A User's Guide to High Definition Aerial Videography

Alberta Fisheries Habitat Enhancement and Sustainability (FISHES) Program

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Overview

The purpose of this manual is to describe the aerial videography recording, assessment and scoring methodology used to assess damage to fish habitat resulting from the 2013 and 2014 Alberta floods under the Fisheries Habitat Enhancement and Sustainability (FISHES) Program. This information should be used in conjunction with the Evaluation, Scoring, and Ranking Model (ESRM) completed by FISHES. The manual covers two main components: high definition aerial videography (HDAV) methodology, and the review of that video and subsequent scoring of impacts and features along the watershed. More information on the ESRM flood impact assessments can be found in the ESRM Manual (ISBN 978-1-4601-4616-3 https://open.alberta.ca/publications/9781460146163)

HDAV Guidelines

HDAV is a method of watershed assessment that utilizes low speed helicopter flight, high definition (HD) videography, audio recording, and GPS information to obtain coarse preliminary information. HDAV is able to assess much larger areas in a shorter time period than what is possible through ground level assessments or drone flights. HDAV methods can also be used in other large scale land-use assessments, or natural resource inventories e.g. ungulate surveys, trail assessments, etc.

Staff roles and responsibilities:

The Government of Alberta has very specific operating, safety, flight following, and contracting requirements for the charter of aircraft. In addition to those requirements, which are described elsewhere in various department policies and procedures (including Safe Operating Procedures, and specific Hazard Assessments), the following recommendations will prove useful for conducting HDAV surveys.

Crew

Pilot: The crew should specify a machine with sufficient power to provide the necessary margin of safety for low level, low speed operations. Additionally, the pilot should be experienced in flying in the mountains at low speeds and low elevations, with the rear door open during flight, or removed completely prior to take off. The pilot should also be amenable to minor deviations from the flight plan, as required, to provide additional video coverage of any features of particular interest.

Navigator: A department staff member who is knowledgeable about the local geography and flight area and is responsible for communicating with the pilot to ensure the actual flight path tracks the correct waterbody. The navigator is also responsible for providing the ongoing in-flight commentary, noting significant features, contributing factors, and points of interest which are critical to the after-flight ESRM scoring and ranking process. The commentary is also very useful as it is time stamped and georeferenced which can be very helpful if further investigation or filming is required.

Videographer: A department staff member who has the knowledge and experience required to handle the specialized audiovisual equipment required in-flight. The videographer is directly responsible for recording in-flight videography and the related audio track. The videographer is also responsible for the general maintenance and handling of the camera equipment, ensuring equipment compatibility with onboard systems, synchronization and testing, and file management.

Note taker: A third department staff person is required in-flight to record notes and any additional information such as GPS waypoints or photo numbers. The notetaker should also provide and be proficient with the use of a digital camera to supplement videography as required.

Helicopter

The helicopter should provide seating for a crew of three with good ground visibility for the videographer. The machine should be capable of flying with the rear left door open, or removed prior to flight. The helicopter should be an appropriate size and type for the expected terrain, crew, and weight, while providing a suitable margin of safety for the required flying conditions i.e. low speed and low altitude. An A-star B2 was the preferred aircraft for the FISHES Program.

Equipment Recommendations and Safety

- ☐ Flight plan and manifest provided to the helicopter and safety check-in
- ☐ Flight Following plan in place per department requirements
- ☐ Full body fall restraint harness properly sized for the videographer
- ☐ Cell phone(s)
- ☐ SPOT unit or InReach unit
- ☐ Survival kit
- ☐ Flight helmets
- ☐ Seatbelt cutters (one per crew member)

Videography Equipment

- ☐ Canon EOS C100 Mark II Camera with 24-105 mm lens with Optical Image Stabilizer and dual recording capabilities.
- ☐ Two (2) 128GB memory cards
- ☐ Spare Camera Battery
- ☐ Garmin 64S GPS or GPS equivalent with tracking ability
- ☐ Spare GPS batteries
- ☐ Helicopter audio recording cable
- ☐ Push-to-talk cable
- ☐ Lens wipes
- ☐ Camera rain cover

Additional equipment

- ☐ Adequate food and water for the duration of the work
- ☐ Nausea medication
- ☐ Paper maps
- ☐ Notebook
- ☐ Pencils

Methodology

Prior to flight, all equipment should be checked to ensure it is in proper working condition, that there is adequate storage capacity on the memory cards, and batteries are fully charged. A flight plan, which includes the watershed and specific watercourses to be assessed, should be loaded into the handheld GPS and provided to the pilot prior to flight.

Prior to boarding, confirm the route and any specific flight or safety requirements with the pilot including any required safety orientation or pre-flight briefing. Ensure the pilot is comfortable with any required operation of aircraft doors in flight, and the videographer is briefed and knowledgeable about the aircraft door mechanisms if they will be responsible for opening and closing them during flight.

Once boarded, set up all camera equipment (see Figure 1 for reference). The audio recording cable allows the camera to capture any audio sent through the microphones while still allowing the videographer to communicate with the pilot and other passengers. The push to talk button can be used by the navigator to eliminate the noise caused by wind activating the videographer's microphone, which results in better audio. Set the GPS unit to track the flight.

When ready to begin recording, the navigator will confirm with the pilot and videographer that everything is set up and it is safe to open the door if needed. When recording begins, the navigator should provide an auditory introduction of the project, including date, time, team members, and watershed being flown for later reference.

