

APPENDIX A

Detail Methodology

FORESHORE INVENTORY AND MAPPING

Standard Methods for Completion of Foreshore Inventory And Mapping Projects

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With proper management, we may begin to find a balance within our ecosystems. Without the ongoing support for inventory and mapping initiatives, the objective of sustainable development and balance will not be achieved.

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1.0 INTRODUCTION

Foreshore Inventory and Mapping is a methodology currently being employed to map the larger lakes of British Columbia experiencing land use and recreational pressures. The protocol for Foreshore Inventory and Mapping (FIM) was first developed by the Regional District of Central Okanagan (RDCO), in conjunction with the Department of Fisheries and Oceans (DFO), Ministry of Environment (MOE), City of Kelowna, District of Lake Country, BC Conservation Foundation, and the Real Estate Foundation of British Columbia (Magnan and Cashin, 2004). The intent of the project was to characterize shoreline areas around the central regions of Okanagan Lake so that sensitive ecosystems could be better managed.

Since 2005, numerous other lakes have been mapped using this methodology. During 2008, the MOE, DFO (Community Mapping Network) and other stakeholders worked to update information collected during FIM to better reflect how this information is being used. With the numerous ongoing works on FIM projects, it was in the best interest of land use managers to ensure a standardization of the FIM methodology.

2.0 FORESHORE INVENTORY AND MAPPING OVERVIEW

Foreshore Inventory and Mapping (FIM) is a GPS/GIS assessment of lake shorelines. The methodology closely resembles that of Sensitive Habitat Inventory and Mapping (SHIM) (Mason and Knight, 2001), a GPS/GIS methodology developed for mapping streams and watercourses. The concepts are similar to other land based spatial mapping initiatives (e.g., Terrestrial Ecosystem Mapping (TEM), Sensitive Ecosystem Inventories (SEI)). However, for lake shorelines, the primary feature under review is the shore zone area. For the purposes of this methodology, the shore zone is the area from the pelagic regions of the lake (deepwater) to 30 to 50 m past the high water level in the upland/riparian zone. In FIM, spatial data describing the shore zone area is attributed to shoreline using a line feature.

The methodology developed incorporates standard practices developed by the Resource Inventory Committee for mapping of fish and fish habitat features. It also adapts standards developed for stream SHIM mapping (Mason and Knight, 2001). The methodology is typically completed in a three step process as follows:

1. Video Documentation of the Lake Shoreline;
2. Data Collection of biophysical and habitat attributes along the lake shoreline;
3. Reporting and Data Analysis;

The intent of FIM projects is to catalogue and describe land uses (e.g., Residential Development), shoreline modifications (e.g., docks), and biophysical attributes (e.g., substrates) along lake shoreline. Information collected allows resource managers at all levels of government to incorporate the information into a variety of land use planning documents including but not limited to:



1. Official Community Plans;
2. Shoreline Management Plans;
3. Land and Resource Management Plans;

For a complete review of background information or for use of a GPS/GIS software/hardware, readers should refer to the SHIM (Mason and Knight, 2001) and the Technical Addendum in Part 3 of the Central Okanagan FIM (Magnan and Cashin, 2004). These documents provide in depth documentation of background information for use of GPS/GIS technologies for mapping habitat features and watercourses. A brief summary of some GIS techniques is found in Appendix D.

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2.1 Development of the Foreshore Inventory and Mapping Protocol

The following provides a summary of projects that have currently been completed using this methodology in British Columbia:

Table 1: Foreshore Inventory and Mapping of Lakes Completed to Date

Lake	Region	Year Completed
Okanagan Lake (Central portions)	Okanagan	2004
Osoyoos Lake	Okanagan	2002
Winderemere		2006
Skaha Lake	Okanagan	2008
Shuswap	Thompson	2008
Nicola Lake (Video)	Thompson	2006
Mara Lake	Thompson	2008
Moyie Lake	Kootenay	2008
Monroe Lake	Kootenay	2008
Rosen	Kootenay	2008
Tie	Kootenay	2008
Columbia	Kootenay	2007
Wasa	Kootenay	2008
Windemere	Kootenay	2008
Charlie	Peace	2008
Swan	Peace	2008
Dragon	Cariboo	2008
Sheridan	Cariboo	2008
Williams	Cariboo	2008
Bigelow	Skeena	2008
Call	Skeena	2008
Kathlyn	Skeena	2008
Lakelse	Skeena	2008
Round	Skeena	2008
Seymore	Skeena	2008
Tyhee	Skeena	2008
Gun	Thompson	2008
Montana	Thompson	2008
Pinantan	Thompson	2008
Sakinaw	Lower Mainland	2008
Ruby	Lower Mainland	2008
Sproat	Vancouver Island	2008
Horne	Vancouver Island	2008
Kemp	Vancouver Island	2008
Langford	Vancouver Island	2008
Prospect	Vancouver Island	2008
Cowichan Lake (Video)	Vancouver Island	2006



Since 2004, when the methodology was first developed for Okanagan Lake, land resource managers at local, provincial, and federal levels have begun to utilize data collected during FIM. Data collected during these inventories has been incorporated into Official Community Plans, has been used to prepare Aquatic or Ecological Habitat Indices (e.g., Schleppe and Arsenault, 2006; McPherson and Hlushak, 2008), and has been used to facilitate making informed land use decisions. The baseline inventory information collected can also be used for monitoring purposes, to develop land management objectives for a shoreline, and to develop shoreline management plans and policies.

Development of the data dictionary, or database, for FIM has undergone several different iterations over the past few years. Contributors to the ongoing FIM projects, the database and methodology are summarized in the acknowledgements section of this document. All funding partners who have provided to the development of the FIM protocol should be given recognition for the investments towards improved lake management.

During the summer of 2008, meetings were coordinated with the RDCO, Regional District of Okanagan Similkameen, City of Kelowna, MOE, and DFO to update the data dictionary to reflect current usage of the database and to ensure data collected is most appropriate to guide shoreline management. As part of these meetings, it was determined that there was a need to standardize the methodology for FIM, as recommended in the FIM report prepared for the central regions of Okanagan Lake (Magnan and Cashin, 2004). The following document is intended to provide this standardization by:

1. Providing an overview of field assessment techniques and methodologies;
2. Providing a detailed summary of the most recent FIM Data Dictionary (SHIM LAKE v. 2.6) (full dictionary is in Appendix C);
3. Reconciling previous versions of the database with the most current version so end users understand how the different fields have been adapted over time (see Appendix B for tabular summary);

3.0 FORESHORE INVENTORY AND MAPPING OVERVIEW

Foreshore Inventory and Mapping is generally a three step process, as follows:

1. Shoreline Video Documentation;
2. Shoreline Data Collection;
3. Data Analysis and Reporting.

During the Video Documentation (Step 1), a video is collected for the entire shoreline of a lake. The video is stamped with GPS coordinates that can be used to help with determination of where you are along the shoreline. The video documentation is typically referred to as Pass 1. During this pass, assessors should make note of significant features and begin to assess where shore segment breaks will be made.

Shoreline Data Collection (Step 2) is where most of the field data for the assessment is collected. This is often referred to as Pass 2. During this stage, data is entered into the



GPS data dictionary for all applicable fields. Other information that may be collected includes shoreline habitat mapping (e.g., delineating the extent of shore marshes on air photos), mapping significant changes in substrates within a segment, etc.

During the Data Analysis and Reporting stage, data is transferred to a computer and then is processed. During this step, data is reviewed and corrections are made as necessary. It is preferred if data collectors also process data, as they have had first hand experience with field collection. This review and correction of the data acts as a quality assurance process and is one of the most important steps in the process. Finally, data is transferred to the shoreline, and segment breaks are adjusted so that they occur where intended during the field assessment.

Once these steps have been completed, this work is often times followed by more detailed data collection such as shoreline wildlife habitat mapping, shore marsh habitat mapping, shore spawning mapping, etc. Other data bases have also been developed that are currently being used to assess compliance with best management practices and permitting. With the accumulation of multiple data sets, end users then may also pursue Aquatic Habitat Index (AHI) development (e.g., Schleppe and Arsenault, 2006; McPherson and Hlushak, 2008). The focus of this document is to detail data collection for items 1 through 3 above. However, recommendations are presented to help facilitate future data management and integration (see Section 7.0).

4.0 FIELD ASSESSMENT

The field assessment, as discussed above, typically occurs during two steps. The following sections will provide methodology for pre field requirements, shoreline video documentation, and shoreline data field collection.

