DATA SUMMARY REPORT

Information into Action:

Synthesizing available data and Traditional Knowledge into recommendations for Arctic grayling recovery

Prepared for
Swan River First Nation

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Swan River First Nation is a Woodland Cree community who is a signatory to Treaty Number 8 and a member of the Lesser Slave Lake Indian Regional Council. Swan River First Nation vision is to restore balance to the land by following in the footsteps of their ancestors and fulfilling our inherent responsibilities through Wahkohtowin. The Nation's mission is to protect their land and weave their language, culture and ceremonies into their work. They continue to be a visible presence in their territory and do everything they can to uphold natural laws and care for their lands according to the teachings they have carried across generations.

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Table of Contents

Table of Figures

Table of Tables

1. Introduction

1.1 Biology

Arctic grayling (*Thymallus arcticus*) is a cold freshwater fish species that can be identified by their large colourful dorsal fin. Regardless of life cycle (fluvial or adfluvial), Arctic grayling (ARGR) require cold, clear, and connected waters (McPherson 2020). They are known to have complex migration patterns for feeding, overwintering, and spawning. These migrations are triggered through water temperature and seasonal changes within local environments (Stamford et al. 2017). Arctic grayling use at least four major habitat types throughout their lifespan (AEP and ACA 2015; Stamford et al. 2017; McPherson 2020). These habitat types range from cobble dominant, silt/sand dominant, run/riffle dominant, and pool/boulder dominant depending on their life stage (McPherson 2020). These habitat types may not exist in one single stream therefore migrations are necessary for survival (Stanislawski 1997). Fluvial ARGR have short trophic migrations in side channels, and stream margins for summer feeding, they then move into refuge channels in the fall (AEP and ACA 2015). These migrations are repeated until sexual maturity is reached at age 4 (AEP and ACA 2015). Once water temperature reaches 4°C, sexually mature female grayling leave deeper waters to enter shallows to spawn, after which, movement from shallows to larger rivers or lakes is common (AEP and ACA 2015; Stamford et al. 2017). These migration patterns can span long distances with some Alberta ARGR populations moving up to 50 km from August to January (Stanislawski 1997). Due to these complex migration patterns,

habitat fragmentation is listed as one of the greatest threats to ARGR within Alberta (AEP and ACA 2015).

The largest group of ARGR in Alberta is in the upper and lower foothills subregions, including the Swan River Watershed (AEP and ACA 2015). ARGR has been provincially listed as a Species of Special Concern due to the decrease in populations within Alberta and their vulnerability to angling, increasing water temperatures and habitat fragmentation and degradation (Christie et al. 2010; AEP and ACA 2015; Stamford et al. 2017). Additionally, ARGR is considered an indicator species of ecological integrity suggesting declines reflect impacts to overall aquatic ecosystem health (Tchir et al. 2003). Together, this illustrates the need for continual monitoring of this cold-water species to better understand how the ecological integrity of the watershed is affected by various activities on the landscape.

Due to the fragmentation that has occurred within ARGR habitat in Alberta, the species was given the general status of *Sensitive* in the Current Status of Alberta Wild Species report in 2000 (ASRD 2000). Six years later ARGR was listed as a *Species of Special Concern* due to a recommendation made by Alberta's Endangered Species Conservation Committee (AEP and ACA 2015). There is currently no federal designation by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), although the species is labelled as a high priority candidate (AEP and ACA 2015). Angling regulations with regards to ARGR have been implemented in Alberta due to these statuses. ARGR currently has a zero-possession limit within Alberta. This means members of Swan River First Nation and other First Nation communities have lost their treaty right to harvest an important traditional food.

1.2 Swan River Watershed

The Swan River Watershed has a high density of industry such as, agriculture, oil and gas, and forestry. The human footprint in 2021 encompasses 34% of the entire watershed, the highest percentage being forestry (Palliser Environmental Services Ltd 2024). In fact, the human footprint of Swan River watershed is 5% higher than the provincial average. The forestry aspect of this footprint is much larger than the comparable provincial average, 63% and 4.3% respectively (Palliser Environmental Services Ltd 2024). This increase in human footprint and industry within the watershed corresponds with the increase in linear features such as roads and trail networks. These features are known to impact hydrology of watersheds by impeding or redirecting flows (Palliser Environmental Services Ltd 2024). In 1998, Swan River Watershed had 3931km of permanent roads and over 759 stream crossings (Tchir et al. 2004). As of 2023 the distance of access roads was 6,118 km, which is a 1.5x increase in 25 years (Palliser Environmental Services Ltd 2024). Industry such as forestry, mining and road construction has been known to decrease the quality of suitable habitat for cold water fish species (Park et al. 2008; AEP and ACA 2015). Loss of riparian habitat can increase stream temperatures which can be detrimental to fish that require specific stream temperature gradients for migration patterns like ARGR (AEP and ACA 2015). According to lab experiments, ARGR become stressed at 17.2 °C (Lohr et al. 1996), temperature stressed fish species are less resistant to other external stressors such as habitat fragmentation, angling pressure, and nutrient loading (AEP and ACA 2015). Fragmentation of habitat can happen when culverts are poorly installed and impede fish passage (Figure 2). Human made fish barriers pose a threat to the

complex migration patterns of ARGR and disrupt gene flow resulting in reduced genetic diversity within populations (Reilly et al. 2014). These barriers can also decrease repopulation of streams and increase

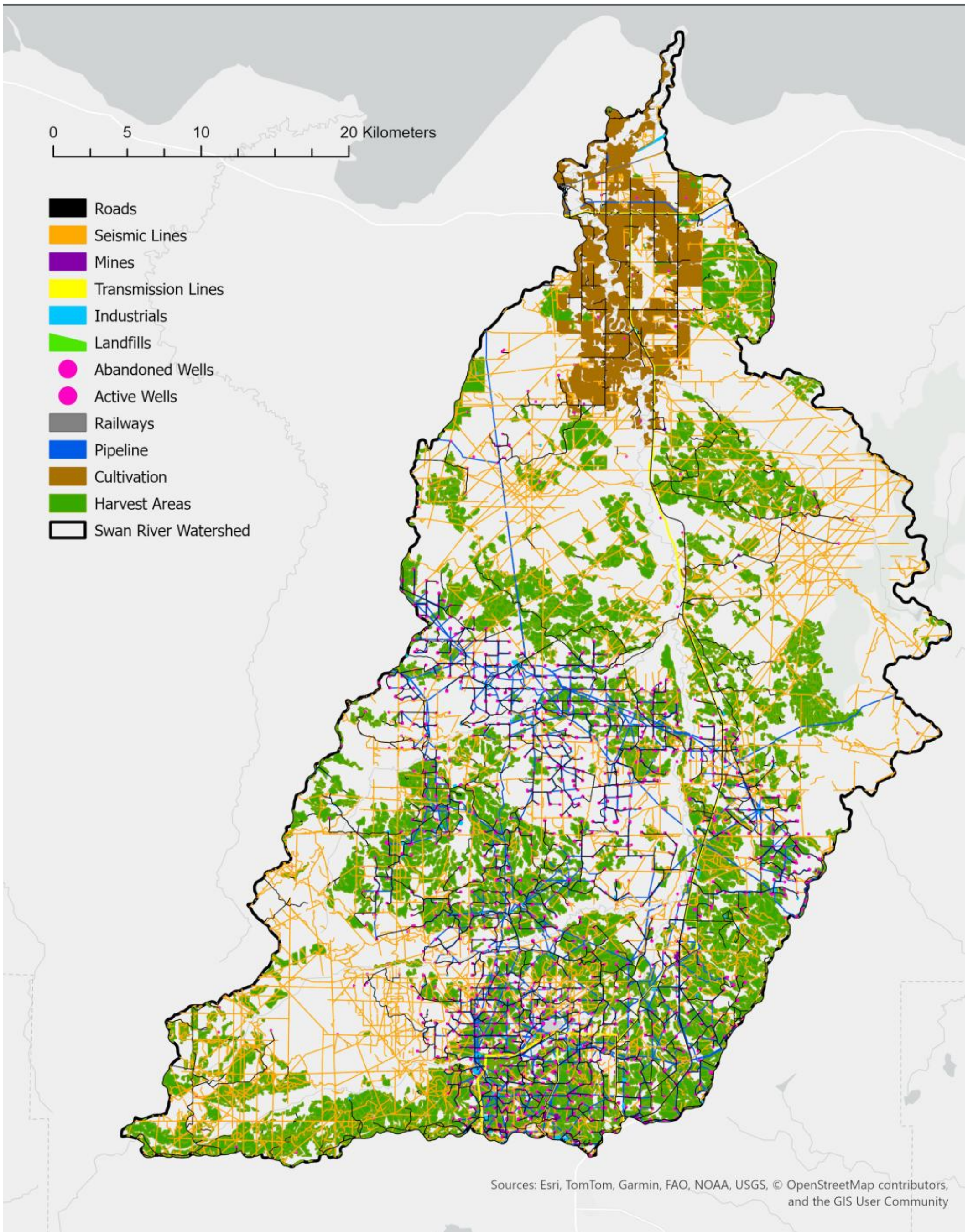


Figure 1. Human footprint illustrating total land use in the Swan River watershed.

population loss during natural events such as flooding or droughts leaving fish no opportunity to escape (Reilly 2014; AEP and ACA 2015; Stamford et al. 2017). Within the Swan River watershed, approximately 737 km of stream has been fragmented due to stream crossing structures (Hurkett and Redman 2016). The reconnection of streams by replacing stream crossing structures is necessary for ARGR to complete their life cycle and the remediation of their habitat (Hurkett and Redman 2016).