During recording, the navigator is responsible for communicating with the pilot to ensure the targeted watercourses and tributaries (as required) are identified, tracked, and recorded. The navigator may also require the pilot to circle a complex feature or re-track a portion of the flight path to obtain adequate video coverage. Throughout the flight the navigator should also be providing ongoing, detailed commentary to assist in video review and ESRM scoring at a later date. It is important that the videographer confirm the camera is continually recording, as it is possible to inadvertently stop recording if the 'record' button is pressed again after record mode has started.

The Canon EOS C100 Mark II camera has the ability to simultaneously record on two (2) SD cards. However, once the flight is completed the data should be backed up as soon as possible to further avoid any data corruption or loss.

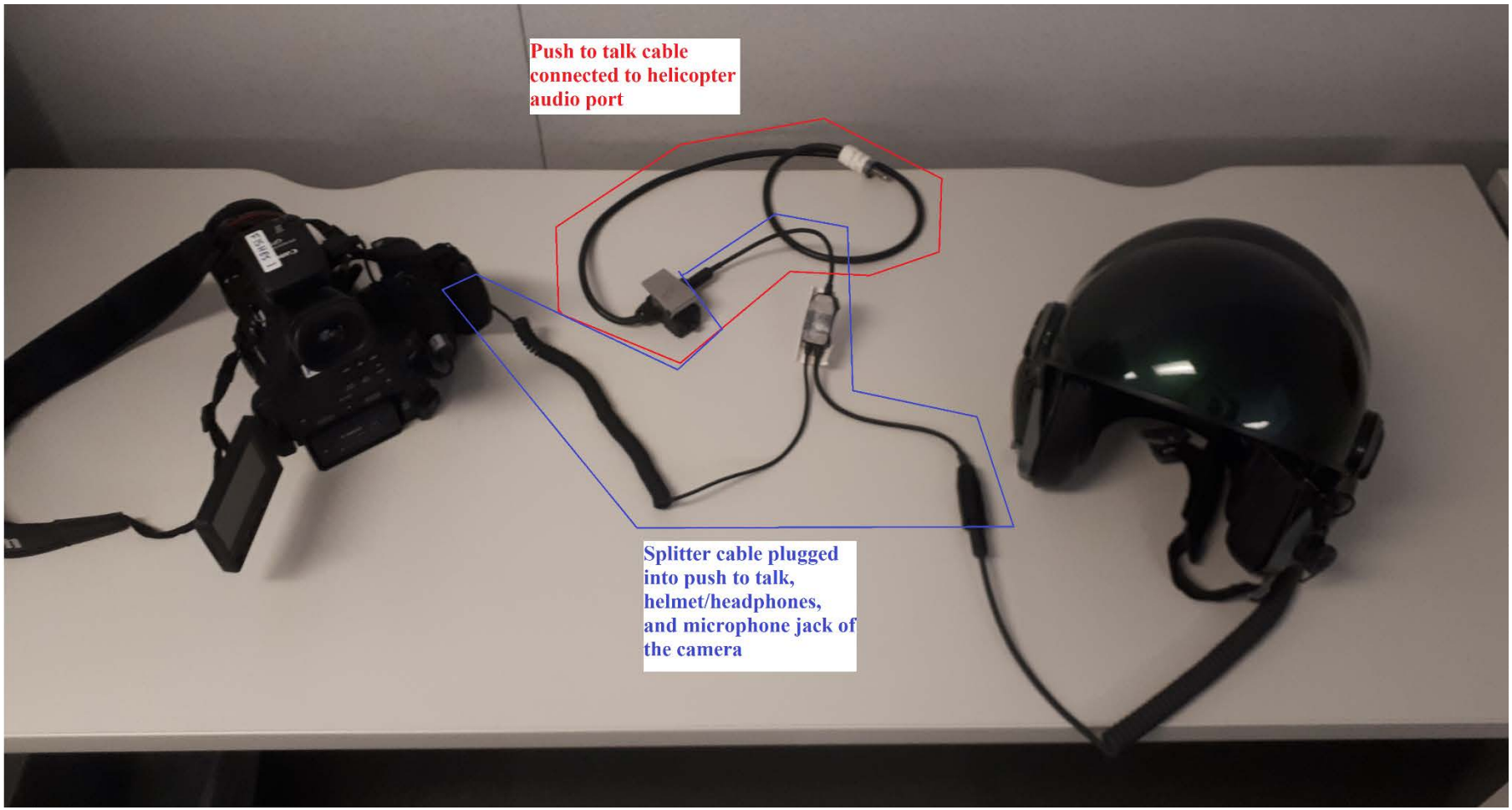

Figure 1: Set up of camera equipment for in flight recording of audio.

High Definition Videography Assessment Guideline

The purpose of the High Definition Videography Assessment Guideline is to provide definitions, and clear and consistent methods for scoring the metrics used during the 'preliminary assessment' phase of a FISHES project; scores will then be entered into the FISHES Program Evaluation Scoring and Ranking Model (ESRM). Use of this guide will help ensure that the outputs from the ESRM e.g. priority reach maps, reach scores and subsequent reach priorities, are consistent between projects and users of the ESRM. A list of materials, definitions, scoring methodology and common scoring scenarios for videography assessments follows. A thorough review of the guideline should be completed before reviewing and attempting to score videography for use with the ESRM.

Prior to reviewing the videography, the GPS data collected in-flight should be overlaid with the video. This is completed using Dashware, a free program available for download that allows travel paths, speed, altitude, and any other data collected via GPS to be shown on the video. When syncing the GPS data to the video it is important to ensure the GPS track is following the flight path as closely as possible to ensure accurate spatial references. Well synchronized video and GPS an be confirmed and is most easily seen by viewing a section of the video when the helicopter makes a tight turn such as when circling a feature or when turning back at the end of a flight.