4.1 Pre-Field Overview

During the pre field overview, assessors should gather as much background information as possible. The pre field overview will help guide the field assessment to ensure that all information is collected.

During the pre field overview, the following information should be gathered, if possible:

1. The most recent digital (GIS) air photographs of the entire shoreline. Air photos are valuable to help determine segment breaks, assess land uses, and to help assess important features such as the location of stream mouths. Air photos are available for most areas of the province and have been flown at varying times. Preferably, air photos will be included in budgets for these projects to ensure the most recent information is available.
2. Any topography information for the shoreline. Topographic information is available for almost all areas of the province from the TRIM mapsheets and can be



obtained digitally (GIS files). This information can help assessors determine reach breaks and assess slope.

3. Local cadastre information for private holdings that occur along the shoreline. This information is typically available digitally (GIS or AutoCAD files) from the local government, first nations offices, or regional districts.
4. Jurisdiction and Zoning information from local government, first nations, and regional districts. This information can help assessors determine land uses and segment breaks. In some instances, this information is available digitally (GIS files), but may also be available as map sheets from the local jurisdiction.
5. Any provincial parks boundaries, conservations areas, or other known features that occur along the shoreline. Much of this information is available from the Land and Data Warehouse, provided by the Integrated Land Management Bureau.

Once the above information has been collected, assessors should prepare field maps that can be used to document information during their survey. Field maps should show all available information possible in a concise manor. Field maps are not required to complete the assessment, but are extremely valuable as they provide a method to record field observations that can be digitized in GIS later. Field maps are especially valuable to help with defining the locations of important shore marsh habitats and stream mouths, because often times the location of these features is not spatially accurate. Matching field map grid sheets to the local government sheets can be helpful.

If field maps are generated, assessors can provide a pre field assessment of the shoreline. During this assessment, possible segment breaks and other information can be set up to assist with the field inventory.

4.2 Shoreline Video

The purpose of recording lake shoreline video is to assist in classifying lake shore substrates, land use and land cover. Detecting change over time as a result of development or natural disturbance can then be examined. The video can also be used to classify or validate the classification of shoreline segments and to assist in quantifying structures such as boat ramps and retaining walls. Depending on the lake, it may be appropriate to capture video at a particular elevation such as high or low water. For example, if video is captured during high water, the number of retaining walls that become submerged or partially submerged can be enumerated.

The selection of a boat is critical. If possible, choose a boat that is stable under windy conditions and that has a small draft to avoid grounding when navigating near the shore. An appropriate power supply such as a car or RV battery should be used with a power inverter to ensure there is adequate power for all of the recording equipment.



The following is a guide for recording georeferenced lake shoreline video. Video equipment is constantly being improved as well as recording methods. However, the tools are only as good as the operator so nothing replaces training, personal experience and practice. There are several models and several setup options for recording shoreline video so the following is to be used only as a guide.

Almost any digital video camera can be used successfully; however, users must become familiar with the video camera controls prior to going into the field. The video should be recorded no more than 50 m from shore if possible. One to two homes should be in the view of the video at one time. Do not use the digital zoom and try not to use the optical zoom if possible, otherwise the video will become blurry especially in rough conditions. The video should be recorded on dry, calm days if possible. A general rule is that the larger the waves, the poorer the quality of the resulting video. Other considerations include:

- good image stabilization
- analog output (mandatory)
- durability for use in the field conditions
- easy to use and reach buttons
- a lens shroud to protect from direct sunlight
- a polarized lens
- an excellent tripod with easy to use controls
- tape or harddrive storage media

Geo-referencing the video output by tagging each frame with a latitude and longitude is recommended. In addition, a GPS track line should be recorded at the same time using one second intervals. This will allow synchronization of the video with the GPS trackline for each shoreline segment.

Analog output from a digital video camera connects to a GPS stamper unit such as Horita or SeaTrak (figure 1). GPS output also connects to the GPS stamper unit. Output from the GPS stamper unit is recorded onto a digital video recorder or a personal computer. In the case of a digital video recorder, the use of a digital video player is useful in order to ensure the video output is correct.

Video files should be edited to remove any unwanted frames. A digital video recorder is very efficient for doing this task. Alternatively, video can be edited using video editing software such as Pinnacle or Adobe on a PC.



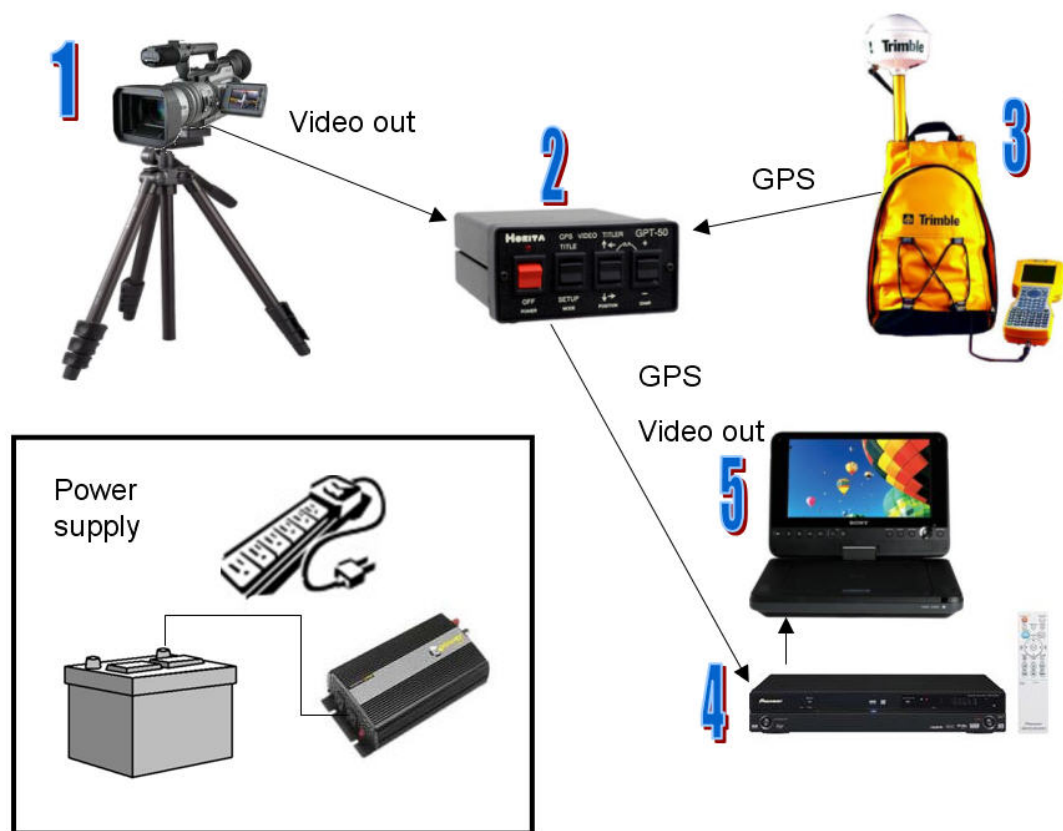


Figure 1: Shoreline video setup. 1) Digital video camera, 2) GPS stamper unit, 3) GPS data logger and receiver, 4) Digital video recorder, 5) Digital video player

4.3 Shoreline Data Field Collection

The shoreline field data collection involves the following different categories of information:

1. *Lake Reference* – This section of the data dictionary includes summary information for the lake being assessed and the crew assessing the information.
2. *Segment Class* – This section of the data dictionary includes a summary of the dominant features of the shore segment, such as land use, shore type, slope, etc.
3. *Shore Type* – This section includes specific information regarding the different shore types that occur along the shore segment.
4. *Land Use* – This section includes specific information regarding the different land uses that occur along the shore segment.
5. *Substrates* – This section includes specific information regarding substrates that occur along the shore segment.
6. *Vegetation Band 1* – This section includes specific information regarding the first distinctive band of vegetation. This section was previously called Riparian (See Appendix A).



7. *Vegetation Band 2* – This section includes specific information regarding the second distinctive band of vegetation. This section was previously called Upland (See Appendix A).
8. *Littoral Zone* – This section contains specific information regarding littoral zone features of the shore segment.
9. *Modifications* – This section contains specific information regarding shoreline modifications, such as retaining walls and docks that exist along the shoreline.
10. *Flora and Fauna* – This section contains specific information regarding flora and fauna information, such as veterans and snags that exist along the shoreline segment.