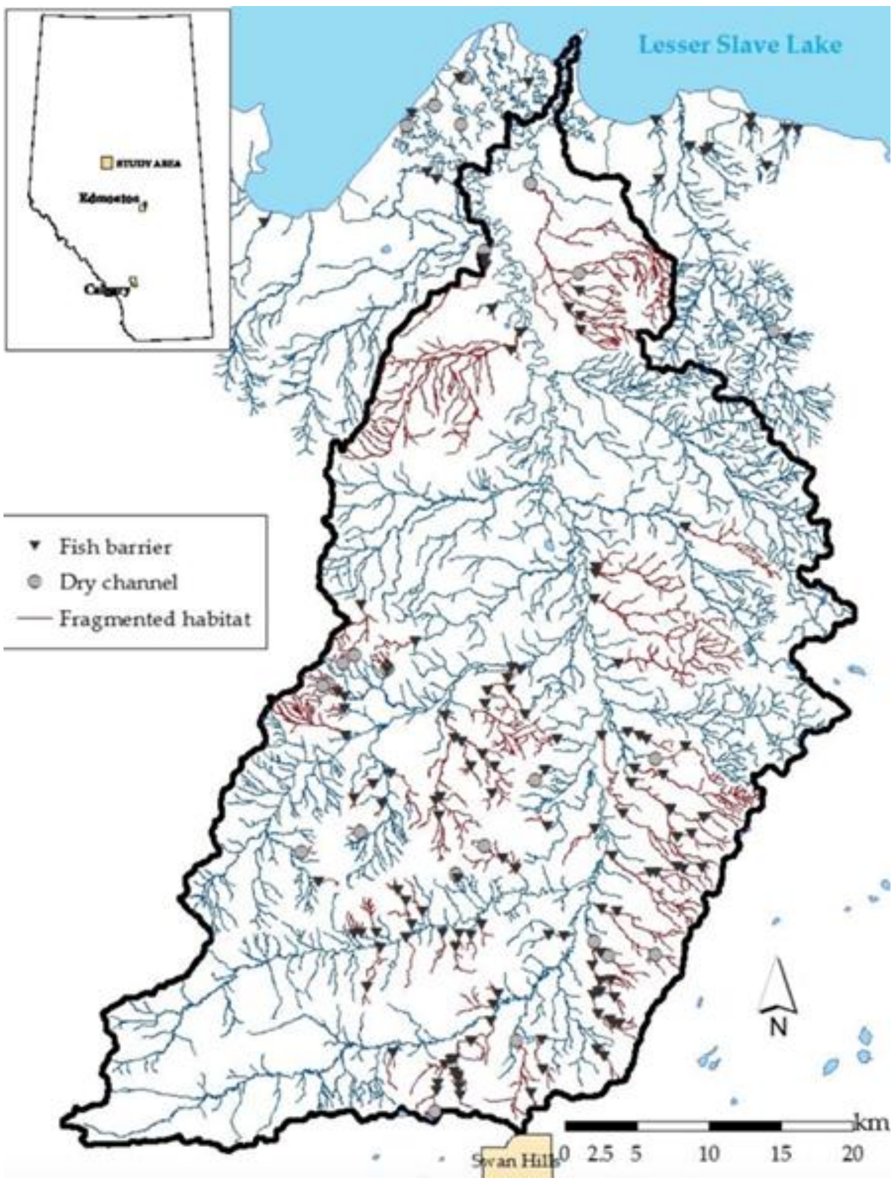


Figure 2. Habitat fragmentation in the Swan River watershed due to stream crossings (Hurkett and Redman 2016).

Swan River First Nation (SRFN) is a Woodland Cree community located on the southern central shore of Lesser Slave Lake. Prior to colonization, human induced fragmentation of the landscape is believed to be non-existent. Swan River First Nation is one of the original signatories to Treaty 8 signed by Kinosayo in 1889. Signatories of Treaty 8 have the right to conduct hunting, trapping, fishing, gathering, spiritual and cultural practices which continue to be upheld by Cree people today. SRFN is concerned about the rapid pace of development within their traditional territory and the loss of land and resources (MSES 2014). With this loss of land and resources, the loss of ability to conduct culturally and spiritually significant practices comes too. To combat the decline of resources within their traditional land use area, SRFN identified an area of 319 km^2 that is considered a no-go development zone called Grizzly Ridge Traditional Use Preserve within Wildlife Management Unit 350 (MSES 2014). Various conservation efforts like this have been conducted by SRFN. Examples of these efforts include, eDNA sampling of the Freeman watershed to better understand the distribution of Athabasca Rainbow Trout, and aquatic connectivity monitoring for Bull Trout in the Athabasca Watershed. Several conservation projects/research have also been conducted by SRFN with a focus on the Swan River watershed and remediation of ARGR habitat. This includes the creation of the Swan River Watershed Initiative with the objectives to increase knowledge sharing and collaboration to advance habitat restoration within the watershed. This initiative supports the research and monitoring that has been done by SRFN on the Swan River watershed such as stream crossing prioritization, habitat surveys, and ARGR monitoring reports.

1.3 Objectives

The objective of this report is to review and summarize the current data collected by SRFN and other organizations (e.g., GOA and ACA) on ARGR and the quality of habitats within the Swan River watershed (Figure 3). This objective also seeks to identify areas of concern and/or gaps in available data regarding fish and habitat conditions within the Swan River watershed.

Figure 3. Timeline of projects conducted by SRFN regarding ARGR and stream crossing conservation and/or monitoring in the Swan River Watershed, AB.

2.0 Research up to Date

2.1 Stream Crossing Prioritization (MSES 2018)

Due to the increase in fragmentation within the watershed, Swan River First Nation requested that Management and Solutions in Environmental Science (MSES) complete a prioritization of stream crossings that are in need of remediation (Figure 4). This project was conducted in 2018 and focussed on increasing habitat connectivity of ARGR across the watershed and decreasing sedimentation. According to the prioritization analysis, 20 crossings were identified for full crossing remediations. This analysis indicated that 778 km of upstream habitat could be accessible to fish populations if all 169