For ease of scoring after reviewing the manual, designate one individual to record the required information in the excel file (see Preliminary Assessment Videography Tracking Template.xlsx). A second individual should be responsible for running the video, providing information to the recorder such as GPS location, metric observed, time of observation on video etc. Supplementing the videography with the best available i.e. high definition satellite imagery of the project area can also be very useful. This will help the second reviewer to estimate lengths of various disturbances so they can be accurately scored, by following the video and utilizing a browser measuring tool to estimate disturbance lengths.

The time of observation of a feature should be noted when the feature can be best seen in the video, ideally centered on the screen (as opposed to when the feature is called on the audio track or first appears). GPS location is assigned in one of three ways: previously from a hand-held unit recorded during flight, from the helicopter location, or from satellite imagery. The accuracy of these waypoints varies due to helicopter position and timing and may need to be confirmed using programs such as Google Earth. Be sure to consult the manual if ambiguous scenarios arise and record your reasons for choosing the metric you did.

List of Materials for Videography Scoring

- Video with overlaid GPS information
- Two laptops
- External hard-drive with recorded aerial video
- Large screen for viewing video
- Video projector with connected computer
- Laser pointer
- Excel Videography tracking file
- Satellite imagery: Google Earth, Bing, GOA imagery, Alberta Backroad Maps
- FISHES Aerial Scoring Manual and Habitat Collection Manual

Scoring Methodology

Geo-spatial Reference – The GPS coordinate in latitude and longitude (decimal degrees) corresponding to the location of the feature. This point will be loaded into ArcMap as part of the reach score evaluation.

Point source features (beaver dams, barriers, watercourse crossings and woody debris) have one GPS coordinate at the location of the feature.

Linear disturbances features (anthropogenic, flood disturbance and non-flood erosion) can have more than one GPS coordinate depending on the feature length.

Linear feature Geo-Spatial Reference – linear features will be referenced based on their downstream linear extent to the upstream linear extent according to the following criteria:

0 m to 100 m = 1 geo-spatial reference point

101 m to 200 m = 2 geo-spatial reference points

201 to 300 m = 3 geo-spatial reference points, and so on and so forth

All disturbances with two or more points will be geo-spatially referenced at the midpoint of the spatial category. For example, a 200 m linear disturbance would have one geo-referenced point at the 50 m mark and another at the 150 m mark. A 150 m linear disturbance would have one geo-spatially referenced point at the 50 m mark and another at the 125 m mark.

Metrics

1. **Beaver Dams – Geospatial Reference Point**
   Dam(s) built by beavers that typically span the width of the active channel perpendicular to the banks. Beaver dams increase a stream's ability to resist disturbance by holding back sediment, increasing water tables for riparian growth and dissipating energy during high flows. Beaver dams are distinct from 'Large Woody Debris" in that dams show consistency in width and shape, are typically made from mud and sticks, and can cause impoundment upstream of the dam.

2. Anthropogenic Disturbance – Geospatial Reference Point

2.1 Anthropogenic Instream Disturbance – is a human caused disturbance to the active channel, below the ordinary high-water mark. Cumulative effects from a large number of these types of disturbances may result in higher sensitivity of the watershed to flood events. These activities include, but are not limited to:

2.1.1. Off-highway vehicle(s) that enter the stream channel, below the ordinary high-water mark, and continue within the active channel, parallel to the direction of flow for a distance greater than 1.5 times the channel width. For example, an off-highway vehicle (OHV) trail enters a watercourse (channel width 40m) and parallels the direction of flow for a distance of 80 m before exiting the watercourse. Off-highway vehicles that drive in circles or meander in the stream before exiting are counted as a point source feature.

2.1.2. Bank armouring structures built from hard materials e.g. riprap and gabian baskets. Riprap located or associated around watercourse crossings is not recorded as a separate feature and should be considered part of the crossing. Riprap that extends 50 meters beyond the edge of the crossing Right of Way (ROW) should be considered a new feature.

2.1.3. Anthropogenic debris located within the active channel. This could include concrete slabs, building materials, abandoned vehicles, etc.

2.1.4. Cattle walking within the active channel.

but does not include: Watercourse crossings e.g. fords, bridges, culverts, etc. (See Section 4 Watercourse Crossings)

2.2 Anthropogenic Riparian Disturbance - is a human caused disturbance to the riparian area that occurs within 10 m of the ordinary high-water mark. Standing water on an OHV trail is also considered an additional anthropogenic disturbance if the area in question has a minimum of 3 m by 2.5 m disturbance area, roughly the footprint size of a 4x4 vehicle. This can occur on a trail in the riparian zone or directly adjacent to a ford. Riparian disturbances that occur further than 10 m from the ordinary high-water mark can be considered if there is a direct or intermittent path for sediment to enter the watercourse. Cumulative effects from a large number of these types of disturbances may result in higher sensitivity of the watershed to flood events. These activities include, but are not limited to, off-highway vehicle trail networks, random campsites, access points, logging activity, right-of-ways, agricultural fields, and grazing activity that is within 10 meters of the bankful width active channel or where there is visual evidence of sediment contribution to the water body. For example, a random camp site within 10 m of the ordinary high-water mark would receive one geo-spatial point. If off-highway vehicle(s) mud bogging is occurring outside 10 m of the riparian area but shows evidence of direct sediment input into the watercourse this feature would receive one geo-spatial point.

2.2. **Potential Barriers – Geospatial Reference Point**– are any physical, physiographic, chemical, or biological obstacles to fish movement. Barriers can provide effective opportunities for habitat restoration or identify locations of species separation. Barriers include, but are not limited to, falls, chutes, velocity barriers, perched culverts, weirs, etc. Beaver dams are not considered barriers in the preliminary assessment.

