



## **APPENDIX 9-1**

### **FLOOD RISK ASSESSMENT**

## **UMMA MORE RENEWABLE ENERGY DEVELOPMENT, CO. WESTMEATH**

### **STAGE III FLOOD RISK ASSESSMENT**

## **FINAL REPORT**

Prepared for:  
**Umma More Ltd**

Prepared by:  
**Hydro-Environmental Services**

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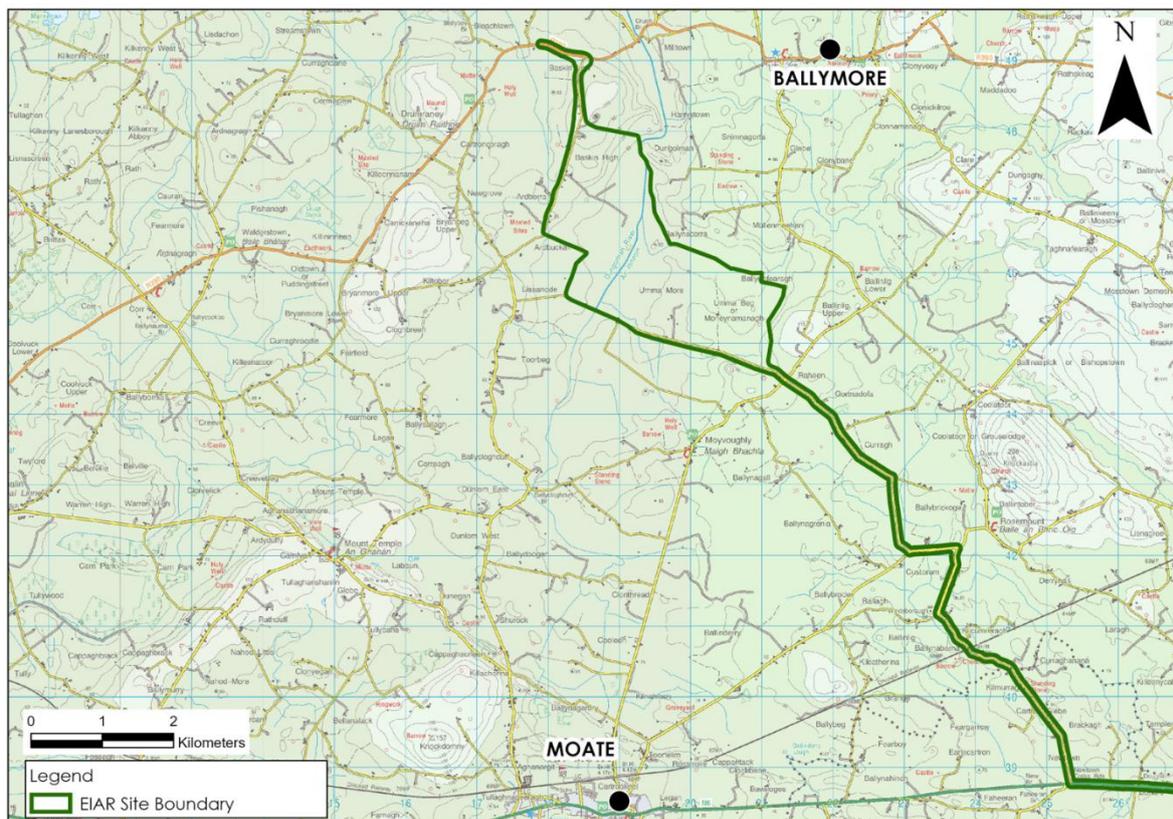
# 1. INTRODUCTION

## 1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Umma More Limited to undertake a Stage III Flood Risk Assessment (FRA) for the proposed Umma More Renewable Energy Development southwest of Ballymore, Co. Westmeath. A study area location map is shown below as **Figure A**.

The FRA was undertaken at the design stage in order to further understand the extents of potential flooding at the proposed Wind Farm Site and to inform the siting of turbines and associated infrastructure within the Wind Farm Site. The initial scoping stage of the project had highlighted areas within the proposed Wind Farm Site which were mapped within the PFRA Flood risk zones.

This FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009).



**Figure A: Site Location Map**

## 1.2 STATEMENT OF EXPERIENCE

Hydro-Environmental Services ("HES") are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling, and prepare flood risk assessment reports.

Adam Keegan (BSc, MSc) is a hydrogeologist with three years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects and associated Flood Risk Assessments, including Derrinlough WF, Lyrenacarriga WF (SID), Cleanrath WF and Carrownagowan WF (SID) as well as flood risk assessments for commercial urban developments.

David Broderick (BSc, MSc) is a Hydrogeologist with 13 years environmental consultancy experience in Ireland. David has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. David has significant experience in surface water drainage issues, SUDs design and flood risk assessment.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland, as well as accompanying Flood Risk Assessments. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

### 1.3 REPORT LAYOUT & METHODOLOGY

This FRA report is structured as follows:

- Section 2 describes the proposed site setting and details of the Proposed Development;
- Section 3 outlines the hydrological and geological characteristics of the local surface water catchment in the vicinity of the Wind Farm Site;
- Section 4 deals with an initial flood risk identification undertaken for the Proposed Development based on desk studies and walkover surveys;
- Section 5 deals with a detailed site-specific flood risk assessment (FRA) which includes flood level modelling;
- Section 6 provides commentary in relation to the County Westmeath Development Plans and Justification Test; and,
- Section 7 presents the FRA report conclusions.

**As stated above, this FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). The assessment methodology involves researching and collating flood related information from the following data sources:**

- OPW Flood Studies Update (FSU) Web Portal;
- Geological Survey of Ireland (GSI) maps on superficial deposits;
- EPA hydrology maps;
- Preliminary Flood Risk Assessment Maps (PFRA);
- National Indicative Fluvial Mapping (released early 2022)
- CFRAM mapping;
- Westmeath County Development Plan 2021 – 2027;
- Site Walkovers (conducted on 14<sup>th</sup> May, 20<sup>th</sup> June, 30<sup>th</sup> June and 14<sup>th</sup> July 2021); and,
- Watercourse topographic surveys and flow monitoring completed between 14<sup>th</sup> May and 20<sup>th</sup> June 2021.

- Hydrological (stage) monitoring at 3 no. locations along the Dungolman and Mullenmeehan watercourses

## 2. BACKGROUND INFORMATION

### 2.1 INTRODUCTION

This section provides details on the topographical setting of the Wind Farm Site along with a description of the Proposed Development.

### 2.2 SITE LOCATION AND TOPOGRAPHY

The Wind Farm Site is located approximately 3.5km southwest of the village of Ballymore and approximately 14km northwest of Athlone, Co. Westmeath. The total Wind Farm Site is approximately 487 Ha.

The Wind Farm Site comprises mainly improved grassland and agricultural pastures separated by hedgerows and drainage ditches. A small area of forestry exists in the southwest of the Wind Farm Site. The topography of the Wind Farm Site is slightly undulating. The majority of Wind Farm Site is situated between 55-70 mOD with a relatively flat plain across the centre of the Wind Farm Site near the Dungolman River. Towards the northwest and southeast of the Wind Farm Site the topography steepens to ~100mOD. The Dungolman River bisects the centre of the Wind Farm Site before running along the eastern boundary of the northern section of the Wind Farm Site.

All proposed turbine locations (T1-T9), with the exception of T4, are situated on improved grassland. T4 is located in the southwest of the Wind Farm Site, in an area of coniferous forestry. The Wind Farm Site access roads are mainly located on improved grassland, but also through forestry near T4.

A study area location map is shown as **Figure A** above.

### 2.3 PROPOSED DEVELOPMENT DETAILS

The Proposed Development comprises of 9 No. wind turbines, access roads, temporary construction compounds, meteorological mast, underground cabling, a 110kV onsite substation and associated underground 110kV cabling connecting to the existing Thornsberry 110kV substation, spoil management, junction accommodation works, tree felling, site drainage and all ancillary works and apparatus. Rock for construction will be sourced off-site. The full description of the Proposed Development is provided in Chapter 4 of the EIAR.

There will also be a requirement for 1 no. new watercourse crossing across the Dungolman river as well as potential new/improved crossings/culverts at the streams/drains that are intersected by the proposed access track alignments at 11 no. locations.

A proposed Wind Farm Site layout map is shown as Figure B below.

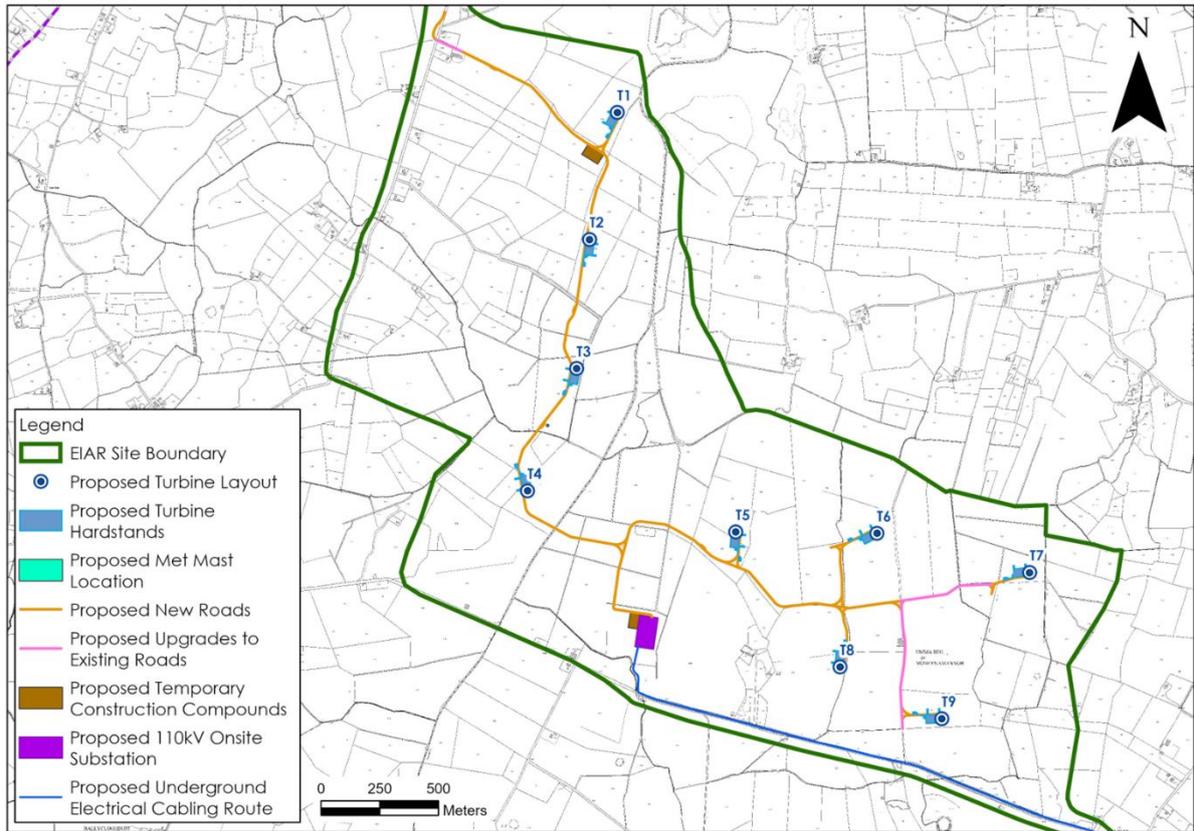


Figure B: Proposed Wind Farm Site Layout Map

## 3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

### 3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics in the area of the Wind Farm Site.

### 3.2 BASELINE HYDROLOGY

#### 3.2.1 Regional and Local Hydrology

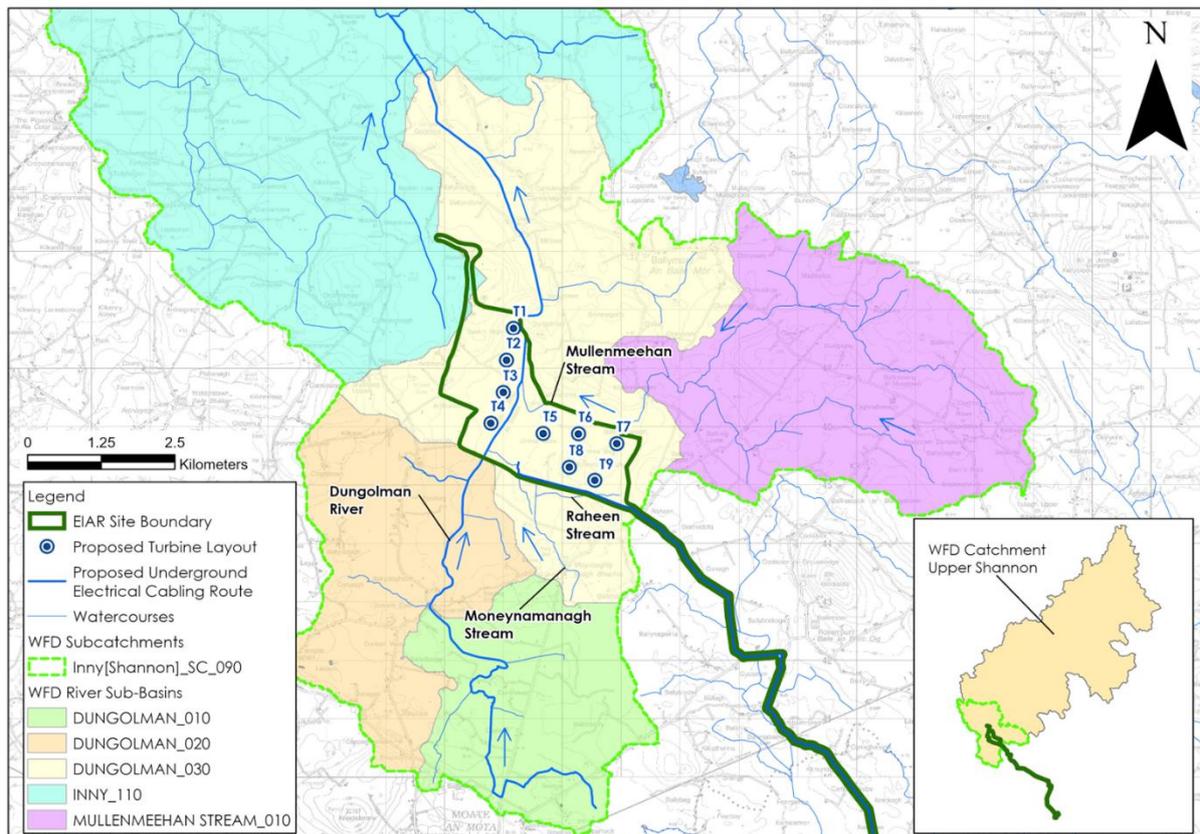
On a regional scale, the Wind Farm Site is located in the Inny River surface water sub-catchment, which is in the Upper Shannon catchment within Hydrometric Area 26 of the Shannon International River Basin District (SIRBD). The Inny River flows to the northwest approximately 8.2km northwest of the Wind Farm Site. The Inny River discharges into Lough Ree approximately 10.6km northwest of the Wind Farm Site.

On a more local scale, the Wind Farm Site is located in the Inny River sub-catchment (Inny[Shannon]\_SC\_090) with the majority of the Wind Farm Site located in the Dungolman WFD river sub basin (Dungolman\_030) (refer to **Figure C**). A small section in the southwest of the Wind Farm Site is mapped in the Dungolman\_020 river sub-basin while the northwestern corner of the Wind Farm Site is located in the Inny River (Inny\_110) river sub-basin. However, none of the proposed turbines are mapped in the Dungolman\_020 or Inny\_110 river sub-basins. A local hydrology map is shown as **Figure C**.

As stated above the majority of the Wind Farm Site is located in the Dungolman\_030 river sub-basin. The Dungolman River (EPA Code: 26D06) flows to the northeast between T4 and T5. This watercourse then flows along the EIAR Site boundary to the east of T2 and T3 before veering to the northeast to the east of T1. Drainage in this river sub-basin flows towards the Dungolman River via several smaller streams and drains. In the southeast of the study area, the Raheen stream (EPA Code: 26R36) flows to the west approximately 150m south of T9. This waterbody discharges into the Moneynamanagh stream (EPA Code: 26M40) 1km southwest of T9 before turning northwest and discharging into the Dungolman River 800m southwest of T5. During site visits there was very little flow in the Raheen stream (1-2l/s), with no flow observed in the area of the stream directly south of the proposed T9 (this area is elevated at the upper reaches of the stream).

The EPA also map a watercourse, the Mullenmeehan stream (EPA Code: 26M12) which flows west along the northern EIAR Site Boundary, approximately 300m to the north of T6. The Mullenmeehan stream reaches a confluence with the Dungolman River approximately 450m northeast of T3. Although referred to as a stream by the EPA, flows in the Mullenmeehan stream were measured at >200 l/s during site visits. The Dungolman River flows north before discharging into the Tang River (EPA Code: 26T02) approximately 5.15km north of the Wind Farm Site. The Tang River continues to flow to the northwest and eventually discharges into the Inny River (EPA Code: 26I01) approximately 8.3km northwest of the Wind Farm Site.

The agricultural lands which cover the majority of the Wind Farm Site contain a network of drains which run along the hedgerows and field boundaries and discharge into Dungolman River and the Moneynamanagh and Mullenmeehan streams. There was very little observable flow in these drains during the site visits. The west of the Wind Farm Site in the vicinity of T4 consists of forestry with smaller forestry drains discharging into the Dungolman River to the east.



**Figure C: Local Hydrology Map**

### 3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Ballymore G.S., approximately 2.2km northeast of the Wind Farm Site, is 1,154.7mm ([www.met.ie](http://www.met.ie)). The average potential evapotranspiration (PE) at Mullingar, approximately 24km northeast of the Wind Farm Site, is 445.8m/year ([www.met.ie](http://www.met.ie)). The actual evapotranspiration ("AE") is calculated to be 423.5mm (95% PE). Using the above figures the effective rainfall ("ER")<sup>1</sup> for the area is calculated to be (ER = SAAR – AE) 731.2mm/year.

Based on recharge coefficient estimates from the GSI ([www.gsi.ie](http://www.gsi.ie)), an estimate of 22.5% recharge is taken for the Wind Farm Site as an overall average. This value is for "Till derived from limestones" with a "High" vulnerability rating. Some areas in the west of the Wind Farm Site are mapped to be underlain by "Fen Peat" (although Fen Peat was not identified within the walkover surveys). Areas underlain by Fen peat will experience lower recharge rates (5%). The value of 22.5% recharge was chosen to reflect the dominance of till across the site and the high drainage density. This means that the hydrology of the Wind Farm Site is characterised by high surface water runoff rates and moderate to low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the Wind Farm Site are estimated to be 164.5mm/year and 566.7mm/year (i.e. 731.2mm/year – 164.5mm/year = 566.7mm/year) respectively.

**Table A** below presents return period rainfall depths for the area of the Wind Farm Site. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

<sup>1</sup> ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.

**Table A: Rainfall return period depths for Wind Farm Site**

Duration	Return Period (Years)			
	<u>1</u>	<u>5</u>	<u>30</u>	<u>100</u>
<u>5 mins</u>	3.9	6.9	12.4	17.8
<u>15 mins</u>	6.4	11.3	20.3	29.2
<u>1 hour</u>	10.3	17.1	28.9	39.9
<u>6 hours</u>	19.0	29.2	45.4	59.6
<u>12 hours</u>	24.1	35.9	54.1	69.6
<u>24 hours</u>	30.6	44.2	64.4	81.3
<u>2 days</u>	38.2	52.7	73.4	90.1

### 3.3 GEOLOGY

Based on the GSI/Teagasc soils mapping ([www.gsi.ie](http://www.gsi.ie)) the Wind Farm Site is mainly underlain by poorly drained mineral soils (AminPD) and to a lesser extent deep well drained mineral (AminDW).

GSI subsoils mapping ([www.gsi.ie](http://www.gsi.ie)) show that limestonetills are the dominant subsoil type in the area of the Wind Farm Site. Trial pit investigations show that the subsoils generally comprise silty SAND and silty gravelly SAND with occasional CLAYS encountered.

Based on the GSI bedrock mapping ([www.gsi.ie](http://www.gsi.ie)), the Wind Farm Site is mapped to be underlain by Lucan Formation Limestone, with some Waulsortian Limestone mapped towards the southeast corner.

### 3.4 DESIGNATED SITES & HABITATS

Within the Republic of Ireland, designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (cSAC), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

The only downstream designated sites that are hydrologically connected to the Wind Farm Site are Lough Ree SAC/SPA. The Dungolman river discharges to the Tang River, which discharges to the Inny river, which eventually reaches Lough Ree approximately 14km downstream of the Wind Farm Site.

Other nearby designated sites include Ballynagrenia and Ballinderry Bog NHA, which is situated 2.5km south of the Wind Farm Site. This bog is situated at the headwaters of the Dungolman River and as such is hydraulically upgradient of the Wind Farm Site.

## 4. FLOOD RISK IDENTIFICATION

### 4.1 INTRODUCTION

The following assessment is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

A Stage 2 assessment has been completed as part of the EIAR for the Proposed Development, and involves the confirmation of sources of flooding, appraising the adequacy of existing information and determining what surveys and modelling approach may be required for further assessment.

As per the guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site; and,
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development.

Further to this, a Stage 3 FRA is a detailed flood risk assessment which assesses flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

### 4.2 SOILS MAPS – FLUVIAL MAPS

A review of the soil types in the vicinity of the Wind Farm Site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers deposits of transported silts/clays referred to as alluvium build up within the floodplain and hence the presence of these soils is a good indicator of potentially flood-prone areas.

Based on the EPA soil map for the area, large areas of the Wind Farm Site are mapped as river alluvium. Extensive alluvium deposits are associated with the Dungolman River in the west, the Raheen and Moneynamanagh stream in the south and the Mullenmeehan stream in the north of the Wind Farm Site. The following turbines are mapped on alluvium: T4 in the west and T5, T6, T7 in the northeast. In addition, lands adjacent to T9 and T8 are mapped as river alluvium.

### 4.3 HISTORICAL MAPPING

There is no text on local available historical 6" or 25" mapping for the proposed Wind Farm Site that identify areas that are "*prone to flooding*" within the Wind Farm Site.

### 4.4 OPW NATIONAL FLOOD HAZARD MAPPING

The OPW National Flood Hazard Maps records the occurrence of several historic and recurring flood instances in the vicinity of the Site. However, no flood instances are located within the Site boundaries (refer to **Figure D** below)

The OPW ([www.floodmaps.ie](http://www.floodmaps.ie)) show several historic and recurring flood events in the vicinity of the Wind Farm Site. The closest mapped recurring flood event is found approximately 250m southwest of Wind Farm Site at Kiltober. Here low-lying lands are reported to flood annually following intense rainfall. Similar flood events have been recorded at Tourbeg, Moate, approximately 700m south of the Wind Farm Site. A further flood event is mapped approximately 1km to the north of the Wind Farm study area along the R390 at Ballymore. The Kilbeggan area engineer notes that "localised low lying area floods after heavy rains every year and that the road is liable to flood".

The OPW map much of the Wind Farm Site along the Dungolman River and the Mullenmeehan stream to be Benefited Land. Benefited land is land which was drained as part of the Arterial Drainage Scheme. Furthermore, the primary watercourses at the Wind Farm Site including the Dungolman River, Mullenmeehan stream and the Moneynamanagh stream are recorded as channels for arterial drainage schemes. The secondary field drains and ditches are not mapped within the arterial drainage scheme.