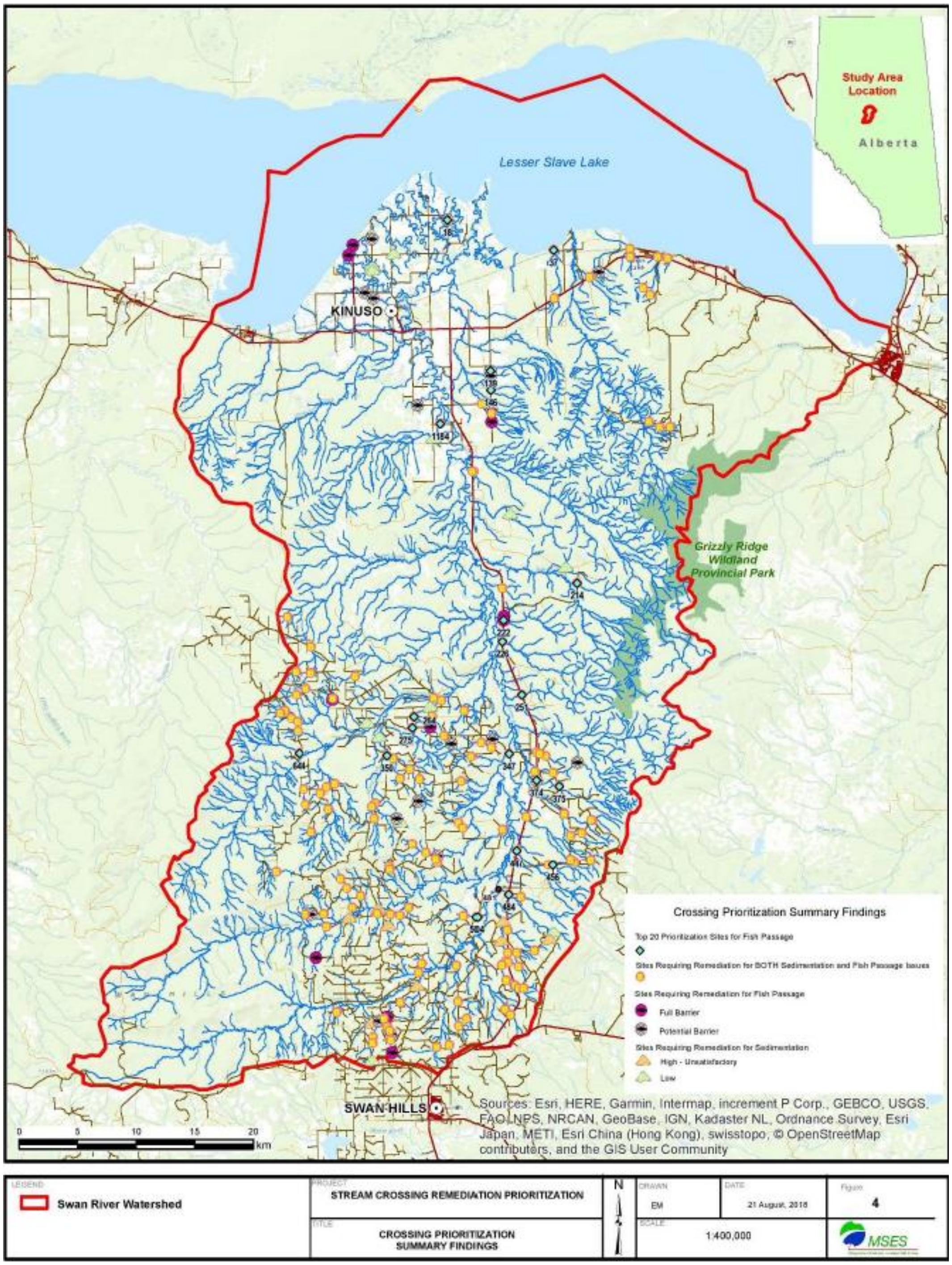


Figure 4. Summary of stream crossings requiring remediation including full and partial barriers, as well as sedimentation concerns (MSES 2018).

crossings were remediated, 47% if top 20 sites were remediated and 25% if the top 5 sites were remediated. There are three spatial clusters for remediation. The highest priority being sites along HWY 33 (sites 251, 226, 447, 222, and 374). These sites were characterized by sloped culverts, high elevation gradient terrain and higher water velocities. The second cluster was in the south and southwest region of the watershed and located in oil and gas industry areas (sites 644, 275, 264, 350, and 504). These sites were characterized by moderate elevation gradients, potential barriers, and less upstream habitat. These culverts contained outlet gaps, culvert slopes and debris blockings. The third cluster was in the lower watershed (139, 18, 214, 146, 347, and 37). These crossings were considered potential barriers with less upstream habitat. Factors that were not included in this prioritization was remediation costs, upstream habitat suitability for ARGR and new data from reassessments of high priority crossings.

Table 1. Top priority sites for fish passage from MSES Stream Crossing Remediation Prioritization (reproduced from MSES 2018).

Priority	Site ID	Fish Barrier	Net Amount of Upstream Habitat (km)	Recommendations
1	1184	Potential barrier	135.1	Fish Passage assessment required
2	251	Full barrier	40.6	Repair outlet gap and sloped culvert, address beaver activity
3	226	Full barrier	35.6	Repair outlet gap and sloped culvert
4	644	Full barrier	27.4	Repair outlet gap; remove woody debris

5	447	Full barrier	36.1	Repair outlet gap and sloped culvert
6	222	Full barrier	20.8	Repair outlet gap and sloped culvert
7	375	Full barrier	27.7	Repair outlet gap and remove obstacles
8	374	Potential barrier	31	Repair outlet gap and sloped culvert
9	275	Full barrier	27.8	Remove woody debris, address beaver activity, assess slope of culvert and water velocity
10	264	Potential barrier	33.6	Repair outlet gap
11	139	Potential barrier	25.3	Fish passage assessment required
12	18	Potential barrier	22.2	Address beaver activity, and remove blockage
13	350	Potential barrier	33.9	Repair outlet gap, remove woody debris
14	214	Potential barrier	18.7	Repair outlet gap
15	484	Potential barrier	23.6	Repair outlet gap and sloped culvert
16	146	Full barrier	9.1	Repair outlet gap
17	347	Potential barrier	21.8	Address beaver activity, repair culvert
18	37	Potential barrier	17.9	Repair outlet gap, inlet slope and culvert slope
19	456	Full barrier	7.8	Repair outlet gap

20	504	Potential barrier	10	Repair outlet gap and sloped culvert; address beaver activity

2.2 Habitat Survey Report (MSES 2021)

Due to the lack of data on upstream habitat within the prioritization of twenty stream crossings, another study was requested by SRFN and conducted by MSES in 2020. The key objective of this project was to collect habitat information of known fish barriers to evaluate the quality of habitat upstream. The collection data improved SRFN's prioritization of stream crossing barriers. Surveys were conducted at 21 priority sites and Traditional Knowledge sites within the Swan River watershed. At each site a road crossing assessment, visual survey, habitat survey and discharge measurements were conducted. The lack of gravel substrate on most of the sites indicates that potential spawning habitat for ARGR is low. The potential for overwintering habitat is also low for the majority of the sites, suggesting overwintering may take place somewhere else in the watershed or in Lesser Slave Lake. Four crossings were free of fish barriers (sites 37, 139, 347, and 484) although the majority of these sites had low potential for overwintering, spawning, rearing, and feeding habitat. The one exception is crossing 139 with high quality upstream rearing habitat. Four crossings (sites 264, 374, 375, and 350) are expected potential fish barriers with no large outlet gap but due to the sloped culvert one could be seen in the future (Table 2). Crossing 264 was the only site where gravel was present and provides an opportunity for overwintering, spawning, rearing, and feeding. Due to this substrate, crossing 264 is best ARGR habitat out of all the sites that were surveyed. Full fish barriers were detected at five crossings (sites 146, 222, 226, 251, and 447; Table 2). All barriers except crossing 146 were detected to have medium to high quality habitat for rearing and feeding. Water levels were low when compared to the MSES 2018 report with various sites containing stagnant water or were completely dry. Two of the top five sites indicated in the MSES 2018 Stream Crossing Prioritization Report (sites 1184, 644) were found to have no barrier to fish passage but lack of adequate habitat for ARGR. Crossing 504 has been remediated since 2018 and two crossings (sites 481, TK2) no longer have a culvert present. Medium to high habitat quality for overwintering, rearing/feeding, or spawning were seen at 45% of sites (9 out of 20 sites), 8 of these sites have a full or potential fish barrier.

Table 2. Upstream habitat potential to support ARGR for sites that were found to have a full barrier or potential barrier (reproduced from MSES 2021).

Priority from 2018	Site ID	Overwintering Habitat	Rearing/feeding Habitat	Spawning Habitat	Fish Passage	Recommendations
5	447	M	H	L	Barrier	Remediation
3	226	L	H	L	Barrier	Remediation
2	251	L	M	L	Barrier	Remediation
6	222	L	M	L	Barrier	Remediation
16	146	L	L	L	Barrier	-
10	264	M	M	M	Potential barrier	Monitor
7	375	M	M	L	Potential barrier	Monitor
8	374	L	H	L	Potential barrier	Monitor

13	350	L	H	L	Potential barrier	Monitor

2.3 Arctic Grayling Monitoring Report 2021/2022 (MSES 2022)

Considering the increased industry impacts on the watershed, SRFN is aiming to protect and restore the capacity of their land to support traditional use through community-based monitoring programs. This community-based monitoring program focused on ARGR presence and habitat assessment within the Swan River watershed. This program was created with the assistance of MSES and associates and the SRFN community. The main objectives of this monitoring project were to improve the current understanding of ARGR habitat at previously prioritized crossings for remediation, assess fish presence around said crossings, collect data on water temperatures and train members of the community on fish habitat surveys and eDNA surveys within their traditional territory. Sites were selected based on priority road crossings found in 2018, Traditional Knowledge sites, and along tributaries containing Class B waterbodies and field work was conducted in the summer of 2021. Road crossing assessment, visual surveys, and habitat surveys were conducted at each site (Table 3). ARGR DNA was found at 56% of the sites. These sites were mainly downstream of crossings, on the main stem of Swan River and in tributaries near confluences with Swan River. Full barriers were found at seven crossings, although grayling DNA was present upstream of two of these crossings therefore, they could be considered potential barriers depending on flow level. High water temperatures were recorded at all sites in July which likely negatively impacted spawning and incubation potential. The upper incipient

lethal temperature (UILT) of ARGR was exceeded in June at two crossings (sites 37, 350) making those crossings not suitable for ARGR that year. Spawning temperatures were only assessed for a short period of time. When assessing habitats for all the sites it was found that Crossing 251 and 374 had the best grayling habitats although both have fish barriers. A total of six sites were considered to have high potential for successful restoration due to low seasonal water temperatures, gravel substrate and adequate stream cover. The highest priority site being crossing 374, as it appears to be the first barrier to fish passage and has high potential to increase the availability to grayling spawning and overwintering habitat if remediated.