Within each of the different sections above, data fields allow assessors to enter specific information into the GPS unit. A field crew of three to four people (plus a boat skipper) is optimal for these assessments. As there are many items that need to be counted and there is some interpretation required, at least one crew member should be very familiar with the database and have a good understanding of the methodology to guide other members of the crew. During the assessment, crew members will assume different roles, such as counting docks, paying attention to substrates, etc. and it is preferred if crew members focus on their particular tasks rather than trading off part way through the assessment. If assessors intend on trading of tasks part way through, they should thoroughly discuss their criteria and ensure that the other is familiar with their task. A paper photo log should also be completed. Assessors should take as many representative photos as possible of the shoreline to aid with data management and quality assurance review.

The following is a list of some of the field equipment that should be taken on the field assessment vessel:

1. Four to Eight Thumb Counters;
2. Field Maps for the entire shoreline (if available);
3. At least one GPS Unit with the data dictionary loaded (with a back up if available);
4. Digital Camera, or preferably a Digital Camera with GPS stamp;
5. Water proof field paper for field notes and data sheets (in case GPS unit fails);
6. Binoculars for viewing shore substrates and other features;
7. Required Safety Equipment such as life vests, rain gear, etc.

The following sections will provide specific information for interpreting and entering data into the data fields of the GPS unit. Appendix A provides a summary of the following sections in tabular format.

4.3.1 *Lake Reference*

The Lake Reference section is intended to provide background information regarding the lake that is being assessed, field conditions during the assessment, and the crew completing the assessment. The following is a summary of data fields and methods for this section of the dictionary (summarize in Appendix A).



1. *Lake Name* – This field is for the local lake name (gazetted or common name).
2. *Lake Level* – This field is for the level or elevation of gauged lakes on the date of the assessment. On gauged lakes, lake level is typically the geodetic level (i.e., above sea level) of the lake the day the assessment was completed. However, each gauging station will be benchmarked to a certain level and this standard should be used. This will help people utilizing data understand at what water level the data was collected. This field should be left blank if the lake level is unknown or if the lake is not gauged. Some lake levels are available online at <http://scitech.pyr.ec.gc.ca/waterweb/formnav.asp>
3. *Secchi Depth* – This field is for entering the Secchi depth. Secchi depth is a measure of the point where a 20 cm weighted white line disappears from view when lowered from the shaded side of a vessel and that point where it reappears upon raising it. This measurement should be made at mid-day as the results are more variable at dawn and dusk. Secchi depths vary depending upon the time of year measured and productivity of a lake, particularly in lakes with increased particulate matter (e.g., algae). This measurement is not required, but can be included if assessors have the necessary equipment to complete it.
4. *Organization* – This field is to enter the organization that is completing the work. Organizations include government, non-profit organization, or companies who are responsible for collection of the field data.
5. *Date and Time* – This field is for the date and time. These fields allow assessors to enter the date and time of the assessment. Some GPS units may enter this information automatically.
6. *Crew* – This field is for the crew completing the field assessment. Assessors should enter the initials of all crew members on the vessel who are completing the assessment.
7. *Weather* - The weather is a categorical field. Available options include Light Rain, Heavy Rain, Snow/Sleet, Over Cast, Clear, Partly Cloudy, and other. This field should be filled in with the most appropriate weather observed throughout the day. If the Other category is chosen, field assessors should identify the weather in the comments field.
8. *Air and Water Temperature* – The air and water temperature fields allows assessors to enter in the temperature during the assessment.
9. *Jurisdiction* – The jurisdiction field is to identify the governmental entity that has predominant governance over the shore segment being assessed. Typically, this would be a local government, regional district or First Nations band. In some cases, the shoreline may occur along crown land or within a provincial park. If possible, field assessors should break segments at all major changes in jurisdiction to allow



for better management of shore line segments. If a segment break is not included at a change in jurisdiction, the jurisdiction with the predominant length of shoreline should be listed here and the secondary jurisdiction should be noted in the comments field.

10. *Comments* – The comments field is for assessors to enter any relevant information regarding the lake information.

4.3.2 *Segment Class*

The Segment Class section is intended to provide a summary of the dominant land uses, shore types, and other characteristics of the entire shore segment. The following is a summary of data fields and methods for this section of the dictionary (summarize in Appendix A).

1. *Segment Number* – The shoreline segment number is a field that identifies the shore segment. The shore segment is the fundamental unit of FIM and each shore segment is characterized by attributes (e.g., land use, shore type, vegetation) that are similar. Typically, shore segments begin at 1 and continue until the entire shoreline has been mapped. However, in some instances, shore segments may begin at another number, particularly in cases where only portions of a lake are mapped at various different time periods. Shore segments should generally have a similar land use, shore type, vegetation, and substrates. The minimum length of shoreline for a shore segment is 50 m and there is no maximum to the length of a shore segment. Generally, assessors will create more segments in densely developed areas due to changes in vegetation cover and land use than they will under more natural conditions, when shorelines tend to be more similar for longer stretches.

Determining Shore Segment Breaks

Shore segments should consider the following different criteria:

- a. Shore Type is a primary characteristic (defined below) that should be used to assess shore breaks;
 - b. Land Use is another primary characteristic (discussed below) that should be used to assess shore segments. Changes from residential development to single family development, for instance, could warrant a segment break.
 - c. Vegetation is another characteristic that can be used to determine segment breaks. Significant differences in vegetation coverage are typically associated with changes in land use also, but sometimes can be due to differences in property management.
 - d. Stream Mouths are extremely important shore types and should be given their own segments for important fish habitat streams.
2. *Shore Type*– Shore type is a categorical field that describes the predominant shore type that occurs along the length of the shore segment (i.e., the highest percentage



of the linear shoreline length). Shore types include Cliff/Bluff, Rocky Shore, Gravel, Sand, Stream Mouth, Wetland, and Other. If other is selected, comments should be included to describe the shore type observed. Definitions for each of the above shore types are found in the Shore Type Section discussed below.

3. *Shore Type Modifier* – The shore type modifier field is used to describe significant shoreline activities that influence the shoreline. The field is categorical and choices include Log Yard, Small Marina (6-20 slips), Large Marina (greater than 20 slips), Railway, Roadway, None, and Other. If Other is selected, the comments field should be used to identify the modifier. If the field is left blank, users should assume that there is no shoreline modifier.
 - a. *Log Yard* – A log yard is an area where logs are temporarily stored until they are moved to a lumber mill. Log yards typically have large log breakwaters, log booms, and associated loading / unloading facilities.
 - b. *Large and Small Marina* – A marina is any type of location where boats are moored. A boat slip is where each boat is moored and each finger of a dock may be used to moor two boats (i.e., one on each side). Marinas can either be on pile supported or floating structures. Marinas may have associated breakwaters, fueling stations, boat launches, etc. Also, marinas can be associated with commercial or multi family dwellings.
 - c. *Railway* – Railways constructed within 5 to 10 m or below the high water level are another shore type modifier. Railways should only be considered a modifier if they are within 0 to 15 m of the shoreline and there is no private holdings between the railway and the shoreline. Decommissioned railways can be considered a railway modifier.
 - d. *Roadway* – The roadway modifier identifies shore segments where a roadway occurs directly adjacent to the shoreline. Roadway should only be considered a modifier when they are within 10 to 15 m of the shoreline and there are no private holdings between the roadway and the shoreline. Boat launch access roads are not considered a roadway modifier.
4. *Slope*– Slope is a categorical determination of the slope or gradient of the shoreline. Categories include Low (less than 5%), Moderate (5-20%), Steep (20-60%), Very Steep (>60%), and Bench. A Bench is a shoreline that rises, typically steep or very steep, has a flat area typically greater than 15 horizontal meters, and then becomes steep or very steep again. On bluff shore types, where the shoreline rises sharply and then flattens, the categorical statement should describe the steep portion of the shoreline (i.e., do not use bench).
5. *Land Use* – Land use is a categorical field that is used to describe the predominant land use observed along the segment. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use can be determined based upon a combination of field observation, review of zoning and bylaw maps,



and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories below.