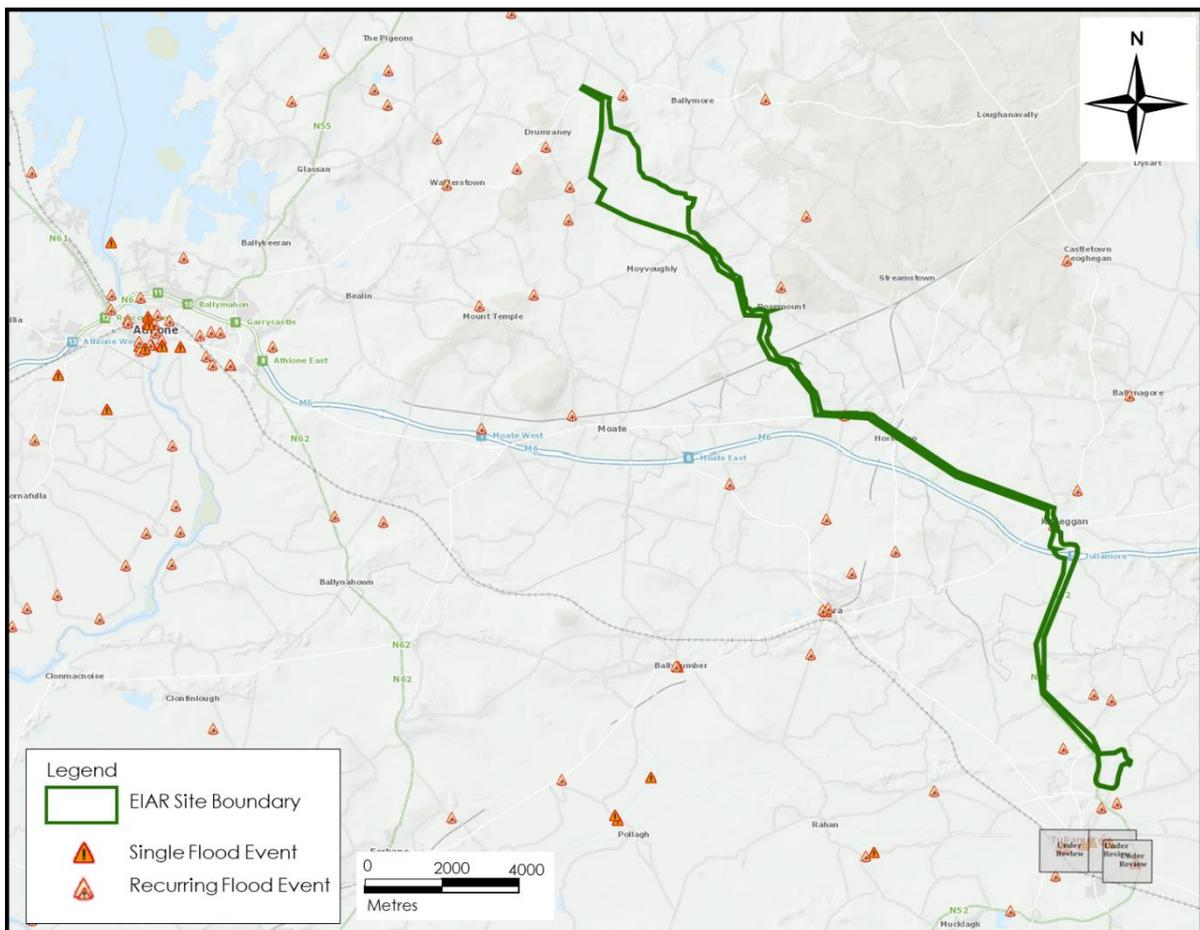


Figure D: OPW Indicative Floods Map (Source: [www.floods.ie](http://www.floods.ie))

## 4.5 CFRAM MAPS – FLUVIAL AND COASTAL FLOODING

Where complete the Catchment Flood Risk Assessment and Management (CFRAM)<sup>2</sup> OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the Preliminary Flood Risk Assessment Maps (PFRA) maps. However, CFRAM mapping is not currently available for the area of the proposed Wind Farm Site.

Indicative flood maps (NIFM) have been produced for all watercourses that are on the EPA watercourse layers 'WATER\_RivNetRoutes' and 'WFD\_LakeSegment', and have a catchment area greater than 5km<sup>2</sup>, and for which flood maps were not produced under the National CFRAM Programme. The NIFM mapping is detailed further in **Section 4.7**.

## 4.6 PRELIMINARY FLOOD RISK ASSESSMENT MAPS – FLUVIAL AND PLUVIAL FLOODING

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types or levels of flood zones defined according to OPW guidelines:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and,
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

The PFRA flood maps were therefore queried for potential areas prone to flooding. The maps show that areas in the west and north of the Wind Farm Site are mapped in the 100-year and the Extreme Event fluvial flood zones (Zones A and B respectively) as outlined below. The majority of the Wind Farm Site is however located in Flood Zone C (Low Risk).

The 100-year flood zone is mapped along the Dungolman River within the Wind Farm Site. In the southwest of the Wind Farm Site, the flood zone extends up to 200m from the mapped river course and is mapped in the area of T4. Further north, T2 is also mapped on the border of the Flood Zone B area, ~300m west of the main river channel, while T1 and T3 are located 50m and 180m west of this mapped flood zone respectively.

The 100-year flood zone along the Mullenmeehan stream in the northeast of the Wind Farm Site does not extend as far south as any of the proposed turbine locations. The topography is slightly steeper away from the river bank along this stream. There are no fluvial flood zones located in the southeast of the Wind Farm Site.

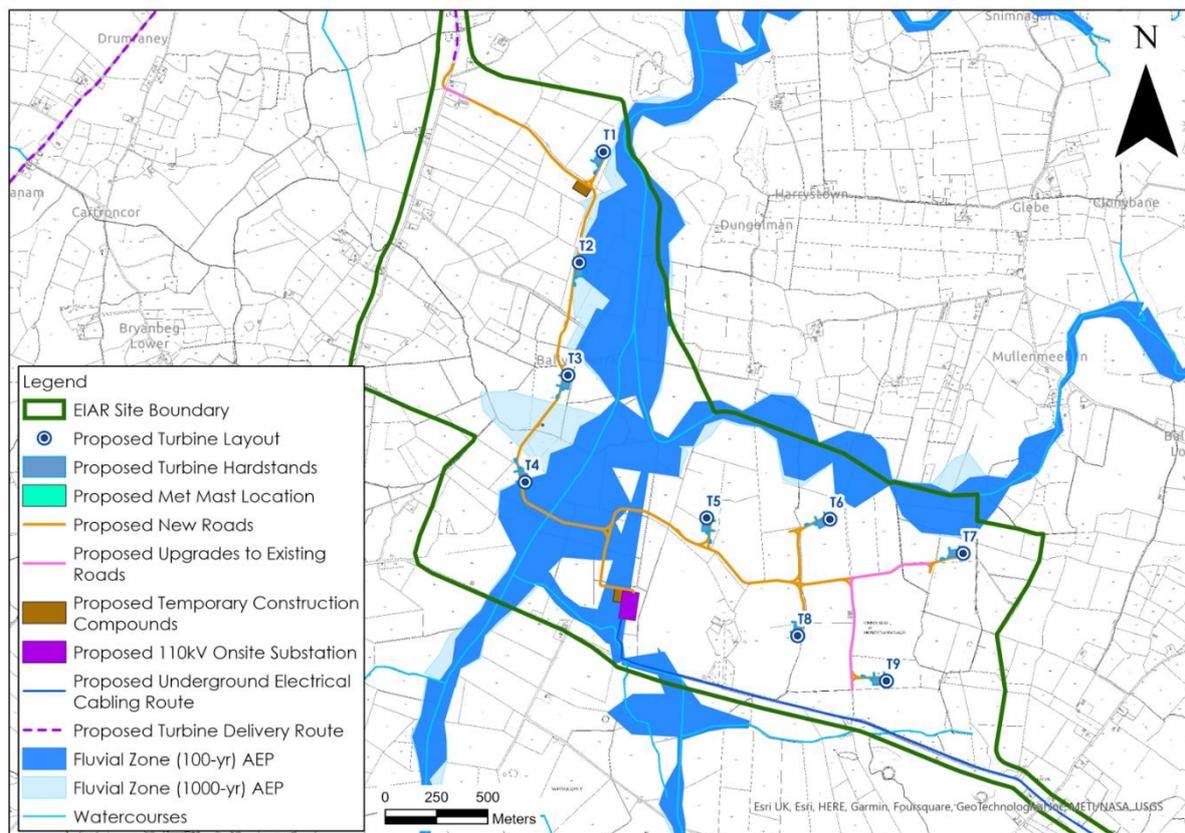
The general blocky shape of the PFRA map is due to the coarse scale nature of the topography data used to create the map. Typically, 2m contours are used to create these maps. In zones where the topography only varies by 1-2m over large areas of lands, the extents of the flood zones can be overestimated.

The GSI Historical 2015/2016 surface water flood map<sup>3</sup> shows fluvial and pluvial floods during the winter 2015/2016 flood event. This map does not show any flooding within the Wind Farm Site, with only small-localised areas of flooding in the surrounding lands.

The flood zones indicated on the PFRA mapping are shown on **Figure E** below.

<sup>2</sup> CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011, and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.

<sup>3</sup> GSI Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise)



**Figure E: PFRA Flood Zone Mapping**

#### 4.7 NATIONAL INDICATIVE FLUVIAL MAPPING

The National Indicative Fluvial Flood maps for the Wind Farm Site were released in early 2022. These maps supersede the older PFRA maps, and are carried out in areas where the more detailed CFRAM mapping has not been undertaken. The online flood mapping database, Floodinfo.ie<sup>4</sup> states;

*The National Indicative Fluvial Maps provide an indication of areas that may flood, during a flood of an estimated probability of occurring. As detailed in the Technical Data, a number of assumptions have been made in order to produce a dataset suitable for national level flood risk assessments.*

*The National Indicative Fluvial Maps are not the best achievable representation of flood extents and they are not as accurate as the Flood Maps produced under the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.*

*The maps should not be used to assess the flood risk associated with individual properties or point locations, or to replace a detailed site-specific flood risk assessment.*

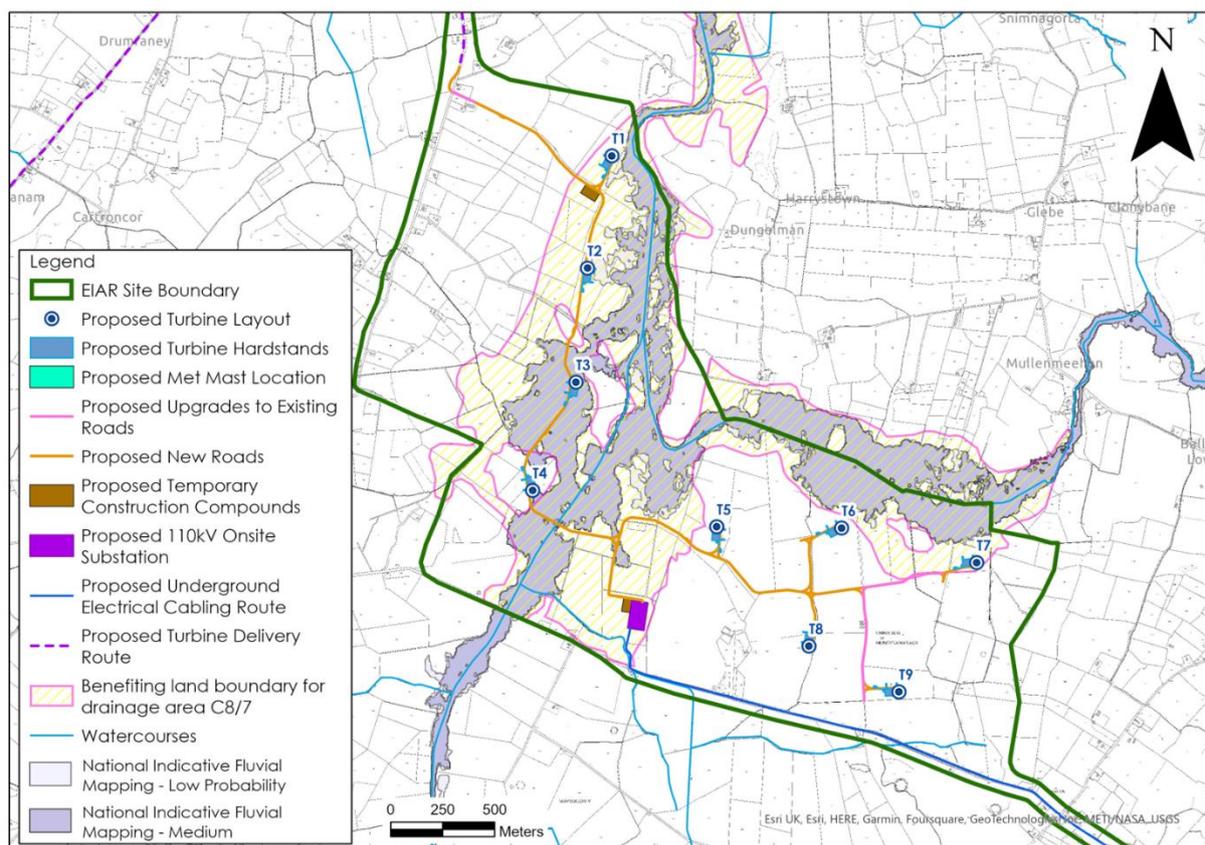
From the NIFM map of the site, turbines T1 – T9 are located outside both the Low probability and Medium probability flood zones. Turbine T3 is located within both probability zones, however both the low probability and medium probability flood zones are mapped with unusual areas along the western side of the Dungolman river. Turbine T3 is located within a mapped flood zone which is separated from the river channel by ~250m of land not mapped

<sup>4</sup> [https://www.floodinfo.ie/map/nifm\\_user\\_guidance\\_notes/](https://www.floodinfo.ie/map/nifm_user_guidance_notes/)

within the flood zone (presumably interpreted as higher ground). The mapped flood zone creates islands of higher ground nearer the river channel, particularly along the western side of the channel with areas of mapped flood zones further west of these "islands".

In reality, these areas of high ground do not exist from site walkover data and from Lidar data sourced for the more detailed flood modelling outlined in **Section 5.3**. It is assumed that the NIFM modelling is using coarser topographic data, which is interpreting areas of high and low ground based on contour data, which is not detailed enough for a site-specific assessment.

The flood zones indicated on the NIFM mapping are shown on **Figure F** below.



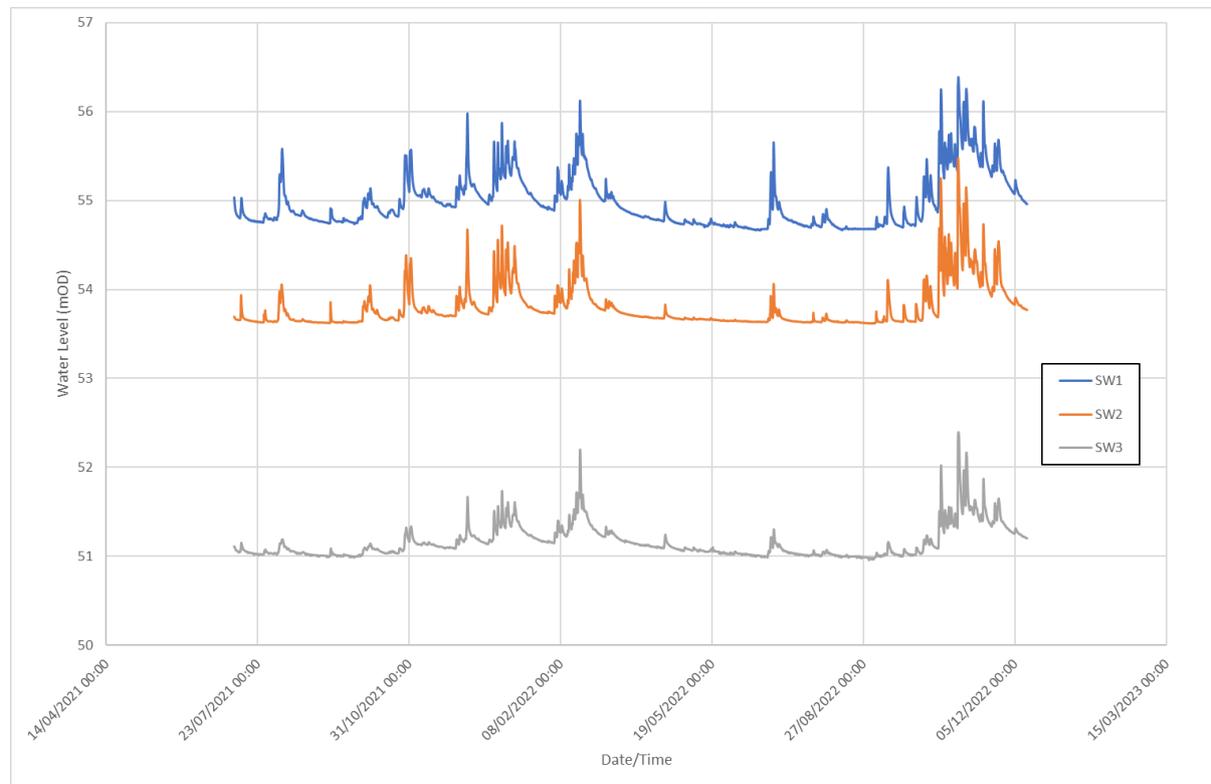
**Figure F: National Indicative Flood Mapping**

#### 4.8 WATER LEVEL MONITORING

Water level monitoring was undertaken at 3 no. locations along the Dungolman and Mullenmeehan stream between July 2021 and December 2022. Water levels in these rivers were recorded using in-situ OTT EcoLog 1000 loggers recording at 30 minute intervals. These water levels were then normalised to mOD, following a topographic (dGPS) survey of the water level at the logger locations. SW1 is located at the southern end of the Wind Farm Site, ~ 475m southwest of the proposed onsite substation. SW2 is located at a small bridge along the Mullenmeehan stream, ~400m northeast of turbine T6, while SW3 is located 1.2km north of the site on a bridge which crosses the Dungolman river. The water levels are shown below in **Figure G**.

Water levels at SW1(Dungolman river) at the southern end of the Wind Farm Site range between 54.7 – 56.4 mOD, while water levels at SW2 (Mullenmeehan stream) range between

53.7 – 55.5 mOD. Further downstream at SW3 (Dungolman river), water levels range between 51 – 52.3 mOD. The water levels were recorded to compare with the modelled flood elevations (**Section 5.3**). The water levels at SW2 are approximately near the centre of the Wind Farm Site and are the most representative of water levels near the Proposed Development infrastructure.



**Figure G: Water Levels (mOD) at 3 no. monitoring locations (Dungolman and Mullenmeehan stream)**

## 4.9 SUMMARY – FLOOD RISK IDENTIFICATION

Based on the information gained through the flood identification process, it would appear that sections of the Wind Farm Site are susceptible to fluvial flooding. While the majority of the Wind Farm Site is mapped in Flood Zone C, PFRA mapping shows areas of the Wind Farm Site adjacent to the Dungolman River and Mullenmeehan stream as Flood Zone A. Turbines T2 and T4 are located on the edges of the mapped PFRA flood zones, along with sections of existing roads and proposed new roads. NIFM mapping of the Wind Farm Site shows that turbine T3 is located within the Low probability and Medium probability flood zone.

This is discussed further in **Section 4.4** below where a site-specific flood risk assessment is carried out to further assess the risk of potential flooding at the Wind Farm Site.

## 4.10 INITIAL FLOOD RISK ASSESSMENT SURVEY

### 4.10.1 Site Survey

An initial walkover of the Wind Farm Site was undertaken on 14<sup>th</sup> May 2021, and a subsequent survey was undertaken on 20<sup>th</sup> June 2021. During both site visits the lands, specifically the areas identified from the PFRA and OSI base mapping (discussed above), were surveyed for any signs or anecdotal evidence of flooding. The local landowners were also consulted in relation to historical flooding on their lands, of which there were no notable instances of anecdotal flooding within the Wind Farm Site.

A walkover survey of the Wind Farm Site, particularly along the banks of the Mullenmeehan stream, identified ~1-1.5m deep drains which flow north discharging to the stream. These drains are emplaced along most field boundaries. The majority of the drains at the site are oriented in a north-south direction and discharge to the Mullenmeehan stream, before reaching the Dungolman River. There was typically no/low flow rates in these drains during site visits, with the largest drains discharging ~1L/s.

Soil samples taken from trial pitting, carried out on 30<sup>th</sup> June 2021 encountered CLAY within some trial pits, particularly at TP-1.2 and TP-2 which generally impedes drainage. Elsewhere, SANDS and gravelly SANDS were typically encountered which may be alluvial deposits, although the thickness is considerable, and a glacial origin is also likely.

#### 4.10.2 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the Proposed Development can be described using the Source – Pathway – Receptor Model (“S-P-R”). The primary potential source of flooding in this area, and the one with most consequence for the Proposed Development, is fluvial with minor pluvial flooding. The primary potential pathway would be fluvial overbank flooding of the main river channel (Dungolman River) which flows through the Wind Farm Site, during significant rainfall events. The potential receptors in the area are infrastructure and land as outlined below.

#### 4.10.3 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process, the sources of flood risk for the Proposed Development are outlined and assessed in **Table B**.

**Table B: Initial S-P-R Assessment of Flood Sources for the proposed development**

Source	Pathway	Receptor	Comment
Tidal	Not applicable.	Land and infrastructure.	The proposed site is >90km from the coast and there is no risk of coastal flooding.
Fluvial	Overbank flooding	Land and infrastructure.	Based on the PFRA mapping areas of the proposed infrastructure, there are 2 no. areas located inside a mapped fluvial flood Zone:  1: Proposed road and river crossing near <b>T5</b> extending to and including areas of the proposed <b>T4</b> hardstand are located within Flood Zone A and B.  2: Proposed Turbine T2 and the sections of proposed road north and south of the turbine are mapped within Flood Zone B.
Pluvial	Ponding of rainwater on the route right of way.	Land and infrastructure.	No pluvial flooding is mapped within the site boundary
Surface water	Surface ponding/ Overflow.	Land and infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels.	Land and infrastructure.	Based on local hydrogeological regime and PFRA mapping, there is no apparent risk from groundwater flooding.

## 5. DETAILED FLOOD RISK ASSESSMENT

### 5.1 INTRODUCTION

In order to carry out a Stage III level site-specific FRA for the Wind Farm Site and to assess the capacity and design flood levels of the Dungolman River and flood plain, a detailed topographic survey of the Dungolman River channel was undertaken as part of this site-specific assessment along with use of Lidar data to determine ground elevations for the wider site and flood plain area. The river channel survey is described in **Section 5.1** below. This combined topographic data was used to create a river channel/flood plain 2-dimensional flow model for the section of Dungolman River channel and valley within the Wind Farm Site.

Flood level modelling for the Dungolman River was undertaken using *HEC-RAS*<sup>5</sup> open channel flow software. *HEC-RAS* is a 2-dimensional flow model which can calculate channel water depth/level using parameters such as flood volumes, channel dimensions, slope and friction coefficients (Mannings *n* number). To investigate the potential for flooding within the Wind Farm Site, modelling of design flood volumes (*i.e.*, 10-year, 100-yr and 1000-yr) was undertaken for the river and its flood plain.

Apart from the PFRA and the more recent NIFM, no direct CFRAM flood studies or modelling have been completed for the Dungolman River catchment itself, and therefore the OPW FSU Web Portal was used to calculate the  $Q_{med}$  (flow) for the river at the Wind Farm Site.

The design flood event growth factors applied in the River Shannon CFRAM study<sup>6</sup> were used to calculate the 10 -year, 100-year and 1000-year design flood flows in the Dungolman River ( $Q_{med} \times \text{Growth Factor} \times \text{Climate Change}$ ). A potential increase in flow of 20% was applied to account for future climate change scenarios. The design flood flows for the Dungolman River and contributing streams are shown in **Table C** below.

**Table C: Design Flood Flows**

Channel	$Q_{med}$ ( $m^3/s$ )	10-yr Design Flood Flow ( $m^3/s$ )*	100-yr Design Flood Flow ( $m^3/s$ )*	1000-yr Design Flood Flow ( $m^3/s$ )*
Dungolman River (Upstream of site)	3.82	6.7	9.3	11.9
Southern Tributary	1	1.75	2.43	3.12
Northern Tributary	5.25	9.2	12.8	16.38
<b>Total (Downstream of site)</b>	10.07	17.64	24.53	31.42

\* Growth factors of 1.46, 2.03 and 2.6 were used to estimate the 10-year, 100-year and 1000-year design floods. Includes 20% increase for climate change

For the stretch of the Dungolman River at the location of the Wind Farm Site in the flood model, a friction coefficient (Mannings *n* number) of 0.07 was used to reflect the weedy and slow moving nature of the channel and for the surrounding lands a coefficient of 0.035 was used for grassland (short grass) and 0.1 for forestry (dense forestry).

The slope of the Dungolman River channel as it flows through the Wind Farm Site was determined from the topographic survey and this is calculated to be 0.00049 upstream of the site and 0.0004 downstream of the Wind Farm Site.

<sup>5</sup> HEC-RAS – Hydrologic Engineering Centre – River Analysis System

<sup>6</sup> Shannon Catchment-based Flood Risk Assessment and Management Study – Hydrology Report Unit of Management 25/26 (OPW/Jacobs, 2016.)