2.4 Arctic Grayling Monitoring Report 2022/2023 (MSES 2023)

Within the second year of the community-based monitoring program for ARGR habitat, the same sites were assessed from the previous year with the addition of fourteen sites in the summer of 2022. These fourteen additional sites were sites along tributary streams that potentially have high quality fish habitat. ARGR DNA was found at 58% of the sites sampled. The majority of these detections were found in the headwaters near Swan Hills, and in tributaries with colder than average water temperature. Grayling DNA was usually found upstream of confluences with Swan River and downstream of road crossings, this was similar results to the previous year. The mean water temperature between July and September for all tributaries was lower than the UILT for ARGR, which is indicated as 24.8-27.9 °C. While the mean temperature for these tributaries was lower than UILT, there

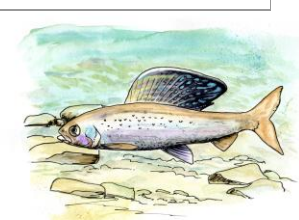
were daily fluctuations in temperatures that exceeded this limit. Spawning in Alberta occurs from May to June, and around water temperatures of 6-10 °C. Temperature was recorded to be higher than optimal for spawning in most tributaries. Temperature loggers were only deployed in the middle to late June therefore it is possible that spawning temperatures may have been more ideal earlier in the season. In addition to the lack of optimal spawning temperatures, spawning habitat was also limited in most sites due to lack of gravel. Ten sites had gravel substrate and access to riffles with moving water which allows for moderate to high spawning habitat quality. It is likely overwintering happens elsewhere within the watershed as there were only five sites that had high potential for overwintering. The highest rank spawning and overwintering potential was at crossing 350, although more temperature monitoring is needed as it did not have ideal spawning temperatures. After assessing the eDNA, temperature and habitat data, all the sites were ranked low to high priority for restoration and for conservation. Twelve out of thirteen sites were ranked high to medium priority for restoration, four of which are full fish barriers (sites 251, 374, 350, and 561; Table 3). Nine out of twenty-three sites were ranked as a high priority for conservation, one of these sites is considered a full barrier (site 561; Table 3).

Table 3. Summary of ARGR habitat potential, fish presence through eDNA sampling and fish passage for sites with high conservation and/or restoration priority from Arctic Grayling Monitoring Reports (reproduced from MSES 2022).

Site ID	Habitat Potential	ARGR Presence (%)	Fish Passage	Priority	Concerns/Recommendations

561	Spawning: low-high Incubation: high Overwintering: low	2021: - 2022: 0	Barrier	Restoration: high Conservation: high	• Optimal spawning and incubation temperature • Continuing temperature and eDNA monitoring
251	Spawning: low-high Incubation: low-moderate Overwintering: high	2021: 0 2022:0	Barrier	Restoration: high Conservation: medium	• Potential thermal refuge • Fix culvert gap and resized to accommodate seasonal discharge
374	Spawning: moderate-high Incubation: high Overwintering: high	2021:0 2022: 4	Barrier	Restoration: high Conservation: medium	• Fix culvert gap • Monitor eDNA and habitat
350	Spawning: low-high Incubation: high Overwintering: moderate-high	2021: 100 2022: 67	Barrier	Restoration: high Conservation: medium	• Potentially passable during high discharge • Optimal spawning and incubation temperature • Fix culvert outlet gap
484	Spawning: low-high Incubation: high Overwintering: high	2021: 100 2022: -	No barrier	Restoration: high Conservation: high	• Excellent spawning and incubation temperature • Monitor to ensure fish passage is maintained

511	Spawning: moderate-high Incubation: high Overwintering: moderate	2021: 100 2022: 100	No barrier	Restoration: high Conservation: high	• Continue monitoring water temperature and eDNA • Good water temperature
533	Spawning: low Incubation: - Overwintering: -	2021: - 2022: 100	No barrier	Restoration: high Conservation: high	• Continuing temperature and eDNA monitoring
447	Spawning: low Incubation: low Overwintering: high	2021: 33-89 2022: -	No barrier	Restoration: high Conservation: medium	• Continuing temperature and eDNA monitoring
398	Spawning: moderate – high Incubation: high Overwintering: -	2021: - 2022: -	No barrier	Restoration: high Conservation: medium	• Barrier reclaimed • Optimal spawning and incubation temperature • Fix culvert outlet gap
387	Spawning: moderate Incubation: moderate Overwintering: low	2021: - 2022: 96	No barrier	Restoration: high Conservation: medium	• Assess fish presence upstream
504	Spawning: low - high	2021: -	-	Restoration: medium	• Continue temperature monitoring



	Incubation: low – high Overwintering: -	2022: 0		Conservation: high	• Good spawning and incubation temperature • Potential fish passage barrier
40	Spawning: low – high Incubation: - Overwintering: low	2021: 100 2022: 100	No barrier	Restoration: medium Conservation: high	• Continue temperature, habitat and eDNA monitoring
599	Spawning: - Incubation: - Overwintering: -	2021: 0 2022: 0	-	Restoration: medium Conservation: high	• Continue temperature, habitat and eDNA monitoring • Potential fish barrier
TK2	Spawning: moderate Incubation: moderate - high Overwintering: low	2021: 0 2022: 13	No barrier	Restoration: low Conservation: high	• Cultural significance • Excellent temperature profiles • Assess downstream for potential barriers
TK1	Spawning: - Incubation: - Overwintering: -	2021: 89 2022: 46	No barrier	Restoration: low Conservation: high	• Cultural significance

Boulder Creek	Spawning: moderate Incubation: - Overwintering: -	2021: - 2022: 100	No barrier	Restoration: low Conservation: high	• Continue temperature monitoring
588	Spawning: moderate Incubation: low - high Overwintering: low	2021: - 2022: 100	No barrier	Restoration: low Conservation: high	• Continue temperature and habitat monitoring

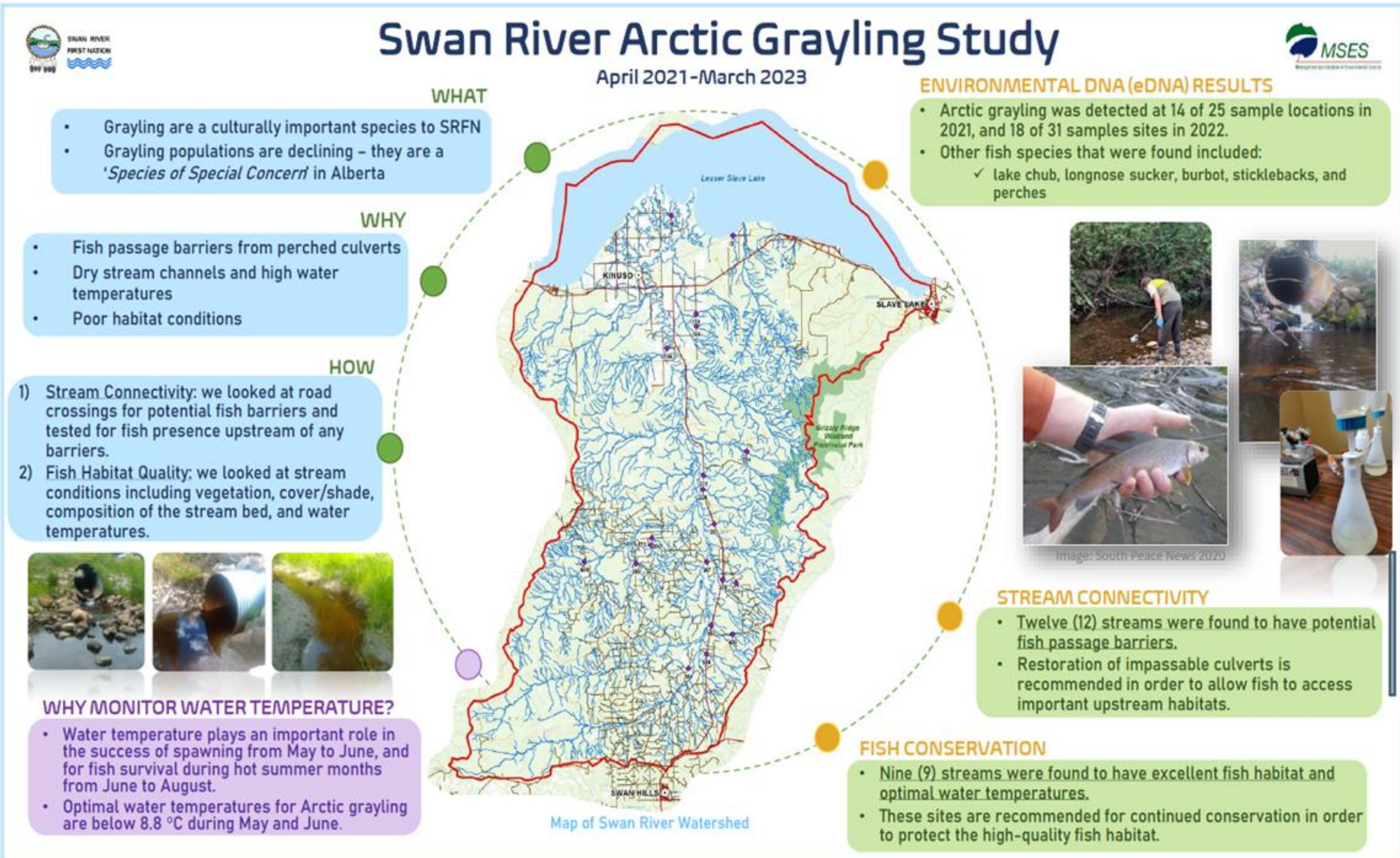


Figure 5. Summary of findings from the Arctic Grayling Monitoring Program within the Swan River watershed (MSES 2022).

