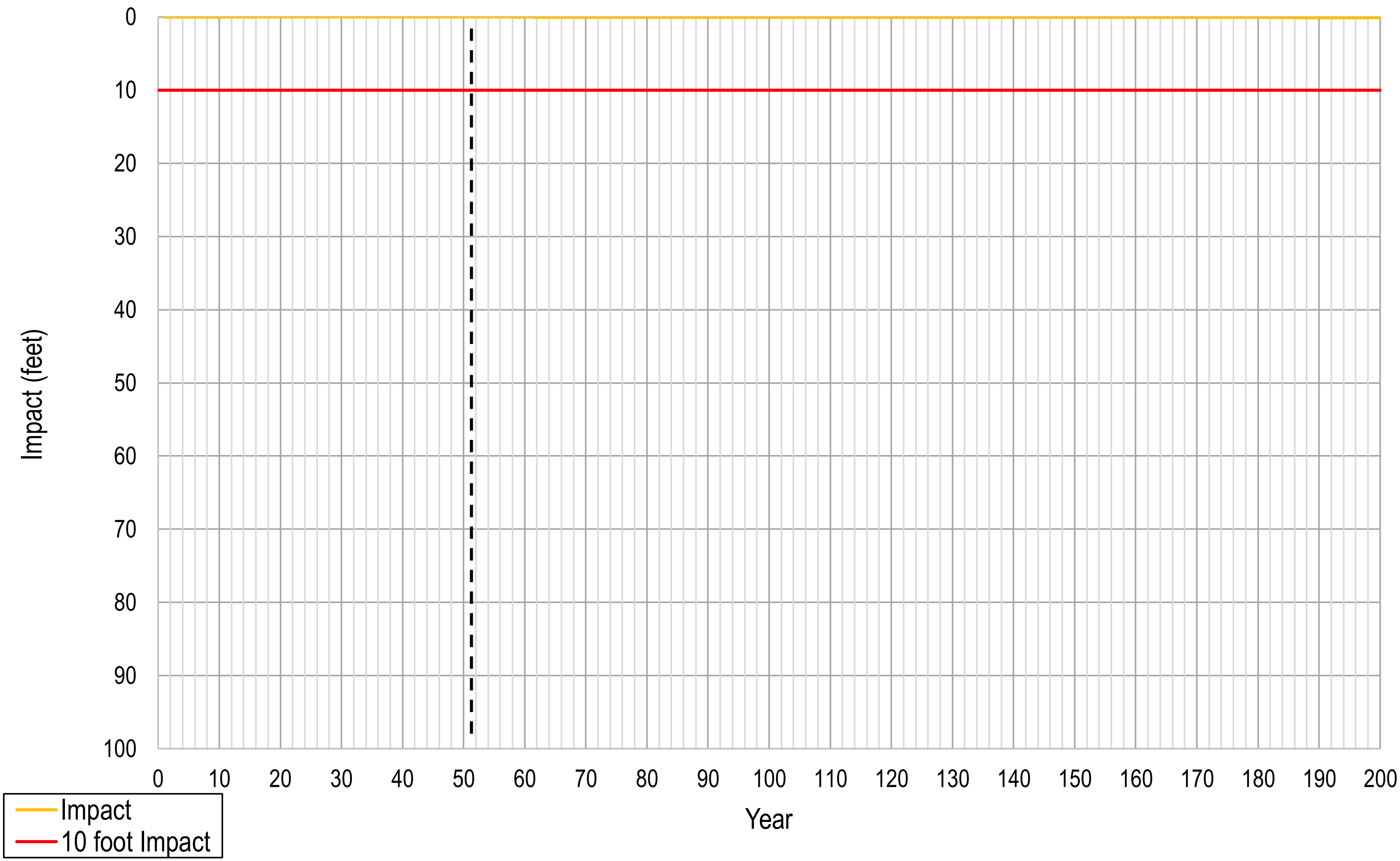
GDE Hydrograph – Water Level Impact – Hidden Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-14		