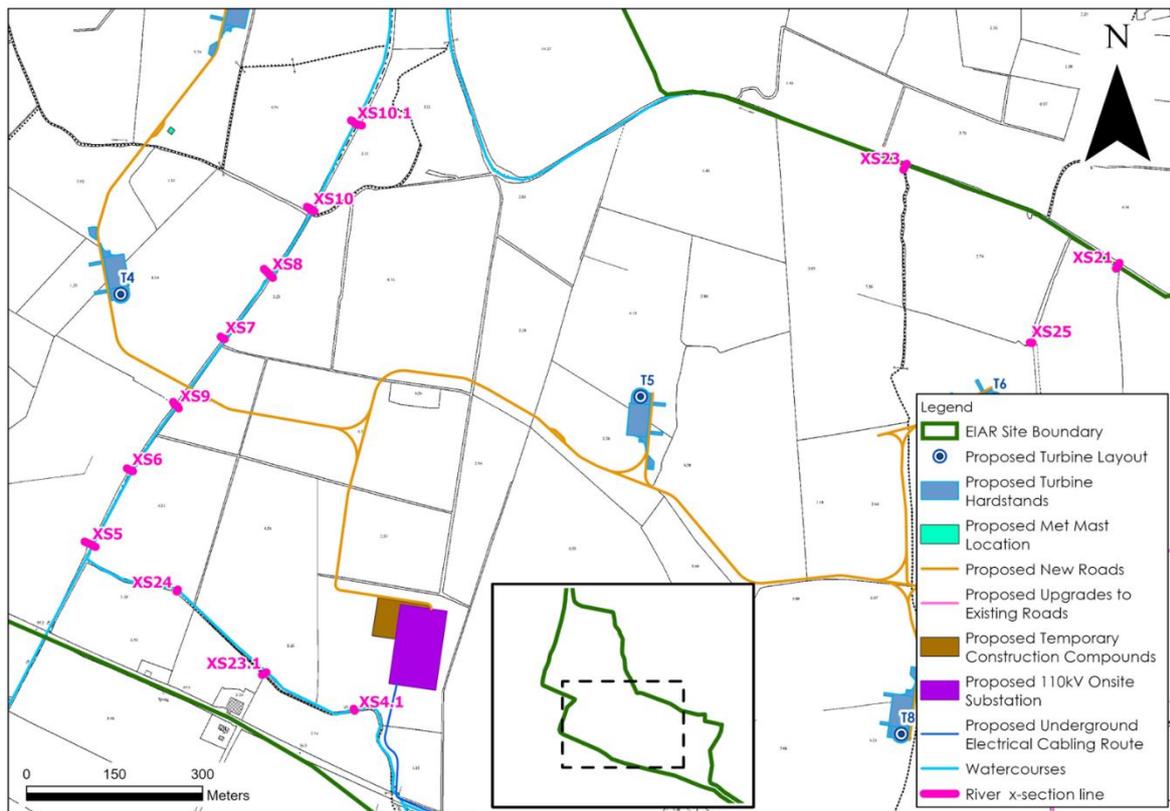
## 5.2 SITE SURVEY

A total of 14 no. open channel cross-sections of the Dungolman River were taken in the vicinity of the Wind Farm Site between 14<sup>th</sup> May and 20<sup>th</sup> June 2021.

Cross-sections were taken from the southern Wind Farm Site boundary, near the unnamed road which runs between the townlands of Raheen and Lissanode, to the northern Wind Farm Site boundary just west of the existing sand and gravel quarry.

The survey cross-sections were extended across the floodplain and study area using Lidar data

The locations of the cross-sections are shown on **Figure H – Figure J** below. Cross-sections elevation data (in HEC-RAS format) are attached as **Appendix I**.



**Figure H: Southern site Channel Cross-Sections**

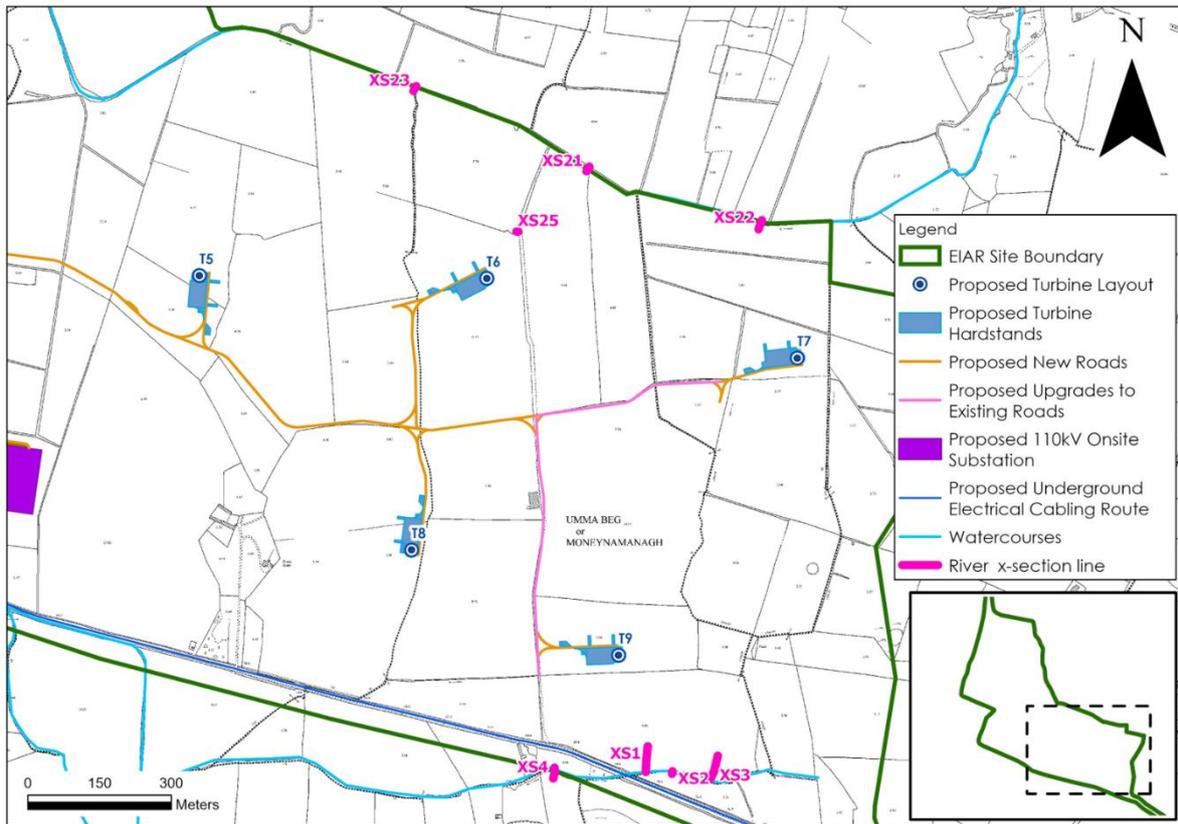


Figure I: Central/Eastern Site area cross sections

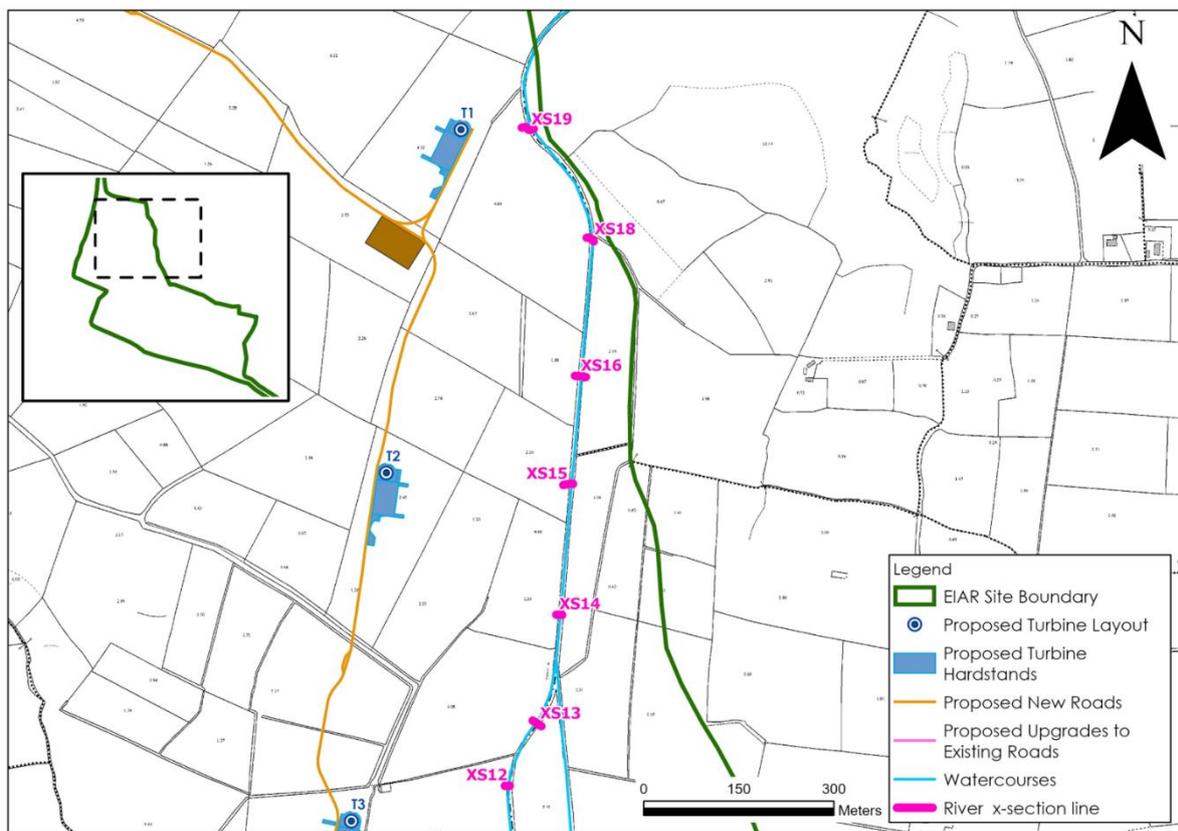


Figure J: Northern Site area cross sections

### 5.3 FLOOD MODELLING

Prior to modelling the design flood flows, the flow in the Dungolman River and Mullenmeehan on the day of the topographic survey was run to assess the accuracy of the model. There are no historical flood flows with known water levels available for flood flow calibration. The flow in the main Dungolman River channel on 20<sup>th</sup> June 2021 was measured to be 0.33m<sup>3</sup>/s upstream of the site and 0.54m<sup>3</sup>/s downstream.

The modelled water levels for measured flows on 20<sup>th</sup> June 2021 are shown in **Table D** below. There is good correlation between measured and modelled water levels at the model cross-sections. The overall model average difference between the measured and modelled level is 0.132m which is generally within acceptable tolerances according to HEC-RAS guidance<sup>7</sup> (i.e. <0.150m).

**Table D: Comparison of Measured and Modelled Levels on 20/06/2021**

Cross-section	Measured Level (m OD)	Modelled Level (m OD)	Difference (m)
1	53.091	52.87	0.221
2	53.168	52.95	0.218
3	53.168	53.01	0.158
4	53.159	53.04	0.119
5	53.342	53.13	0.212
6	53.551	53.35	0.201
7	53.576	53.43	0.146
9	53.695	53.72	-0.025
10	54.026	53.89	0.136
11	54.231	54.09	0.141
12	54.264	54.13	0.134
13	54.203	54.16	0.043
14	54.222	54.21	0.012

The CFRAM design flood flows were then modelled and the results are shown in **Table E** below. The primary areas of concern were along the main channel, between X5 and X19, as the PFRA mapping identified these areas as being potentially flood prone. These areas are low lying and they coincide with the proposed locations of a number of turbines and site access roads. The proposed infrastructure towards the east of the site, particularly T6 and T7 are significantly above any modelled flood levels. These turbines are at elevations of 60-61mOD based on available Lidar data, ~5-6m above the maximum modelled flood elevations.

HEC-RAS model output tables for the design flood modelling are attached as **Appendix II**.

<sup>7</sup> HEC RAS River Analysis System – User’s Manual (February 2016)

**Table E: Modelled River Flood Levels in the Dungolman River**

Cross-section	10-year Flood Level (m OD)	100-year Flood Level (m OD)	1000-year Flood Level (m OD)
1	55.1	55.38	55.66
2	55.24	55.52	55.78
3	55.53	55.77	55.93
4	55.6	55.81	55.96
5	55.64	55.84	55.98
6	55.67	55.86	56
7	55.68	55.86	56
8	55.72	55.88	56.01
9	55.74	55.89	56.02
10	55.78	55.91	56.02
11	55.81	55.93	56.04
12	55.84	55.95	56.04
13	55.92	56.07	56.21
14	55.99	56.16	56.31

The modelled flood level for the 100-year flow (1% AEP) (Flood zone A) for the Wind Farm Site ranges between 56.16 mOD at the southern upstream section of the Wind Farm Site, to 55.38 mOD at the northern downstream section near the existing sand and gravel quarry. During the modelled flood conditions a slope of 0.03% is calculated between the northern and southern sections.

The modelled flood level for the 1000-year flow (0.1% AEP) (Flood zone B) ranges between 56.31 mOD at the southern upstream section of the Wind Farm Site, to 55.66 mOD at the northern downstream section near the existing sand and gravel quarry. This modelled 1000-yr flood level is ~0.3m higher than the modelled 100-year flood level.

## 5.4 SUMMARY- DETAILED FLOOD RISK ASSESSMENT

Using the modelled flood levels (100-year (1% AEP) and 1000-year (0.1% AEP) flood levels) along with the Wind Farm Site topography and Lidar data, a site-specific flood zone map for the Wind Farm Site was created and this is attached as **Figure 1**.

Based on the information gained through the flood modelling, the areas of the Wind Farm Site at risk of flooding with regard the proposed development are outlined and assessed in **Table F**.

Through an iterative process of flood modelling and the design of the infrastructure locations around the modelled flood zones, the layout of the Wind Farm Site has been optimized. The only remaining infrastructure within a modelled flood zone is a small section (~110m) of access track between T4 and T5. This can be mitigated by building up the road within this section above the modelled flood elevation (100 year – 55.86 mOD, 1000 year – 56 mOD).

**Table F: Summary of Flood Risk Based on Site Specific Flood Modelling**

Source	Pathway	Receptor	Desk Study Data	Site Specific Modelling Data
Tidal	Not applicable.	Land and infrastructure.	The Wind Farm Site is >90km from the coast and there is no risk of coastal flooding.	No modelling completed on tidal flooding as not applicable given the distance involved.
Fluvial	Overbank flooding	Land and infrastructure.	Based on the detailed flood risk assessment and site-specific flood zone map:  1: Proposed road and river crossing near <b>T5</b> , as well as the turbine hardstand area at T5 are located within Flood Zone A and B.  2: Proposed Turbine <b>T2</b> and the sections of proposed road north and south of the turbine are mapped within Flood Zone A and B.	All turbines (T1-T9) located outside of modelled 100 year and 1000 year flood zones.  Iterative process of site layout design and flood modelling, only 1 no. section of access road (110m) between T4 and T5 is mapped within the 100 year and 1000 year flood zones.  The temporary site compounds, spoil management areas and substation are not located within modelled flood zones.
Pluvial	Ponding of rainwater on the route right of way.	Land and infrastructure.	No pluvial flooding is mapped within the site boundary	No pluvial modelling completed due to a review of the desk study data and the soils/subsoils information from the trial pitting (generally permeable sands)
Surface water	Surface ponding/ Overflow.	Land and infrastructure	Same as above (pluvial).	No surface water modelling completed due to a review of the desk study data and the soils/subsoils information from the trial pitting (generally permeable sands)

Groundwater	Rising groundwater levels.	Land and infrastructure.	No risk from groundwater flooding.	No modelling completed – no risk from groundwater flooding on this site.
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Proposed turbines T1 – T9 are located outside of the modelled flood zones. The proposed onsite substation and temporary construction compounds are also mapped outside of the modelled flood zones. The only area of the Wind Farm Site which is mapped within the modelled flood zones is a small section of access road (110m) located ~300m west of turbine T5. As mentioned above, this can be mitigated by building up the finished access road level above the modelled flood level.

## 6. PLANNING POLICY AND JUSTIFICATION TEST

### 6.1 PLANNING POLICY AND THE WESTMEATH COUNTY DEVELOPMENT PLAN

The following policies are defined in the Westmeath CDP 2021-2027 (**Table G**) in respect of flooding, and we have outlined in the column to the right how these policies are provided for within the Proposed Development design:

**Table G: Westmeath County Development Plan Objectives/Policies and Project Responses**

No.	Policy	Development Design Response
CPO 10.96	Implement and comply fully with the recommendations of the Strategic Flood Risk Assessment prepared as part of the Westmeath County Development Plan 2021-2027.	This FRA is consistent with the requirements of the "Planning System and Flood Risk Management – Guidelines for Planning Authorities" and is in line with the recommendations of the SFRA prepared as part of the Westmeath County Development Plan 2021-2027.
CPO 10.97	Have regard to the Guidelines for Planning Authorities on the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014, through the use of the sequential approach and application of the Justification Tests in Development Management.	This FRA is consistent with the requirements of the "Planning System and Flood Risk Management – Guidelines for Planning Authorities"  A Justification Test (JT) for the Proposed Development is undertaken in Section 6.2 below.
CPO 10.98	Ensure that a flood risk assessment is carried out for any development proposal, within 200m of a watercourse and at risk of flooding, in accordance with the Planning System and Flood Risk Management (DoEHLG/OPW 2009). This assessment shall be appropriate to the scale and nature of risk to the potential development.	Included to the scale and nature of the Proposed Development.
CPO 10.99	Support the implementation of recommendations in the CFRAM Programme to ensure that flood risk management policies and infrastructure are progressively implemented.	This FRA is in line with the management policies outlined in the objective.
CPO 10.100	Support the implementation of recommendations in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk.	N/A
CPO 10.101	Consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible, and to retain a strip on either side of such channels where required, to facilitate maintenance access thereto.	OPW mapping has been consulted and access to either side of managed channels will be maintained
CPO 10.102	Assist the OPW in developing catchment-based Flood Risk Management Plans for rivers in County Westmeath and have regard to their provisions/recommendations.	No plan in place currently for the Wind Farm Site
CPO 10.103	Protect and enhance the County's floodplains and wetlands as 'green infrastructure' which	No alteration of hydromorphology is recommended within this report

	provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defenses in the future, subject to normal planning and environmental criteria.	or within the overall development plan for the Proposed Development.
CPO 10.104	Protect the integrity of any formal (OPW or Westmeath County Council) flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defense infrastructure or compromise any proposed new infrastructure.	No existing defences at the Wind Farm Site. OPW access to arterial drainage areas will be maintained as outlined above.
CPO 10.105	Ensure that where flood risk management works take place that the natural and cultural heritage, rivers, streams and watercourses are protected and enhanced.	No flood risk management works i.e flood barriers, recommended.
CPO 10.106	Ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan Flood Risk Management applicable at the time.	No flood risk management activity recommended.
CPO 10.107	Consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the provision of flood alleviation measures in the County.	N/A

## 6.2 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development that are required to meet the Justification Test<sup>8</sup> is shown in **Table H** below.

The Proposed Development is considered to be a 'Highly Vulnerable Development' due to the nature of the turbine infrastructure and the onsite substation.

The majority of the Wind Farm Site is situated within Flood Zone C, however a proposed section of access road between T4 and T5 (110m) is located within the modelled extents of Flood Zone A and B therefore a justification is required for this area. A justification test for this layout is presented as illustrated below.

**Table H: Matrix of Vulnerability versus Flood Zone**

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	<b><u>Justification test</u></b>	<b><u>Justification test</u></b>	Appropriate
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: Taken from Table 3.2 (DoEHLG, 2009)

<sup>8</sup> A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).

**Bold:** Applies to this project.

Box 5.1 of "The Planning System and Flood Risk Management Guidelines" (PSFRM Guidelines) outlines the criteria required to complete the "Justification Test".

**Table I: Format of Justification Test for Development Management**

Box 5.1 Justification Test for Development Management (to be submitted by the applicant)
<p>When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:</p> <ol style="list-style-type: none"> <li>1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.</li> <li>2. The proposal has been subject to an appropriate flood risk assessment that demonstrates: <ol style="list-style-type: none"> <li>i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;</li> <li>ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;</li> <li>iii. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and</li> <li>iv. The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.</li> </ol> </li> </ol> <p>The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.</p>

**Note:** this table has been adapted from Box 5.1 of "The Planning System and Flood Risk Management Guidelines", (2009).

Referring to Point 1 and Points 2 (i) to (iv) inclusive:

The section of the access tracks located in the mapped flood zones (110m) are located within the Wind Farm Site, providing access between the Proposed Development turbines and ancillary infrastructure. The closest third-party sensitive receptor to the section of the access tracks located in the mapped flood zones is approximately 578 metres. During the site selection process, one of the criteria considered was the identification of an area that can maintain an appropriate set-back from third-party sensitive receptors. Having reviewed the settlement patterns in the vicinity, along with a number of other criteria, the Wind Farm Site was identified as a suitable location for the provision of a renewable energy development of the scale proposed.

1. The Proposed Development has been the subject of a flood risk assessment (this report) and the following has been determined:
  - i. Due to the relatively small footprint of the Proposed Development and the only portion of the Proposed Development within a modelled flood zone being a 110m section of access track, the Proposed Development is predicted to have an unmeasurable/imperceptible impact on flood water levels downstream of the Wind Farm Site. No increase in downstream flood risk is anticipated.
  - ii. The design of the Wind Farm Site has undergone an iterative process following the flood modelling, moving proposed turbines and all other site infrastructure (aside from the 110m road section) outside of the modelled flood zones. These measures will mitigate against any potential disruption to the natural hydrology of the Wind Farm Site. No increase in flood risk to people, property, the economy or the environment during extreme flood events as a result of the

Proposed Development is predicted due to the appropriate design measures which will result in unmeasurable/imperceptible upstream and downstream effects;

- iii. Detailed flood level and flow modelling have been undertaken to assess the effects of locating some sections of access tracks within fluvial flood zones whereby both the upstream and downstream impacts has been determined to be unmeasurable/imperceptible. Further mitigation is deemed not necessary; and,
- iv. The Proposed Development is compatible with the wider planning objectives of the area, including the provision of wind energy developments at appropriate locations and the proper planning and sustainable development of the area.