2.5 Water Temperature Monitoring

Since 2020, SRFN has been actively deploying temperature loggers within and around the Swan River watershed. In 2024, SRFN was contracted by fRI Research for the continuation of this deployment. The data collected from these loggers will contribute to a larger project focussing on water temperature monitoring along Alberta's Eastern Slopes. The primary goal of this project is to produce a predictive water temperature model for this region. This model can be used to identify watersheds that provide

the most thermally suitable habitat for various cold-water species, as well as those that may be most vulnerable to a changing climate. To date, a total of 76 temperature loggers have been deployed by SRFN. The majority of the loggers that were deployed within the watershed were in 2022 (Figure 6). The temperature loggers were primarily deployed in June and retrieved in October.

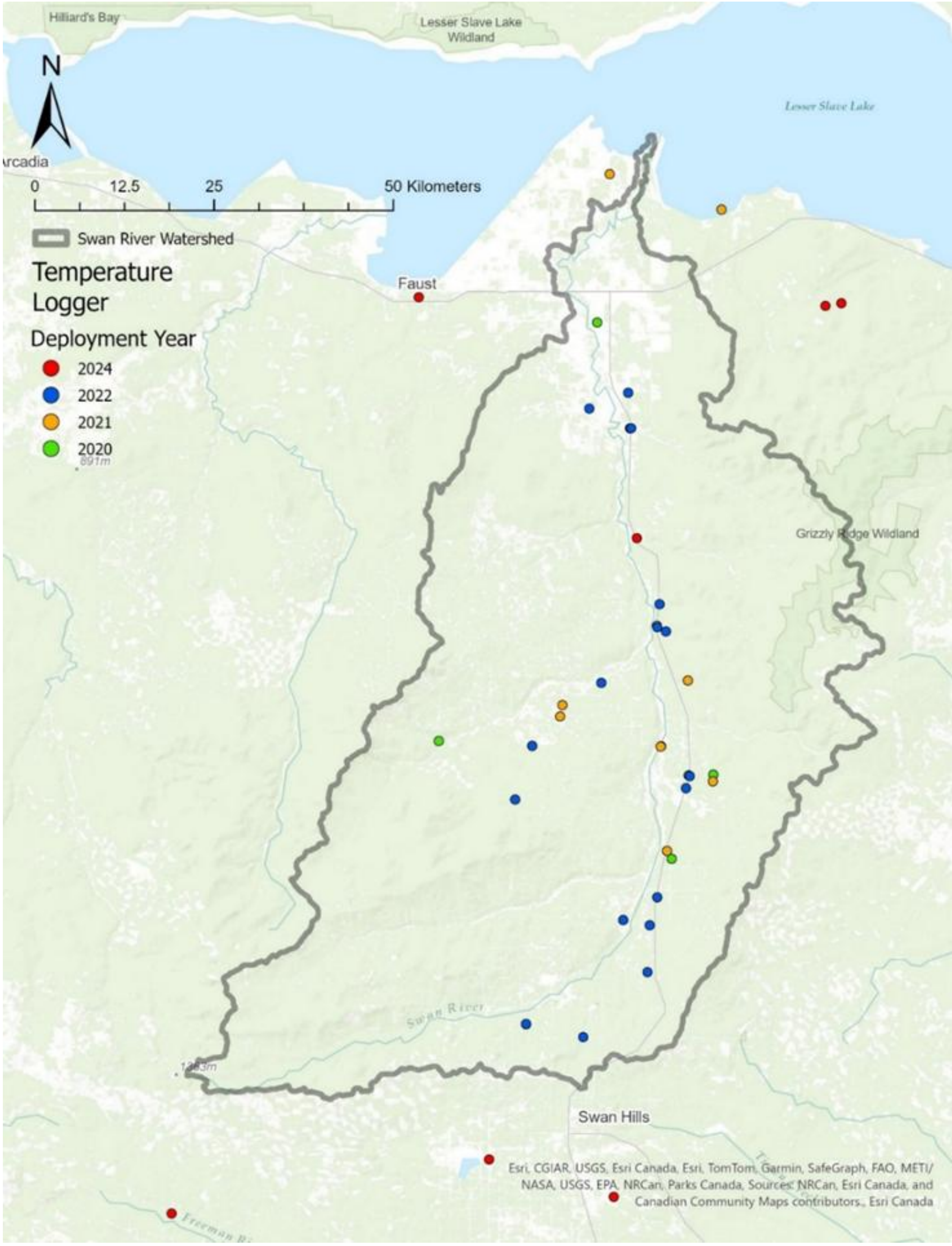


Figure 6. Temperature loggers deployed within the Swan River watershed.

2.6 Fisheries and Wildlife Management Information System Data (AEP 2024)

Fisheries and Wildlife Management Information System (FWMIS) is the Government of Alberta's repository for fish and wildlife inventory data. This data, which is publicly accessible, is collected by various sources. Within the Swan River watershed, a total of 2,032 fish surveys have been conducted since 1968 (Figure 7). Of these, 139 surveys recorded the presence of ARGR (Figure 8). Prior to the implementation of province wide Sport Fishing Regulations in 2015, 679 surveys were conducted, 79 of which captured ARGR (approximately 11.6%). Following the regulation's introduction, 1353 surveys have been conducted, 60 of these surveys documented ARGR presence (approximately 4.43%). When separating the surveys pre- and post- introduction of Alberta ARGR regulation in 2015, there is a notable reduction in ARGR captured. The percentages of surveys that have captured ARGR have more than halved since the regulation's implementation. Given that ARGR have a high capture rate during angling when compared to electrofishing, it was initially thought that the change in percentages of survey type may account for the decline. Prior to 2015, 4.71% of surveys were angling. Following 2015, angling surveys increased to 6.06%. Despite the increase in angling surveys, the percentage of surveys capturing ARGR has decreased. Some caution that should be considered with this data is, 1. they have been collected from various organizations with a range of priorities, 2. They represent various sampling techniques (e.g., angling, electrofishing, minnow traps, etc.), 3. They were not always evenly distributed throughout the watershed. For these reasons, biases may be present in the data, and it is encouraged to resample this watershed following standardized approaches that are evenly distributed. In saying

this, the observed reduction in capture is worrisome and could suggest a substantial decline in the ARGR population within the Swan River watershed.