6. *Level of Impact* - Level of Impact is a categorical field that is used to describe the general disturbance that is observed along the shoreline. Disturbances are considered any anthropogenic influence that has altered the shoreline including foreshore substrates, vegetation, or the shoreline itself (e.g., retaining walls). Level of impact is considered both looking at the length of the shoreline (i.e., along the segment) and the depth of the shore zone area to between 15 to 50 m back. In more rural settings, typically the assessment area is greater (i.e., 50 m) and in more developed shorelines, typically the assessment area is less (i.e., 15 to 30 m). In cases of roadways or railways, one should generally consider the location of the rail or roadway along the segment (i.e., how far back it is set, is the lake infill, etc.). To facilitate interpretation of this category, air photo interpretation is recommended to better estimate disturbance. Disturbance categories include High (>40%), Medium (10-40%), Low (<10%), or None. Consistency of determination is very important and assessors should use the same criteria to determine the level of impact. The RDCO Foreshore Inventory and Mapping report defines the *Level of Impact* as follows (Magnan and Cashin, 2004):
 - a. *Low* - Segments that show little or limited signs of foreshore disturbance and impacts. These segments exhibit healthy, functioning riparian vegetation. They have substrates that are largely undisturbed, limited beach grooming activities, and no to few modifications.
 - b. *Moderate* - Segments that show moderate signs of foreshore disturbance and impacts. These segments exhibit isolated, intact, functioning riparian areas (often between residences). Substrates (where disturbed) exhibit signs of isolated beach grooming activities. Retaining walls (where present) are generally discontinuous. General modifications are well spaced and do not impact the majority of the foreshore segment.
 - c. *High* - Segments that show extensive signs of disturbance and impacts. These segments exhibit heavily disturbed riparian vegetation, often completely removed or replaced with non-native species. Modifications to the foreshore are extensive and likely continuous or include a large number of docks. Generally, residential development is high intensity. Modifications often impact a majority of the foreshore.
7. *Livestock Access* - Livestock access is a categorical field that is used to determine whether livestock, such as cattle, have access to the foreshore. Choices include Yes, No or blank. If the field is left blank, one should assume that cattle do not have access.
8. *Disturbed* - The disturbed field allows assessors to enter the percentage of the shoreline that is disturbed by anthropogenic influence. This is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage



disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. If air photo field maps are available, use of a scale ruler can help assessors determine the percentage that has been disturbed. Although this field is somewhat qualitative, assessors should do their best to be consistent and to be as quantitative as possible.

9. *Natural* – The natural field is the percentage of the shoreline that is natural. This is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the Percentage Natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. If air photo field maps are available, use of a scale ruler can help assessors determine the percentage that has been disturbed. Although this field is somewhat qualitative, assessors should do their best to be consistent and to be as quantitative as possible.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.3 *Shore Type*

The Shore Type section is intended to provide a summary of the different shore types that may occur over the entire shore segment. In many cases, one shore type will be predominant in a segment, with other shore types occurring to a smaller extent. Examples of this include rocky shorelines, with intermittent gravel beach areas in depositional areas. The shore type section allows assessors to enter in the approximate percentage of the shore segment that is occupied by the different shore types.

When determining the percentage of a segment that a shore type occupies, assessors should utilize whatever data is available to them. During the field assessments, scaled air photos can be used to determine the approximate percentage. If field maps are not available, assessors should use best judgment to estimate the percentages. As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

Initial shore type fields were developed by the Resources Inventory Committee (RIC, 2001) and were subsequently refined and adapted for the FIM of Okanagan Lake (Magnan and Cashin, 2004). The shore types below were again refined during the summer of 2008 in discussions with the MOE, DFO, and local government stakeholders and consultants. The most significant change in SHIM Lake v.2.6 is the removal of the Vegetated Shore Type. This shore type was removed because all shore types describe physical aspects of the shoreline whereas the vegetated shore type described vegetation characteristics. The following is a summary of data fields and methods for this section of the dictionary (summarize in Appendix A).



1. *Cliff / Bluff Shoreline*– The Cliff / Bluff field allows assessors to enter the percentage of the segment, based upon the shore segment length, that is a cliff or bluff shore type. A cliff shore type is typically very steep with substantial vertical elements that are greater than 70° or 275%. A bluff shore type is typically steep or very steep, and then flat for a substantial distance, typically formed by the fast recession of water levels during glacial periods. Bluff substrates tend to consist mostly of silts and clays.



The above photos are examples of a cliff shoreline (left) and a bluff shoreline (right).

2. *Rocky Shoreline* – The Rocky Shoreline field allows assessors to enter the percentage of the segment, based upon the shore segment length, which is rocky. Rocky shores consist mostly of boulders and bedrock, with components of large cobble and some gravels. These shores tend to occur on steeper shorelines. Previous versions of the data dictionary called these shorelines low rocky shorelines or possibly (but less so) vegetated shorelines.



The photo above is an example of a typical rocky shoreline. Sometimes, a rocky shoreline may contain less bedrock and larger boulders. Substrates on these shoreline should consist predominantly of larger cobbles, boulders, and bedrock.



3. *Gravel Shoreline* – The Gravel shoreline field contains the percentage of the segment, based upon the shore segment length, that is a gravel beach. Gravel beach shorelines tend to occur on Low or Moderate slopes, and substrates are predominantly gravels and cobbles. These shore types may also contain small percentages of boulders and / or bedrock. Often times, gravels beaches and rocky shores occur along one segment, with gravel shore types occurring in depositional areas (i.e., in bays) and rocky shores (i.e., at points) occurring in erosion areas. Previous data base versions may have also referred to these shorelines as vegetated shores.



The photo above shows a typical gravel beach. Notice that substrates consist mostly of gravels and cobbles. Gravel shorelines may also have boulders and periodic patches of bedrock in some instances. In previous database versions, a shoreline such as this may also have been referred to as a vegetated shore.



4. *Sand Shoreline* – The Sand Shoreline type contains the percentage of the shoreline, based upon the shore segment length, which is a sand beach. Sand beach shorelines tend to occur within low gradient areas and consist predominated of sands and small gravels. These shore types may also contain some gravel shoreline areas in places that are more exposed to wind and wave action (e.g., points).



The photo above shows a typical sandy shoreline.

5. *Stream Mouth* – The Stream Mouth field contains the percentage of the shoreline, based upon the shore segment length, which is a stream confluence. A stream mouth is defined as the space where there is a confluence between a lake and a stream or a river and the stream has direct influence on sediment movements and deposition or is part of the active floodplain. Typically, the stream mouth segment is larger for rivers and smaller for creeks. A separate segment should be created for significant fisheries streams, such as those known to contain spawning populations of anadromous salmon.



The photo above is the Adams River on Shuswap Lake.
This is a good example of a stream mouth segment.

6. *Wetland* – The Wetland shore type field contains the percentage of the shoreline, based upon the shore segment length, which is a shore marsh wetland. A wetland segment typically occurs on low gradient sites, the littoral zones is wide and shallow, substrates are predominantly silts, organics, or clays, and there is emergent vegetation present. The Wetlands of British Columbia defines a shore marsh as a seasonally or permanently flooded non tidal mineral wetland that is dominated by emergent grass like vegetation. The BC Wetland book contains descriptions of some of the wetland shore types that may be observed along lake shorelines





The photo above shows an example of a wetland shore type. Notice the significant amounts of emergent vegetation. The *Wetlands of British Columbia A Guide to Identification* (MacKenzie and Moran, 2004) book provides specific classifications for the different types of marshes that occur.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.4 Land Use

The Land Use section allows assessors to provide more detail regarding existing land uses. Land use categories have been created to generally correspond with a broad range of local government zoning bylaws. Other categories have been created to correspond with provincial, non-profit, and federal government land use types (e.g., natural areas parks, conservations areas, etc.). In many cases, shore segments will have only one land use type. However, in some instances, land uses may slightly vary along a segment and the differences do not warrant creation of a new shore segment. These fields allows users to enter the percentage of the shoreline, based upon the shore segment length, which the different land uses occupy.

When determining the percentage of a segment that a shore type occupies, assessors should utilize whatever data is available to them. During the field assessments, scaled air photos can be used to determine the approximate percentage. If field maps are not available, assessors should use best judgment to estimate the percentages. As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a



particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

1. *Agriculture* – The agriculture land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for crop based agricultural or as active livestock range lands (i.e., extensive holding areas, large numbers of cattle etc.). Livestock pastures that are not active rangelands (i.e., a few cows or horses) are typically considered a rural land use and not an agriculture land use (see rural). These lands are typically part of the Agriculture Land Reserve or aprovincial range tenure.
2. *Commercial* - The Commercial land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for commercial purposes. Commercial purposes include retail, hotels, food establishments, marinas with fuel, stores, etc. Commercial areas tend to occur along highly impacted shorelines. Where feasibly, significant commercial areas should be part of one segment because the land use on these shore types has a different assortment of potential impacts. Commercially zoned, but yet to be constructed areas, may also warrant there own segment.
3. *Conservation* - The Conservation land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for conservation of critical or important habitats. Examples of conservation shorelines include lands held by the Land Conservancy, biological reserves, etc. Conservation lands cannot occur on privately held shorelines, unless conservation covenants or other agreements are in place to protect areas in perpetuity.
4. *Forestry* - The Forestry Land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for forestry. These areas are typically crown lands that are part of active cut blocks or forestry operations. Log Yards are considered an industrial land use and are not considered a Forestry Land because they tend to have associated industrial infrastructure.
5. *Industrial* - The Industrial land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for industrial purposes. Examples of industrial purposes include log yards, processing facilities, lumber mills, etc. These shorelines are typically heavily impacted by infrastructure, impervious surfaces, buildings, etc.
6. *Institutional* - The Institutional land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for institutional purposes. Examples of institutional land uses include schools, public libraries, etc.
7. *Multi-Family Residential* - The Multi-Family land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for



multi-family residences. Multi-family developments are typically condominiums, apartments, or town homes.