## 7. FRA CONCLUSIONS

### 7.1 CONCLUSIONS

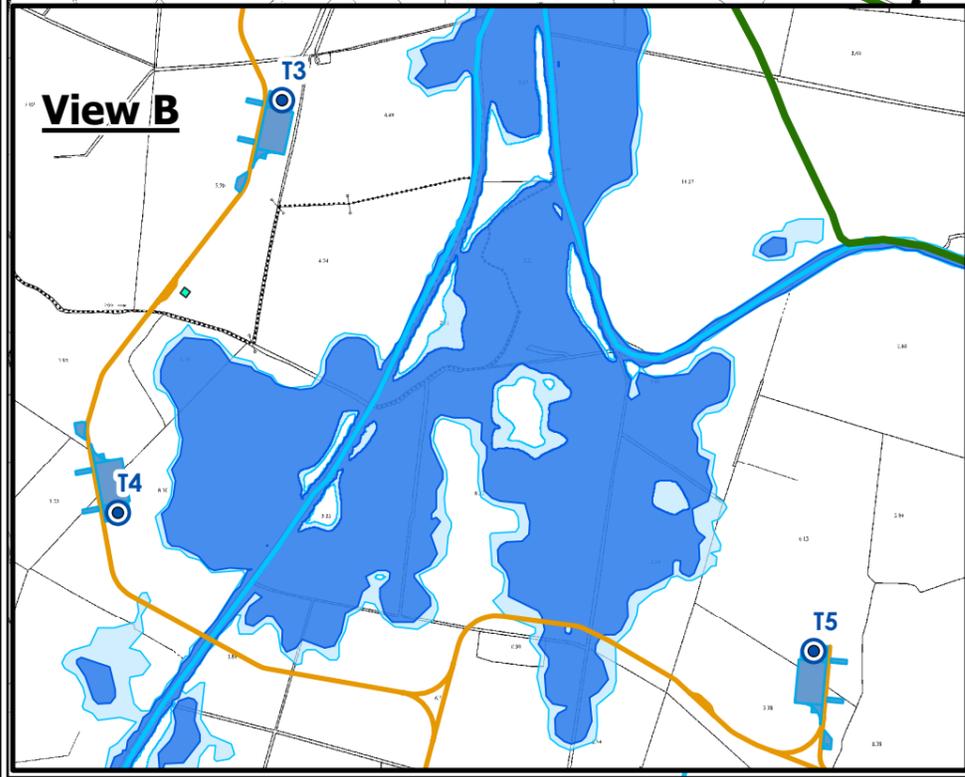
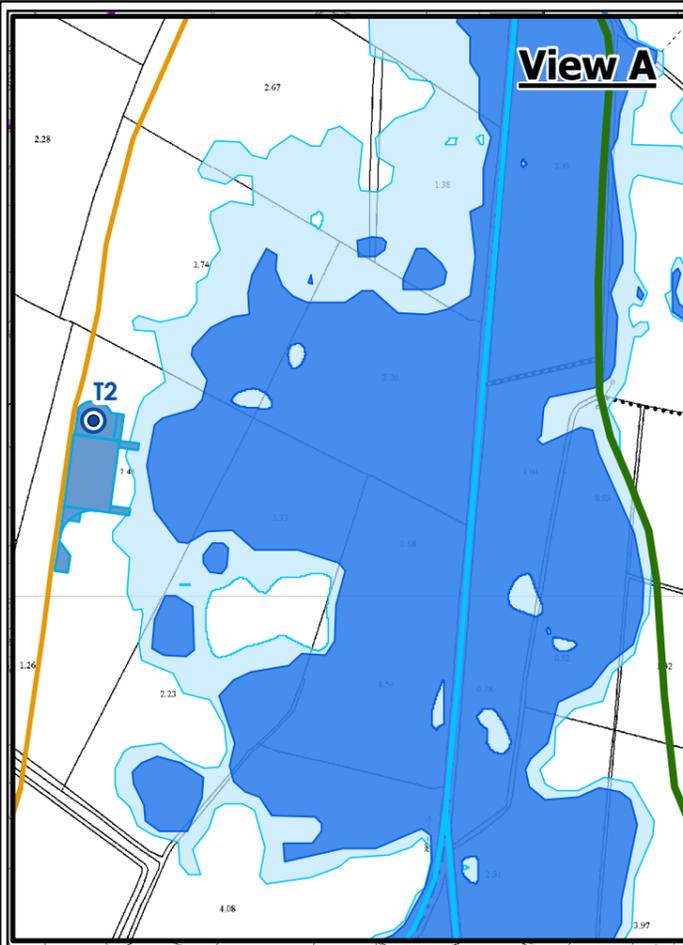
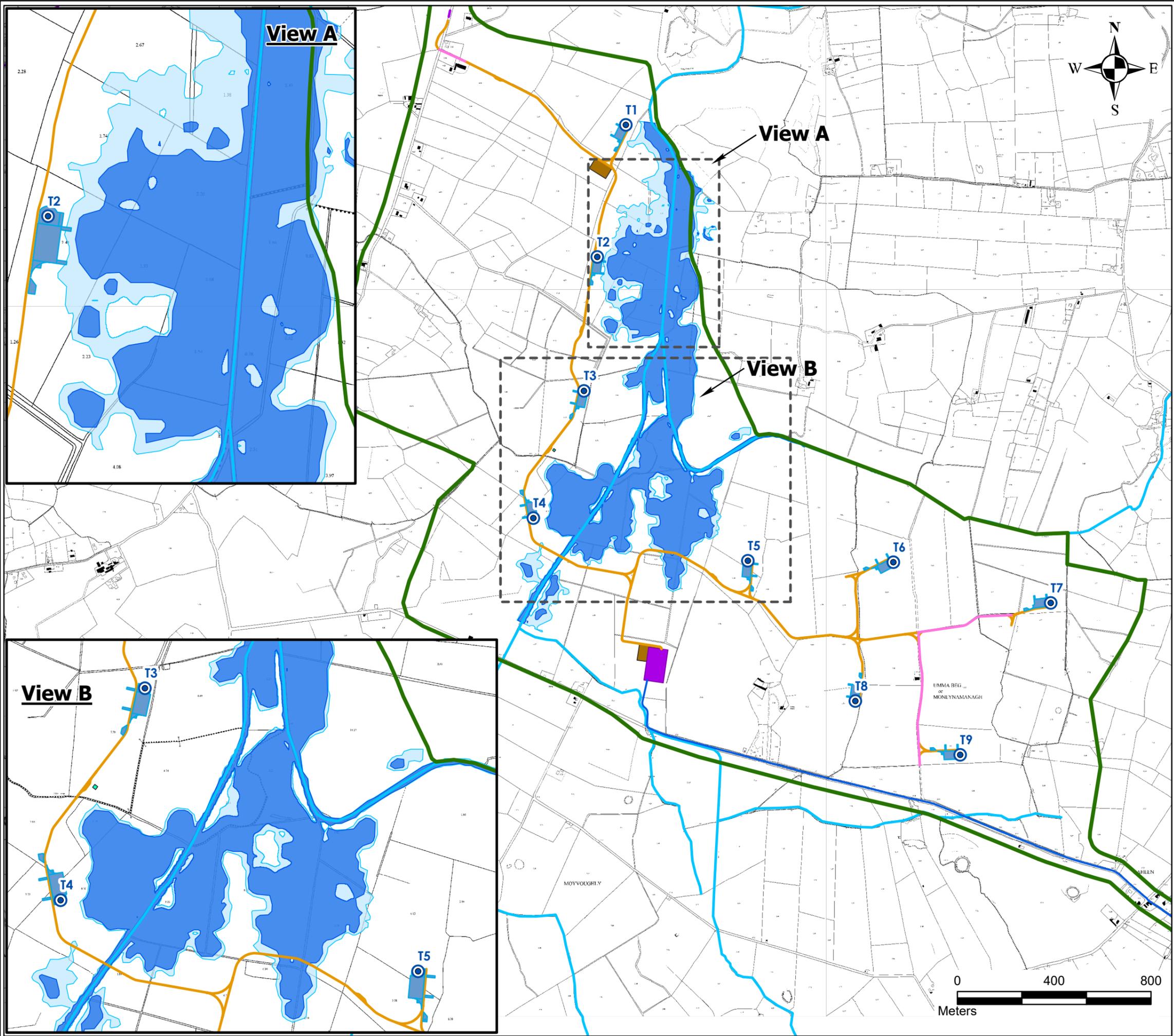
- There is no CFRAM mapping available for the Wind Farm Site area;
- The PFRA mapping and NIFM flood mapping is available for the Wind Farm Site.
- They are “broad scale” and based on OSI contour data. Some of the Proposed Development is located within flood zones indicated by the PFRA and NIFM mapping;
- HES have completed site-specific flood modelling for the Proposed Development areas identified as being in mapped flood zones (PFRA/NIFM mapping):
  - The assessment in **Section 5.2** and **5.3** above show there are no turbines located within modelled flood zones;
  - The substation and Wind Farm Site underground electrical cabling connection are also located outside of the modelled flood zones;
  - The access roads (proposed/upgraded) are located outside of the modelled flood zones apart from 1 no. section (110m) of access road located ~300m west of T5;
- There is therefore, 1 no. section of 110m of access road which remains within a modelled flood zone. In order to mitigate this flood risk, all proposed Wind Farm Site access tracks within the modelled flood pluvial zones will have the track surface raised at least 500mm above the 1000-year flood level. There is an existing field drain which will be culverted under the proposed access track. This culvert will provide a drainage outlet for flood water following a significant flood event. This will prevent any damming effect from the proposed access road within this section during significant flooding events.
- Based on the iterative design process, designed around the site specific flood modelling, any potential upstream and downstream flood impacts associated with the proposed development will be unmeasurable/imperceptible; and,
- Therefore, there will be no increase in flood risk to people, property, the economy or the environment during extreme flood events.

\*\*\*\*\*

## 8. REFERENCES

AGMET	1996	Agroclimatic Atlas of Ireland.
DOEHLG	2009	The Planning System and Flood Risk Management.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.
OPW	2011	Preliminary Flood Risk Assessment Maps
Westmeath County Council	2021	Westmeath County Development Plan 2021-2027

## FIGURES



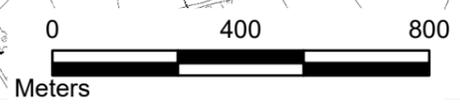
- ### Legend
- EIAR Site Boundary
  - Proposed Turbine Layout
  - Proposed Turbine Hardstands
  - Proposed Met Mast Location
  - Proposed New Roads
  - Proposed Upgrades to Existing Roads
  - Proposed Temporary Construction Compounds
  - Proposed 110kV Onsite Substation
  - Proposed Underground Electrical Cabling Route
  - Watercourses
  - 100-Year AEP Flood Area
  - 1000-Year AEP Flood Area

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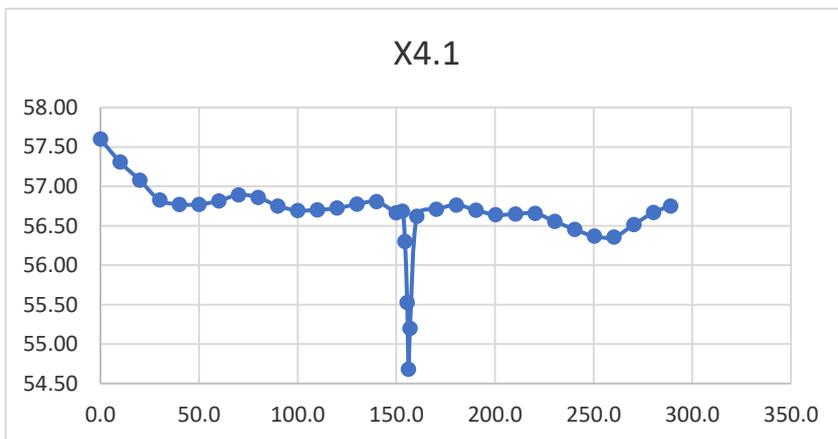
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Job: Umma More Renewable Energy Development	
Title: Flood Risk Map	
Figure No: FR01	
Drawing No: P1553-0-0123-A3-FR1-00A	
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Scale: 1:15,000	Drawn By: GD
Date: 31/01/2023	Checked By: MG



## APPENDIX I: DUNGOLMAN RIVER CHANNEL SURVEY

## X Section 4

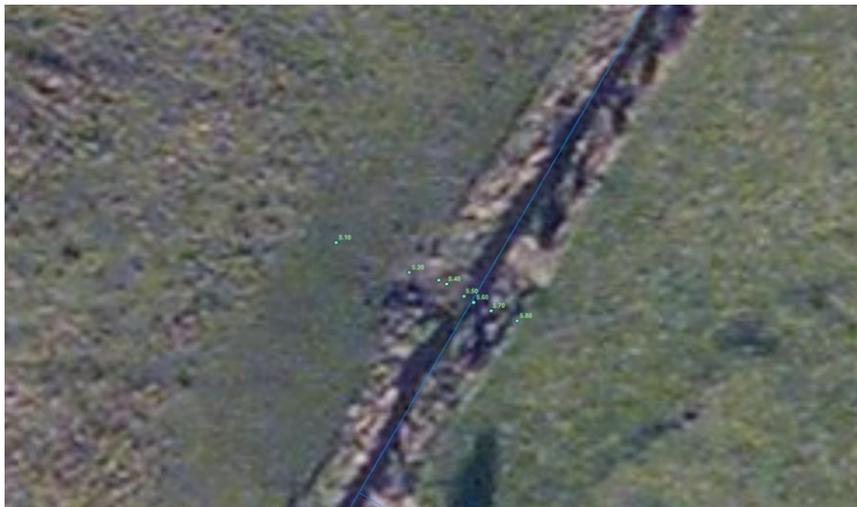
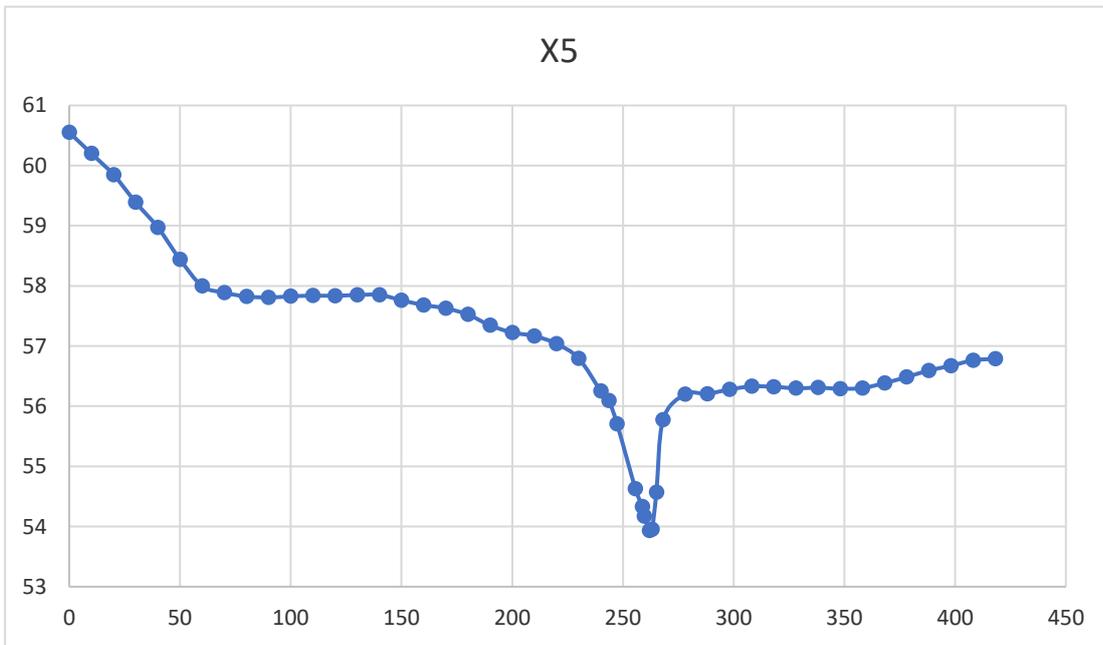
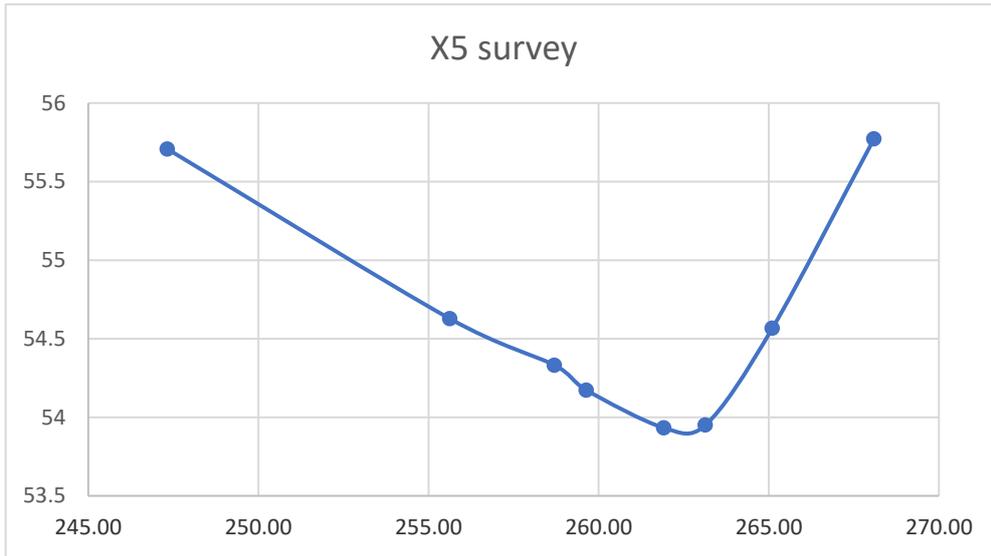
Id	E	N	Elevation	Distance	WL
1	219245.6	245198.9	57.60	0.0	
2	219241.9	245208.2	57.31	10.0	
3	219238.3	245217.5	57.08	20.0	
4	219234.7	245226.9	56.83	30.0	
5	219231	245236.2	56.77	40.0	
6	219227.4	245245.5	56.77	50.0	
7	219223.7	245254.8	56.82	60.0	
8	219220.1	245264.1	56.89	70.0	
9	219216.5	245273.4	56.86	80.0	
10	219212.8	245282.7	56.75	90.0	
11	219209.2	245292.1	56.69	100.0	
12	219205.6	245301.4	56.70	110.0	
13	219201.9	245310.7	56.72	120.0	
14	219198.3	245320	56.77	130.0	
15	219194.7	245329.3	56.80	140.0	
16	219191	245338.6	56.67	150.0	
x4.1	619133.8	745368.3	56.68	153.1	55.016
x4.2	619134.5	745367.2	56.30	154.4	55.016
x4.3	619135	745366.3	55.53	155.5	55.016
x4.4	619135.5	745365.7	54.68	156.2	55.016
x4.5	619135.5	745365	55.20	156.9	55.016
1	219187.2	245347.4	56.62	160.4	
2	219187.3	245357.4	56.71	170.4	
3	219187.3	245367.4	56.76	180.4	
4	219187.3	245377.4	56.70	190.4	
5	219187.4	245387.4	56.64	200.4	
6	219187.4	245397.4	56.65	210.4	
7	219187.5	245407.4	56.66	220.4	
8	219187.5	245417.4	56.55	230.4	
9	219187.5	245427.4	56.45	240.4	
10	219187.6	245437.4	56.37	250.4	
11	219187.6	245447.4	56.36	260.4	
12	219187.6	245457.4	56.51	270.4	
13	219187.7	245467.4	56.67	280.4	
14	219187.7	245476.1	56.75	289.1	



## X Section 5

Id	E	N	Elevation	Distance	WL
1	218507.6	245736.3	60.551	0	
2	218516.7	245732.1	60.201	10	
3	218525.7	245727.9	59.847	20	
4	218534.8	245723.7	59.389	30	
5	218543.9	245719.5	58.97	40	
6	218553	245715.4	58.44	50	
7	218562.1	245711.2	57.997	60	
8	218571.2	245707	57.887	70	
9	218580.2	245702.8	57.824	80	
10	218589.3	245698.6	57.808	90	
11	218598.4	245694.4	57.827	100	
12	218607.5	245690.3	57.838	110	
13	218616.6	245686.1	57.836	120	
14	218625.7	245681.9	57.849	130	
15	218634.7	245677.7	57.851	140	
16	218643.8	245673.5	57.762	150	
17	218652.9	245669.3	57.682	160	
18	218662	245665.2	57.628	170	
19	218671.1	245661	57.524	180	
20	218680.2	245656.8	57.344	190	
21	218689.2	245652.6	57.225	200	
22	218698.3	245648.4	57.167	210	
23	218707.4	245644.2	57.038	220	
24	218716.5	245640.1	56.795	230	
25	218725.6	245635.9	56.251	240	
26	218728.9	245634.3	56.091	243.66	
5.1	618675	745655	55.708	247.32	54.222
5.2	618683	745652	54.628	255.63	54.222
5.3	618686	745651	54.332	258.70	54.222
5.4	618687	745650	54.173	259.64	54.222
5.5	618689	745649	53.933	261.92	54.222
5.6	618690	745648	53.951	263.14	54.222
5.7	618691	745647	54.567	265.11	54.222
5.8	618694	745646	55.772	268.09	54.222
1	218756.5	245621.1	56.199	278.09	
2	218765.6	245616.9	56.207	288.09	
3	218774.6	245612.6	56.279	298.09	
4	218783.7	245608.4	56.33	308.09	
5	218792.7	245604.1	56.323	318.09	
6	218801.8	245599.9	56.298	328.09	
7	218810.9	245595.6	56.308	338.09	
8	218819.9	245591.4	56.29	348.09	
9	218829	245587.1	56.301	358.09	
10	218838	245582.9	56.385	368.09	
11	218847.1	245578.6	56.484	378.09	
12	218856.1	245574.4	56.594	388.09	
13	218865.2	245570.1	56.672	398.09	
14	218874.2	245565.9	56.764	408.09	
15	218883.3	245561.6	56.786	418.09	

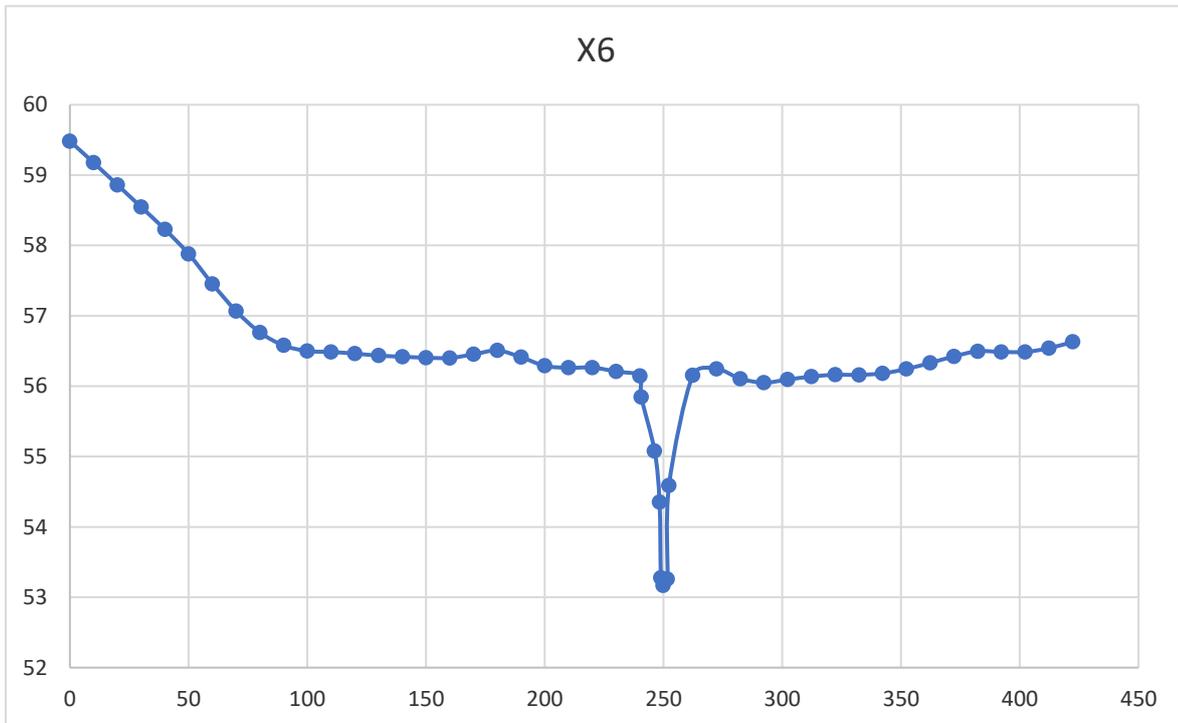
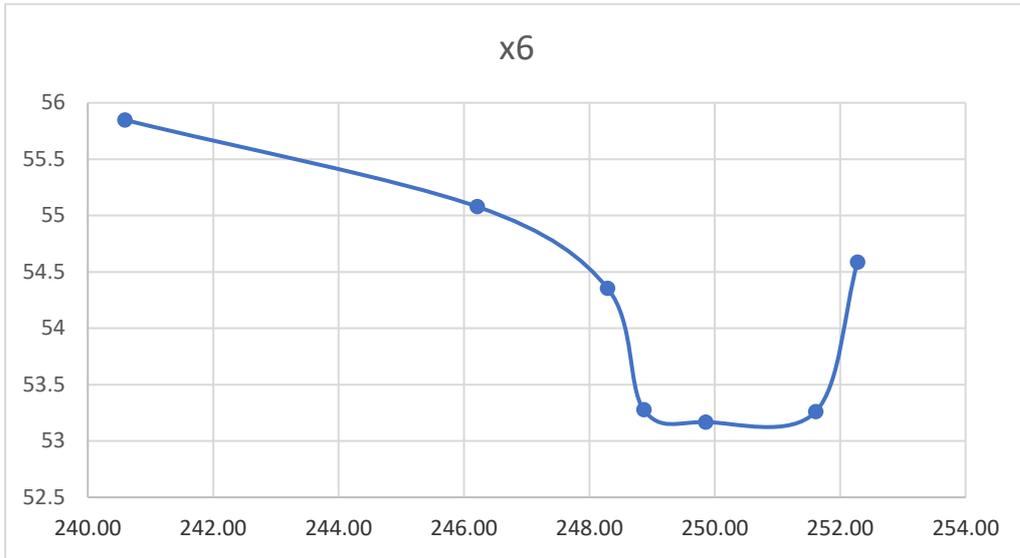
Id	E	N	Elevation	Distance 0
16	218892.3	245557.4	56.765	428.09
17	218901.4	245553.1	56.524	438.09
18	218910.4	245548.8	56.387	448.09
19	218919.5	245544.6	56.357	458.09
20	218928.5	245540.3	56.52	468.09
21	218937.6	245536.1	56.762	478.09
22	218946.6	245531.8	56.989	488.09
23	218955.7	245527.6	57.152	498.09
24	218964.7	245523.3	57.258	508.09
25	218973.8	245519.1	57.242	518.09
26	218982.8	245514.8	57.012	528.09
27	218991.9	245510.6	56.811	538.09
28	219000.9	245506.3	56.717	548.09
29	219010	245502.1	56.611	558.09
30	219019	245497.8	56.539	568.09
31	219028.1	245493.6	56.529	578.09
32	219037.2	245489.3	56.491	588.09
33	219046.2	245485.1	56.447	598.09
34	219055.3	245480.8	56.398	608.09
35	219064.3	245476.6	56.4	618.09
36	219073.4	245472.3	56.434	628.09
37	219082.4	245468.1	56.491	638.09
38	219091.5	245463.8	56.496	648.09
39	219100.5	245459.6	56.443	658.09
40	219109.6	245455.3	56.341	668.09
41	219118.6	245451.1	56.216	678.09
42	219127.7	245446.8	56.159	688.09
43	219136.7	245442.6	56.259	698.09
44	219145.8	245438.3	56.375	708.09
45	219154.8	245434.1	56.398	718.09
46	219163.9	245429.8	56.349	728.09
47	219172.9	245425.6	56.395	738.09
48	219182	245421.3	56.493	748.09
49	219191	245417.1	56.539	758.09
50	219200.1	245412.8	56.545	768.09
51	219209.1	245408.6	56.58	778.09
52	219218.2	245404.3	56.581	788.09
53	219227.2	245400.1	56.589	798.09
54	219236.3	245395.8	56.692	808.09
55	219245.3	245391.6	56.82	818.09
56	219254.4	245387.3	56.911	828.09
57	219263.5	245383.1	57.017	838.09
58	219272.5	245378.8	57.217	848.09
59	219281.6	245374.6	57.482	858.09
60	219290.6	245370.3	57.611	868.09
61	219299.7	245366.1	57.608	878.09
62	219308.7	245361.8	57.673	888.09
63	219309.3	245361.5	57.68	888.72