3. Watercourse Crossings – Geospatial Reference Point

Permanent or temporary crossing(s) and any associated permanent or temporary structures that are or will be constructed to provide access over or through a water body, including but not limited to bridge, culvert, or ford. Crossings can potentially be associated with erosional processes, and are susceptible to flood damage.

3.1. Bridge crossing means a watercourse crossing that is constructed using a single span bridge, single span pipeline bridge, multi-span bridge with abutments or piers, or other similar structure. Note any extensive armoring at crossings. Recall that riprap located or associated around watercourse crossings is not recorded as a separate feature and should be considered part of the crossing. However, riprap that extends 50 meters beyond the edge of the crossing Right of Way (ROW) can be considered a new feature.

3.2. Culvert crossing means a watercourse crossing that is constructed using a round, arch, box culvert or other similar structure, on or within the bed of a water body;

3.3. Ford crossing is a low-level crossing that results in disturbance to the active channel and adjacent riparian area. A ford has only one access and egress point that includes the area 50 m from the active channel, and crosses the water body in a perpendicular manner to the flow. Access and egress trails that split within 50 m of the active channel do not encompass a typical ford crossing and should be considered as an additional anthropogenic riparian disturbance. Notes can be included to help determine the primary users of the ford (ATV, 4x4, livestock or wildlife).

3.4. Other crossing is all other potential crossings including logfill, recreational foot, pipeline etc;

4. Large Woody Debris – Geospatial Reference Point

Logs, sticks, branches, and other large woody material that are located within the active channel. Instream woody debris is an important component of fish habitat; fish populations often respond negatively to the removal of woody debris. Large woody debris will be geo-spatially referenced according to the following criteria:

Clusters of three or more logs will receive one geo-spatial referenced point; this rule applies when low numbers of clusters are present. When numerous logs are encountered in an area e.g. forest fire burn, every fifth log represents one geo-spatially referenced point of large woody debris.

5. Flood Disturbance – Linear Disturbance

A disturbance to the natural channel geometry resulting from high flow events which include, but are not limited to, braided channels, excessive gravel depositions, and eroded banks. Use pre-flood satellite imagery to determine the extent of flood damage. In some cases, this imagery will show historic flood disturbances in a location presently disturbed, in which case the existing disturbance is not counted. Natural bank erosion is categorized as '**Non-flood Erosion**' as the disturbance has not been impacted by high flow events.

6. Non-flood Erosion – Linear Disturbance

Eroded banks caused by alluvial processes that are not a result of extreme high flow events. Extreme high flow events are defined as flood events equal to or greater than 1 and 100 year flood events.

Example Scoring Scenarios

The following legend should be used in conjunction with the example scoring scenarios provided in Figure 1through Figure 6 below.

	Geo-spatial reference
	River/Stream, water flow is left to right.
	Road/Trail
	Rip-Rap
	Bridge