8. *Natural Areas* - The Natural Areas land use field is the percentage of the shoreline, based upon the shore segment length, which are predominantly undisturbed crown lands. These areas do not occur in provincial or federal parklands and cannot be privately held.
9. *Park* - The Park land use field is the percentage of the shoreline, based upon the shore segment length, which are predominantly natural areas parklands. These parks areas can be provincial, federal, or local government parks. These parks tend to be relatively undisturbed and natural. They differ from urban parks (discussed below), which are used intensively for recreational purposes (e.g., public beaches).
10. *Recreation* - The Recreation land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for recreational purposes. Examples include public or private campgrounds, areas of known cabin rentals, etc. In some cases recreational shoreline may also be referred to as a single family land use, depending upon how much information is known about them. Generally, if a shoreline contains privately held cabins that are rented out occasionally, these should be referred to as single family land uses rather than recreational.
11. *Rural* - The Rural land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for rural purposes. These shorelines are typically large lots, private estates, or hobby farms. Differentiation between rural and single family land use can be difficult when lots are narrow but deep (i.e., buildings appear dense on the shoreline but extend quite far back). When doubt exists between a rural designation and a single family land use, assessors should be consistent in their judgments and refer back to local government zoning or bylaws to help decide on the appropriate land use type.
12. *Single Family Residential* - The Single Family Residential land use field is the percentage of the shoreline, based upon the shore segments length, which is predominantly used for single family residential purposes. Typically, single family residential occurs in more densely developed areas. However, seasonal use cottages or cabins can often be considered single family residential areas if the dwellings have associated outbuildings, docks, and other features consistent with more densely developed areas. In areas where there are numerous seasonal use cabins and cottages, assessors should consider this single family residential if lots have smaller lake frontages and land uses and buildings are consistent with single family types of development. If lake frontages for seasonal use cabins and cottages are quite large, the land use would be considered rural. The differentiation between rural and single family in these cases can be difficult and assessors should be consistent in their determination.



13. *Urban Parklands* - The Urban Park land use field is the percentage of the shoreline, based upon the shore segments length, which is predominantly used as an urban park. Examples of this land use include public beaches, picnic areas, etc. Shorelines dominated by this land use tend to have limited riparian vegetation and contain extensive areas of turf in the understory.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.5 *Substrates*

The substrate section of the data dictionary allows assessors to enter in detailed information regarding foreshore substrates. Shore substrates are important for a variety of reasons and can influence primary productivity. When describing shore substrates, assessors should describe a *representative distribution* of substrates along the shoreline. It is acknowledge that shore substrates are variable along shore segments; with many areas have concentrations of coarse or fine materials. Thus, this section provides a description of the distribution of substrates and may not be representative of particular micro-sites that occur along the segment.

When assessing substrates, the entire shore segment should be considered. In many cases, small amounts of a particular substrate type may be observed (e.g., one small bedrock outcrop along a gravel shoreline). In these cases, a value of 1% should be used to acknowledge the presence of this substrate type along the shore segment.

Shore substrates are best viewed at low water levels because more of the foreshore is visible. However, often assessments do not coincide with these periods. Thus, binoculars are extremely helpful to help determine substrates along a shoreline. They allow assessors to better assess particle size to appropriately fill in data fields. Assessors may also wish to exit the vessel and visually inspect the shoreline substrates. The data fields in the data dictionary allow assessors to enter in detailed information for highly visible shorelines and summary information for less visible shorelines (e.g., Gravels can be entered as total gravels or sub described as fine and coarse gravels). As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

The following are descriptions of the different substrate type fields that occur within the data dictionary. Substrate definitions below are derived from the SHIM manual (Mason and Knight, 2001) and Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (2001)

1. *Marl* - The Marl substrate field allows assessors to enter the relative percentage of marl occurring along the shoreline. Marl is a substrate that is typically white in color, associated with clear lakes and consists of loose clay, precipitated calcium



carbonate, mollusk/invertebrate shells, and other impurities. Marl substrates would often be associated with fines, mud, or organics depending upon the lake.

2. *Mud* - The Mud substrate field allows assessors to enter the relative percentage of mud occurring along the segment. Mud is a substrate that is typically dark in color and consists of a mixture of silts, clays, and finely decayed organic material that is not typically discernable.
3. *Organics* - The Organic substrate field allows assessors to enter the relative percentage of organic materials that occur along the shoreline. Organic substrates are typically associated with wetland sites and consist of detritus material that is identifiable to some extent (e.g., sticks, leaves, etc.). Organics generally do not form a large proportion of the substrates unless the shore segment is an extremely productive wetland.
4. *Fine Substrates* - The Fine Substrate field allows assessors to enter the relative percentage of fines that occur along the shoreline. Fines consist of silts and clays and these substrates are typically less than 0.06 mm in size. Fines are differentiated from mud because there is little to no organic content.
5. *Sand Substrates* - The Sand substrates field allows assessors to enter the relative percentage of sands that occur along the shoreline. Sands are any particle that contains granular particles visible to the naked eye. These particles are typically .06 to 2 mm in size.
6. *Gravel Substrates* - The Grave substrates field allows assessors to enter the relative percentage of gravels that occur along the shoreline. Gravels are particles that range from 2 mm to approximately 64 mm. Thus, they are the size of a lady bug to the size of a tennis ball or orange. This field should only be used when substrates are difficult to identify and assessors cannot determine whether fine or coarse gravels (see below).
7. *Fine Gravel Substrates* - The Fine Gravel substrates field allows assessors to enter the relative percentage of fine gravels that occur along the shoreline. Fine gravels are particles that are 2 mm to approximately 16 mm or the size of a ladybug to the size of a grape. This field should only be used when assessors have good visibility and can confidently identify fine gravels. If this field is used, the general gravel category should *not* be used.
8. *Coarse Gravel Substrates* - The Coarse Gravel substrates field allows assessors to enter the relative percentage of coarse gravels that occur along the shoreline. Coarse gravels are particles that are 16 mm to approximately 64 mm or the size of a grape to the size of a tennis ball or orange. This field should only be used when assessors have good visibility and can confidently identify coarse gravels. If this field is used, the generally gravel category should *not* be used.



9. *Cobble Substrates* - The Cobble substrates field allows assessors to enter the relative percentage of cobbles that occur along the shoreline. Cobbles are particles that are 64 to 256 mm in size (tennis ball to basketball).
10. *Fine Cobble Substrates* - The Fine Cobble substrates field allows assessors to enter the relative percentage of fine cobbles that occur along the shoreline. Fine cobbles are particles that are 64 to 128 mm in size (tennis ball to coconut). This field should only be used when assessors have good visibility and can confidently identify fine cobbles. If this field is used, the general cobble category should *not* be used.
11. *Coarse Cobble Substrates* - The Coarse Cobble substrates field allows assessors to enter the relative percentage of coarse cobbles that occur along the shoreline. Coarse cobbles are particles that are 128 to 256 mm in size (coconut to basketball). This field should only be used when assessors have good visibility and can confidently identify coarse cobbles. If this field is used, the general cobble category should *not* be used.
12. *Boulder Substrates* - The Boulder substrates field allows assessors to enter the relative percentage of boulders that occur along the shoreline. Boulders are particles that are greater than 256 mm in size (bigger than a basketball). These substrates can not typically be lifted by one person as they are too heavy.
13. *Bedrock Substrates* - The Bedrock substrates field allows assessors to enter the relative percentage of bedrock that occurs along the shoreline. Bedrock is considered any rock where blocks are larger than 4 m or is solid, un-weathered underlying rock.
14. *Embeddedness of Substrates* - Embeddedness is a categorical field that allows assessors to enter the approximate embeddedness of substrates. Embeddedness is a measure of the degree to which boulders, cobbles and other large materials are covered by fine sediments. Categories for embeddedness include None (0%), Low (0 to 25%), Medium (25-75%), High (>75%), or Unknown. When assessors are unclear of the embeddedness they should either complete measurements of foreshore substrates or leave the field as unknown.
15. *Substrate Shape* - Shape is a categorical field that allows assessors to identify the shape of larger particles such as cobble or boulders. Angular shapes refer to naturally occurring angular rock material that has not been substantially weathered. Blast rock refers to angular blast rock materials, such as rip rap. Smooth materials are rocks that are generally rounded. This field should be used to describe the predominant substrates that occur along the shoreline (e.g., if 85 % of the substrates are round and smooth, and 10% are blast rock, the field should be used to describe the 85%).