## X Section 6

Id	E	N	Elevation	Distance	WL
1	218581.4	245858.8	59.483	0	
2	218590.6	245854.7	59.176	10	
3	218599.7	245850.6	58.862	20	
4	218608.8	245846.5	58.546	30	
5	218617.9	245842.4	58.229	40	
6	218627	245838.3	57.88	50	
7	218636.2	245834.2	57.454	60	
8	218645.3	245830.1	57.068	70	
9	218654.4	245826	56.765	80	
10	218663.5	245821.9	56.58	90	
11	218672.6	245817.8	56.5	100	
12	218681.8	245813.7	56.487	110	
13	218690.9	245809.6	56.463	120	
14	218700	245805.5	56.435	130	
15	218709.1	245801.3	56.419	140	
16	218718.2	245797.2	56.405	150	
17	218727.4	245793.1	56.401	160	
18	218736.5	245789	56.453	170	
19	218745.6	245784.9	56.507	180	
20	218754.7	245780.8	56.413	190	
21	218763.8	245776.7	56.289	200	
22	218773	245772.6	56.262	210	
23	218782.1	245768.5	56.265	220	
24	218791.2	245764.4	56.209	230	
25	218800.3	245760.3	56.145	240	
6.1	618747	745781	55.848	240.59	54.203
6.2	618752	745778	55.079	246.21	54.203
6.3	618754	745778	54.354	248.29	54.203
6.4	618755	745777	53.278	248.87	54.203
6.5	618756	745777	53.168	249.86	54.203
6.6	618757	745776	53.26	251.61	54.203
6.7	618758	745776	54.588	252.28	54.203
1	218820.1	245750.6	56.156	262.28	
2	218829.1	245746.2	56.247	272.28	
3	218838.1	245741.8	56.107	282.28	
4	218847	245737.4	56.051	292.28	
5	218856	245732.9	56.095	302.28	
6	218865	245728.5	56.137	312.28	
7	218873.9	245724.1	56.162	322.28	
8	218882.9	245719.7	56.161	332.28	
9	218891.9	245715.3	56.182	342.28	
10	218900.9	245710.8	56.245	352.28	
11	218909.8	245706.4	56.331	362.28	
12	218918.8	245702	56.424	372.28	
13	218927.8	245697.6	56.497	382.28	
14	218936.7	245693.1	56.487	392.28	
15	218945.7	245688.7	56.487	402.28	
16	218954.7	245684.3	56.54	412.28	
17	218963.6	245679.9	56.63	422.28	

Id	E	N	Elevation	Distance 0
18	218972.6	245675.5	56.78	432.28
19	218981.6	245671	56.939	442.28
20	218990.5	245666.6	56.969	452.28
21	218999.5	245662.2	56.904	462.28
22	219008.5	245657.8	56.821	472.28
23	219017.5	245653.3	56.795	482.28
24	219026.4	245648.9	56.755	492.28
25	219035.4	245644.5	56.617	502.28
26	219044.4	245640.1	56.587	512.28
27	219053.3	245635.7	56.7	522.28
28	219062.3	245631.2	56.835	532.28
29	219071.3	245626.8	56.934	542.28
30	219080.2	245622.4	56.973	552.28
31	219089.2	245618	56.879	562.28
32	219098.2	245613.5	56.687	572.28
33	219107.2	245609.1	56.578	582.28
34	219116.1	245604.7	56.607	592.28
35	219125.1	245600.3	56.609	602.28
36	219134.1	245595.9	56.558	612.28
37	219143	245591.4	56.518	622.28
38	219152	245587	56.48	632.28
39	219161	245582.6	56.42	642.28
40	219169.9	245578.2	56.385	652.28
41	219178.9	245573.7	56.372	662.28
42	219187.9	245569.3	56.353	672.28
43	219196.8	245564.9	56.363	682.28
44	219205.8	245560.5	56.391	692.28
45	219214.8	245556	56.383	702.28
46	219223.8	245551.6	56.41	712.28
47	219232.7	245547.2	56.341	722.28
48	219241.7	245542.8	56.252	732.28
49	219250.7	245538.4	56.256	742.28
50	219259.6	245533.9	56.281	752.28
51	219268.6	245529.5	56.307	762.28
52	219277.6	245525.1	56.322	772.28
53	219286.5	245520.7	56.32	782.28
54	219295.5	245516.2	56.292	792.28
55	219304.5	245511.8	56.283	802.28
56	219313.4	245507.4	56.348	812.28
57	219322.4	245503	56.458	822.28
58	219331.4	245498.6	56.64	832.28
59	219340.4	245494.1	56.866	842.28
60	219349.3	245489.7	57.076	852.28
61	219358.3	245485.3	57.242	862.28
62	219367.3	245480.9	57.454	872.28
63	219376.2	245476.4	57.718	882.28
64	219385.2	245472	57.946	892.28
65	219394.2	245467.6	58.101	902.28
66	219403.1	245463.2	58.278	912.28



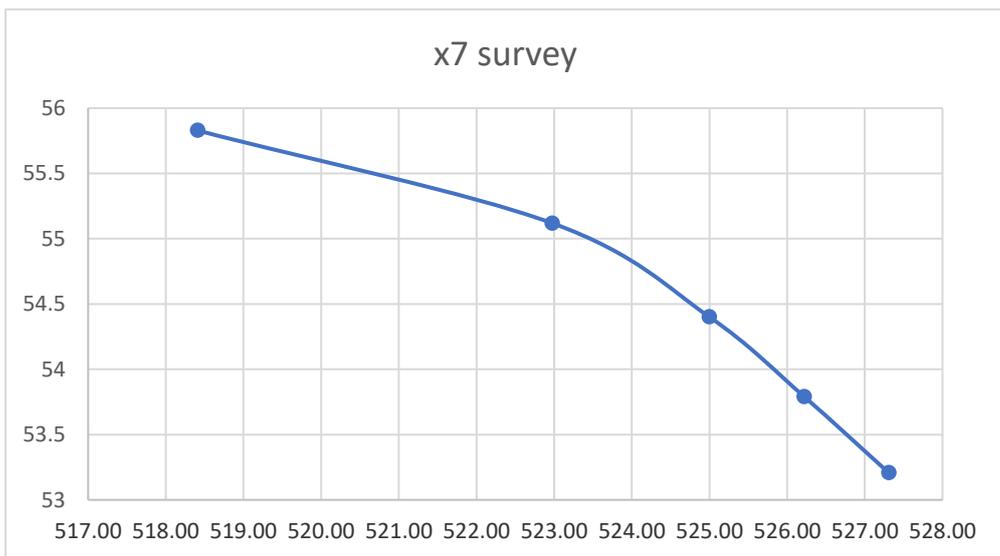
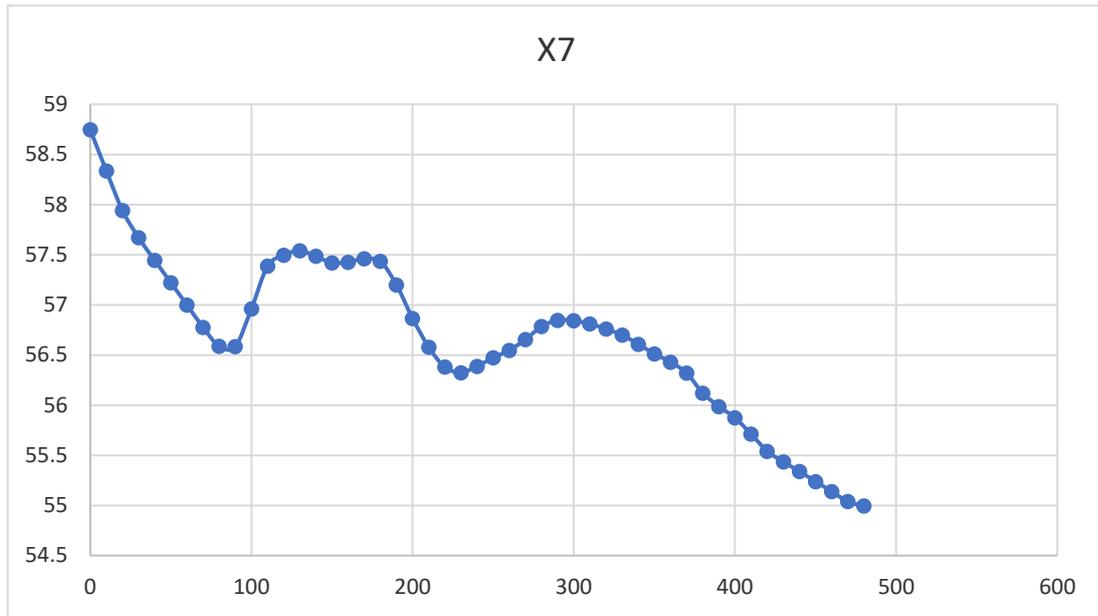
## X Section 7

Id	E	N	Elevation	Distance	WL
1	218504	246231.7	58.748	0	
2	218512.8	246227	58.336	10	
3	218521.6	246222.2	57.941	20	
4	218530.4	246217.5	57.67	30	
5	218539.2	246212.8	57.444	40	
6	218548	246208	57.221	50	
7	218556.8	246203.3	56.999	60	
8	218565.6	246198.6	56.776	70	
9	218574.4	246193.8	56.587	80	
10	218583.3	246189.1	56.585	90	
11	218592.1	246184.4	56.961	100	
12	218600.9	246179.6	57.386	110	
13	218609.7	246174.9	57.497	120	
14	218618.5	246170.2	57.54	130	
15	218627.3	246165.4	57.485	140	
16	218636.1	246160.7	57.418	150	
17	218644.9	246156	57.426	160	
18	218653.7	246151.2	57.459	170	
19	218662.5	246146.5	57.434	180	
20	218671.3	246141.8	57.198	190	
21	218680.1	246137	56.865	200	
22	218689	246132.3	56.578	210	
23	218697.8	246127.5	56.38	220	
24	218706.6	246122.8	56.325	230	
25	218715.4	246118.1	56.388	240	
26	218724.2	246113.3	56.473	250	
27	218733	246108.6	56.546	260	
28	218741.8	246103.9	56.655	270	
29	218750.6	246099.1	56.784	280	
30	218759.4	246094.4	56.847	290	
31	218768.2	246089.7	56.843	300	
32	218777	246084.9	56.81	310	
33	218785.9	246080.2	56.76	320	
34	218794.7	246075.5	56.699	330	
35	218803.5	246070.7	56.608	340	
36	218812.3	246066	56.512	350	
37	218821.1	246061.3	56.43	360	
38	218829.9	246056.5	56.32	370	
39	218838.7	246051.8	56.121	380	
40	218847.5	246047.1	55.987	390	
41	218856.3	246042.3	55.874	400	
42	218865.1	246037.6	55.712	410	
43	218873.9	246032.9	55.541	420	
44	218882.7	246028.1	55.435	430	
45	218891.6	246023.4	55.339	440	
46	218900.4	246018.7	55.239	450	
47	218909.2	246013.9	55.139	460	
48	218918	246009.2	55.039	470	
49	218926.8	246004.5	54.995	480	

ld

	E	N	Elevation	Distance	WL
50	218935.6	245999.7	55.167	490	
51	218944.4	245995	55.443	500	
52	218953.2	245990.2	55.723	510	
7.1	618907	746007	55.829	518.41	54.231
7.2	618911	746004	55.119	522.98	54.231
7.3	618912	746003	54.402	525.00	54.231
7.4	618913	746003	53.791	526.22	54.231
7.5	618914	746003	53.208	527.31	54.231
2	218976.6	245977.6	55.557	537.31	
3	218985.6	245973.1	55.689	547.31	
4	218994.5	245968.7	55.669	557.31	
5	219003.5	245964.3	55.743	567.31	
6	219012.5	245959.9	55.783	577.31	
7	219021.4	245955.4	55.801	587.31	
8	219030.4	245951	55.761	597.31	
9	219039.4	245946.6	55.708	607.31	
10	219048.3	245942.1	55.687	617.31	
11	219057.3	245937.7	55.7	627.31	
12	219066.3	245933.3	55.777	637.31	
13	219075.2	245928.8	55.896	647.31	
14	219084.2	245924.4	56.077	657.31	
15	219093.2	245920	56.354	667.31	
16	219102.1	245915.6	56.59	677.31	
17	219111.1	245911.1	56.661	687.31	
18	219120.1	245906.7	56.586	697.31	
19	219129	245902.3	56.554	707.31	
20	219138	245897.8	56.527	717.31	
21	219147	245893.4	56.473	727.31	
22	219155.9	245889	56.421	737.31	
23	219164.9	245884.6	56.357	747.31	
24	219173.9	245880.1	56.309	757.31	
25	219182.8	245875.7	56.102	767.31	
26	219191.8	245871.3	56.008	777.31	
27	219200.8	245866.8	56.092	787.31	
28	219209.7	245862.4	56.197	797.31	
29	219218.7	245858	56.33	807.31	
30	219227.7	245853.5	56.454	817.31	
31	219236.6	245849.1	56.571	827.31	
32	219245.6	245844.7	56.66	837.31	
33	219254.6	245840.3	56.666	847.31	
34	219263.5	245835.8	56.635	857.31	
35	219272.5	245831.4	56.554	867.31	
36	219281.5	245827	56.491	877.31	
37	219290.4	245822.5	56.411	887.31	
38	219299.4	245818.1	56.317	897.31	
39	219308.4	245813.7	56.241	907.31	
40	219317.3	245809.3	56.283	917.31	
41	219326.3	245804.8	56.281	927.31	
42	219335.3	245800.4	56.138	937.31	

43	219344.2	245796	56.008	947.31
44	219353.2	245791.5	55.903	957.31
45	219362.2	245787.1	55.821	967.31
46	219371.1	245782.7	55.762	977.31
47	219380.1	245778.2	55.825	987.31
48	219389.1	245773.8	55.961	997.31
49	219398	245769.4	56.048	1007.31
50	219407	245765	56.118	1017.31
51	219415.9	245760.5	56.191	1027.31
52	219424.9	245756.1	56.248	1037.31
53	219433.9	245751.7	56.358	1047.31
54	219442.8	245747.2	56.497	1057.31
55	219451.8	245742.8	56.675	1067.31
56	219460.8	245738.4	56.865	1077.31
57	219469.7	245734	57.033	1087.31
58	219478.7	245729.5	57.236	1097.31
59	219487.7	245725.1	57.449	1107.31
60	219496.6	245720.7	57.649	1117.31
61	219505.6	245716.2	57.799	1127.31
62	219514.6	245711.8	57.858	1137.31
63	219523.5	245707.4	57.867	1147.31
64	219532.5	245703	57.86	1157.31
65	219541.5	245698.5	57.85	1167.31
66	219545.3	245696.6	57.842	1171.56



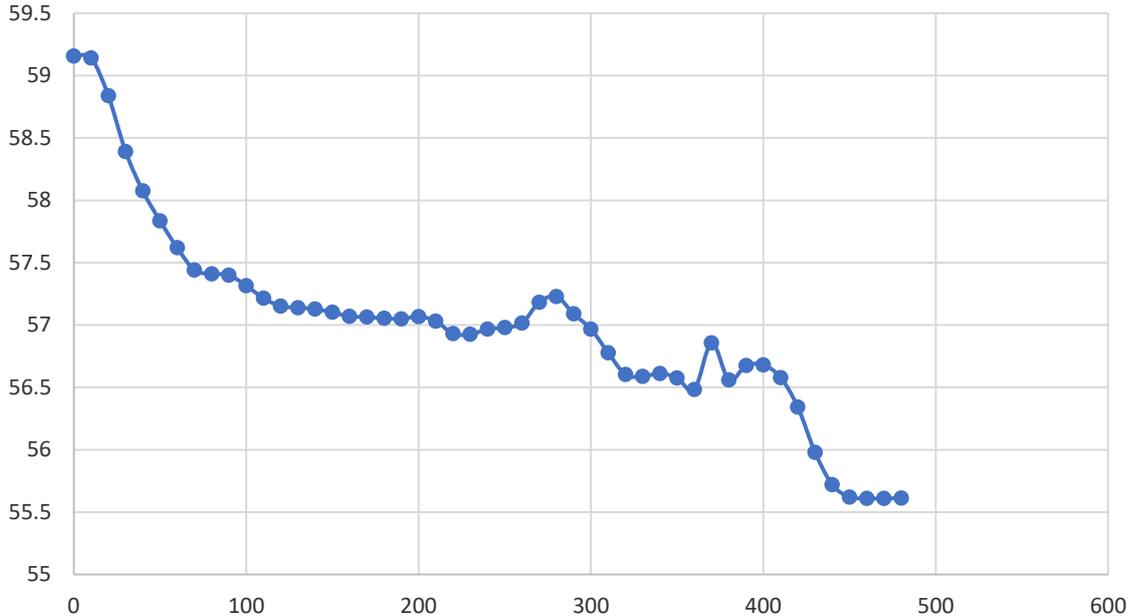
## X Section 8

Id	E	N	Elevation	Distance	WL
1	218473.3	246348.8	59.157	0	
2	218482.5	246344.8	59.141	10	
3	218491.7	246340.8	58.839	20	
4	218500.8	246336.7	58.392	30	
5	218510	246332.7	58.075	40	
6	218519.1	246328.7	57.835	50	
7	218528.3	246324.7	57.619	60	
8	218537.4	246320.7	57.44	70	
9	218546.6	246316.6	57.411	80	
10	218555.8	246312.6	57.4	90	
11	218564.9	246308.6	57.316	100	
12	218574.1	246304.6	57.215	110	
13	218583.2	246300.6	57.152	120	
14	218592.4	246296.5	57.139	130	
15	218601.5	246292.5	57.128	140	
16	218610.7	246288.5	57.102	150	
17	218619.9	246284.5	57.069	160	
18	218629	246280.5	57.064	170	
19	218638.2	246276.4	57.053	180	
20	218647.3	246272.4	57.05	190	
21	218656.5	246268.4	57.067	200	
22	218665.6	246264.4	57.032	210	
23	218674.8	246260.4	56.93	220	
24	218683.9	246256.3	56.926	230	
25	218693.1	246252.3	56.967	240	
26	218702.3	246248.3	56.98	250	
27	218711.4	246244.3	57.015	260	
28	218720.6	246240.3	57.183	270	
29	218729.7	246236.2	57.228	280	
30	218738.9	246232.2	57.089	290	
31	218748	246228.2	56.967	300	
32	218757.2	246224.2	56.778	310	
33	218766.4	246220.2	56.603	320	
34	218775.5	246216.1	56.587	330	
35	218784.7	246212.1	56.612	340	
36	218793.8	246208.1	56.575	350	
37	218803	246204.1	56.482	360	
38	218812.1	246200	56.857	370	
39	218821.3	246196	56.561	380	
40	218830.5	246192	56.674	390	
41	218839.6	246188	56.68	400	
42	218848.8	246184	56.579	410	
43	218857.9	246179.9	56.342	420	
44	218867.1	246175.9	55.979	430	
45	218876.2	246171.9	55.72	440	
46	218885.4	246167.9	55.621	450	
47	218894.6	246163.9	55.61	460	
48	218903.7	246159.8	55.609	470	
49	218912.9	246155.8	55.613	480	

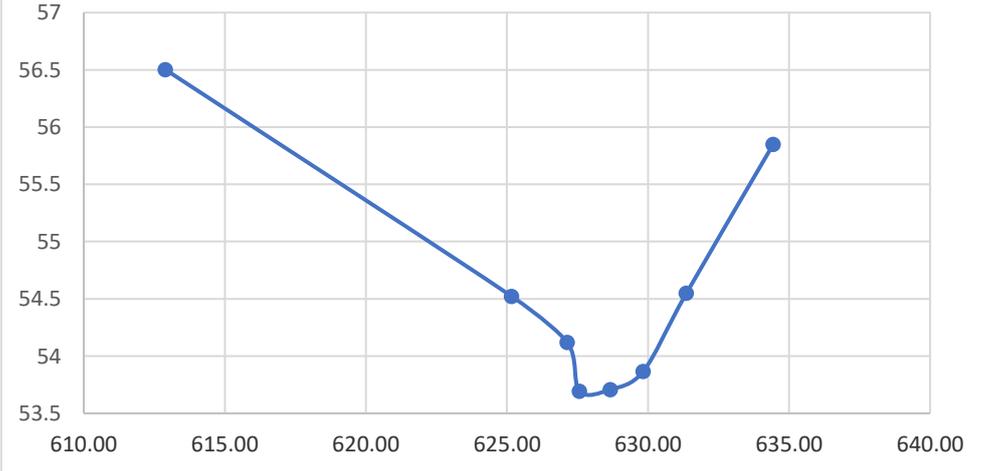
Id	E	N	Elevation	Distance	WL
50	218922	246151.8	55.648	490	
51	218931.2	246147.8	55.355	500	
52	218940.3	246143.8	55.232	510	
53	218949.5	246139.7	55.4	520	
54	218958.6	246135.7	55.492	530	
55	218967.8	246131.7	55.5	540	
56	218977	246127.7	55.519	550	
57	218986.1	246123.7	55.56	560	
58	218995.3	246119.6	55.595	570	
59	219004.4	246115.6	55.677	580	
60	219013.6	246111.6	55.813	590	
61	219022.7	246107.6	55.947	600	
62	219031.9	246103.6	56.099	610	
8.1	618981	746123	56.501	612.90	54.026
8.2	618990	746114	54.522	625.17	54.026
8.3	618991	746113	54.119	627.14	54.026
8.4	618991	746113	53.693	627.57	54.026
8.5	618992	746112	53.708	628.66	54.026
8.6	618993	746111	53.866	629.83	54.026
8.7	618994	746110	54.549	631.36	54.026
8.8	618996	746108	55.849	634.44	54.026
2	219058.6	246082.9	56.221	644.44	
3	219067.7	246078.7	56.118	654.44	
4	219076.8	246074.6	55.92	664.44	
5	219085.9	246070.4	55.77	674.44	
6	219095	246066.2	55.746	684.44	
7	219104.1	246062.1	55.774	694.44	
8	219113.2	246057.9	55.793	704.44	
9	219122.3	246053.8	55.791	714.44	
10	219131.4	246049.6	55.778	724.44	
11	219140.5	246045.4	55.771	734.44	
12	219149.6	246041.3	55.746	744.44	
13	219158.7	246037.1	55.699	754.44	
14	219167.7	246032.9	55.72	764.44	
15	219176.8	246028.8	55.835	774.44	
16	219185.9	246024.6	55.932	784.44	
17	219195	246020.4	55.986	794.44	
18	219204.1	246016.3	56.033	804.44	
19	219213.2	246012.1	56.1	814.44	
20	219222.3	246007.9	56.179	824.44	
21	219231.4	246003.8	56.221	834.44	
22	219240.5	245999.6	56.229	844.44	
23	219249.6	245995.5	56.213	854.44	
24	219258.7	245991.3	56.168	864.44	
25	219267.8	245987.1	56.12	874.44	
26	219276.9	245983	56.093	884.44	
27	219285.9	245978.8	55.965	894.44	
28	219295	245974.6	55.879	904.44	
29	219304.1	245970.5	55.88	914.44	