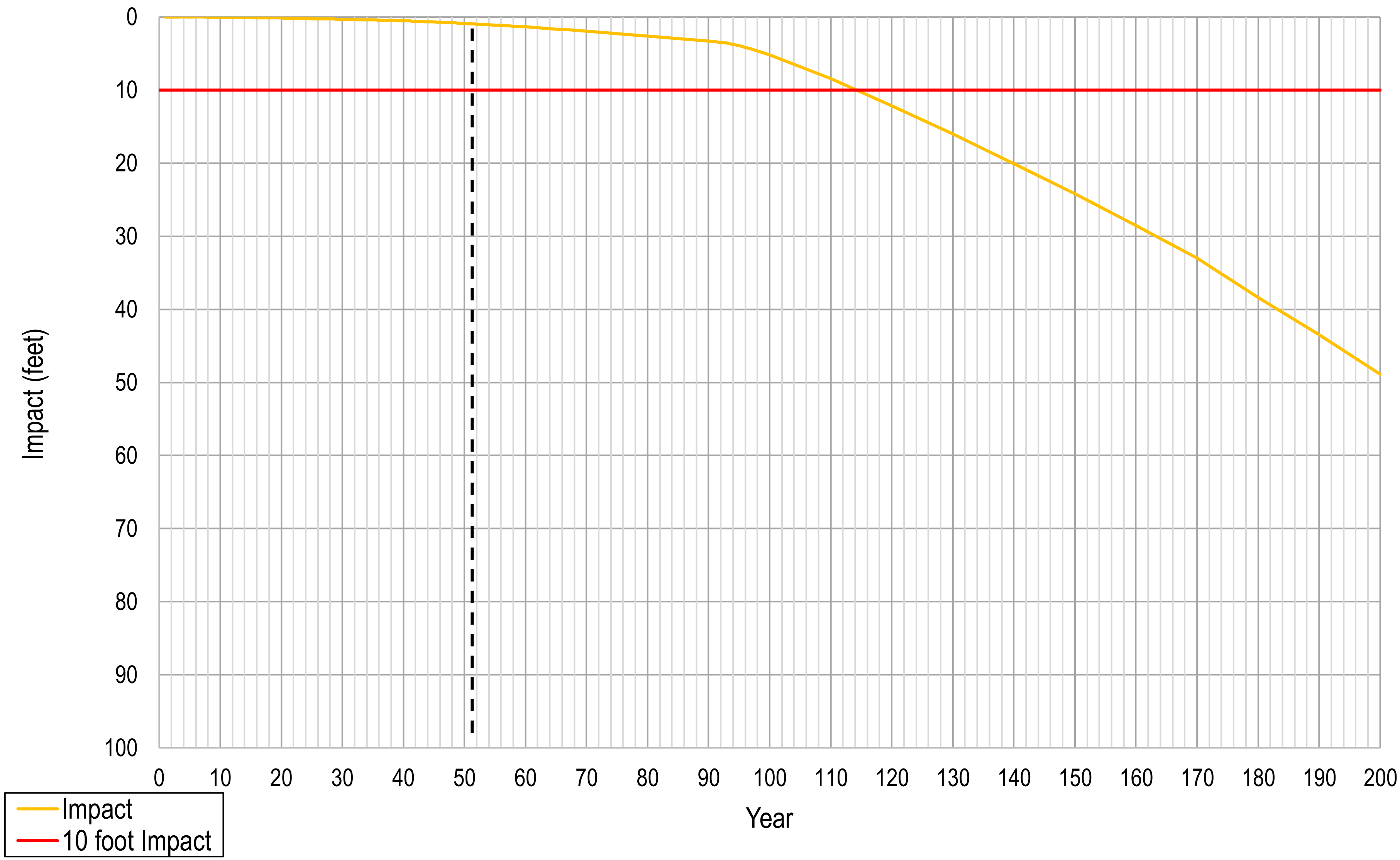
GDE Hydrograph – Water Level Impact – HRES-06

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN: CP	CHECKED: DO
DATE:	October 2018	FIGURE:	B-15

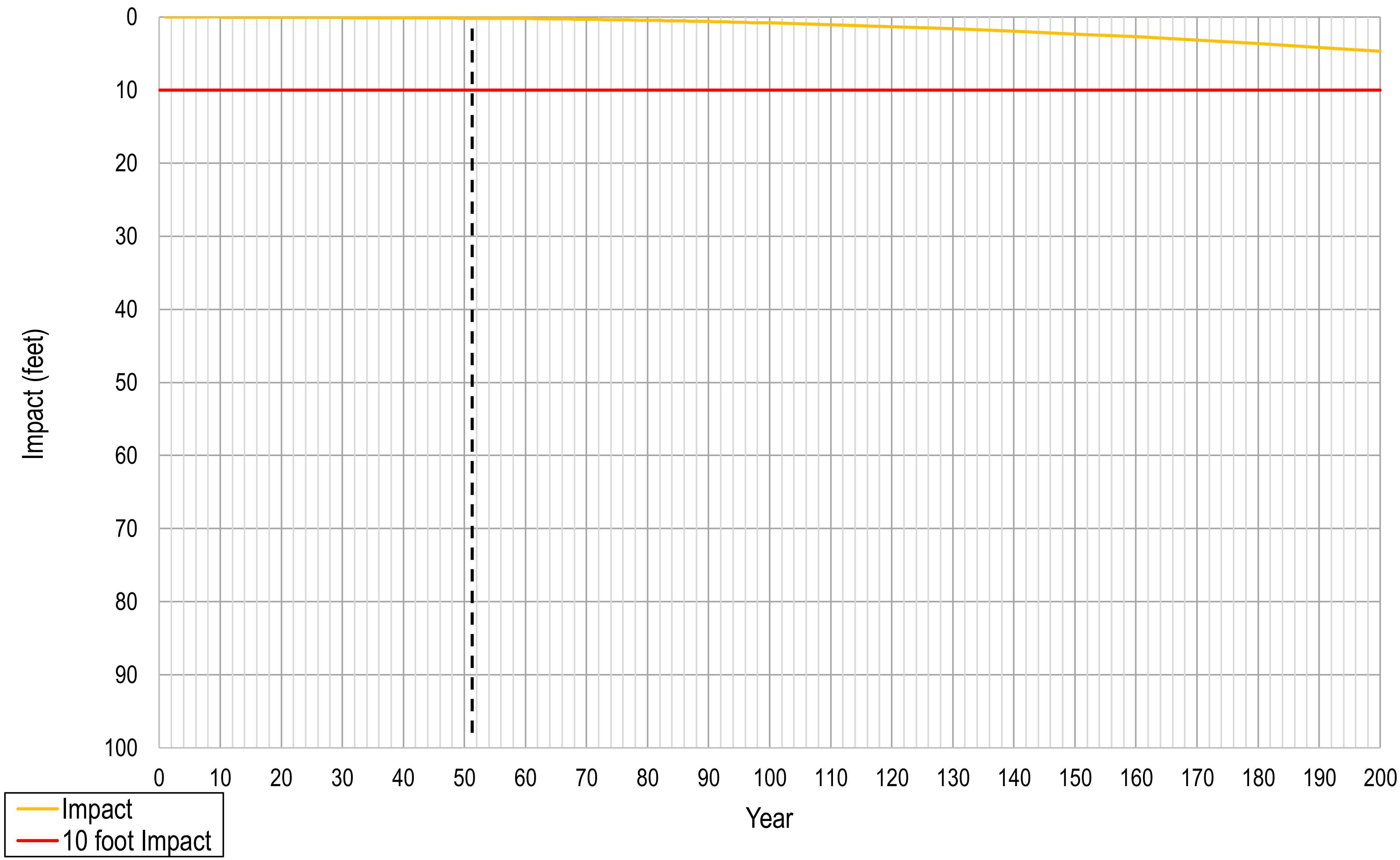


GDE Hydrograph – Water Level Impact – Iberri Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-16		