The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.6 *Vegetation Bands (Vegetation Band 1 & 2)*

The Vegetation Bands sections of the data dictionary are intended to allow assessors to describe lake side vegetation that occurs. The data dictionary includes two sections, Vegetation Band 1 and Vegetation Band 2, which are almost identical. The addition of a second Vegetation Band occurred during the summer of 2008 because in many cases there are two distinctive vegetation zones that exist adjacent to lakes. Other dictionaries have called these two sections Riparian and Upland. The riparian zone, tends to occur in moist areas, and often transitions to drier upland areas. Also, in many wetlands, there is a wide band of emergent shrubs and willows, and then a riparian zone beyond the wetland features. When assessing Vegetation Bands, assessors should consider everything within 50 m of the shoreline and possible the band of emergent riparian vegetation associated with wetland features. The approximate length of the bands considered is the sum of Vegetation Band 1 and 2 Bandwidths.

Vegetation bands can be extremely variable along a segment. Assessors should focus on the primary or dominant vegetation observed along the segment and people utilizing the data must understand that this overview inventory cannot describe every micro-site that may exist. When assessing the different bands, assessors should consider both the linear length and depth of the bands. The intent is to describe a representative section of the shore segment.

In highly urbanized or impacted areas, it is often difficult to define a clear band. In these cases, it is generally preferred to limit the assessment to the first row of development, which often times results in describing only one vegetation band. In other cases, shorelines may not contain two distinctive bands of vegetation. In these circumstances, assessors should only describe the shoreline with one vegetation band, leaving the second band blank. The comments field is a useful section that allows assessors to describe exactly what is being described. Also, the bandwidth fields (discussed below) are helpful because they give an indication of the width of the band.

The following sections describe all fields that occur in Vegetation Band 1 and 2. Fields are duplicated in Vegetation Band 2 and are therefore only described once here. Please refer to Appendix A for a tabular description of information below.

1. *Vegetation Class* - The Vegetation Band 1 Land Cover Class is a description of the predominant vegetation class present. Categories are largely derived from the SHIM Module 4 (Mason and Knight, 2001).
 - a. The Coniferous Class occurs where tree cover is at least 20% of the shore zone area and at least 80% of the trees are coniferous.



- b. The Broadleaf Class occurs where the tree cover is at least 20% and at least 65% of the trees are broadleaf or deciduous.
 - c. The Mixed Forest Class occurs where tree cover is at least 20% and there are no more than 80% coniferous trees and no more than 65% broadleaf trees.
 - d. The Shrubs Class occurs where tree coverage is less than 10% and there shrubs cover at least of 20%. Shrubs are defined as multi-stemmed woody perennial plants.
 - e. The Herbs / Grasses Class occur where there is less than 10% tree coverage and less than 20% of shrubs.
 - f. The Exposes Soil Class occurs where recent disturbance, either anthropogenic or natural, has occurred and mineral soils are exposed.
 - g. The Landscape Class refers to urbanized areas where most natural vegetation has been replaced by at least 30% coverage of ornamental trees, shrubs, and other vegetation.
 - h. The Lawn Class occurs in urbanized areas where turf grasses cover at least 30% of the shore zone area and landscaping with ornamental shrubs or trees is less than 30% coverage.
 - i. The Natural Wetland Class occurs where shore marshes dominate the shore zone area and they have not been significantly influenced by human disturbance.
 - j. The Disturbed Wetland Class occurs where shore marshes predominate the shore zone area and they have experience significant disturbance (i.e., greater than 30%).
 - k. The Row Crops Class occurs in agricultural areas where crops are growing. If sites are agricultural, but are not used for row crops (e.g., pasture lands), they should be described as Herbs/Grasses and comments should be used to indicate the agricultural nature of the shore segment.
 - l. Un-vegetated Sites occur where there is less than 5% vegetation cover and at least 50% of the vegetation cover is mosses or lichens. Un-vegetated sites tend to occur on rocky, exposed shorelines.
2. *Vegetation Stage* - The Vegetation Band 1 Stage is a description of the structural stage of the dominant vegetation. Categories are largely derived from the SHIM Module 3 and the Field Manual for Describing Terrestrial Ecosystems (MOE, 1998). On highly developed shorelines, assessors should attempt to describe the structural of the dominant vegetation type observed.
- a. The Sparse Stage describes sites that are in the primary or secondary stages of succession, with vegetation consisting mostly of lichens and mosses, and the total shrub coverage is less than 20% and tree coverage is less than 10%.
 - b. The Grass / Herb Stage describes sites where shore zones are dominated by grasses and herbs, as a result of persistent disturbance of natural conditions (e.g., grasslands).
 - c. The Low Shrubs stage describes sites that are dominated by shrubby vegetation less than 2 m in height.



- d. The Tall Shrubs Stage is dominated by vegetation that is 2 to 10 m in height and seedlings and advance regeneration may be present.
 - e. The Pole / Sapling Stage describes sites that contain trees greater than 10 m in height, typically densely stocked, and there is little evidence of self thinning or vertical structure.
 - f. The Young Forest Stage describes sites that are typically less than 40 years old (but could be as great as 50 to 80 years depending upon the forest community), self thinning is evident, and the forest canopy has begun to differentiate into distinct layers.
 - g. The Mature Forest Stage describes sites that are typically 40 to 80 years old (but could be as high as 140 years), and the understory is well developed with a second cycle of shade trees.
 - h. The Old Forest Stage describes sites that are typically greater than 80 years old and the stands are structurally complex. Old Forests contain abundant coarse woody debris at varying stages of decay. Old Forests are at least 80 years in age, but may be as old as 250 years and should be considered relative to the forest community assessors are in.
3. *Shrub Cover* - The Shrub Coverage categorically describes shrub coverage within the shore zone. Shrubs are defined as multi-stemmed woody perennial plants. Sparse sites have less than 10% shrub coverage. Moderate shrub coverage occurs on sites that have between 10 to 50% coverage. Abundant shrub coverage occurs on sites that have greater than 50% shrub coverage.
 4. *Tree Cover* - The Tree Cover categorically describes tree coverage within the shore zone. Sparse sites have less than 10% tree coverage. Moderate tree coverage occurs on sites that have between 10 to 50% coverage. Abundant tree coverage occurs on sites that have greater than 50% tree coverage.
 5. *Distribution* - The Distribution field is used to describe whether the vegetation band described is continuous along the entire shore segment. Categories include Continuous and Patchy (for sites where the dominant vegetation band occurs in patches along the segment). An example of a patchy distribution is a shore segment where most areas are extensively landscaped, with the exception of a few shore lots which remain relatively natural. In this case, the dominant landscaped area would be described and comments would be used to identify residual natural areas.
 6. *Bandwidth* - The Vegetation Band 1 Bandwidth field is used to provide an estimate of the approximate width of the band being described. In cases where bandwidth varies along the segment, a representative width should be used to describe the shore segment. The intent of this field is to provide a general description of the width of the vegetation band that is being described and users of the database need to consider this when assessing data within the database.
 7. *Overhanging Vegetation* - The Overhanging Vegetation field is used to describe the percentage of the shore segment length that contains significant overhanging



vegetation. Overhanging vegetation should be considered as if the lake was at full pool or the mean annual high water level.