Id	E	N	Elevation	Distance	WL
30	219313.2	245966.3	55.864	924.44	
31	219322.3	245962.1	55.82	934.44	
32	219331.4	245958	55.786	944.44	
33	219340.5	245953.8	55.771	954.44	
34	219349.6	245949.7	55.776	964.44	
35	219358.7	245945.5	55.804	974.44	
36	219367.8	245941.3	55.823	984.44	
37	219376.9	245937.2	55.816	994.44	
38	219386	245933	55.802	1004.44	
39	219395	245928.8	55.755	1014.44	
40	219404.1	245924.7	55.735	1024.44	
41	219413.2	245920.5	55.811	1034.44	
42	219422.3	245916.3	55.852	1044.44	
43	219431.4	245912.2	55.902	1054.44	
44	219440.5	245908	56.021	1064.44	
45	219449.6	245903.8	56.165	1074.44	
46	219458.7	245899.7	56.327	1084.44	
47	219467.8	245895.5	56.41	1094.44	
48	219476.9	245891.4	56.398	1104.44	
49	219486	245887.2	56.371	1114.44	
50	219495.1	245883	56.306	1124.44	
51	219504.2	245878.9	56.336	1134.44	
52	219513.2	245874.7	56.513	1144.44	
53	219522.3	245870.5	56.706	1154.44	
54	219531.4	245866.4	56.812	1164.44	
55	219540.5	245862.2	56.894	1174.44	
56	219549.6	245858	57.019	1184.44	
57	219558.7	245853.9	57.185	1194.44	
58	219567.8	245849.7	57.383	1204.44	
59	219576.9	245845.6	57.628	1214.44	
60	219586	245841.4	57.805	1224.44	
61	219595.1	245837.2	57.866	1234.44	
62	219604.2	245833.1	58.073	1244.44	
63	219613.3	245828.9	58.186	1254.44	
64	219622.4	245824.7	58.285	1264.44	
65	219622.8	245824.6	58.291	1264.87	

x8



X8 survey



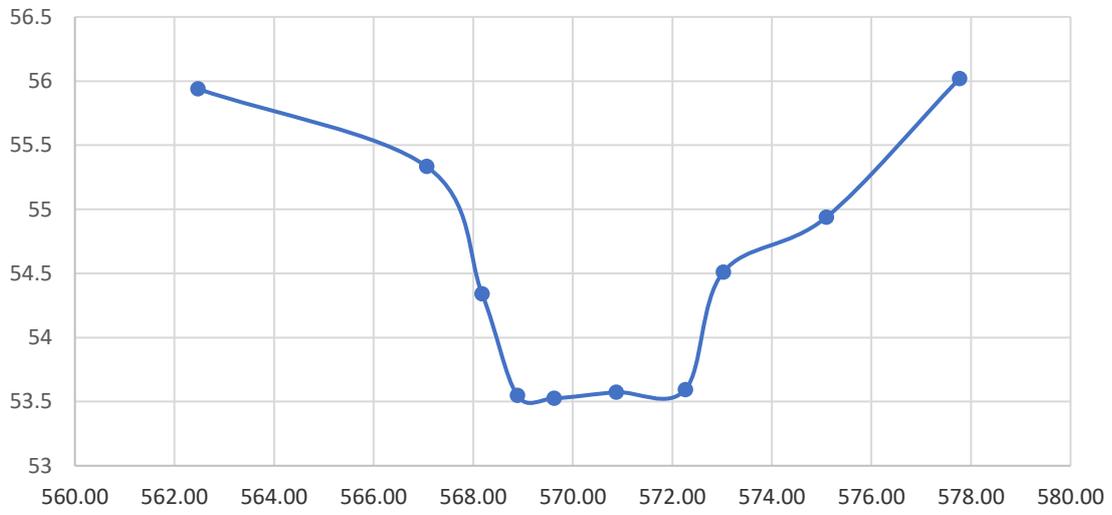
## X Section 9

Id	E	N	Elevation	Distance	WL
1	218391.9	246154.2	58.935	0	
2	218400.6	246149.2	58.932	10	
3	218409.3	246144.2	58.864	20	
4	218418	246139.3	58.898	30	
5	218426.6	246134.3	59	40	
6	218435.3	246129.3	59.083	50	
7	218444	246124.3	59.168	60	
8	218452.6	246119.3	59.231	70	
9	218461.3	246114.4	59.195	80	
10	218470	246109.4	59.151	90	
11	218478.7	246104.4	59.018	100	
12	218487.3	246099.4	58.808	110	
13	218496	246094.4	58.54	120	
14	218504.7	246089.5	58.277	130	
15	218513.3	246084.5	58.054	140	
16	218522	246079.5	57.852	150	
17	218530.7	246074.5	57.664	160	
18	218539.4	246069.5	57.513	170	
19	218548	246064.5	57.562	180	
20	218556.7	246059.6	57.589	190	
21	218565.4	246054.6	57.549	200	
22	218574	246049.6	57.426	210	
23	218582.7	246044.6	57.295	220	
24	218591.4	246039.6	57.193	230	
25	218600.1	246034.7	57.117	240	
26	218608.7	246029.7	57.086	250	
27	218617.4	246024.7	56.958	260	
28	218626.1	246019.7	56.803	270	
29	218634.7	246014.7	56.784	280	
30	218643.4	246009.8	56.896	290	
31	218652.1	246004.8	57.001	300	
32	218660.8	245999.8	56.958	310	
33	218669.4	245994.8	56.877	320	
34	218678.1	245989.8	56.794	330	
35	218686.8	245984.9	56.825	340	
36	218695.5	245979.9	56.893	350	
37	218704.1	245974.9	56.781	360	
38	218712.8	245969.9	56.689	370	
39	218721.5	245964.9	56.533	380	
40	218730.1	245960	56.493	390	
41	218738.8	245955	56.521	400	
42	218747.5	245950	56.653	410	
43	218756.2	245945	56.67	420	
44	218764.8	245940	56.56	430	
45	218773.5	245935	56.39	440	
46	218782.2	245930.1	56.337	450	
47	218790.8	245925.1	56.304	460	
48	218799.5	245920.1	56.264	470	
49	218808.2	245915.1	56.162	480	

Id	E	N	Elevation	Distance	WL
50	218816.9	245910.1	56.126	490	
51	218825.5	245905.2	56.178	500	
52	218834.2	245900.2	56.32	510	
53	218842.9	245895.2	56.488	520	
54	218851.5	245890.2	56.575	530	
55	218860.2	245885.2	56.52	540	
56	218868.9	245880.3	56.274	550	
57	218877.6	245875.3	56.189	560	
9.1	618826	745895	55.939	562.47	54.264
9.2	618829	745891	55.334	567.06	54.264 Top of bank west
9.3	618829	745890	54.341	568.18	54.264
9.4	618830	745890	53.549	568.89	54.264
9.5	618831	745890	53.526	569.63	54.264
9.6	618832	745889	53.573	570.87	54.264
9.7	618832	745888	53.594	572.26	54.264
9.8	618833	745888	54.51	573.02	54.264
9.9	618834	745886	54.938	575.09	54.264 Top of bank east
9.10	618836	745884	56.018	577.77	54.264
1	218897.8	245858.1	56.358	587.77	
2	218906.5	245853	56.221	597.77	
3	218915.1	245848	56.31	607.77	
4	218923.8	245843	56.452	617.77	
5	218932.4	245838	56.609	627.77	
6	218941.1	245833	56.677	637.77	
7	218949.8	245828	56.63	647.77	
8	218958.4	245823	56.582	657.77	
9	218967.1	245817.9	56.547	667.77	
10	218975.7	245812.9	56.52	677.77	
11	218984.4	245807.9	56.484	687.77	
12	218993	245802.9	56.461	697.77	
13	219001.7	245797.9	56.465	707.77	
14	219010.3	245792.9	56.505	717.77	
15	219019	245787.9	56.627	727.77	
16	219027.6	245782.8	56.736	737.77	
17	219036.3	245777.8	56.733	747.77	
18	219044.9	245772.8	56.583	757.77	
19	219053.6	245767.8	56.485	767.77	
20	219062.2	245762.8	56.54	777.77	
21	219070.9	245757.8	56.675	787.77	
22	219079.5	245752.8	56.703	797.77	
23	219088.2	245747.7	56.628	807.77	
24	219096.8	245742.7	56.492	817.77	
25	219105.5	245737.7	56.397	827.77	
26	219114.1	245732.7	56.242	837.77	
27	219122.8	245727.7	56.111	847.77	
28	219131.5	245722.7	56.122	857.77	
29	219140.1	245717.7	56.225	867.77	
30	219148.8	245712.6	56.353	877.77	
31	219157.4	245707.6	56.48	887.77	

Id	E	N	Elevation	Distance	WL
32	219166.1	245702.6	56.581	897.77	
33	219174.7	245697.6	56.534	907.77	
34	219183.4	245692.6	56.494	917.77	
35	219192	245687.6	56.514	927.77	
36	219200.7	245682.6	56.577	937.77	
37	219209.3	245677.5	56.694	947.77	
38	219218	245672.5	56.843	957.77	
39	219226.6	245667.5	56.899	967.77	
40	219235.3	245662.5	56.747	977.77	
41	219243.9	245657.5	56.547	987.77	
42	219252.6	245652.5	56.371	997.77	
43	219261.2	245647.5	56.197	1007.77	
44	219269.9	245642.4	56.137	1017.77	
45	219278.5	245637.4	56.182	1027.77	
46	219287.2	245632.4	56.213	1037.77	
47	219295.8	245627.4	56.212	1047.77	
48	219304.5	245622.4	56.226	1057.77	
49	219313.2	245617.4	56.23	1067.77	
50	219321.8	245612.4	56.183	1077.77	
51	219330.5	245607.3	56.128	1087.77	
52	219339.1	245602.3	56.105	1097.77	
53	219347.8	245597.3	56.179	1107.77	
54	219356.4	245592.3	56.444	1117.77	
55	219365.1	245587.3	56.741	1127.77	
56	219373.7	245582.3	56.923	1137.77	
57	219382.4	245577.3	57.085	1147.77	
58	219391	245572.2	57.244	1157.77	
59	219399.7	245567.2	57.427	1167.77	
60	219408.3	245562.2	57.62	1177.77	
61	219417	245557.2	57.783	1187.77	
62	219425.6	245552.2	57.861	1197.77	
63	219434.3	245547.2	57.972	1207.77	
64	219442.9	245542.2	58.139	1217.77	
65	219451.6	245537.1	58.327	1227.77	
66	219460.2	245532.1	58.486	1237.77	
67	219468.9	245527.1	58.679	1247.77	
68	219477.5	245522.1	58.928	1257.77	
69	219486.2	245517.1	59.181	1267.77	
70	219491.1	245514.3	59.331	1273.40	

x9 survey



## X Section 10.1

Id	E	N	Elevation	Distance	WL
1	218584.9	246633.2	57.433	0	
2	218593.9	246629	57.097	10	
3	218603	246624.8	56.762	20	
4	218612	246620.5	56.564	30	
5	218621.1	246616.3	56.474	40	
6	218630.2	246612.1	56.384	50	
7	218639.2	246607.8	56.34	60	
8	218648.3	246603.6	56.323	70	
9	218657.3	246599.4	56.321	80	
10	218666.4	246595.1	56.327	90	
11	218675.5	246590.9	56.342	100	
12	218684.5	246586.7	56.35	110	
13	218693.6	246582.4	56.359	120	
14	218702.6	246578.2	56.384	130	
15	218711.7	246574	56.418	140	
16	218720.8	246569.7	56.442	150	
17	218729.8	246565.5	56.414	160	
18	218738.9	246561.3	56.341	170	
19	218747.9	246557	56.297	180	
20	218757	246552.8	56.32	190	
21	218766.1	246548.6	56.314	200	
22	218775.1	246544.3	56.222	210	
23	218784.2	246540.1	56.119	220	
24	218793.3	246535.9	56.09	230	
25	218802.3	246531.6	56.203	240	
26	218811.4	246527.4	56.337	250	
27	218820.4	246523.2	56.385	260	
28	218829.5	246518.9	56.231	270	
29	218838.6	246514.7	56.013	280	
30	218847.6	246510.5	55.863	290	
31	218856.7	246506.2	55.827	300	
32	218865.7	246502	55.81	310	
33	218874.8	246497.8	55.811	320	
34	218883.9	246493.6	55.826	330	
35	218892.9	246489.3	55.871	340	
36	218902	246485.1	55.918	350	
37	218911	246480.9	55.916	360	
38	218920.1	246476.6	55.814	370	
39	218929.2	246472.4	55.679	380	
40	218938.2	246468.2	55.739	390	
41	218947.3	246463.9	55.807	400	
42	218956.3	246459.7	55.806	410	
43	218965.4	246455.5	55.818	420	
44	218974.5	246451.2	55.81	430	
45	218983.5	246447	55.772	440	
46	218992.6	246442.8	55.695	450	
47	219001.6	246438.5	55.614	460	
48	219010.7	246434.3	55.581	470	
49	219019.8	246430.1	55.584	480	

Id	E	N	Elevation	Distance	WL
50	219028.8	246425.8	55.622	490	
51	219037.9	246421.6	55.693	500	
52	219046.9	246417.4	55.78	510	
53	219056	246413.1	55.879	520	
54	219065.1	246408.9	56.033	530	
55	219074.1	246404.7	56.328	540	
56	219083.2	246400.4	56.609	550	
57	219092.3	246396.2	56.759	560	
58	219101.3	246392	56.888	570	
59	219110.4	246387.7	57.11	580	
60	219119.4	246383.5	57.504	590	
61	219128.5	246379.3	58.198	600	
62	219137.6	246375	58.677	610	
63	219146.6	246370.8	58.129	620	
64	219155.7	246366.6	57.265	630	
65	219164.7	246362.3	56.554	640	
66	219173.8	246358.1	56.205	650	
10.1	619129	746378	55.241	650.32	53.625
10.2	619135	746375	54.726	656.93	53.625
10.4	619136	746373	53.275	657.59	53.625
10.5	619137	746224	52.958	658.59	53.625
10.6	619137	746372	53.098	659.94	53.625
10.7	619138	746372	53.422	660.67	53.625
10.8	619140	746371	54.182	661.79	53.625
10.9	619148	746370	55.242	663.91	53.625
68	219191.9	246349.7	55.67	671.87	
69	219201	246345.4	56.093	681.87	
70	219210	246341.2	56.089	691.87	
71	219219.1	246337	55.898	701.87	
72	219228.2	246332.7	55.875	711.87	
73	219237.2	246328.5	55.815	721.87	
74	219246.3	246324.3	55.707	731.87	
75	219255.3	246320	55.551	741.87	
76	219264.4	246315.8	55.369	751.87	
77	219273.5	246311.6	55.317	761.87	
78	219282.5	246307.3	55.323	771.87	
79	219291.6	246303.1	55.311	781.87	
80	219300.6	246298.9	55.293	791.87	
81	219309.7	246294.6	55.409	801.87	
82	219318.8	246290.4	55.636	811.87	
83	219327.8	246286.2	55.783	821.87	
84	219336.9	246281.9	55.802	831.87	
85	219346	246277.7	55.78	841.87	
86	219355	246273.5	55.67	851.87	
87	219364.1	246269.2	55.583	861.87	
88	219373.1	246265	55.5	871.87	
89	219382.2	246260.8	55.436	881.87	
90	219391.3	246256.5	55.475	891.87	
91	219400.3	246252.3	55.573	901.87	

Id	E	N	Elevation	Distance WL
92	219409.4	246248.1	55.66	911.87
93	219418.4	246243.8	55.637	921.87
94	219427.5	246239.6	55.603	931.87
95	219436.6	246235.4	55.635	941.87
96	219445.6	246231.1	56.067	951.87
97	219454.7	246226.9	55.816	961.87
98	219463.7	246222.7	55.663	971.87
99	219472.8	246218.5	55.653	981.87
100	219481.9	246214.2	55.689	991.87
101	219490.9	246210	55.751	1001.87
102	219500	246205.8	55.785	1011.87
103	219509	246201.5	55.739	1021.87
104	219518.1	246197.3	55.708	1031.87
105	219527.2	246193.1	55.763	1041.87
106	219536.2	246188.8	55.861	1051.87
107	219545.3	246184.6	55.995	1061.87
108	219554.3	246180.4	56.106	1071.87
109	219563.4	246176.1	56.245	1081.87
110	219572.5	246171.9	56.502	1091.87
111	219581.5	246167.7	56.795	1101.87
112	219590.6	246163.4	57.028	1111.87
113	219599.6	246159.2	57.171	1121.87
114	219608.7	246155	57.302	1131.87
115	219617.8	246150.7	57.426	1141.87
116	219626.8	246146.5	57.583	1151.87
117	219635.9	246142.3	57.787	1161.87
118	219643.9	246138.5	57.923	1170.74

## X Section 10

Id	E	N	Elevation	Distance	WL
1	218384.5	246594.2	58.953	0	
2	218393.3	246589.5	58.558	10	
3	218402.2	246584.8	58.322	20	
4	218411	246580.1	58.315	30	
5	218419.8	246575.4	58.452	40	
6	218428.6	246570.7	58.659	50	
7	218437.5	246566	58.695	60	
8	218446.3	246561.3	58.309	70	
9	218455.1	246556.6	57.839	80	
10	218463.9	246551.9	57.383	90	
11	218472.8	246547.2	57.044	100	
12	218481.6	246542.5	56.932	110	
13	218490.4	246537.8	56.949	120	
14	218499.2	246533.1	56.996	130	
15	218508.1	246528.4	57.055	140	
16	218516.9	246523.7	57.077	150	
17	218525.7	246519	57.085	160	
18	218534.6	246514.3	57.091	170	
19	218543.4	246509.6	57.087	180	
20	218552.2	246504.9	57.086	190	
21	218561	246500.2	57.021	200	
22	218569.9	246495.5	56.959	210	
23	218578.7	246490.8	56.89	220	
24	218587.5	246486.1	56.828	230	
25	218596.3	246481.4	56.766	240	
26	218605.2	246476.7	56.673	250	
27	218614	246472	56.559	260	
28	218622.8	246467.3	56.451	270	
29	218631.6	246462.6	56.316	280	
30	218640.5	246457.9	56.216	290	
31	218649.3	246453.2	56.226	300	
32	218658.1	246448.5	56.327	310	
33	218666.9	246443.8	56.387	320	
34	218675.8	246439.1	56.386	330	
35	218684.6	246434.4	56.368	340	
36	218693.4	246429.7	56.253	350	
37	218702.3	246425	56.118	360	
38	218711.1	246420.3	56.092	370	
39	218719.9	246415.6	56.044	380	
40	218728.7	246410.9	55.996	390	
41	218737.6	246406.2	55.983	400	
42	218746.4	246401.5	55.988	410	
43	218755.2	246396.8	55.957	420	
44	218764	246392.1	55.921	430	
45	218772.9	246387.4	55.919	440	
46	218781.7	246382.7	55.927	450	
47	218790.5	246378	55.9	460	
48	218799.3	246373.3	55.872	470	
49	218808.2	246368.6	55.866	480	

Id	E	N	Elevation	Distance	WL
50	218817	246363.9	55.904	490	
51	218825.8	246359.2	55.863	500	
52	218834.7	246354.5	55.806	510	
53	218843.5	246349.8	55.801	520	
54	218852.3	246345.1	55.893	530	
55	218861.1	246340.4	56.011	540	
56	218870	246335.7	56.069	550	
57	218878.8	246330.9	56.118	560	
58	218887.6	246326.2	56.119	570	
59	218896.4	246321.5	56.099	580	
60	218905.3	246316.8	56.164	590	
61	218914.1	246312.1	56.191	600	
62	218922.9	246307.4	56.207	610	
63	218931.7	246302.7	56.196	620	
64	218940.6	246298	56.168	630	
65	218949.4	246293.3	56.15	640	
66	218958.2	246288.6	56.207	650	
67	218967	246283.9	56.231	660	
68	218975.9	246279.2	56.176	670	
69	218984.7	246274.5	56.149	680	
70	218993.5	246269.8	56.209	690	
71	219002.4	246265.1	56.324	700	
72	219011.2	246260.4	56.467	710	
73	219020	246255.7	56.572	720	
74	219028.8	246251	56.575	730	
75	219037.7	246246.3	56.369	740	
76	219046.5	246241.6	56.108	750	
77	219055.3	246236.9	55.916	760	
78	219064.1	246232.2	55.775	770	
79	219073	246227.5	55.653	780	
80	219081.8	246222.8	55.482	790	
81	219090.6	246218.1	55.298	800	
82	219099.4	246213.4	55.183	810	
10.1	619054	746230	55.305	819.41	53.695
10.2	619060	746227	54.844	826.02	53.695 Top of bank west
10.3	619061	746224	53.677	828.71	53.695
10.4	619061	746224	53.318	829.37	53.695
10.5	619062	746224	53.011	830.37	53.695
10.6	619063	746223	53.138	831.72	53.695
10.7	619064	746223	53.479	832.45	53.695
10.8	619065	746223	54.289	833.58	53.695
10.9	619067	746222	55.316	835.69	53.695 top of bank east
2	219129.3	246196.8	55.717	845.69	
3	219138.2	246192.2	55.678	855.69	
4	219147.1	246187.7	55.698	865.69	
5	219156	246183.1	55.791	875.69	
6	219164.9	246178.6	55.758	885.69	
7	219173.8	246174	55.686	895.69	
8	219182.7	246169.5	55.713	905.69	

Id	E	N	Elevation	Distance	WL
9	219191.6	246164.9	55.914	915.69	
10	219200.5	246160.4	56.16	925.69	
11	219209.4	246155.8	56.257	935.69	
12	219218.4	246151.3	56.319	945.69	
13	219227.3	246146.7	56.319	955.69	
14	219236.2	246142.2	56.158	965.69	
15	219245.1	246137.6	56.059	975.69	
16	219254	246133.1	55.994	985.69	
17	219262.9	246128.5	55.901	995.69	
18	219271.8	246124	55.766	1005.69	
19	219280.7	246119.4	55.653	1015.69	
20	219289.6	246114.9	55.633	1025.69	
21	219298.5	246110.3	55.66	1035.69	
22	219307.4	246105.8	55.721	1045.69	
23	219316.3	246101.2	55.834	1055.69	
24	219325.2	246096.7	55.921	1065.69	
25	219334.1	246092.1	55.916	1075.69	
26	219343	246087.6	55.837	1085.69	
27	219351.9	246083	55.695	1095.69	
28	219360.8	246078.5	55.601	1105.69	
29	219369.8	246073.9	55.578	1115.69	
30	219378.7	246069.4	55.568	1125.69	
31	219387.6	246064.8	55.572	1135.69	
32	219396.5	246060.3	55.66	1145.69	
33	219405.4	246055.7	55.61	1155.69	
34	219414.3	246051.2	55.53	1165.69	
35	219423.2	246046.6	55.621	1175.69	
36	219432.1	246042.1	55.705	1185.69	
37	219441	246037.5	55.774	1195.69	
38	219449.9	246033	55.795	1205.69	
39	219458.8	246028.4	55.8	1215.69	
40	219467.7	246023.9	55.802	1225.69	
41	219476.6	246019.3	55.812	1235.69	
42	219485.5	246014.8	55.831	1245.69	
43	219494.4	246010.2	55.851	1255.69	
44	219503.3	246005.7	55.882	1265.69	
45	219512.2	246001.1	55.883	1275.69	
46	219521.2	245996.6	55.862	1285.69	
47	219530.1	245992	55.911	1295.69	
48	219539	245987.5	55.97	1305.69	
49	219547.9	245983	56.12	1315.69	
50	219556.8	245978.4	56.221	1325.69	
51	219565.7	245973.9	56.188	1335.69	
52	219574.6	245969.3	56.224	1345.69	
53	219583.5	245964.8	56.274	1355.69	
54	219592.4	245960.2	56.428	1365.69	
55	219601.3	245955.7	56.637	1375.69	
56	219610.2	245951.1	56.898	1385.69	
57	219619.1	245946.6	57.102	1395.69	

Id	E	N	Elevation	Distance	WL
59	219636.9	245937.5	57.373	1415.69	
60	219645.8	245932.9	57.492	1425.69	
61	219654.7	245928.4	57.647	1435.69	
62	219663.6	245923.8	57.82	1445.69	
63	219672.6	245919.3	57.969	1455.69	
64	219681.5	245914.7	58.087	1465.69	
65	219690.4	245910.2	58.206	1475.69	
66	219699.3	245905.6	58.327	1485.69	
67	219708.2	245901.1	58.436	1495.69	
68	219717.1	245896.5	58.527	1505.69	
69	219726	245892	58.655	1515.69	
70	219734.9	245887.4	58.924	1525.69	
71	219736.4	245886.7	58.976	1527.34	

## X Section 12

Id	E	N	Elevation	Distance	WL
1	218511.8	246678.5	58.464	0	
2	218521.8	246678	58.183	10	
3	218531.8	246677.4	57.557	20	
4	218541.7	246676.9	57.237	30	
5	218551.7	246676.4	57.15	40	
6	218561.7	246675.9	57.126	50	
7	218571.7	246675.4	57.095	60	
8	218581.7	246674.8	57.039	70	
9	218591.7	246674.3	56.989	80	
10	218601.7	246673.8	56.928	90	
11	218611.6	246673.3	56.834	100	
12	218621.6	246672.7	56.741	110	
13	218631.6	246672.2	56.657	120	
14	218641.6	246671.7	56.595	130	
15	218651.6	246671.2	56.499	140	
16	218661.6	246670.6	56.425	150	
17	218671.6	246670.1	56.397	160	
18	218681.6	246669.6	56.39	170	
19	218691.5	246669.1	56.363	180	
20	218701.5	246668.5	56.369	190	
21	218711.5	246668	56.479	200	
22	218721.5	246667.5	56.513	210	
23	218731.5	246667	56.346	220	
24	218741.5	246666.4	56.29	230	
25	218751.5	246665.9	56.316	240	
26	218761.4	246665.4	56.222	250	
27	218771.4	246664.9	56.153	260	
28	218781.4	246664.3	56.145	270	
29	218791.4	246663.8	56.123	280	
30	218801.4	246663.3	56.1	290	
31	218811.4	246662.8	56.203	300	
32	218821.4	246662.2	56.3	310	
33	218831.4	246661.7	56.266	320	
34	218841.3	246661.2	56.186	330	
35	218851.3	246660.7	56.112	340	
36	218861.3	246660.1	56.089	350	
37	218871.3	246659.6	56.106	360	
38	218881.3	246659.1	56.145	370	
39	218891.3	246658.6	56.157	380	
40	218901.3	246658	56.1	390	
41	218911.2	246657.5	56.023	400	
42	218921.2	246657	55.964	410	
43	218931.2	246656.5	55.999	420	
44	218941.2	246656	56.086	430	
45	218951.2	246655.4	56.109	440	
46	218961.2	246654.9	56.089	450	
47	218971.2	246654.4	56.064	460	
48	218981.2	246653.9	56.083	470	
49	218991.1	246653.3	56.136	480	