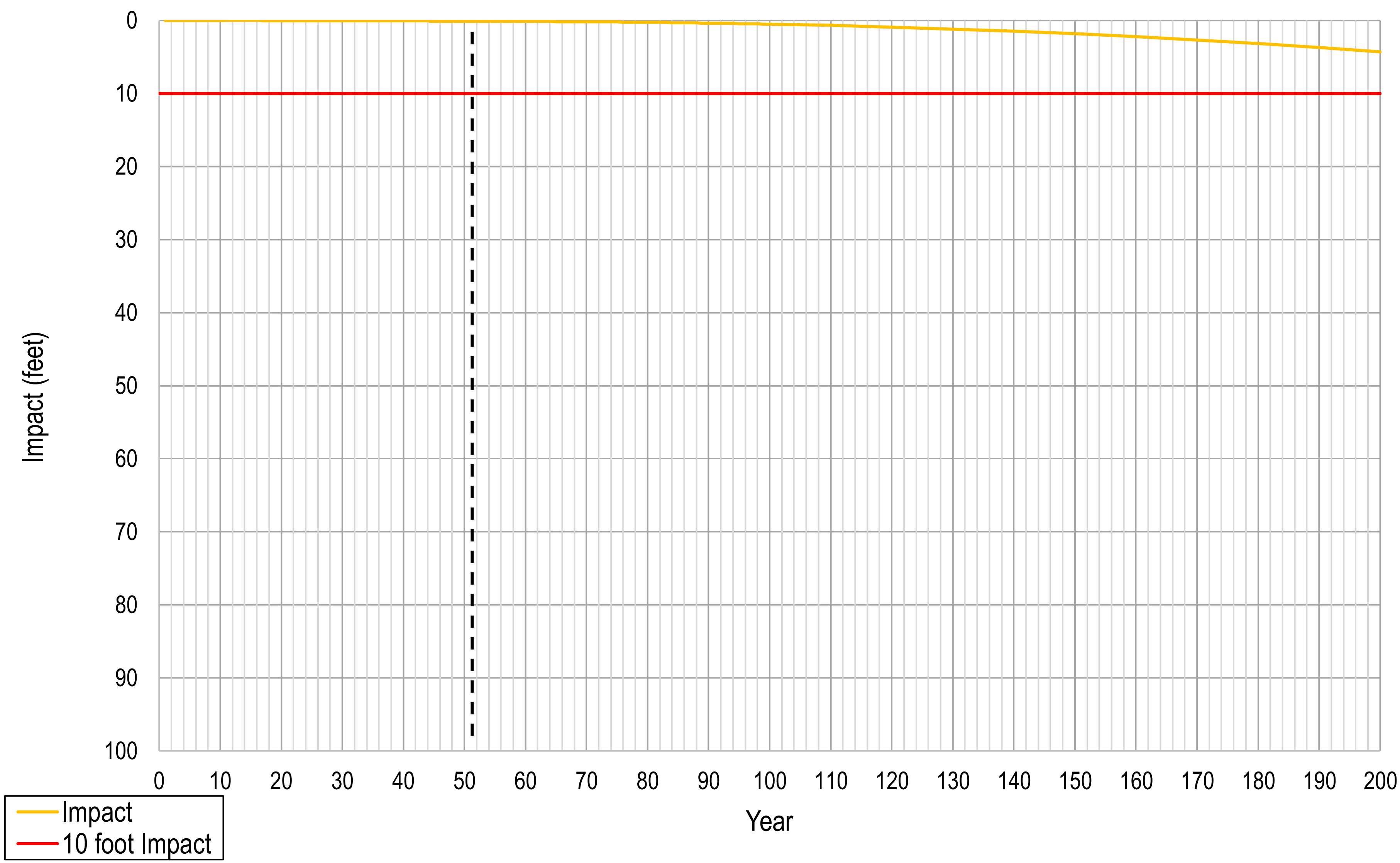


GDE Hydrograph – Water Level Impact – Kane Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-17	