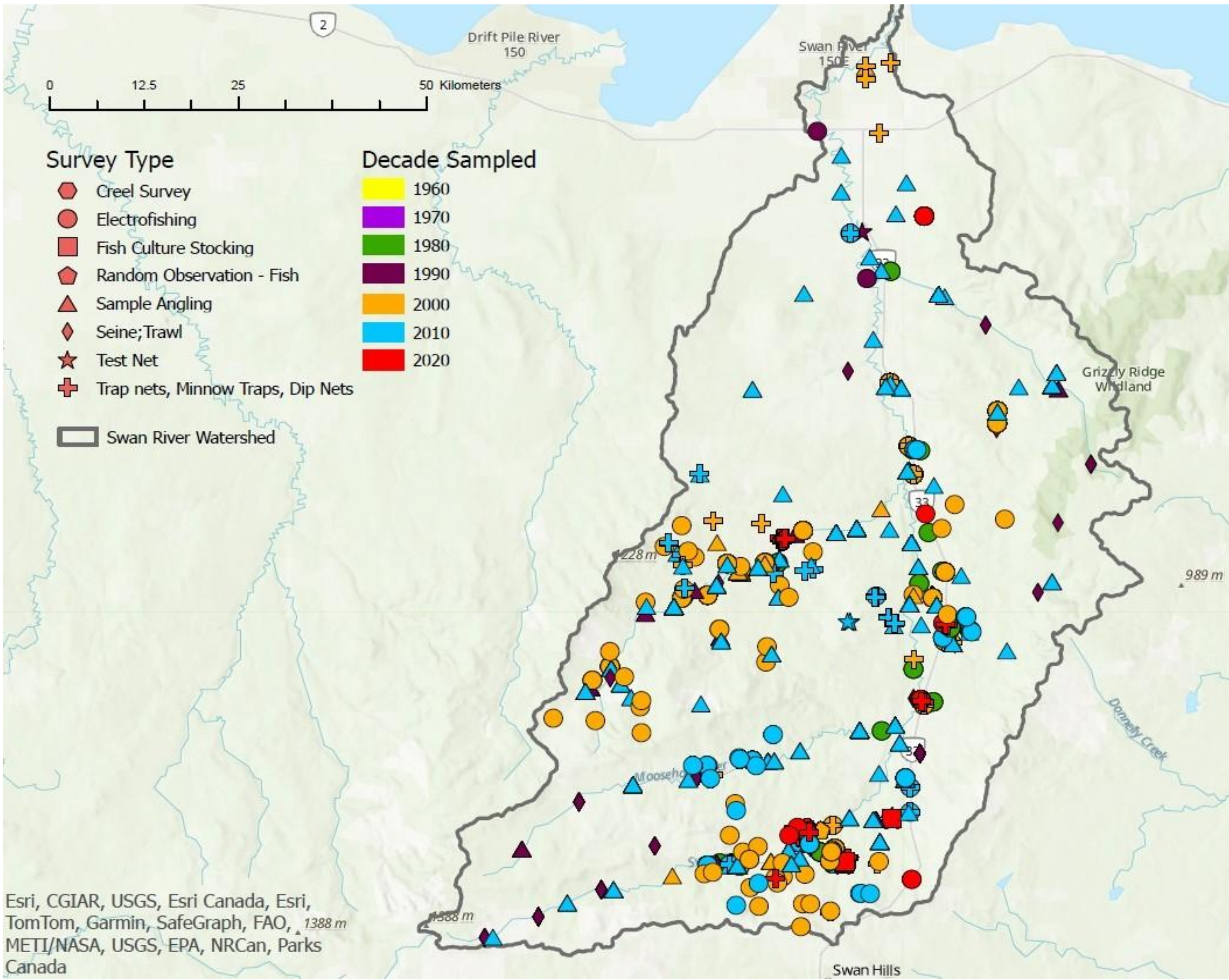


Figure 7. Fish survey's that have been conducted within the Swan River watershed. Surveys are categorized via type of survey and the decade the survey was conducted.

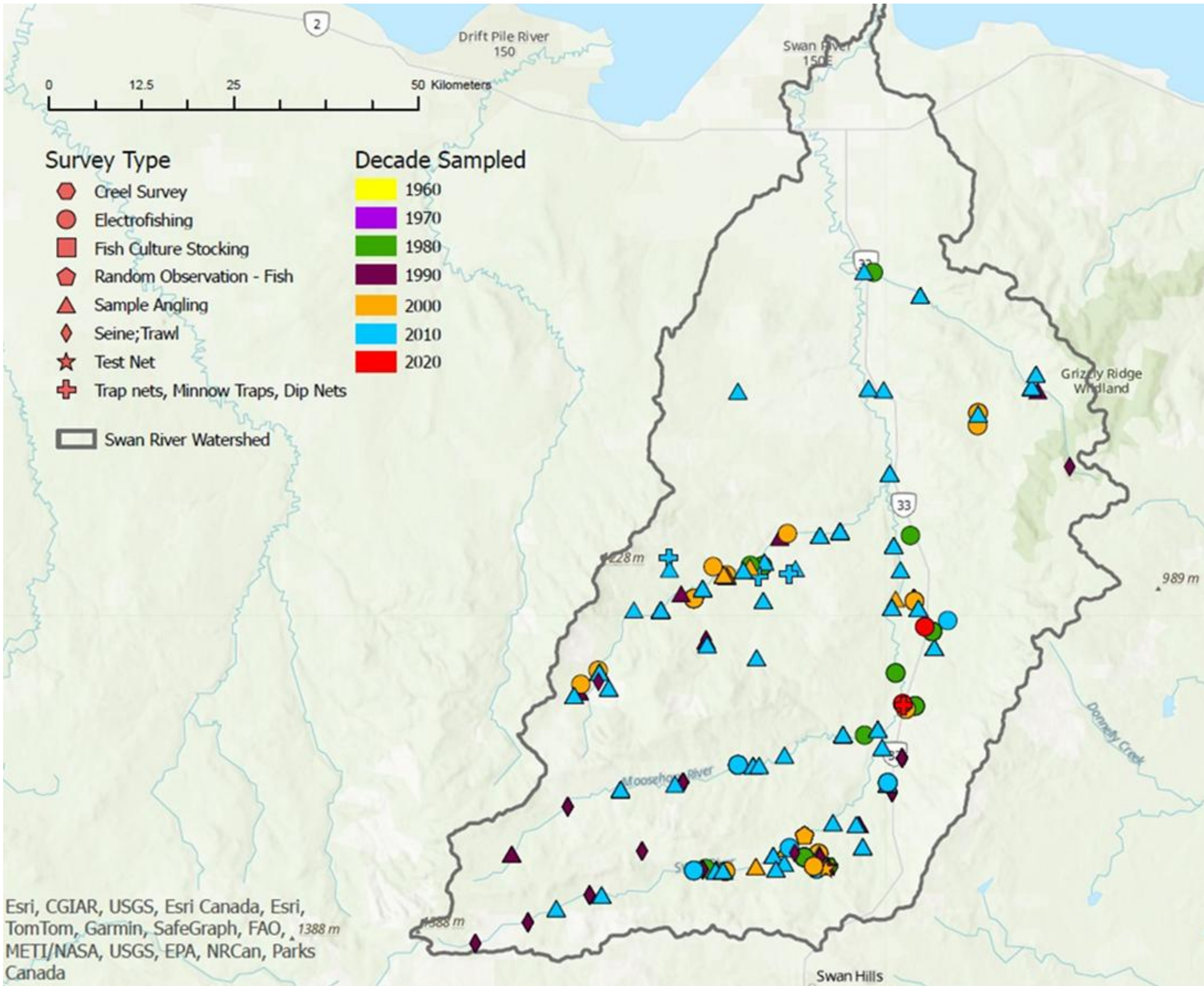


Figure 8. Fish survey's that have captured ARGR. Surveys are categorized via type of survey and the decade the survey was conducted.

2.7 Alberta Energy Regulator Field Surveillance Incident Inspection Data (AER 2025)

Regulation of Alberta's energy sector started in 1938. Since then, the regulator has had many names, the most recent being Alberta Energy Regulator (AER). Currently, AER is the sole energy regulator of Alberta. AER regulates oil, bitumen, natural gas and coal development by reviewing applications, overseeing resource activities in accordance with government policy, inspect developments, penalize and hold hearings for noncompliant companies. When an incident has occurred, companies must notify AER immediately through the release report form. Incidents that must be reported are 1. Leak/break of pipelines, 2. Release into a waterbody, watercourse, groundwater or surface water, 3. Release of oil, water or unrefined product exceeding two cubic meters on site or has caused, is causing adverse effects, 4. Release of oil field waste, 5. Release of substance in excess quantity identified in the schedule of the Release Reporting Regulation, 6. Release of a substance that has caused or may cause adverse effect. The incident data is publicly accessible within the AER website. Within the Swan River Watershed there has been 1,988 spills reported from 1974 to 2024 with the majority being in the headwaters of the watershed (Figure 9; Figure 10). Pipelines have been the source of 68% of these spills (Figure 10) and 46% of spills within the watershed have released crude oil (Figure 9). When looking at spills over decades, there was a peak from 1980 and 1990 with a steady decrease in spills from 1990 to present (Figure 11). This decline could be attributed to improvements to operations or changes in reporting policy, which will require further investigation.