8. *Aquatic Vegetation* - The Aquatic Vegetation field is used to describe the percentage of the shoreline that contains emergent, submergent, and floating aquatic vegetation. This field is the combined length of aquatic vegetation along the segment, not considering overlapping areas.
9. *Submergent Vegetation* - The Submergent Vegetation field is used to describe the percentage of the shoreline segment that contains submergent vegetation. Submergent vegetation includes species such as milfoil, *Potamogeton* spp., etc.
10. *Submergent Vegetation Presence* - The Submergent Vegetation Presence field is used to indicate whether submergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.
11. *Emergent Vegetation* - The Emergent Vegetation field is used to describe the percentage of the shoreline segment that contains emergent vegetation. Emergent vegetation includes species such as cattails, bulrushes, various sedges, willow and cottonwood on floodplains, grasses, etc.
12. *Emergent Vegetation Presence* - The Emergent Vegetation Presence field is used to indicate whether emergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.
13. *Floating Vegetation* - The Floating Vegetation field is used to describe the percentage of the shoreline segment that contains floating vegetation. Floating vegetation includes species such as pond lilies, etc.
14. *Floating Vegetation Presence* - The Floating Vegetation Presence field is used to indicate whether floating vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.7 Littoral Zone

The Littoral Zone section of the data dictionary includes biophysical information about the littoral zone within the segment. Air photos are extremely helpful for determining the width of this zone, but are not necessary. The data fields in this section are quite easy to fill out and interpretation is not that difficult.



1. *Littoral Zone* - The Littoral Zone Width Category provides a general classification of the littoral zone. Wide littoral zones are greater than 50 m. Moderate littoral zones are 10 to 50 m in width, and narrow littoral zones are less than 10 m wide.
2. *Large Woody Debris* - The Large Woody Debris (LWD) presence field allows assessors to indicate whether LWD is present along the segment. Categories include less than 5 Pieces, 5 to 25 Pieces, and greater than 25 Pieces.
3. *Large Woody Debris Number* - The LWD count field allows assessors to enter the total number of LWD pieces counted along the shore segment. Only significant pieces of LWD, which are contributing to fish habitat, should be counted.
4. *Littoral Zone Width* - The Littoral Zone Width field allows assessors to enter the average littoral width of the segment. This field can be determined using air photo interpretation or field measurements. Typically, the field is rounded to the nearest 5 m as the number is intended to be representative of the segment.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.8 Modifications

The Modifications section allows assessors to enter a summary of all of the different types of shoreline modifications that may occur along the shore segment. Most of the categories described in this section are features or structures that are counted. However, some of the fields require assessors to pay attention to the percentage of the segment that modifications are observed along. As mentioned above, assessors need to be cognizant of boat speed, distance traveled, and this relationship to the feature in question. Again, use of air photos to estimate and scale shoreline length to determine the percentage is extremely beneficial and improves the accuracy of measurements.

1. *Retaining Walls* - The Retaining Wall count field is the total number of retaining walls occurring along the segment. Retaining walls should only be counted if they are within 5 to 10 m of the high water level. Retaining walls must have a vertical element that is greater than 30 cm and must be retaining earth to some degree. On steep sloping sites, more than one retaining wall may be present (i.e., the property is tiered). In these cases each retaining wall is counted.
2. *Percent Retaining Walls* - The Percent Retaining Wall field indicates that approximate percentage of the shore segment length where retaining walls occur.
3. *Docks* - The Docks Count field is the total number of pile supported or floating docks or swimming platforms that occur along the segment. Properties may have more than one dock present and each different structure is considered a separate dock. For instance, a property could have one swimming float and one dock.



4. *Docks per Kilometer* - The Docks per Kilometer field is determined during post processing. This field is calculated by dividing the total number of docks observed by the total length of the shore segment.
5. *Boat House* - The Boat House count field is used to count boat houses that occur along the segment. Boat Houses are structures that are specifically designed to house boats or watercraft. Boat Houses can either be located on land or as structures over the water. If only structures over the water are counted, assessors should be consistent and make note of this so end users are aware of what definition was used for a boat house. If structures on land are considered as boat houses, a rail or boat launch should be present that land owners use to launch the boat to the lake. Garages that house boats should not be counted as boat houses because there is not an associated launch structure.
6. *Groynes* - The Groyne count field is used to count any structure that is perpendicular to the shoreline that is impacting regular sediment drift along the shoreline. Groynes can be constructed out of concrete, rock, piles, wood, or other materials. Docks or other structures that are acting as groynes, and affecting sediment movement should be included in the groyne count. Rock lines that are too small to significantly impact sediment movement should not be counted as a groyne.
7. *Groynes per Kilometer* - The Groynes per Kilometer field is determined during post processing of data. This field is calculated by dividing the total number of groynes observed by the total length of the shore segment.
8. *Boat Launch* - The Boat Launch count field is the total number of boat launches that were observed along the shoreline. Generally, only permanent boat launches are counted (e.g., made of concrete). However, on small systems assessors may choose to count gravel boat launches as these may be the only type present. Assessors should document criteria used to determine what constitutes a boat launch during the assessment.
9. *Percent Rail Modifier* - The Percent Rail Modifier field is used to describe the percentage of the linear shore segment length that contains railways in close proximity to the shoreline.
10. *Percent Road Modifier* - The Percent Road Modifier field is used to describe the percentage of the linear shore segment length that contains a roadway in close proximity to the shoreline.
11. *Marine Railways* - The Marine Rail count field is the total number of marine rails that occur along a shore segment. Marine Rails are a track system that is used to remove boats from a lake during the winter months.



12. *Marinas* - The Marinas Field is the total number of large and small marinas that were documented along the shoreline. A marina is considered to be any pile supported or floating structure that has slips for 6 or more boats.
13. *Substrate Modification Presence* - The Substrate Modification Presence field is used to document whether substrate modification is occurring along the shore segment. Substrate modification includes any type of importation of sands, significant movement of natural substrates (e.g., to construct groynes), or earthworks.
14. *Percent Substrate Modification* - The Percent Substrate Modification field is the estimated percentage of the shore segment where substrate modification has occurred.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.9 *Flora and Fauna*

The Flora and Fauna sections contain specific information for flora and fauna observations and data along the shore segment. The fields in this section are quite self explanatory and are either count or comments fields.

1. *Veterans* - The Veterans field is a categorical field to describe the number of veteran trees that occur along the shore segment. Veteran trees are defined as a tree that is significantly older than the dominant forest cover and provides increased structural diversity. Categories include no, less than 5 trees, 5 to 25 trees, and greater than 25 trees.
2. *Snags* - The Snags field is a categorical field to describe the number of dead standing snags that occur along the shore segment. Snags are defined as dead standing trees that provide increased structural diversity. Categories include no, less than 5 trees, 5 to 25 trees, and greater than 25 trees.
3. *Flora and Fauna Comments* – These fields are important to note observations made. Examples of important observations are known spawning areas, osprey or other birds of prey nesting locations, etc. Significant features should be individually mapped if possible, especially sensitive nesting areas, etc.

5.0 DATA PROCESSING AND QUALITY ASSURANCE

The data processing and quality assurance portions of these projects are extremely important. It is preferred if assessors carry out these steps because they have firsthand knowledge of the shoreline and its condition. Although data entry into the GPS unit results in minimal errors (i.e., forgotten fields, etc.), there is often times small items that are



missed or accidentally overlooked. It is during the data processing stages that data gets reviewed and finalized.

5.1 Data Processing

Data processing for FIM projects is slightly different than SHIM (Mason and Knight, 2001). Module 5 of the SHIM manual provides very detailed information regarding accuracy requirements for stream mapping. This manual should be referred to as it contains useful information regarding standard GPS receivers, data logging, and other requirements that field assessors need to know and be able to do. The methodology below is intended to provide assessors with a summary of the post processing steps that occur as part of a FIM project and does not contain a summary of methods for use of the GPS or GIS software.

5.1.1 Accuracy and Determining the Shoreline Location

Typically accuracy targets for stream mapping are 5 m (Mason and Knight, 2001). These targets are realistic for stream mapping, but are not possible while carrying out boat surveys of a shoreline. Generally, boat surveys are done 20 to 30 m from the actual shoreline being measured. Thus, there is an immediate accuracy issue, as the line feature being collected with the GPS unit is already inaccurate because it is 20 to 30 m from the shoreline. Thus, precision mapping with the GPS is not required for FIM projects (i.e., PDOP values) because of the inherent data inaccuracies.

Accuracy of shore segment information ultimately relates to the accuracy of the shoreline. Mapped shorelines and the spatial data associated with them should be attached the approximate high water level of the shoreline. The above highlights how accuracy is not feasible with a FIM boat survey. Thus, shoreline accuracy with these surveys is typically obtained using air photo interpretation, detailed topographic modeling, or by using existing lake shoreline information. Each of the above provides a different level of accuracy, and typically a combination approach is preferred. Accuracy of the shoreline segment features can affect the following:

1. The length of the shoreline segment;
2. The location of segment breaks;
3. Calculation in the data base such as docks per kilometer.