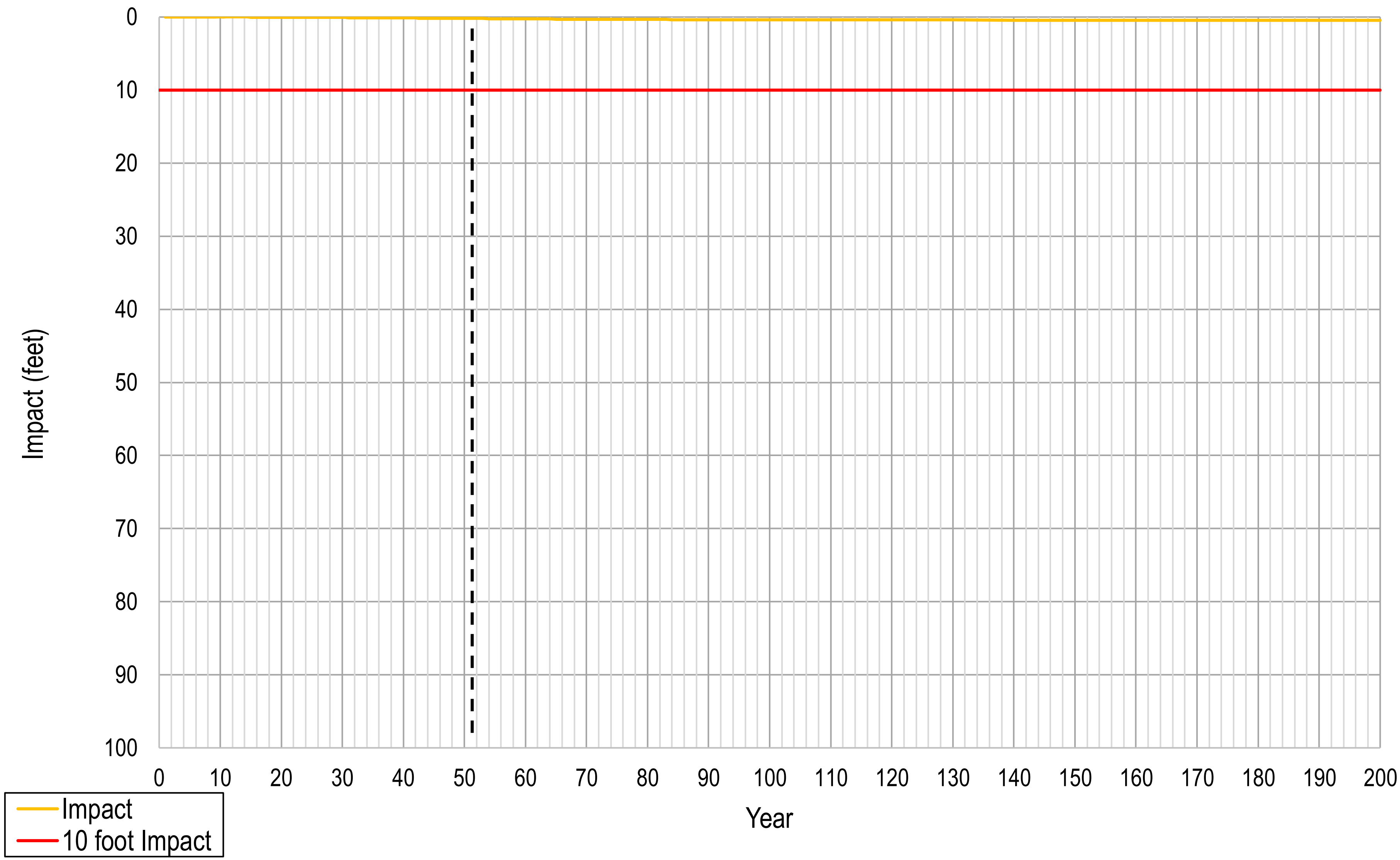
GDE Hydrograph – Water Level Impact – McGinnel Mine Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-18		