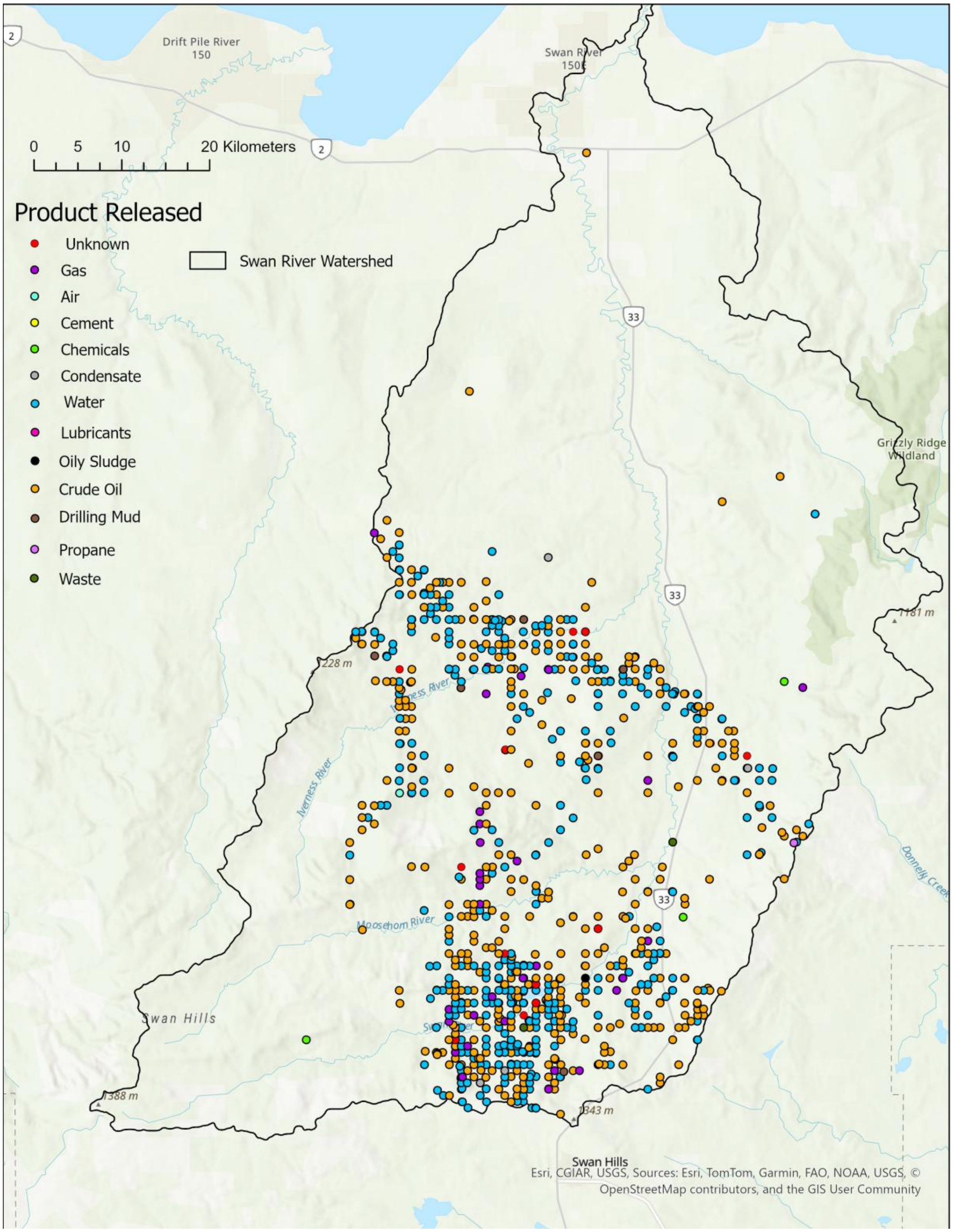


Figure 9. Spill incidents showing product released that were reported to AER which have occurred within the Swan River watershed from 1974-2024.

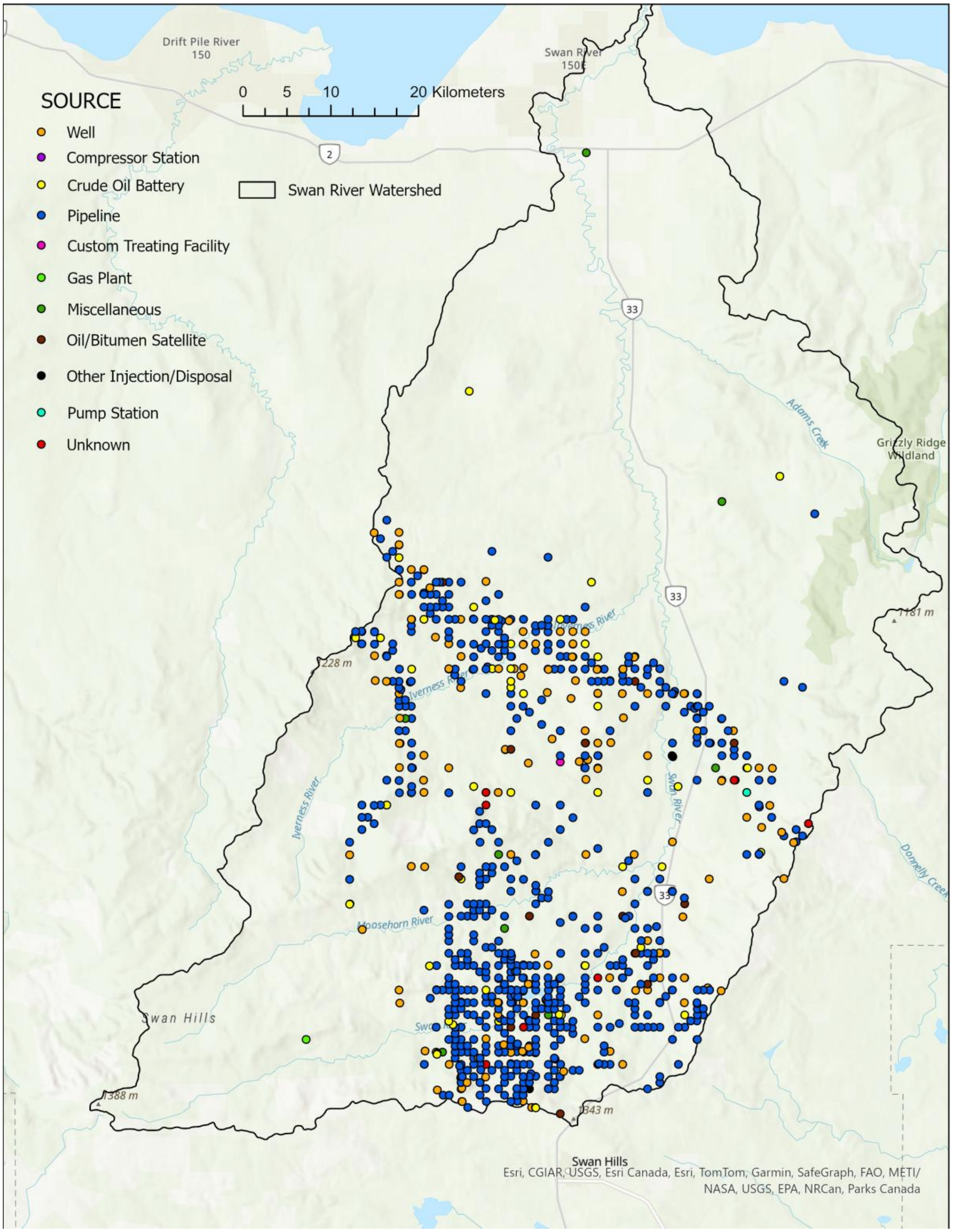


Figure 10. Source of spill incidents reported to AER that have occurred within the Swan River watershed from 1974-2024.

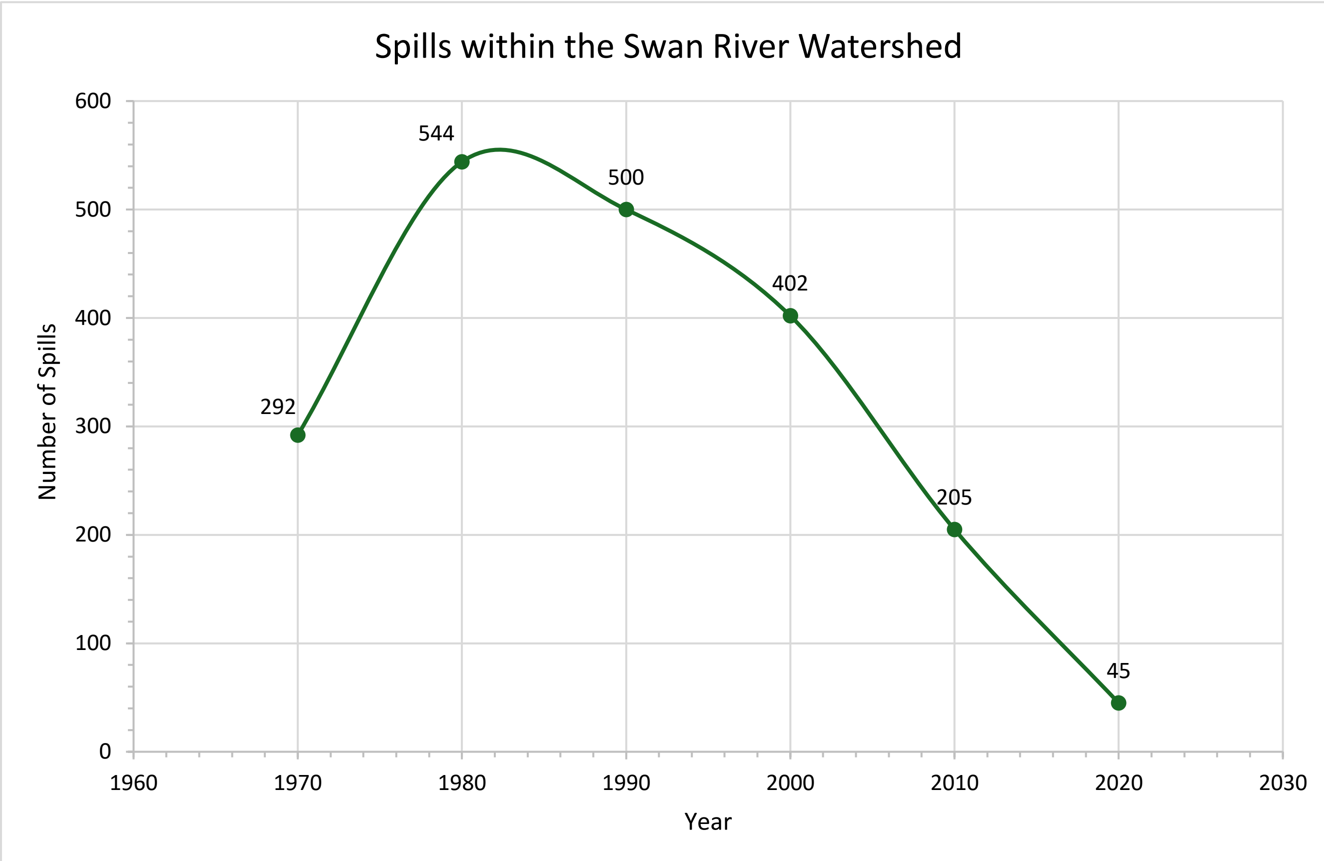


Figure 11. Number of spills that have occurred within Swan River watershed each decade from 1974 – 2024.