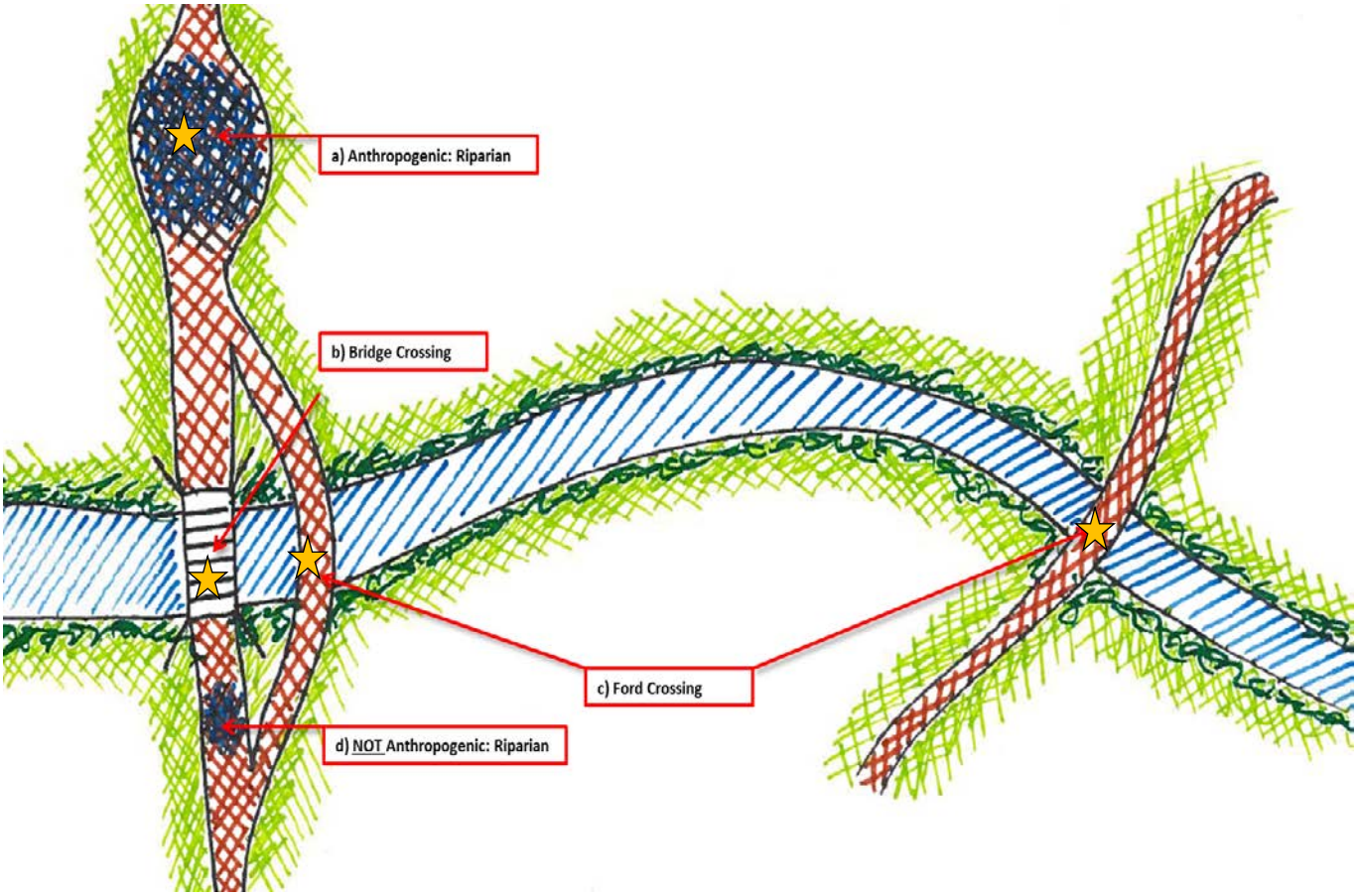

Figure 1. The above scenario has two ford crossings (c), one bridge crossing (b) and one anthropogenic riparian disturbance (a).

(a) Anthropogenic Riparian Disturbance –standing water on the OHV trail is considered an additional anthropogenic disturbance if the area in question has a minimum dimension of 3 m by 2.5 m of disturbance i.e. roughly the footprint of a 4x4 road vehicle. The standing water area also has a direct or intermittent path for sediment to enter the watercourse

(b) Bridge Crossing – the watercourse is being crossed by a bridge. Note that riprap located or associated around watercourse crossings is not recorded as a separate feature and should be considered part of the crossing. Riprap that extends 50 meters beyond the edge of the bridge or associated ROW can be considered a new feature.

(c) Ford Crossing – the watercourse is being crossed by OHV(s) adjacent to the bridge crossing that is typical of a ford crossing.

(d) Anthropogenic Riparian Disturbance – the small area of standing water on the OHV trail is NOT considered a unique feature as the area in question is smaller than 3 m by 2.5 m. Watercourse crossings have a typical level of anthropogenic disturbance associated with them such as standing water, compact soil and erosion/sediment input. Additional anthropogenic disturbances should only be considered when the disturbance in question is beyond or above the typical level of disturbance associated with that activity.

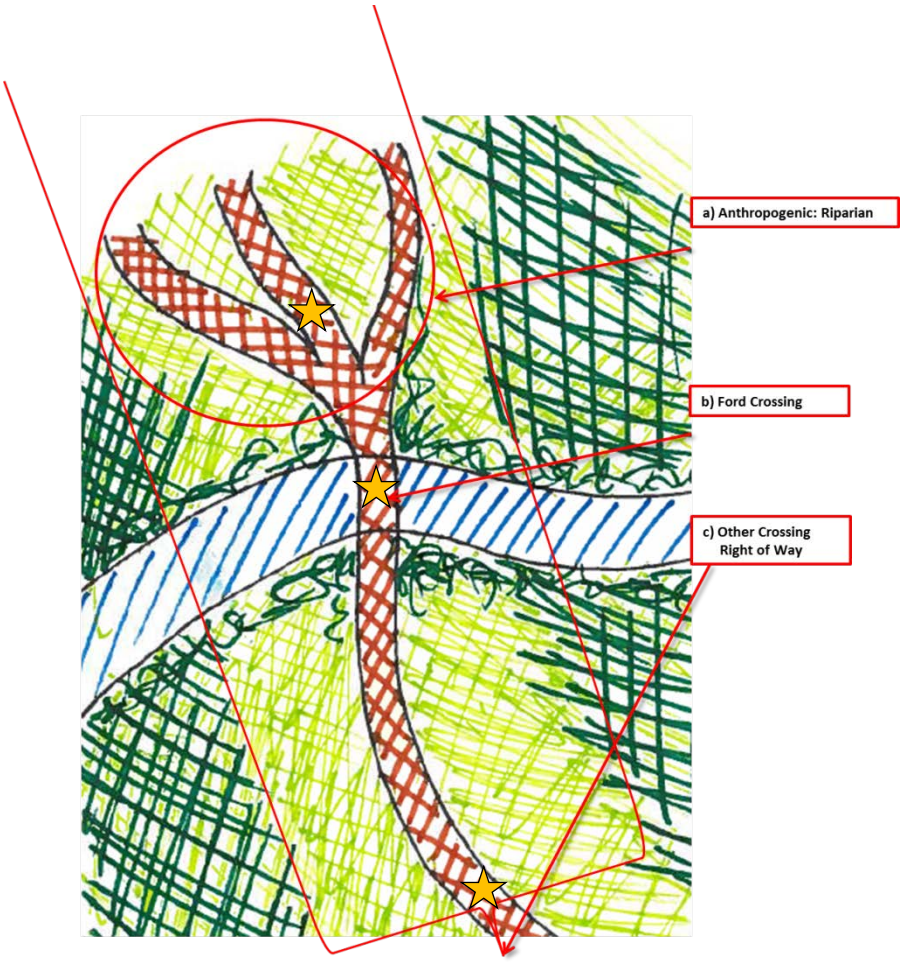

Figure 2. The above scenario has two anthropogenic riparian disturbances (a, c) and one ford crossing (b).