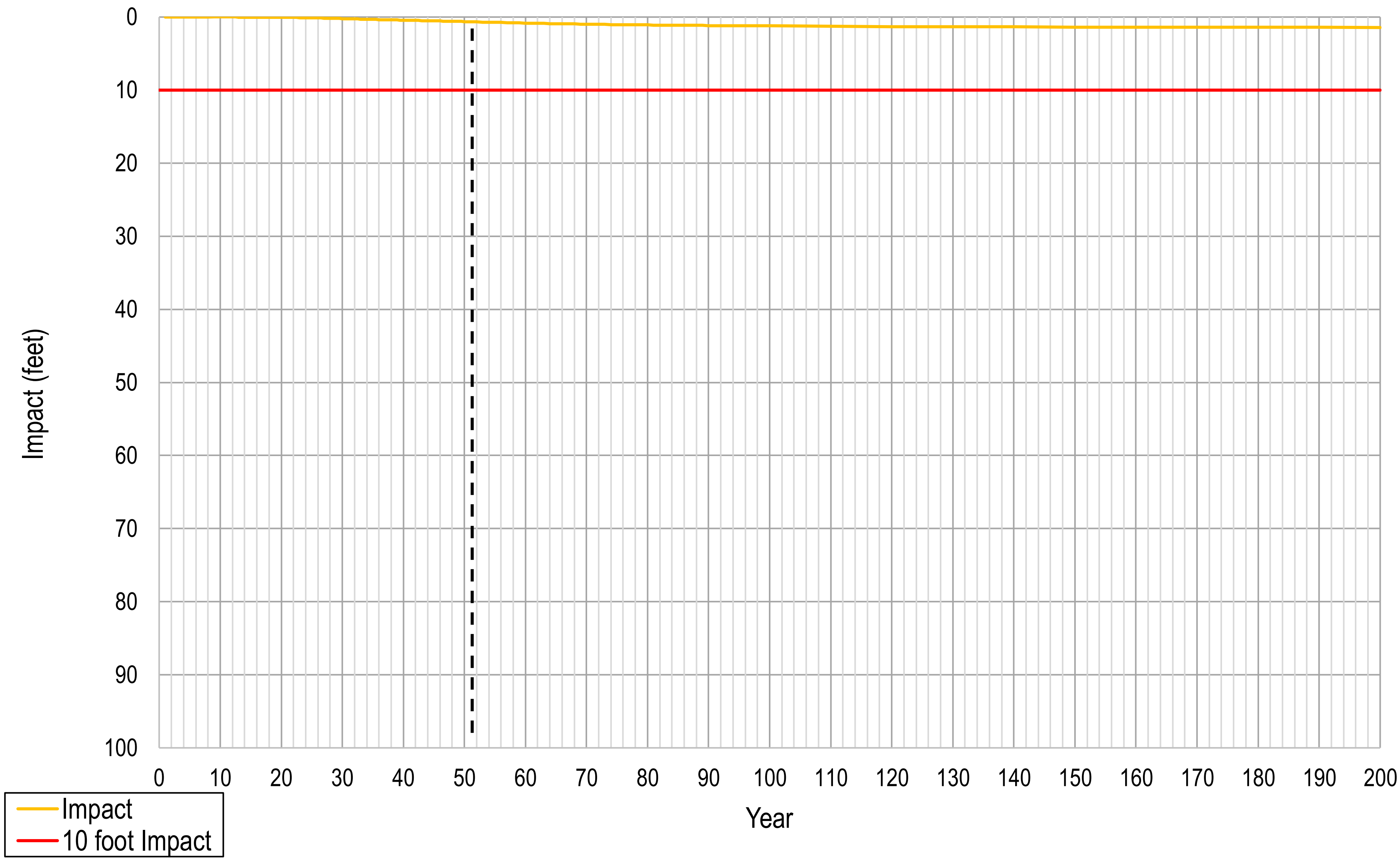


GDE Hydrograph – Water Level Impact – McGinnel Spring

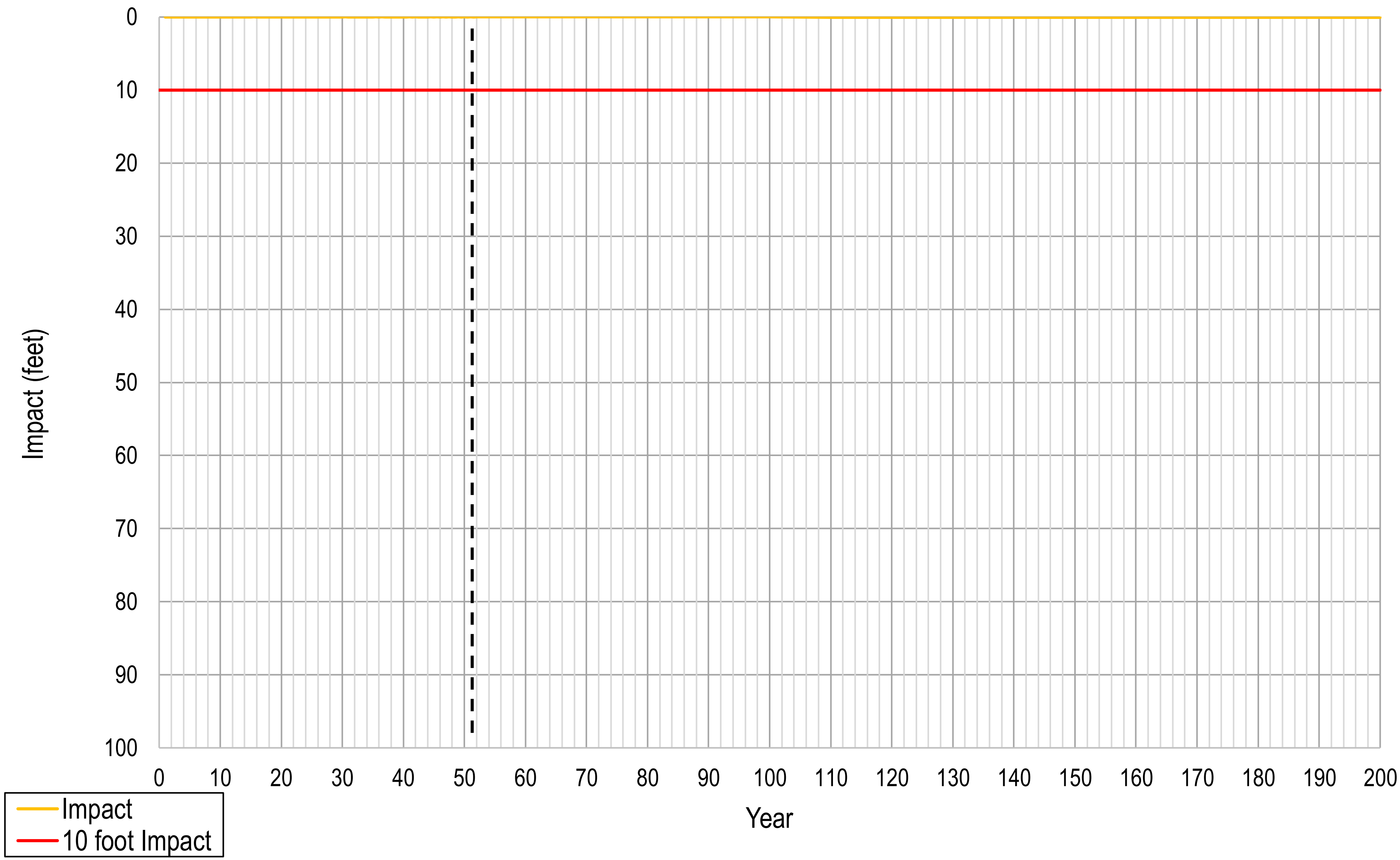
CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-19		