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	E	N	Elevation	Distance	WL
50	219001.1	246652.8	56.179	490	
51	219011.1	246652.3	56.194	500	
52	219021.1	246651.8	56.176	510	
53	219031.1	246651.2	56.208	520	
54	219041.1	246650.7	56.302	530	
55	219051.1	246650.2	56.462	540	
56	219061	246649.7	56.657	550	
57	219071	246649.1	56.64	560	
58	219081	246648.6	56.463	570	
59	219091	246648.1	56.395	580	
60	219101	246647.6	56.403	590	
61	219111	246647	56.389	600	
62	219121	246646.5	56.344	610	
63	219131	246646	56.323	620	
64	219140.9	246645.5	56.353	630	
65	219150.9	246644.9	56.216	640	
66	219160.9	246644.4	55.994	650	
67	219170.9	246643.9	55.897	660	
68	219180.9	246643.4	55.844	670	
69	219190.9	246642.8	55.778	680	
70	219200.9	246642.3	55.727	690	
71	219210.8	246641.8	55.692	700	
72	219220.8	246641.3	55.685	710	
73	219230.8	246640.7	55.73	720	
74	219240.8	246640.2	55.71	730	
12.1	619188	746661	55.602	730.61	53.576
12.2	619191	746661	55.16	733.53	53.576
12.3	619192	746661	54.38	734.63	53.576
12.4	619193	746661	53.692	735.96	53.576
12.5	619193	746661	52.983	736.27	53.576
12.6	619195	746661	52.695	737.58	53.576
12.7	619196	746661	53.152	738.55	53.576
2	219259.1	246640.1	55.405	748.55	
3	219269.1	246639.9	55.571	758.55	
4	219279.1	246639.8	55.646	768.55	
5	219289.1	246639.6	55.711	778.55	
6	219299.1	246639.5	55.665	788.55	
7	219309.1	246639.3	55.616	798.55	
8	219319.1	246639.1	55.661	808.55	
9	219329.1	246639	56.331	818.55	
10	219339.1	246638.8	54.745	828.55	
11	219349.1	246638.7	55.388	838.55	
12	219359.1	246638.5	55.773	848.55	
13	219369.1	246638.4	55.663	858.55	
14	219379.1	246638.2	55.637	868.55	
15	219389.1	246638	55.634	878.55	
16	219399.1	246637.9	55.622	888.55	
17	219409.1	246637.7	55.607	898.55	
18	219419.1	246637.6	55.633	908.55	

Id	E	N	Elevation	Distance	WL
19	219429.1	246637.4	55.616	918.55	
20	219439.1	246637.3	55.552	928.55	
21	219449.1	246637.1	55.662	938.55	
22	219459.1	246637	56.006	948.55	
23	219469.1	246636.8	56.439	958.55	
24	219479.1	246636.6	56.913	968.55	
25	219489.1	246636.5	57.14	978.55	
26	219499.1	246636.3	57.195	988.55	
27	219509.1	246636.2	57.287	998.55	
28	219519.1	246636	57.425	1008.55	
29	219529.1	246635.9	57.587	1018.55	
30	219539.1	246635.7	57.816	1028.55	
31	219549.1	246635.5	58.153	1038.55	
32	219559.1	246635.4	58.472	1048.55	
33	219567.5	246635.3	58.53	1056.95	

## X Section 13

Id	E	N	Elevation	Distance	WL
1	218718.4	247019.6	60.159	0	
2	218727.4	247015.2	59.928	10	
3	218736.3	247010.8	59.826	20	
4	218745.3	247006.5	59.704	30	
5	218754.3	247002.1	59.596	40	
6	218763.3	246997.7	59.494	50	
7	218772.3	246993.4	59.392	60	
8	218781.3	246989	59.355	70	
9	218790.3	246984.6	59.148	80	
10	218799.3	246980.2	58.827	90	
11	218808.3	246975.9	58.593	100	
12	218817.3	246971.5	58.469	110	
13	218826.3	246967.1	58.313	120	
14	218835.3	246962.7	58.117	130	
15	218844.3	246958.4	57.949	140	
16	218853.3	246954	57.911	150	
17	218862.3	246949.6	57.946	160	
18	218871.2	246945.2	57.854	170	
19	218880.2	246940.9	57.772	180	
20	218889.2	246936.5	57.685	190	
21	218898.2	246932.1	57.386	200	
22	218907.2	246927.7	57.267	210	
23	218916.2	246923.4	57.479	220	
24	218925.2	246919	57.663	230	
25	218934.2	246914.6	57.745	240	
26	218943.2	246910.3	57.817	250	
27	218952.2	246905.9	57.796	260	
28	218961.2	246901.5	57.654	270	
29	218970.2	246897.1	57.693	280	
30	218979.2	246892.8	57.805	290	
31	218988.2	246888.4	57.679	300	
32	218997.2	246884	57.309	310	
33	219006.1	246879.6	56.993	320	
34	219015.1	246875.3	56.759	330	
35	219024.1	246870.9	56.555	340	
36	219033.1	246866.5	56.422	350	
37	219042.1	246862.1	56.341	360	
38	219051.1	246857.8	56.236	370	
39	219060.1	246853.4	56.085	380	
40	219069.1	246849	56.014	390	
41	219078.1	246844.6	56.01	400	
42	219087.1	246840.3	55.933	410	
43	219096.1	246835.9	55.83	420	
44	219105.1	246831.5	55.726	430	
45	219114.1	246827.2	55.767	440	
46	219123.1	246822.8	55.85	450	
47	219132.1	246818.4	55.92	460	
48	219141	246814	56.067	470	
49	219150	246809.7	56.171	480	

Id	E	N	Elevation	Distance	WL	
	50	219159	246805.3	56.23	490	
	51	219168	246800.9	56.204	500	
	52	219177	246796.5	56.083	510	
	53	219186	246792.2	55.958	520	
	54	219195	246787.8	55.95	530	
	55	219204	246783.4	55.996	540	
	56	219213	246779	56.042	550	
	57	219222	246774.7	56.069	560	
	58	219231	246770.3	56.177	570	
	59	219240	246765.9	56.386	580	
	60	219249	246761.5	56.412	590	
	61	219258	246757.2	56.326	600	
	62	219267	246752.8	56.249	610	
	63	219275.9	246748.4	56.13	620	
	64	219284.9	246744.1	55.799	630	
x13-1	619232	746765	55.615	630.32	53.551	
x13-2	619234	746763	55.541	633.43	53.551	
x13-3	619236	746762	55.381	635.14	53.551	top of bank west
x13-4	619237	746761	54.372	636.88	53.551	
x13-5	619237	746761	54.356	637.03	53.551	
x13-6	619239	746760	53.603	638.84	53.551	
x13-7	619240	746759	52.719	640.34	53.551	
x13-8	619241	746759	52.718	641.12	53.551	
x13-9	619242	746758	52.835	642.08	53.551	
x13-10	619242	746758	53.197	642.87	53.551	
x13-12	619242	746758	53.525	643.04	53.551	
x13-13	619243	746757	54.135	643.76	53.551	
x13-14	619244	746757	55.287	645.19	53.551	top of bank east
x13-15	619246	746756	55.392	647.04	53.551	
	2	219308.4	246731.4	55.762	657.04	
	3	219317.7	246727.8	55.619	667.04	
	4	219327.1	246724.3	54.831	677.04	
	5	219336.4	246720.7	54.467	687.04	
	6	219345.8	246717.2	55.441	697.04	
	7	219355.1	246713.7	55.518	707.04	
	8	219364.5	246710.1	55.495	717.04	
	9	219373.8	246706.6	55.512	727.04	
	10	219383.2	246703	55.518	737.04	
	11	219392.5	246699.5	55.518	747.04	
	12	219401.9	246695.9	55.465	757.04	
	13	219411.2	246692.4	55.458	767.04	
	14	219420.6	246688.8	55.486	777.04	
	15	219429.9	246685.3	55.486	787.04	
	16	219439.3	246681.7	55.481	797.04	
	17	219448.6	246678.2	55.564	807.04	
	18	219458	246674.6	55.714	817.04	
	19	219467.3	246671.1	55.874	827.04	
	20	219476.7	246667.5	56.322	837.04	
	21	219486	246664	56.758	847.04	

Id	E	N	Elevation	Distance	WL
22	219495.4	246660.4	56.969	857.04	
23	219504.7	246656.9	57.061	867.04	
24	219514.1	246653.3	57.124	877.04	
25	219523.4	246649.8	57.213	887.04	
26	219532.8	246646.2	57.416	897.04	
27	219542.1	246642.7	57.692	907.04	
28	219551.5	246639.1	58.108	917.04	
29	219560.8	246635.6	58.49	927.04	
30	219570.2	246632	58.647	937.04	
31	219579.5	246628.5	58.725	947.04	
32	219580.7	246628.1	58.732	948.31	

## X Section 14

Id	E	N	Elevation	Distance	WL
1	218731.6	246964.7	60.132	0	
2	218741.5	246963.9	59.908	10	
3	218751.5	246963	59.629	20	
4	218761.5	246962.1	59.389	30	
5	218771.4	246961.2	59.163	40	
6	218781.4	246960.3	58.833	50	
7	218791.3	246959.4	58.546	60	
8	218801.3	246958.5	58.315	70	
9	218811.3	246957.6	58.203	80	
10	218821.2	246956.8	58.089	90	
11	218831.2	246955.9	57.964	100	
12	218841.1	246955	57.86	110	
13	218851.1	246954.1	57.882	120	
14	218861.1	246953.2	58.01	130	
15	218871	246952.3	57.965	140	
16	218881	246951.4	57.85	150	
17	218890.9	246950.5	57.774	160	
18	218900.9	246949.6	57.712	170	
19	218910.9	246948.8	57.721	180	
20	218920.8	246947.9	57.782	190	
21	218930.8	246947	57.792	200	
22	218940.8	246946.1	57.748	210	
23	218950.7	246945.2	57.635	220	
24	218960.7	246944.3	57.485	230	
25	218970.6	246943.4	57.394	240	
26	218980.6	246942.5	57.29	250	
27	218990.6	246941.6	57.172	260	
28	219000.5	246940.8	57.073	270	
29	219010.5	246939.9	56.924	280	
30	219020.4	246939	56.787	290	
31	219030.4	246938.1	56.64	300	
32	219040.4	246937.2	56.45	310	
33	219050.3	246936.3	56.319	320	
34	219060.3	246935.4	56.239	330	
35	219070.2	246934.5	56.233	340	
36	219080.2	246933.7	56.236	350	
37	219090.2	246932.8	56.192	360	
38	219100.1	246931.9	56.127	370	
39	219110.1	246931	56.069	380	
40	219120	246930.1	55.991	390	
41	219130	246929.2	55.948	400	
42	219140	246928.3	55.945	410	
43	219149.9	246927.4	55.873	420	
44	219159.9	246926.5	55.743	430	
45	219169.9	246925.7	55.638	440	
46	219179.8	246924.8	55.554	450	
47	219189.8	246923.9	55.491	460	
48	219199.7	246923	55.464	470	
49	219209.7	246922.1	55.409	480	

Id	E	N	Elevation	Distance	WL
	50	219219.7	246921.2	55.347	490
	51	219229.6	246920.3	55.303	500
	52	219239.6	246919.4	55.257	510
	53	219249.5	246918.5	55.255	520
	54	219259.5	246917.7	55.248	530
	55	219269.5	246916.8	55.23	540
	56	219279.4	246915.9	55.25	550
	57	219289.4	246915	55.366	560
	58	219299.3	246914.1	55.604	570
	59	219309.3	246913.2	55.786	580
	60	219319.3	246912.3	55.913	590
x14-1	619269	746933	55.704	593.25	53.342
x14-2	619271	746933	55.043	595.25	53.342
x14-3	619272	746933	54.675	596.13	53.342
x14-4	619274	746933	53.43	598.10	53.342
x14-5	619274	746933	52.747	598.38	53.342
x14-6	619276	746933	52.556	600.03	53.342
x14-7	619277	746933	52.779	601.70	53.342
x14-8	619278	746933	53.46	602.27	53.342
x14-9	619278	746932	53.81	602.83	53.342
	2	219341.9	246911	55.511	612.83
	3	219351.8	246910.4	55.874	622.83
	4	219361.8	246909.9	55.854	632.83
	5	219371.8	246909.3	55.774	642.83
	6	219381.8	246908.7	55.677	652.83
	7	219391.8	246908.1	55.687	662.83
	8	219401.8	246907.6	55.772	672.83
	9	219411.7	246907	55.954	682.83
	10	219421.7	246906.4	56.133	692.83
	11	219431.7	246905.8	56.233	702.83
	12	219441.7	246905.3	56.219	712.83
	13	219451.7	246904.7	56.247	722.83
	14	219461.7	246904.1	56.267	732.83
	15	219471.7	246903.5	56.261	742.83
	16	219481.6	246903	56.278	752.83
	17	219491.6	246902.4	56.376	762.83
	18	219501.6	246901.8	56.43	772.83
	19	219511.6	246901.2	56.361	782.83
	20	219521.6	246900.7	56.357	792.83
	21	219531.6	246900.1	56.345	802.83
	22	219541.5	246899.5	56.343	812.83
	23	219551.5	246898.9	56.456	822.83
	24	219561.5	246898.4	56.596	832.83
	25	219571.5	246897.8	56.724	842.83
	26	219581.5	246897.2	56.838	852.83
	27	219591.5	246896.6	57.106	862.83
	28	219601.4	246896.1	57.483	872.83
	29	219611.4	246895.5	57.983	882.83
	30	219621.4	246894.9	58.626	892.83

Id	E	N	Elevation	Distance	WL
31	219631.4	246894.3	59.436	902.83	
32	219641.4	246893.7	60.268	912.83	
33	219646	246893.5	60.578	917.44	

## X Section 15

Id	E	N	Elevation	Distance	WL
1	218747.6	247175.3	60.458	0	
2	218757.5	247174.4	60.064	10	
3	218767.5	247173.4	59.774	20	
4	218777.4	247172.4	59.574	30	
5	218787.4	247171.4	59.315	40	
6	218797.4	247170.5	59.011	50	
7	218807.3	247169.5	58.758	60	
8	218817.3	247168.5	58.526	70	
9	218827.2	247167.5	58.332	80	
10	218837.2	247166.6	58.206	90	
11	218847.1	247165.6	58.11	100	
12	218857.1	247164.6	58.059	110	
13	218867	247163.6	57.983	120	
14	218877	247162.6	57.869	130	
15	218886.9	247161.7	57.748	140	
16	218896.9	247160.7	57.631	150	
17	218906.8	247159.7	57.53	160	
18	218916.8	247158.7	57.444	170	
19	218926.7	247157.8	57.368	180	
20	218936.7	247156.8	57.309	190	
21	218946.6	247155.8	57.216	200	
22	218956.6	247154.8	57.107	210	
23	218966.5	247153.9	57.017	220	
24	218976.5	247152.9	56.993	230	
25	218986.5	247151.9	56.934	240	
26	218996.4	247150.9	56.819	250	
27	219006.4	247150	56.703	260	
28	219016.3	247149	56.579	270	
29	219026.3	247148	56.489	280	
30	219036.2	247147	56.421	290	
31	219046.2	247146.1	56.331	300	
32	219056.1	247145.1	56.244	310	
33	219066.1	247144.1	56.163	320	
34	219076	247143.1	56.081	330	
35	219086	247142.2	55.994	340	
36	219095.9	247141.2	55.892	350	
37	219105.9	247140.2	55.837	360	
38	219115.8	247139.2	55.818	370	
39	219125.8	247138.3	55.763	380	
40	219135.7	247137.3	55.71	390	
41	219145.7	247136.3	55.645	400	
42	219155.6	247135.3	55.604	410	
43	219165.6	247134.4	55.61	420	
44	219175.6	247133.4	55.643	430	
45	219185.5	247132.4	55.691	440	
46	219195.5	247131.4	55.639	450	
47	219205.4	247130.5	55.572	460	
48	219215.4	247129.5	55.617	470	
49	219225.3	247128.5	55.631	480	

Id	E	N	Elevation	Distance	WL
	50	219235.3	247127.5	55.524	490
	51	219245.2	247126.6	55.4	500
	52	219255.2	247125.6	55.326	510
	53	219265.1	247124.6	55.291	520
	54	219275.1	247123.6	55.27	530
	55	219285	247122.7	55.241	540
	56	219295	247121.7	55.163	550
	57	219304.9	247120.7	55.08	560
	58	219314.9	247119.7	55.1	570
	59	219324.8	247118.8	55.288	580
x15-1	619280	747139	55.172	588.78	53.159
x15-2	619283	747140	55.317	592.251	53.159
x15-3	619287	747140	55.166	596.184	53.159
x15-4	619289	747140	54.606	597.977	53.159
x15-5	619290	747141	53.866	599.474	53.159
x15-6	619292	747141	52.087	601.28	53.159
x15-7	619294	747141	51.936	602.592	53.159
x15-8	619295	747141	52.3	604.408	53.159
x15-9	619296	747141	53.438	604.798	53.159
	2	219359	247119.7	55.211	614.798
	3	219369	247119.5	55.469	624.798
	4	219379	247119.4	55.632	634.798
	5	219389	247119.3	55.772	644.798
	6	219399	247119.1	55.82	654.798
	7	219409	247119	55.769	664.798
	8	219419	247118.9	55.719	674.798
	9	219429	247118.8	55.734	684.798
	10	219439	247118.6	55.818	694.798
	11	219449	247118.5	55.894	704.798
	12	219459	247118.4	55.982	714.798
	13	219469	247118.2	56.067	724.798
	14	219479	247118.1	56.141	734.798
	15	219489	247118	56.333	744.798
	16	219499	247117.8	56.648	754.798
	17	219509	247117.7	57.081	764.798
	18	219519	247117.6	57.607	774.798
	19	219529	247117.5	58.091	784.798
	20	219539	247117.3	58.554	794.798
	21	219549	247117.2	58.843	804.798
	22	219559	247117.1	59.061	814.798
	23	219569	247116.9	59.113	824.798
	24	219579	247116.8	58.975	834.798
	25	219589	247116.7	58.862	844.798
	26	219599	247116.6	58.489	854.798
	27	219609	247116.4	58.525	864.798
	28	219619	247116.3	58.67	874.798
	29	219629	247116.2	58.889	884.798
	30	219636.4	247116.1	59.64	892.138

## X Section 16

Id	E	N	Elevation	Distance	WL
1	218850.1	247321.9	60.469	0	
2	218860.1	247321.3	60.008	10	
3	218870	247320.6	59.513	20	
4	218880	247320	59.01	30	
5	218890	247319.4	58.579	40	
6	218900	247318.8	58.194	50	
7	218910	247318.2	57.883	60	
8	218920	247317.6	57.701	70	
9	218929.9	247317	57.58	80	
10	218939.9	247316.4	57.493	90	
11	218949.9	247315.8	57.346	100	
12	218959.9	247315.2	57.155	110	
13	218969.9	247314.6	56.98	120	
14	218979.8	247314	56.8	130	
15	218989.8	247313.4	56.704	140	
16	218999.8	247312.8	56.64	150	
17	219009.8	247312.2	56.551	160	
18	219019.8	247311.6	56.464	170	
19	219029.8	247311	56.418	180	
20	219039.7	247310.4	56.43	190	
21	219049.7	247309.8	56.382	200	
22	219059.7	247309.1	56.288	210	
23	219069.7	247308.5	56.214	220	
24	219079.7	247307.9	56.148	230	
25	219089.6	247307.3	56.094	240	
26	219099.6	247306.7	56.077	250	
27	219109.6	247306.1	56.06	260	
28	219119.6	247305.5	56.024	270	
29	219129.6	247304.9	55.974	280	
30	219139.6	247304.3	55.949	290	
31	219149.5	247303.7	55.932	300	
32	219159.5	247303.1	55.915	310	
33	219169.5	247302.5	55.912	320	
34	219179.5	247301.9	55.906	330	
35	219189.5	247301.3	55.89	340	
36	219199.4	247300.7	55.867	350	
37	219209.4	247300.1	55.856	360	
38	219219.4	247299.5	55.873	370	
39	219229.4	247298.9	55.893	380	
40	219239.4	247298.3	55.879	390	
41	219249.4	247297.6	55.866	400	
42	219259.3	247297	55.885	410	
43	219269.3	247296.4	55.885	420	
44	219279.3	247295.8	55.868	430	
45	219289.3	247295.2	55.84	440	
46	219299.3	247294.6	55.811	450	
47	219309.3	247294	55.783	460	
48	219319.2	247293.4	55.756	470	
49	219329.2	247292.8	55.732	480	

Id	E	N	Elevation	Distance	WL	
	50	219339.2	247292.2	55.72	490	
	51	219349.2	247291.6	55.599	500	
x16-1	619299	747312	55.283	502.79	53.168	
x16-2	619302	747312	55.24	506.44	53.168	top of bank-west
x16-3	619302	747312	55.235	506.45	53.168	
x16-4	619304	747311	54.507	508.09	53.168	
x16-5	619305	747312	53.708	509.14	53.168	
x16-6	619306	747312	52.323	510.77	53.168	
x16-7	619308	747312	51.784	512.27	53.168	
x16-8	619308	747312	51.781	512.29	53.168	
x16-9	619309	747312	52.04	513.83	53.168	
x16-10	619310	747312	53.005	514.19	53.168	
x16-11	619310	747312	52.997	514.24	53.168	
x16-13	619311	747312	53.624	515.44	53.168	
x16-14	619313	747311	54.8	517.56	53.168	
x16-15	619314	747310	55.251	518.95	53.168	top of bank-east
x16-16	619316	747310	55.31	521.23	53.168	
	2	219379.3	247289	55.597	531.23	
	3	219389.3	247288.5	55.437	541.23	
	4	219399.3	247288	55.349	551.23	
	5	219409.3	247287.5	55.362	561.23	
	6	219419.2	247287	55.476	571.23	
	7	219429.2	247286.5	55.532	581.23	
	8	219439.2	247286	55.526	591.23	
	9	219449.2	247285.5	55.587	601.23	
	10	219459.2	247285	55.779	611.23	
	11	219469.2	247284.5	55.938	621.23	
	12	219479.2	247284	56.047	631.23	
	13	219489.2	247283.5	56.186	641.23	
	14	219499.1	247283	56.305	651.23	
	15	219509.1	247282.5	56.411	661.23	
	16	219519.1	247282	56.818	671.23	
	17	219529.1	247281.5	57.139	681.23	
	18	219539.1	247281.1	57.464	691.23	
	19	219549.1	247280.6	57.501	701.23	
	20	219559.1	247280.1	57.648	711.23	
	21	219569.1	247279.6	57.784	721.23	
	22	219579.1	247279.1	57.657	731.23	
	23	219589	247278.6	57.453	741.23	
	24	219599	247278.1	57.337	751.23	
	25	219609	247277.6	57.381	761.23	
	26	219619	247277.1	57.622	771.23	
	27	219629	247276.6	58.111	781.23	
	28	219639	247276.1	59.238	791.23	
	29	219649	247275.6	59.751	801.23	
	30	219659	247275.1	59.941	811.23	
	31	219668.9	247274.6	60.042	821.23	
	32	219678.9	247274.1	60.356	831.23	
	33	219688.9	247273.6	60.332	841.23	