(a) Anthropogenic Riparian Disturbance – the ford crossing immediately branches out into three trails within 50 m of the watercourse and has the potential to cause additional adverse effects on the watercourse that are greater than a single OHV trail associated with a typical ford crossing.
(b) Ford Crossing – the watercourse is being crossed by OHV(s) using the existing ROW as an access and egress point.
(c) Anthropogenic Riparian Disturbance – the ROW has disturbed the natural riparian area around the watercourse.

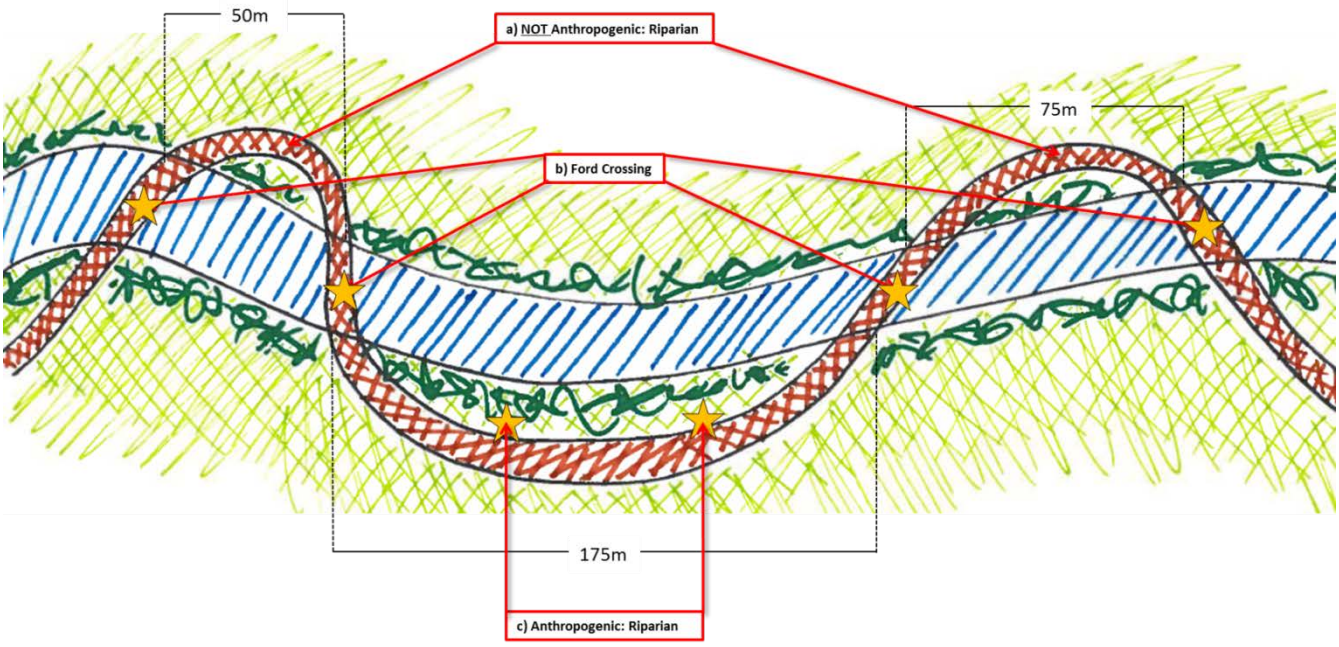

Figure 3. The above scenario has four fording crossings (b) and two riparian disturbances (c).

(a) Anthropogenic Riparian Disturbance – the trail paralleling the watercourse is NOT considered a 'Riparian Disturbance'as the access/egress point leaves the watercourse and fords the watercourse again less than 100 m from the previous ford. The allowance of 50 m for access and egress on each 'Ford Crossing' is the reason the 50 m and 75 m trails were not considered an anthropogenic riparian disturbance.
(b) Ford Crossing – the watercourse is being crossed at four unique locations.
(c) Anthropogenic Riparian Disturbance – the trail stays within the 10 m riparian buffer zone of the watercourse, and is longer than the 50 m allowance for each ford crossing.