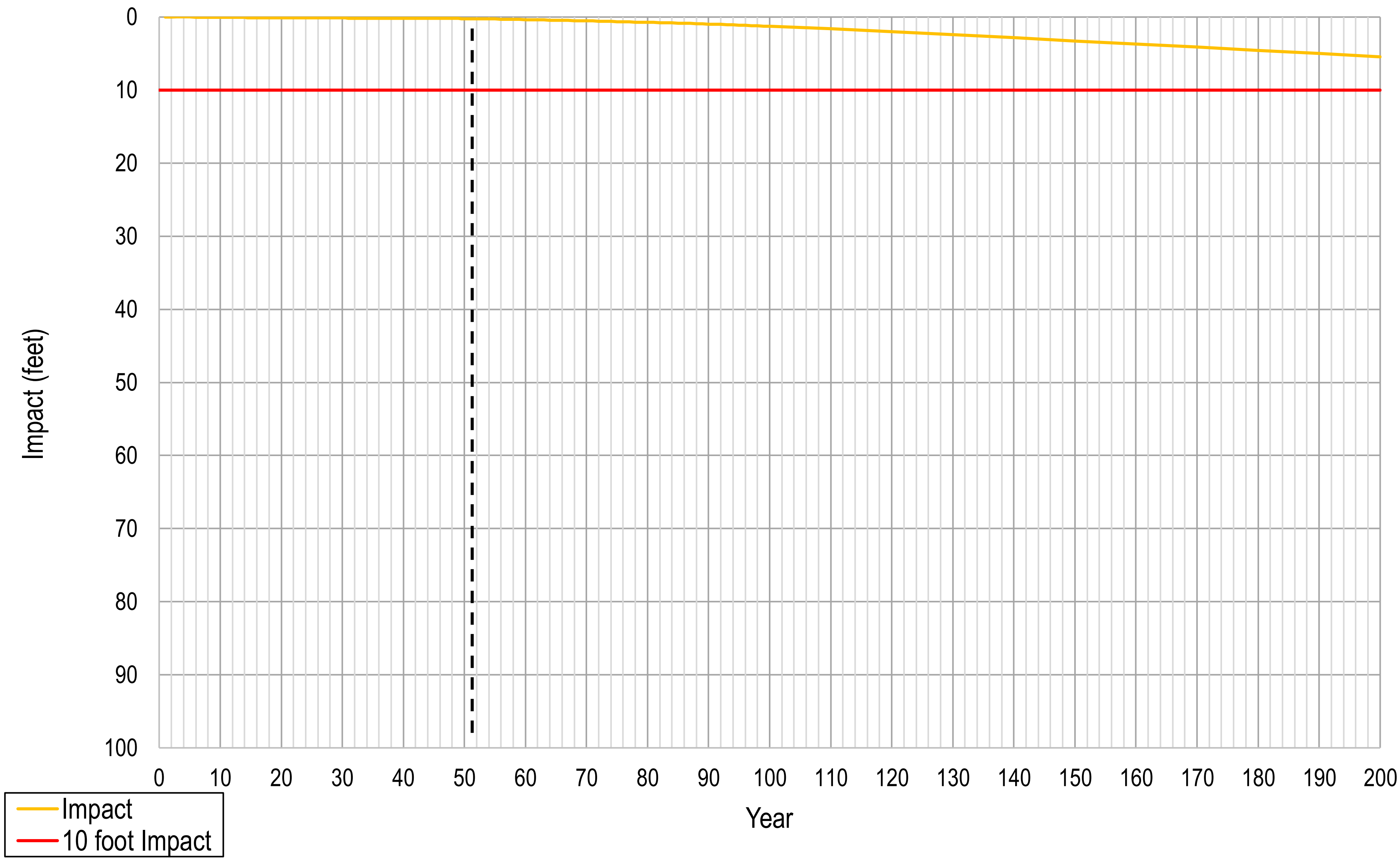
GDE Hydrograph – Water Level Impact – Lower Mineral Creek			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-20	



GDE Hydrograph – Water Level Impact – Mineral Creek (MC) 6.9			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-21	



GDE Hydrograph – Water Level Impact – No Name Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-22	