## X Section 18

Id	E	N	Elevation	Distance 0	WL
1	218952.2	247553.7	60.291		0
2	218962.1	247552.6	60.045		10
3	218972.1	247551.6	59.75		20
4	218982	247550.6	59.43		30
5	218992	247549.6	59.067		40
6	219001.9	247548.5	58.654		50
7	219011.9	247547.5	58.355		60
8	219021.8	247546.5	58.11		70
9	219031.7	247545.5	57.841		80
10	219041.7	247544.4	57.537		90
11	219051.6	247543.4	57.271		100
12	219061.6	247542.4	57.046		110
13	219071.5	247541.4	56.835		120
14	219081.5	247540.3	56.64		130
15	219091.4	247539.3	56.461		140
16	219101.4	247538.3	56.393		150
17	219111.3	247537.3	56.41		160
18	219121.3	247536.2	56.4		170
19	219131.2	247535.2	56.369		180
20	219141.2	247534.2	56.326		190
21	219151.1	247533.2	56.227		200
22	219161.1	247532.1	56.062		210
23	219171	247531.1	56.048		220
24	219181	247530.1	56.17		230
25	219190.9	247529.1	56.258		240
26	219200.9	247528	56.302		250
27	219210.8	247527	56.302		260
28	219220.8	247526	56.281		270
29	219230.7	247525	56.217		280
30	219240.7	247523.9	56.13		290
31	219250.6	247522.9	56.072		300
32	219260.5	247521.9	56.053		310
33	219270.5	247520.9	56.057		320
34	219280.4	247519.8	56.082		330
35	219290.4	247518.8	55.985		340
36	219300.3	247517.8	55.867		350
37	219310.3	247516.8	55.747		360
38	219320.2	247515.8	55.595		370
39	219330.2	247514.7	55.539		380
40	219340.1	247513.7	55.549		390
41	219350.1	247512.7	55.565		400
42	219360	247511.7	55.558		410
43	219370	247510.6	55.401		420
x18-12	619317	747531	54.964	420.57	53.168
x18-11	619322	747532	54.196	425.10	53.168
x18-10	619322	747532	54.187	426.42	53.168
x18-9	619323	747530	53.623	427.52	53.168
x18-8	619323	747530	53.622	427.53	53.168

Id	E	N	Elevation	Distance	WL
x18-7	619323	747530	53.638	427.58	53.168
x18-6	619325	747528	53.098	430.28	53.168
x18-5	619326	747528	51.82	430.49	53.168
x18-2	619327	747528	51.703	432.22	53.168
x18-1	619328	747526	55.387	434.65	53.168
2	219391.7	247504.3	55.32	444.65	
3	219401.6	247503.9	55.617	454.65	
4	219411.6	247503.4	56.363	464.65	
5	219421.6	247503	57.172	474.65	
6	219431.6	247502.5	57.242	484.65	
7	219441.6	247502.1	57.297	494.65	
8	219451.6	247501.7	56.969	504.65	
9	219461.6	247501.2	56.91	514.65	
10	219471	247500.8	57.237	524.08	

## X Section 19

Id	E	N	Elevation	Distance 0	WL
1	219063.4	247715.7	60.608		0
2	219073.3	247714.2	60.107		10
3	219083.2	247712.7	59.608		20
4	219093.1	247711.3	59.175		30
5	219102.9	247709.8	58.753		40
6	219112.8	247708.4	58.317		50
7	219122.7	247706.9	57.932		60
8	219132.6	247705.4	57.551		70
9	219142.5	247704	57.183		80
10	219152.4	247702.5	56.941		90
11	219162.3	247701.1	56.806		100
12	219172.2	247699.6	56.777		110
13	219182.1	247698.1	56.696		120
14	219192	247696.7	56.517		130
15	219201.9	247695.2	56.306		140
16	219211.8	247693.8	56.019		150
17	219221.7	247692.3	55.784		160
18	219231.6	247690.8	55.682		170
19	219241.4	247689.4	55.579		180
20	219251.3	247687.9	55.378		190
21	219261.2	247686.4	55.189		200
x19-1	619215	747706	54.717	206.97	53.091
x19-2	619221	747707	54.545	213.4293217	53.091
x19-3	619225	747703	53.956	219.484191	53.091
x19-4	619226	747703	53.241	220.6859601	53.091
x19-5	619228	747703	52.015	222.0829687	53.091
x19-6	619228	747703	52.029	222.2152789	53.091
x19-7	619229	747703	52.085	223.4525469	53.091
x19-8	619231	747703	52.322	225.2240892	53.091
x19-10	619231	747704	53.261	225.786396	53.091
x19-11	619234	747704	53.601	228.0808766	53.091
2	219297	247683.2	55.55	238.0808766	
3	219307	247683.1	55.526	248.0808766	
4	219317	247683.1	56.278	258.0808766	
5	219327	247683	58.187	268.0808766	
6	219333.8	247682.9	59.09	274.8918766	

## X Section 21

Id	E	N	Elevation	Distance	WL
1	220335.5	245876.7	58.131	0	
2	220341	245885	57.883	10	
3	220346.6	245893.3	57.612	20	
4	220352.1	245901.7	57.378	30	
5	220357.7	245910	57.179	40	
6	220363.2	245918.3	57.071	50	
7	220368.8	245926.6	56.982	60	
8	220374.3	245934.9	56.915	70	
9	220379.9	245943.3	56.85	80	
10	220385.4	245951.6	56.757	90	
11	220391	245959.9	56.643	100	
12	220396.5	245968.2	56.613	110	
13	220402	245976.6	56.522	120	
14	220407.6	245984.9	56.416	130	
15	220413.1	245993.2	56.37	140	
16	220418.7	246001.5	56.371	150	
17	220424.2	246009.8	56.418	160	
18	220429.8	246018.2	56.429	170	
19	220435.3	246026.5	56.42	180	
20	220440.9	246034.8	56.405	190	
21	220446.4	246043.1	56.397	200	
22	220452	246051.4	56.387	210	
23	220457.5	246059.8	56.409	220	
24	220463.1	246068.1	56.454	230	
25	220468.6	246076.4	56.535	240	
26	220474.2	246084.7	56.617	250	
27	220479.7	246093	56.774	260	
28	220485.3	246101.4	56.775	270	
21.1	620433	746124	56.797	271.85	54.94
21.2	620435	746127	56.5	275.17	54.94
21.3	620436	746127	55.184	276.76	54.94
21.4	620437	746128	54.257	277.63	54.94
21.5	620437	746128	54.245	277.64	54.94
21.6	620437	746129	54.113	278.80	54.94
21.7	620438	746130	54.276	279.94	54.94
21.8	620438	746131	55.283	280.57	54.94
21.9	620438	746132	55.963	282.14	54.94
21.1	620439	746134	56.839	283.95	54.94
1	220496.7	246121.9	56.874	293.95	
2	220501.1	246130.9	56.719	303.95	
3	220505.4	246139.9	56.603	313.95	
4	220509.8	246148.9	56.542	323.95	
5	220514.1	246157.9	56.556	333.95	
6	220518.5	246166.9	56.522	343.95	
7	220522.8	246175.9	56.461	353.95	
8	220527.2	246184.9	56.416	363.95	
9	220531.5	246193.9	56.428	373.95	
10	220535.9	246202.9	56.44	383.95	
11	220540.3	246211.9	56.477	393.95	

Id	E	N	Elevation	Distance	WL
12	220544.6	246220.9	56.523	403.95	
13	220549	246229.9	56.55	413.95	
14	220553.3	246238.9	56.557	423.95	
15	220557.7	246247.9	56.552	433.95	
16	220562	246256.9	56.572	443.95	
17	220566.4	246265.9	56.61	453.95	
18	220570.7	246274.9	56.67	463.95	
19	220575.1	246283.9	56.772	473.95	
20	220579.4	246292.9	56.886	483.95	
21	220583.8	246301.9	57.006	493.95	
22	220588.1	246310.9	57.21	503.95	
23	220592.5	246319.9	57.47	513.95	
24	220596.9	246328.9	57.639	523.95	
25	220601.2	246338	57.946	533.95	
26	220605.6	246347	58.351	543.95	
27	220609.9	246356	58.571	553.95	
28	220614.3	246365	58.781	563.95	
29	220614.9	246366.3	58.821	565.47	

## X Section 21

Id	E	N	Elevation	Distance	WL	
1	220774.9	245665.1	58.282	0		
2	220777.1	245674.9	58.125	10		
3	220779.3	245684.6	57.99	20		
4	220781.5	245694.4	57.888	30		
5	220783.7	245704.1	57.78	40		
6	220785.9	245713.9	57.677	50		
7	220788.1	245723.6	57.58	60		
8	220790.3	245733.4	57.523	70		
9	220792.6	245743.1	57.474	80		
10	220794.8	245752.9	57.394	90		
11	220797	245762.6	57.331	100		
12	220799.2	245772.4	57.282	110		
13	220801.4	245782.1	57.216	120		
14	220803.6	245791.9	57.15	130		
15	220805.8	245801.7	57.117	140		
16	220808	245811.4	57.121	150		
17	220810.2	245821.2	57.093	160		
18	220812.4	245830.9	56.995	170		
19	220814.7	245840.7	56.879	180		
20	220816.9	245850.4	56.825	190		
21	220819.1	245860.2	56.814	200		
22	220821.3	245869.9	56.79	210		
23	220823.5	245879.7	56.795	220		
24	220825.7	245889.4	56.783	230		
25	220827.9	245899.2	56.727	240		
26	220830.1	245908.9	56.693	250		
27	220832.3	245918.7	56.706	260		
28	220834.6	245928.4	56.708	270		
29	220836.8	245938.2	56.703	280		
30	220839	245948	56.711	290		
31	220841.2	245957.7	56.723	300		
32	220843.4	245967.5	56.769	310		
33	220845.6	245977.2	56.937	320		
22.9	620800	746021	57.13	324.31	55.252	Top of bank south
22.1	620799	746019	56.225	326.65	55.252	
22.11	620799	746017	55.627	328.32	55.252	
22.12	620798	746016	54.841	329.21	55.252	
22.13	620798	746015	54.878	330.33	55.252	
22.14	620798	746014	54.935	331.46	55.252	
22.15	620798	746014	55.545	332.05	55.252	
22.16	620798	746013	55.872	332.39	55.252	
22.17	620797	746012	56.749	333.54	55.252	
22.18	620796	746010	57.223	336.07	55.252	top of bank north
22.19	620793	746001	56.627	345.46	55.252	
1	220856.3	246009.6	57.204	355.46		
2	220859.3	246019.2	57.162	365.46		
3	220862.2	246028.7	57.141	375.46		
4	220865.2	246038.3	57.114	385.46		
5	220868.2	246047.8	57.102	395.46		

Id	E	N	Elevation	Distance	WL
6	220871.2	246057.4	57.014	405.46	
7	220874.2	246066.9	56.917	415.46	
8	220877.1	246076.5	56.893	425.46	
9	220880.1	246086	56.955	435.46	
10	220883.1	246095.6	56.946	445.46	
11	220886.1	246105.1	56.9	455.46	
12	220889.1	246114.6	56.844	465.46	
13	220892	246124.2	56.791	475.46	
14	220895	246133.7	56.755	485.46	
15	220898	246143.3	56.744	495.46	
16	220901	246152.8	56.716	505.46	
17	220904	246162.4	56.717	515.46	
18	220906.9	246171.9	56.737	525.46	
19	220909.9	246181.5	56.794	535.46	
20	220912.9	246191	56.989	545.46	
21	220915.9	246200.6	57.195	555.46	
22	220918.9	246210.1	57.315	565.46	
23	220921.8	246219.7	57.44	575.46	
24	220924.8	246229.2	57.696	585.46	
25	220927.8	246238.7	58.13	595.46	
26	220930.8	246248.3	58.481	605.46	
27	220933.8	246257.8	58.862	615.46	
28	220935.8	246264.4	59.127	622.36	

## X Section 23

Id	E	N	Elevation	Distance	WL
	1	218971.2	245322.7	59.572	0
	2	218977	245330.8	59.128	10
	3	218982.9	245338.9	58.85	20
	4	218988.8	245347	58.597	30
	5	218994.6	245355.1	58.389	40
	6	219000.5	245363.3	58.144	50
	7	219006.3	245371.4	57.753	60
	8	219012.2	245379.5	57.268	70
	9	219018	245387.6	57.01	80
	10	219023.9	245395.7	56.769	90
	11	219029.7	245403.8	56.582	100
x23.1	618985	745431	56.982	102.375	55
x23.2	618984	745430	55.819	107.62	55
x23.3	618983	745429	55.355	109.17	55
x23.4	618981	745429	54.356	110.01	55
x23.5	618980	745428	55.116	110.60	55
x23.6	618979	745427	55.773	112.17	55
x23.7	618978	745427	56.508	114.22	55
	2	219044.2	245418.3	56.529	124.22
	3	219049.9	245426.6	56.544	134.22
	4	219055.5	245434.8	56.498	144.22
	5	219061.2	245443.1	56.446	154.22
	6	219066.8	245451.4	56.445	164.22
	7	219072.5	245459.6	56.467	174.22
	8	219078.1	245467.9	56.477	184.22
	9	219083.8	245476.1	56.434	194.22
	10	219089.4	245484.4	56.37	204.22
	11	219095.1	245492.6	56.364	214.22
	12	219100.7	245500.9	56.401	224.22
	13	219106.4	245509.1	56.413	234.22
	14	219112	245517.4	56.343	244.22
	15	219117.7	245525.6	56.274	254.22
	16	219123.3	245533.9	56.249	264.22
	17	219129	245542.1	56.283	274.22
	18	219134.6	245550.4	56.378	284.22
	19	219140.3	245558.6	56.454	294.22
	20	219145.9	245566.9	56.454	304.22
	21	219151.6	245575.1	56.415	314.22
	22	219157.2	245583.4	56.437	324.22
	23	219162.9	245591.6	56.477	334.22
	24	219168.5	245599.9	56.508	344.22
	25	219174.2	245608.1	56.54	354.22
	26	219179.8	245616.4	56.63	364.22
	27	219185.5	245624.6	56.729	374.22
	28	219190.1	245631.3	56.809	382.35

## X Section 23

Id	E	N	Elevation	Distance	WL
1	220041	246024.8	57.658		0
2	220044.2	246034.3	57.517		10
3	220047.4	246043.8	57.372		20
4	220050.6	246053.3	57.197		30
5	220053.7	246062.8	57.127		40
6	220056.9	246072.2	57.168		50
7	220060.1	246081.7	57.152		60
8	220063.3	246091.2	57.134		70
9	220066.4	246100.7	57.085		80
10	220069.6	246110.2	57.028		90
11	220072.8	246119.6	56.962		100
12	220076	246129.1	56.908		110
13	220079.2	246138.6	56.879		120
14	220082.3	246148.1	56.832		130
15	220085.5	246157.6	56.74		140
16	220088.7	246167.1	56.689		150
17	220091.9	246176.5	56.773		160
18	220095	246186	56.873		170
19	220098.2	246195.5	56.894		180
20	220101.4	246205	56.86		190
21	220104.6	246214.5	56.82		200
22	220107.7	246224	56.807		210
23	220110.9	246233.4	56.827		220
24	220114.1	246242.9	56.827		230
25	220117.3	246252.4	56.76		240
26	220120.5	246261.9	56.545		250
27	220123.6	246271.4	56.391		260
23.1	620071	746293	56.587	261.32	54.577
23.2	620073	746298	56.004	266.57	54.577
23.3	620073	746300	55.429	268.12	54.577
23.4	620074	746301	54.602	268.95	54.577
23.5	620074	746301	54.061	269.54	54.577
23.6	620075	746302	53.867	271.12	54.577
23.7	620077	746303	53.982	273.16	54.577
23.8	620077	746304	55.128	273.51	54.577
1	220133.4	246292.1	56.455	283.51	
2	220136.8	246301.5	56.438	293.51	
3	220140.2	246310.9	56.39	303.51	
4	220143.7	246320.3	56.287	313.51	
5	220147.1	246329.7	56.255	323.51	
6	220150.5	246339.1	56.264	333.51	
7	220154	246348.5	56.266	343.51	
8	220157.4	246357.9	56.307	353.51	
9	220160.8	246367.3	56.32	363.51	
10	220164.2	246376.7	56.276	373.51	
11	220167.7	246386.1	56.261	383.51	
12	220171.1	246395.5	56.258	393.51	
13	220174.5	246404.9	56.254	403.51	
14	220178	246414.3	56.294	413.51	

Id

	E	N	Elevation	Distance
15	220181.4	246423.7	56.368	423.51
16	220184.8	246433.1	56.473	433.51
17	220188.2	246442.4	56.601	443.51
18	220191.7	246451.8	56.962	453.51
19	220195.1	246461.2	57.784	463.51
20	220198.5	246470.6	58.383	473.51
21	220202	246480	58.803	483.51
22	220205.4	246489.4	59.112	493.51
23	220206.8	246493.2	59.157	497.57



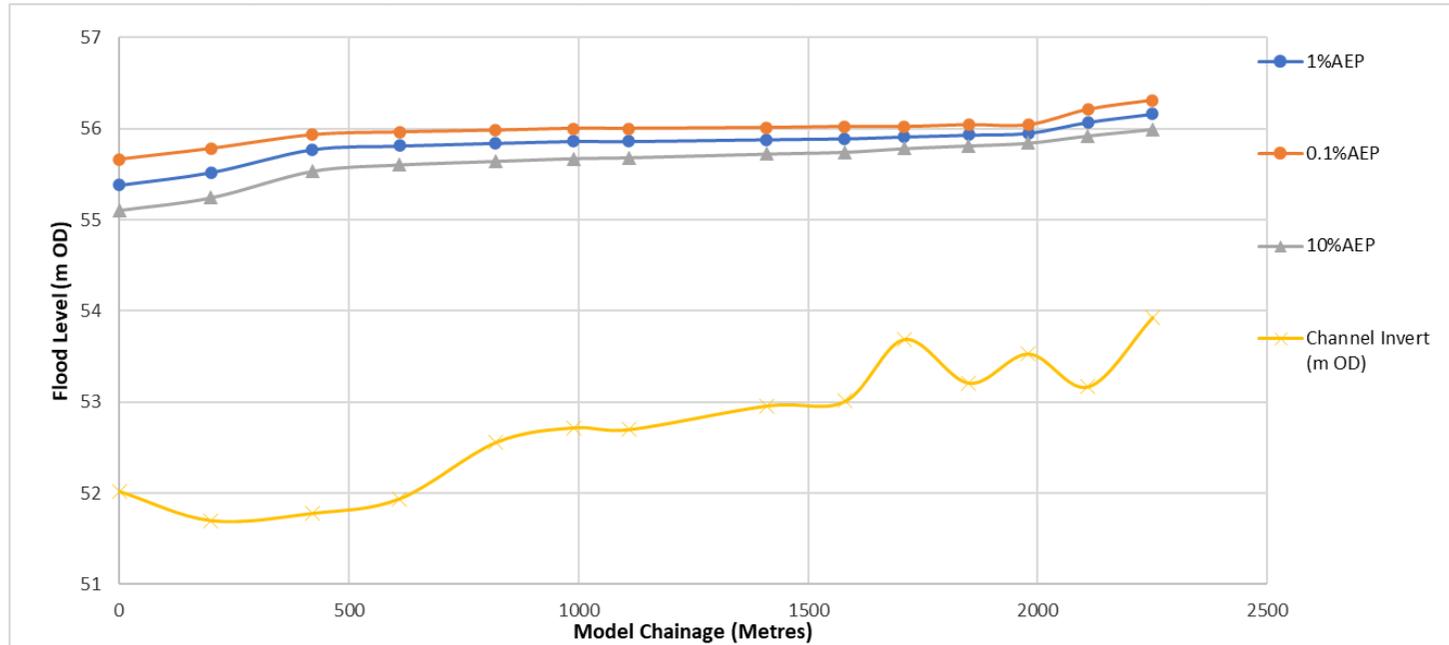


## X Section 24

Id	E	N	Elevation	Distance	WL
1	218817.4	245430	57.158	0	
2	218822.4	245438.7	57.144	10	
3	218827.4	245447.4	57.167	20	
4	218832.4	245456	57.321	30	
5	218837.3	245464.7	57.503	40	
6	218842.3	245473.4	57.526	50	
7	218847.3	245482.1	57.535	60	
8	218852.3	245490.7	57.461	70	
9	218857.3	245499.4	57.319	80	
10	218862.2	245508.1	57.18	90	
11	218867.2	245516.8	57.193	100	
12	218872.2	245525.4	57.239	110	
13	218877.2	245534.1	57.357	120	
14	218882.1	245542.8	57.333	130	
x24.1	618834	745573	56.544	133.84	54.495
x24.2	618834	745572	55.951	135.094	54.495
x24.3	618832	745570	54.773	136.82	54.495
x24.4	618832	745570	54.172	137.253	54.495
2	218920.1	245626.2	57.192	147.253	
3	218916	245617.1	57.009	157.253	
4	218912	245607.9	56.839	167.253	
5	218908	245598.7	56.707	177.253	
6	218904	245589.6	56.61	187.253	
7	218900	245580.4	56.539	197.253	
8	218896	245571.3	56.536	207.253	
9	218891.9	245562.1	56.701	217.253	
10	218887.9	245553	56.874	227.253	
11	218887.6	245552.1	56.903	228.16	

## APPENDIX II: HEC-RAS MODEL OUTPUT DATA

Chainage	HECRAS XS ID	XS Start Point		XS Finish Point		Channel Survey ID	Min Channel invert	10-year	100-year	1000-year
		Easting	Northing	Easting	Northing					
0	1	219,073.27	247,714.21	219,327.02	247,682.98	19	52.02	55.1	55.38	55.66
200	2	218,962.11	247,552.64	219,461.59	247,501.23	18	51.7	55.24	55.52	55.78
420	3	218,860.06	247,321.25	219,698.91	247,273.13	16	51.78	55.53	55.77	55.93
610	4	218,757.54	247,174.35	219,629.02	247,116.17	15	51.94	55.6	55.81	55.96
820	5	218,731.57	246,964.75	219,645.97	246,893.48	14	52.56	55.64	55.84	55.98
990	6	218,727.35	247,015.22	219,579.53	246,628.50	13	52.72	55.67	55.86	56
1110	7	218,521.77	246,677.97	219,549.11	246,635.55	12	52.7	55.68	55.86	56
1410	8	218,484.01	246,632.42	219,621.82	246,165.74	10.1	52.96	55.72	55.88	56.01
1580	9	218,384.50	246,594.22	219,736.36	245,886.67	10	53.01	55.74	55.89	56.02
1710	10	218,482.50	246,344.79	219,622.36	245,824.73	8	53.69	55.78	55.91	56.02
1850	11	218,512.78	246,226.97	219,541.47	245,698.52	7	53.21	55.81	55.93	56.04
1980	12	218,391.94	246,154.20	219,491.07	245,514.26	9	53.53	55.84	55.95	56.04
2110	13	218,581.44	245,858.78	219,411.97	245,458.83	6	53.17	55.92	56.07	56.21
2250	14	218,507.58	245,736.27	219,309.28	245,361.55	5	53.93	55.99	56.16	56.31



	Easting				Northing	Flood Elevation_10 yr	Flood Elevation_100 yr	Flood Elevation_1000 yr
Section Ch 0 start	219231.556				247690.829	55.1	55.38	55.66
Section Ch 0 end	219317.02				247683.065	55.1	55.38	55.66
Section Ch 200 start	219300.337				247517.8	55.24	55.52	55.78
Section Ch 200 end	219421.631				247502.976	55.24	55.52	55.78
Section Ch 420 start	219149.538				247303.7	55.53	55.77	55.93
Section Ch 420 end	219469.185				247284.516	55.53	55.77	55.93
Section Ch 610 start	219076.026				247143.14	55.6	55.81	55.96
Section Ch 610 end	219459.031				247118.365	55.6	55.81	55.96
Section Ch 820 start	219120.046				246930.098	55.64	55.84	55.98
Section Ch 820 end	219421.731				246906.416	55.64	55.84	55.98
Section Ch 990 start	219275.945				246748.429	55.67	55.86	56
Section Ch 990 end	219476.679				246667.528	55.67	55.86	56
Section Ch 1110 start	219150.926				246644.941	55.68	55.86	56
Section Ch 1110 end	219329.128				246638.981	55.68	55.86	56
Section Ch1410 start	218838.553				246514.711	55.72	55.88	56.01
Section Ch 1410 end	219445.617				246231.148	55.72	55.88	56.01
Section Ch 1580 start	219046.485				246241.624	55.74	55.89	56.02
Section Ch 1580 end	219200.543				246160.365	55.74	55.89	56.02
Section Ch 1710 start	218857.925				246179.947	55.78	55.91	56.02
Section Ch 1710 end	219204.112				246016.274	55.78	55.91	56.02
Section Ch 1850 start	218838.704				246051.796	55.81	55.93	56.04
Section Ch 1850 end	219084.208				245924.417	55.81	55.93	56.04
Section Ch 1980 start	218877.557				245875.278	55.84	55.95	56.04
Section Ch 1980 end	218897.837				245858.058	55.84	55.95	56.04
Section Ch 2110 start	218782.088				245768.531	55.92	56.07	56.21
Section Ch 2110 end	218900.854				245710.83	55.92	56.07	56.21
Section Ch 2250 start	218716.493				245640.052	55.99	56.16	56.31
Section Ch 2250 end	218783.697				245608.36	55.99	56.16	56.31