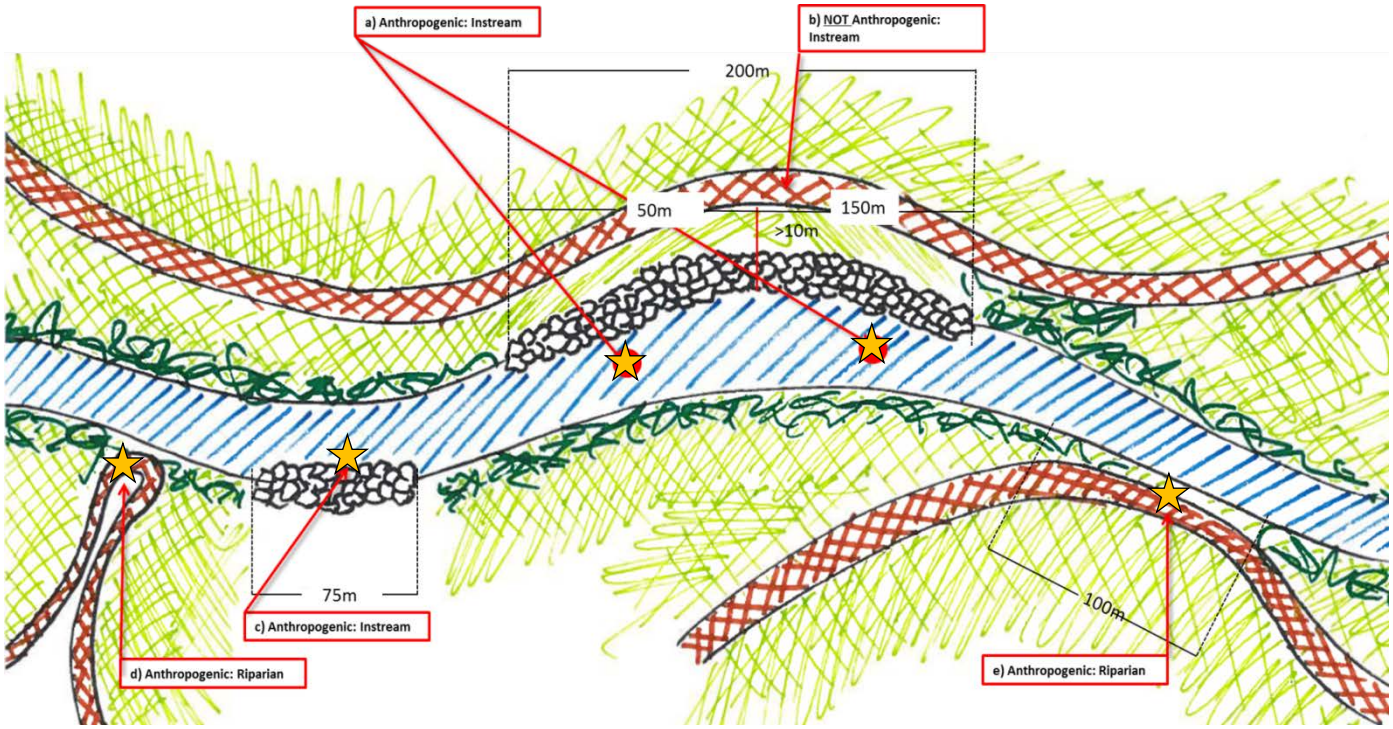

Figure 4. The above scenario has three anthropogenic instream disturbances (a, c, d) and two anthropogenic riparian disturbances (d,e).

(a) Anthropogenic Instream Disturbance – hard bank armouring (riprap) for a total length of 200 m is considered an instream disturbance and two geo-spatial reference points at 50 m and 150 m were applied to this scenario.
(b) Non-Anthropogenic Riparian Disturbance – the trail paralleling the watercourse is greater than 10 m away and therefore is NOT considered a riparian disturbance.
(c) Anthropogenic Instream Disturbance – hard bank armouring (rip-rap) for 75 m is considered an instream disturbance and one geo-spatial reference point was applied to this scenario.
(d) Anthropogenic Riparian Disturbance – the trail approaches the watercourse within the 10 m riparian buffer zone.
(e) Anthropogenic Riparian Disturbance – the trail parallels the watercourse within the 10 m buffer zone for 100 m and therefore receives one geo-spatial reference point.

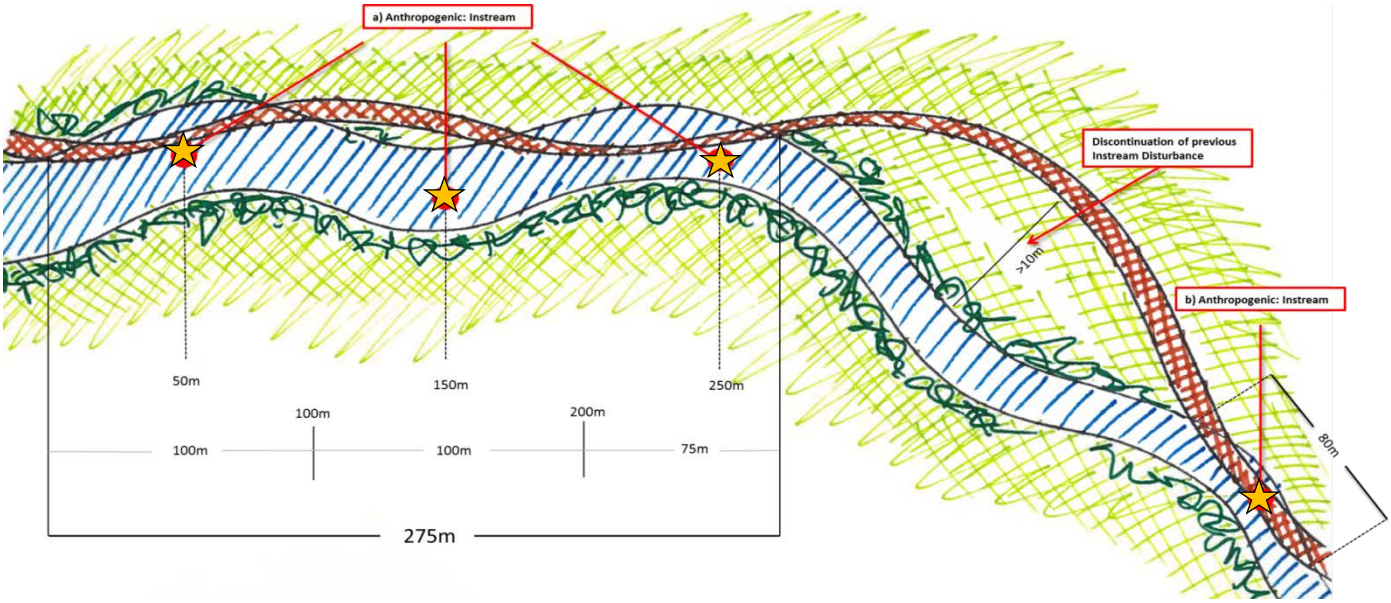

Figure 5. The above scenario has four anthropogenic instream disturbances (a, b).