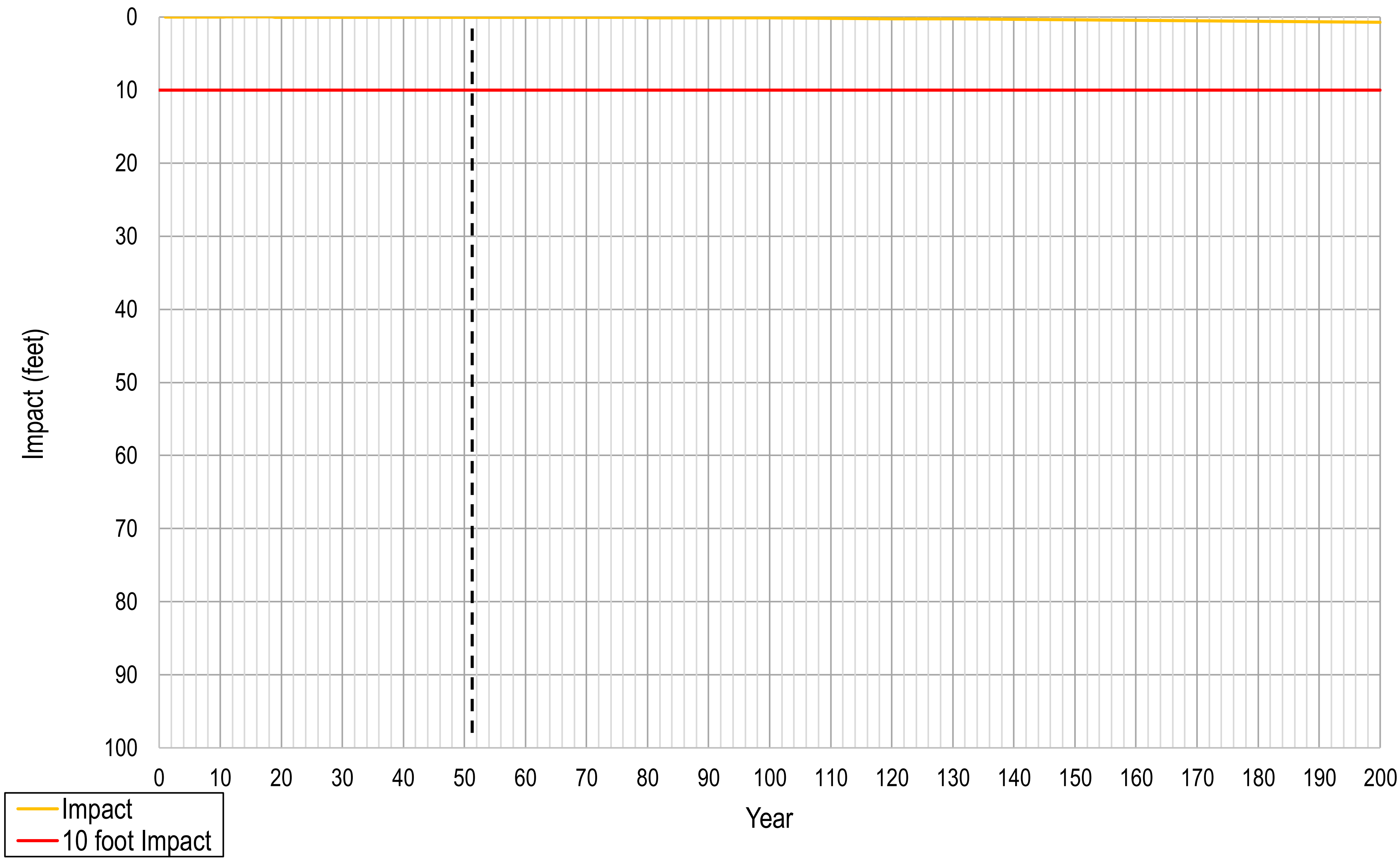


wsp

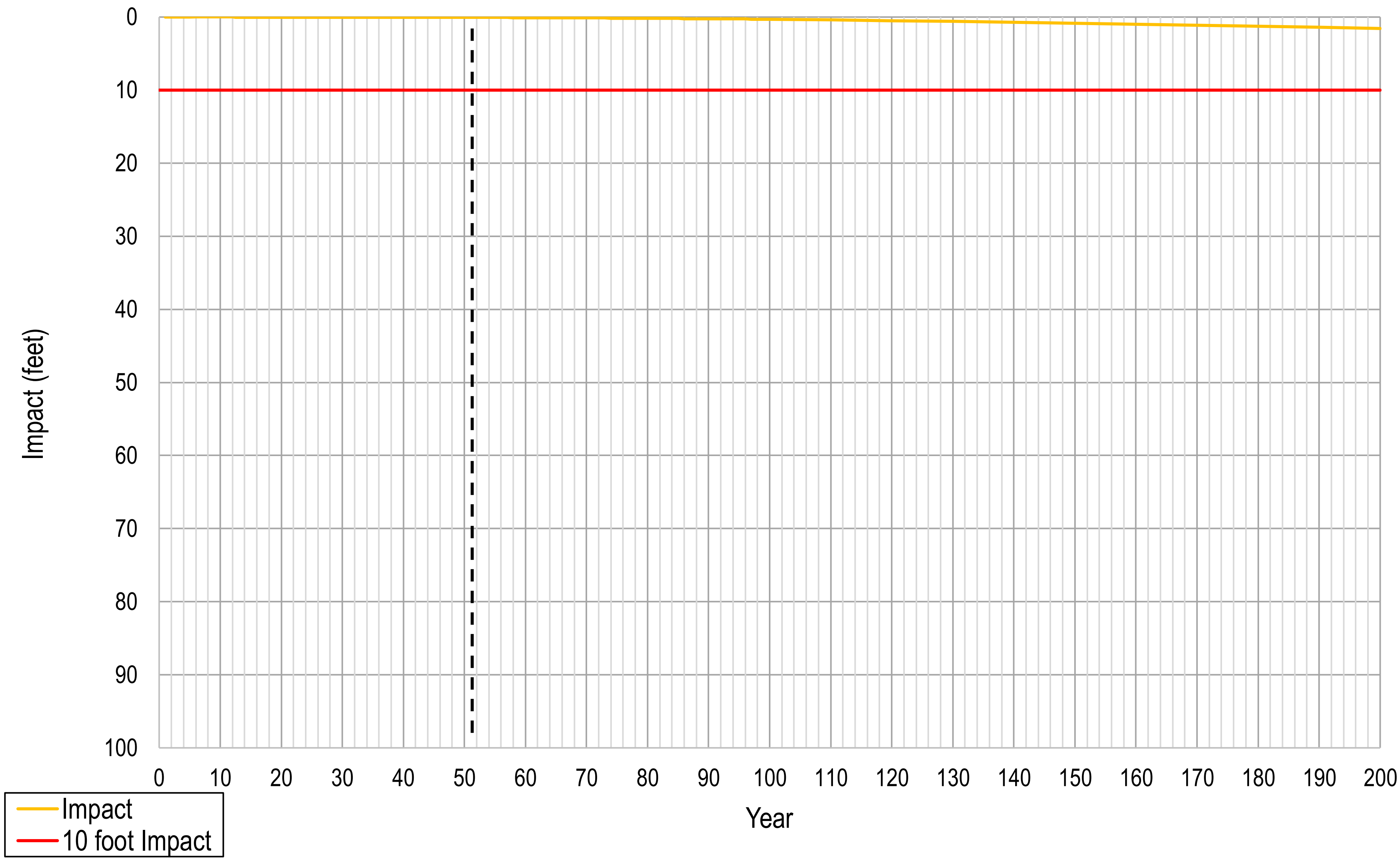
GDE Hydrograph – Water Level Impact – Queen Creek (QC) 17.39

CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-23	

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



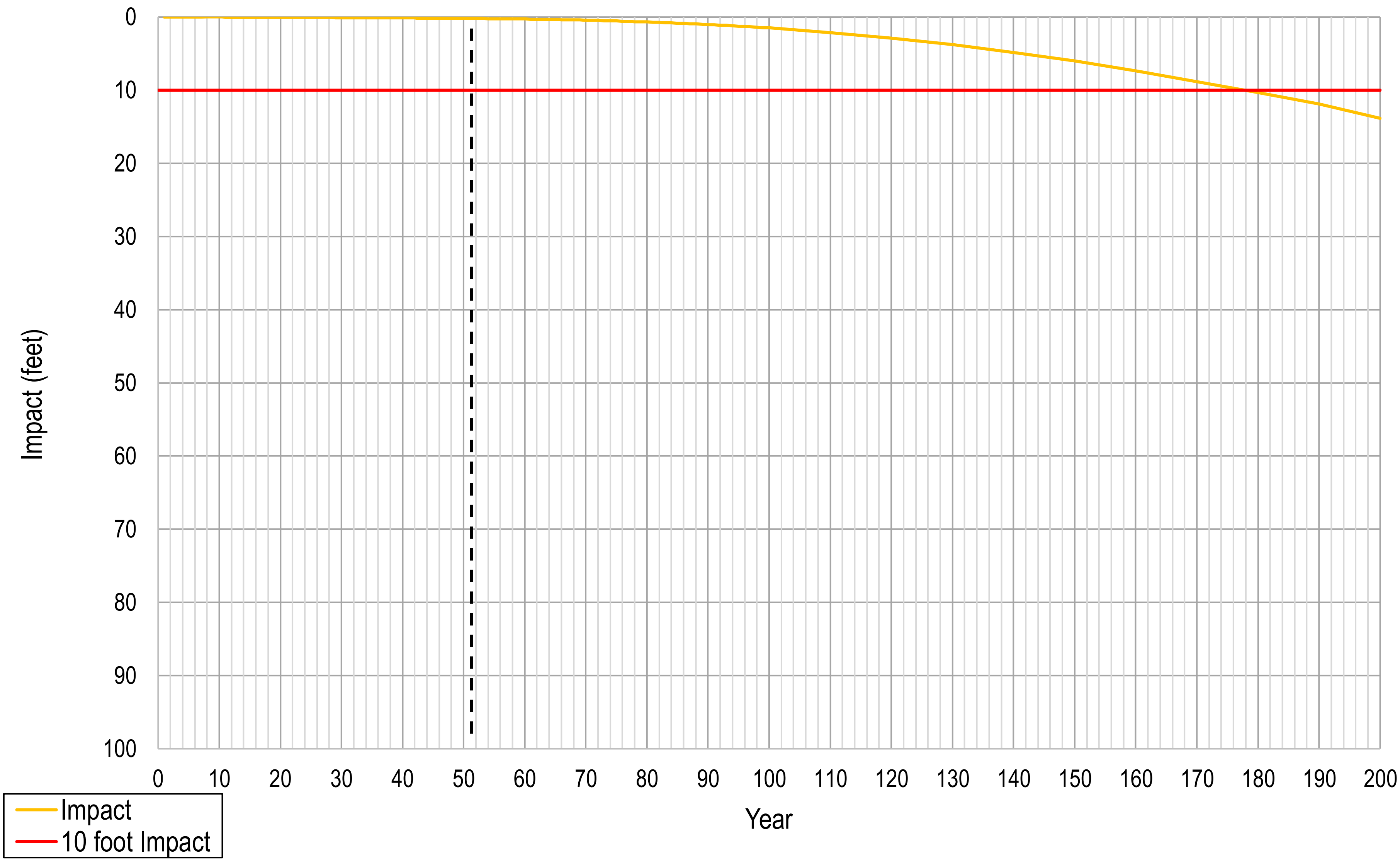
GDE Hydrograph – Water Level Impact – Rock Horizontal Spring			
CLIENT: Resolution Copper		PROJECT: 3D Regional Groundwater Model	
JOB: 31400968.001		DRAWN: CP	CHECKED: DO
DATE: October 2018		FIGURE: B-24	



GDE Hydrograph – Water Level Impact – Telegraph Canyon (TC) 0.6

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model		
JOB:	31400968.001	DRAWN:	CP	CHECKED:	DO
DATE:	October 2018	FIGURE:	B-25		

D:\Resolution_models\Results Processing\GDE\GDE_LinkedChart.docx



GDE Hydrograph – Water Level Impact – Walker Spring

CLIENT:	Resolution Copper	PROJECT:	3D Regional Groundwater Model
JOB:	31400968.001	DRAWN: CP	CHECKED: DO
DATE:	October 2018	FIGURE:	B-26

102 Magma Heights – P.O. Box 1944
Superior, AZ 85173
Tel.: 520.689.9374
Fax: 520.689.9304

November 6, 2018

Ms. Mary Rasmussen
US Forest Service
Supervisor's Office
2324 East McDowell Road
Phoenix, AZ 85006-2496

Subject: Response to Action Items from September 12, 2018 Groundwater Modeling Workgroup

Dear Ms. Rasmussen,

In response to the action items from the September 12, 2018 groundwater modeling workgroup the following technical reports from WSP are enclosed:

- WSP, October 2018. Resolution Copper Groundwater Flow Model – Predictive Results.
- WSP, November 2018. Resolution Copper Groundwater Flow Model – "Climate Change" Scenario.

Sincerely,

Vicky Peacey,

Senior Manager, Environment, Permitting and Approvals; Resolution Copper Company, as Manager of Resolution Copper Mining, LLC

Cc: Ms. Mary Morissette; Senior Environmental Specialist; Resolution Copper Company

Enclosure(s):

WSP, October 2018. Resolution Copper Groundwater Flow Model – Predictive Results
WSP, November 2018. Resolution Copper Groundwater Flow Model – "Climate Change" Scenario.