3.0 Discussion

3.1 Summary of Results up to date

The research conducted on ARGR in the Swan River watershed reveals critical threats to their populations due to habitat fragmentation and changes in land use. Most sites where research has been conducted from 2018 to present have been in the Southern half of the watershed near Swan Hills. Focusing on the upstream portion of the watershed is justified due to the increased industrial

development and prevalence of linear features. The data that was collected on stream crossings, habitat and water temperature provide valuable insights into the condition of the watershed for ARGR. According to the ARGR Monitoring Project, sites with barriers generally have medium to high habitat quality whereas sites without barriers provide lower habitat potential. The main areas of concern are sites 350, 251, 374, and 561, due to being full barriers to fish passage and relatively high habitat quality. These sites are in the upstream portion of the watershed, closer to Swan Hills. Three of these sites are along HWY 33. The presence of grayling eDNA in both years at site 350 suggests grayling are present above this barrier as either residents or that there is potential connectivity during high discharge events. Despite good water temperatures and high spawning and overwintering, site 251 remains a full barrier with no ARGR presence. Moderate spawning and high overwintering habitat in 2021 and high spawning and incubation habitat in 2022 were seen at site 374, along with eDNA presence downstream but not upstream. This presence downstream but not upstream highlighted it as a likely barrier to grayling movement. This site appears to be the first barrier to fish passage given its location and has a high potential to increase the availability to grayling spawning and overwintering habitat if remediated. Site 561 showed optimal spawning and incubation temperatures, with high spawning and incubation in 2022, despite being a barrier to fish passage. The 2021 habitat survey revealed that 11 of 20 surveyed sites had no barriers, mostly in the latter half of the priority list previously created in 2018.

The addition of upstream habitat data in 2021 helped improve stream crossing prioritization that was previously done in 2018. The lack of gravel and low spawning potential were noted at various sites, with only 34% of sites in 2023 showing moderate to high spawning potential. Low overwintering habitat was recorded in surveys conducted in 2021, 2022 and 2023 which suggests overwintering is

likely to take place elsewhere in the watershed (likely the mainstem or Lesser Slave Lake). The inclusion of eDNA monitoring provided future insights into the effects stream crossings have on the presence of ARGR below and above crossings. ARGR presence was higher in the southern reaches of the watershed near Swan Hills when compared to downstream areas near Lesser Slave Lake. Grayling presence was mainly found along the main stem of the Swan River and in tributaries near confluences with Swan River, suggesting barriers in tributaries may be cutting off large portions of habitat to grayling populations. Water temperature data highlighted significant differences in 2021 and 2022. Temperatures were much higher in 2021; many sites exceeded the UILT for ARGR in July and highlight the fact that annual variation exists within this watershed. This would have had negative effects on spawning and incubation. Many streams exceeded optimal spawning temperatures in 2021 and 2022, it is likely that spawning temperatures were more suitable earlier in the year. Beaver activity has been seen at various crossings throughout these studies. Beaver dams are recognized for having both positive and negative effects on various cold-water fish species. Dams can raise the water table, provide additional cover for fish, enhance habitat diversity, retain water longer in a watershed, and increase groundwater recharge, all of which may help mitigate the impacts of drought and climate change on stream ecosystems (Albertson et al. 2021). While beaver dams can improve habitat suitability for salmonid species, they may also create seasonal barriers to the migration of grayling (Wuttig 2000; Cutting et al. 2018). A study conducted in Montana found that the probability of grayling successfully passing through dams increased when air temperatures were at 6-10°C, as this temperature range enhanced their motivation to migrate upstream to spawning areas (Cutting et al., 2018). This highlights the importance of understanding the role of water temperature within the watershed. Within the Swan

River watershed there has been 1,988 incident spills reported within the last five decades. Most of these spills have been in the headwaters and could have had drastic implications to the overall health of the watershed. FWMIS data indicates that there has been a drop (~7%) in surveys containing ARGR when comparing surveys done pre and post 2015. This decrease suggests that there could be a decline in the ARGR population within the Swan River watershed. Taking the results of these projects into consideration, the key data gaps identified are:

1. Temperature data that includes the spawning period and assesses areas that are proposed for restoration.
2. eDNA sampling to improve the understanding of the distribution of Arctic grayling within the watershed with a focus on areas where crossing repairs have occurred to allow ARGR access habitat that was previously lost.
3. A reassessment of barriers to better understand which have been successfully remediated.
4. An up-to-date population assessment following standard techniques to determine the current status of ARGR and compare these results with past surveys (i.e. ACA 2015).
5. Water quality and invertebrate (CABIN) data to improve the understanding of the overall health of the watershed.

3.2 Next Steps

Reassessment of Stream Crossings

The next steps in monitoring ARGR in the Swan River watershed involve several key actions. A reassessment of previously repaired culverts is essential to ensure that they have been properly fixed. It

is important to reidentify high priority crossings while taking habitat and eDNA data into consideration. Revisiting and replicating the Swan River Arctic Grayling and Watercourse Crossing Assessment that was done by Alberta Conservation Association in 2016 would be valuable in evaluating the changes to the watershed over the past nine years. The identification of the ownership of these high priority crossings is essential to ensure remediation efforts. Additional research should be conducted to quantify the remediation cost of the high priority crossings. Observing beaver activity within the watershed and gaining a better understanding of how dams are influencing stream dynamics would be beneficial to understanding the implications to stream crossings and the ARGR population.

Traditional Knowledge

Although there has been an introduction of Traditional Knowledge sites into monitoring reports, there should be an effort to incorporate more Traditional Knowledge into the monitoring of ARGR. This could include interviewing community members to better understand the changes the watershed has undergone and what the community concerns are. Interviewing community members could provide insight into more areas that are in need of monitoring and provide historic knowledge and information for time periods where western science data does not exist (i.e. pre-1968, based on oldest FWMIS record, FWMIS 2024).

Temperature Monitoring

Ongoing temperature monitoring is crucial to better understand possible areas of thermal refuge for ARGR. Thermal refuge will be important for future prioritization of crossings due to predicted increases in water temperatures from climate change. As temperature monitoring occurred

later in the year and often missed essential spawning periods, temperature monitoring during earlier periods of the season is an important addition to better understanding spawning potential within the watershed. The addition of temperature monitoring above sites that are viewed as priority crossings for remediation would be beneficial in understanding if they fall within the optimal temperature range for ARGR.

Updated Backpack Electrofishing Study

An updated backpack electrofishing study would increase our understanding of the relative abundance of the ARGR population within the Swan River watershed and compare data to past surveys conducted by the ACA in 2015. Additionally, electrofishing above and below stream crossings could be used to assess the fish passage ability through remediated culverts. This updated study would give an insight into effectiveness of remediation efforts.

Updated eDNA study

An updated eDNA study would be beneficial in understanding where ARGR are within the watershed. Monitoring of eDNA should be expanded to known barriers to assess effectiveness of restoration efforts when improving fish passage. Acoustic tracking is often used to model the relative density of a tagged population and describe where animals distribute themselves through space and time (Bottoms 2024). Acoustic fish tracking could also be used as a tool to not only assess the effectiveness of restoration efforts but also to better understand ARGR migration patterns and better prioritize remediation.

Water Quality Assessments

With the increase industrial development within the watershed, it would be beneficial to conduct more research and monitoring on the overall health of the watershed. The increased eDNA, temperature and habitat monitoring will allow for better assessment of long-term suitability for ARGR within Swan River watershed. The introduction of studies focused on toxicology, water chemistry and Canadian Aquatic Biomonitoring Network (CABIN) surveys may be beneficial in the understanding and monitoring of the overall health of the watershed and comparison to reference sites. This continuation of monitoring will help inform new barrier prioritization strategies and will allow for a more targeted approach when addressing key obstacles for ARGR restoration and conservation.

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