(a) Anthropogenic Instream Disturbance – the trail enters the active channel in a manner that is NOT perpendicular to the watercourse and continues to parallel the direction of flow, periodically leaving the active channel and immediately re-entering the active channel. This feature is NOT typical of a ford crossing and is therefore considered an instream disturbance. The linear disturbance is 275 m measuring from the point where the trail enters the active channel for the first time and then finally exits the active channel without entering again. Three geo-spatial reference points where applied to this scenario at 50m, 150m, and 237.5m.

(b) Anthropogenic Instream Disturbance – the trail enters the active channel in a manner that is NOT perpendicular to the watercourse and continues to parallel the direction of flow for 80 m before leaving the active channel and the riparian 10 m buffer zone.

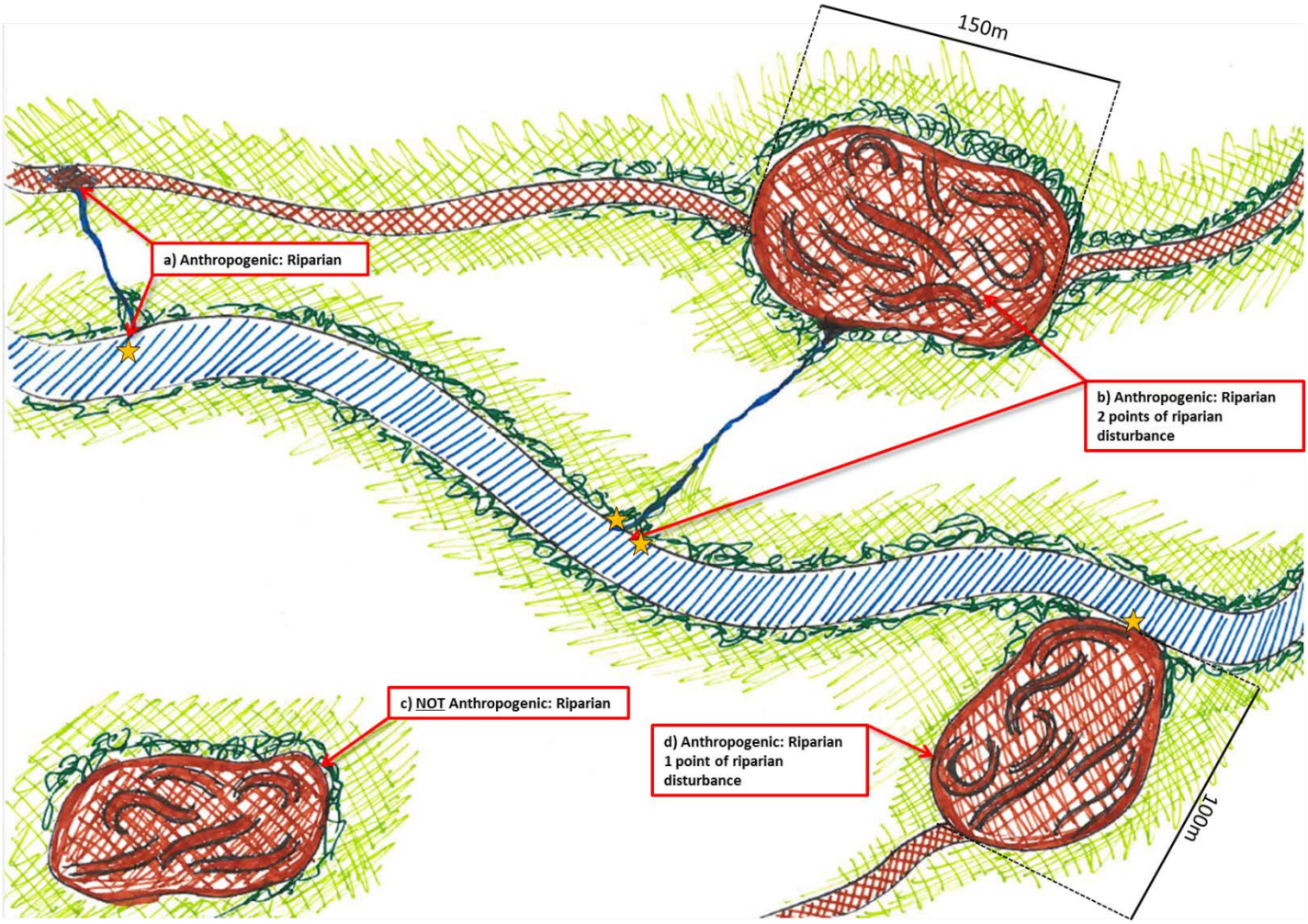

Figure 6. The above scenario has three anthropogenic riparian disturbances (a, b, d).

(a) Anthropogenic Riparian Disturbance – standing water from the OHV trail that is outside the 10 m buffer zone has created a direct path for sediment input into the watercourse.
(b) Anthropogenic Riparian Disturbance –the mud-bogging area on the OHV trail has created a direct link for sediment input into the watercourse. Due to the size of the mud-bogging area which has a linear length of 150 m, linear geo-spatial reference will apply. As a result, two geo-spatial reference points were applied to the watercourse in the area where sediment inputs into the watercourse.
(c) Non-Anthropogenic Riparian Disturbance – mud-bogging area is outside the 10 m riparian buffer zone and there is no obvious direct sediment input into the watercourse, therefore NO geo-spatial reference points were applied.

Anthropogenic Riparian Disturbance – soil compaction and pooling of water from the trail is within the 10m riparian buffer zone and has a linear length of 100 m. One geo-referenced point was applied for the geo-spatial referencing for the length of the mud pool.