The first step in post processing is to accurately identify the location of the approximate high water level of the lake being assessed. This can be accomplished, as mentioned above, by using one or a combination of the following:

1. Creation of the shoreline by air photo interpretation using changes in vegetation, retaining walls, and other visible features;
2. Using a topographical model and spatial analyst software to calculate an elevation, which can be used for a shoreline (e.g., 343 m asl is often used for Okanagan Lake); and,



3. Using existing TRIM shoreline;

There are distinct advantages and disadvantages to each of the above. Advantages of air photo interpretation are that it tends to be quite accurate with good air photos. However, it also tends to be quite time consuming to complete. Use of spatial analyst software is possible, but often the data available to create the model is not very accurate and the software is extremely costly. Use of the TRIM shorelines is very cost efficient, but this line work can often be quite inaccurate (i.e., up to 20 linear m in some instances). Given the above, assessors must consider the accuracy requirements of their assessments to ensure that the desired accuracy is achieved. Assessors should attempt to achieve the 5 m accuracy recommendations of SHIM and utilize whatever means necessary within allowable budgets to achieve these results. GIS software allows data to be updated as increased accuracy becomes possible.

5.1.2 Segment Breaks

Segment breaks are often determined in field assessments by marking field air photos that were produced for the survey because it is more efficient than manually marking the point using the GPS. These visual markers allow segment breaks to be easily added to the shoreline once it has been determined (above) and allows field crews to be very specific about where the break is being made from the boat. If air photo field maps are not possible, assessors are strongly encouraged to manually mark the segment break using a point feature on the GPS unit. Using offset features, it is possible to mark this from the vessel. This is recommended because it is the most accurate ways to ensure the segment break occurs where desired on lakes without high resolution air photos.

Once the shoreline has been mapped, and segment breaks have been determined, the database should be “transferred” to the shoreline. This process involves moving the spatial line features to the shoreline with the appropriate breaks. Some databases include the transferred GPS settings (e.g., PDOP data). This data can be retained, but is somewhat unnecessary because it is associated with line features collected in the boat survey and not associated with the manually determined shoreline features discussed above.

5.2 Data Management and Quality Assurance

Data management is extremely important. One of the typical GPS settings used is a copy feature that allows assessors to quickly begin a segment. However, use of this feature can result in data field carry over (i.e., substrate data from Segment 25 is carried over to Segment 26. The assessor forgets to zero a substrate percentage and the number carries over. The substrates total now exceeds 100%). Therefore, once data has been collected, it must be proofed. This process involves review of photos, data fields, etc. The following are specific items that should be reviewed:

1. Lake Reference – Errors in data collection are not common in this section. Clean up of spelling and comments is most common.



2. Segment Class – In this section, the shore type and shore modifier fields are most important and percentages in other sections should be consulted to confirm. Review percentages and ensure that photo numbers are correct. Video time can be entered if available.
3. Shore Type – Field pictures and air photos should be reviewed in conjunction with field data entered. Typically, only minor adjustments are required to ensure data adds to 100%.
4. Land Use – Land use is often more difficult to determine in rural areas. Often times, digital data is lacking and land use is assessed by field interpretation. Review of local government zoning is helpful as it provides a basis for interpretation. Assessors should do their best to document land uses as observed, and adjustments should be made as necessary.
5. Substrates – Field photos can be reviewed, to assist in final determination of substrates. Generally, these fields just need to be reviewed to determine that they add to 100%. Substrates are intended to provide a broad overview of the distribution of segment.
6. Vegetation Bands – Review of field photos is extremely helpful to review these fields. Having a large number of photos can help assessors in ensuring these sections are accurate. Adjustments should be made as necessary.
7. Littoral Zone – These fields are usually quite accurate. A review of air photos to look at the littoral zone widths will help improve accuracy.
8. Modifications – In these fields, the docks per kilometer and groynes per kilometer need to be calculated. These field as calculated as follows:
 - a. Dock (or groynes) per Kilometer = # of Docks / Shore Segment LengthOther items to pay attention to are modifiers. Airphotos and photos should be carefully reviewed to confirm these fields.
9. Flora and Fauna – These fields usually just need to be briefly reviewed and added as necessary.

Review and finalization of the spatial location of the shoreline, segment breaks, and associated data is very important and assessors should do their best to review data sets.

6.0 REPORTING

Reporting for FIM is a budget dependant item. Reporting is not as important as field data collection, review, and verification. Thus, a variety of different reporting can be completed and the reporting completed varies with budgets and time allotted for the project. Reporting should focus on identification of key concerns observed along the shoreline and data analysis should be used to corroborate findings.

6.1 Data Analysis

Data analysis can be completed in numerous different ways using FIM databases. Most reports prepared to date have followed the templates developed by the RDCO for the central regions of Okanagan Lake. There reports contain numerous different graphs, figures, and correlations prepared using the dataset, and all help with understanding and



interpreting data. Important correlations can lead to a better understanding of modified shorelines.

Integration of biophysical data with spatial data and analysis is also important. These types of analyses often follow and examples include the various different aquatic habitat indices that have been developed. Ultimately, the shore segments described above provide a basis for long term monitoring and data analysis for lake shorelines because new spatial and biophysical data may be appended to the database from future assessments.

7.0 RECOMMENDATIONS FOR ONGOING DATA MANAGEMENT

The following are recommendations for management of these data sets:

- One location should be determined to hold the master database for the different lake systems being assessed. Spatial data management is a big responsibility and one authority should be determined to hold master data sets. However, municipalities, consultants, non-profit organizations, and the public should all have access to data. Local governments are also good at holding and managing data sets because often times they routinely utilize data on a day to day basis. Regardless, one government body should maintain responsibility for data sets.
- As new data is gathered (e.g., AHI), it should be appended to the FIM database. Sub databases should be considered (e.g., detailed substrate mapping, more detailed modifications inventories, etc.) as they are developed. Any sub data bases should be referenced in the FIM Database as a field or column of data. The **Shore Segment Number** should be used as the unique identifier for all sub data sets created. Examples of this include geo hazard assessments, shore spawning assessments, substrate mapping, etc.
- Funding should be allocated at all levels to facilitate ongoing data management and collection. These inventories form the basis for all future land management and land use decisions for large lakes. They will help managers at all levels of government work within a unified framework for understanding environmental data and managing the complex aquatic systems associated with our large interior lakes.
- The most recent data base version is SHIM LAKE v. 2.6. This report has attempted to identify and consolidate versions of the dictionary. Future revisions of the methodology should provide a reference guide for changes / additions.



8.0 REFERENCES

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Appendix A – Foreshore Inventory and Mapping Field Code Definitions



Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Lake Reference	LAKE_NAME	Lake Name		Alphanumeric	Local lake name	
	LAKE_LEVEL	Lake Level		Numeric	On gauged lakes, lake level is the geodetic level (i.e., above sea level) of the lake the day the assessment was completed. This will help people utilizing data understand at what water level the data was collected. This field should be left blank if the lake level is unknown or if the lake is not gauged.	
	SECHI_DEPT	Secchi Depth		Numeric	Secchi depth is a measure of the point where a 20 cm weighted white line disappears from view when lowered from the shaded side of a vessel and that point where it reappears upon raising it. This measurement should be made at mid-day as it results are more variable at dawn and dusk. Secchi depths vary depending upon the time of year measured and productivity of a lake, and in lakes with increased particulate matter (e.g., algae).	Meter
	ORGANIZATI	Organization		Alphanumeric	Organization is the government, non-profit organization, or companies who are responsible for collection of the field data.	
	DATE_	Date		Alphanumeric	Date field data was collected.	
	TIME_	Time		Time	Time field data was collected.	
	CREW	Crew		Alphanumeric	The initials of all field crew, including boat skippers, should be included.	
	WEATHER	Weather		Categorical	The weather is a categorical field. Available options include Light Rain, Heavy Rain, Snow/Sleet, Over Cast, Clear, Partly Cloudy, and other. This field should be filled in with the most appropriate weather observed throughout the day. If the Other category is chosen, field assessors should identify the weather in the comments field.	
	AIR_TEMP_	Air temperature		Numeric	Air temperature is the temperature observed during the assessment.	Celsius
	WATER_TEMP	Water Temperature		Numeric	Water temperature is the water temperature observed during the assessment. This field is not mandatory.	Celsius
	JURISDICTI	Jurisdiction		Alphanumeric	Jurisdiction is the governmental entity that has predominant governance over the shoreline being assessed. Typically, this would be a local government, regional district or native band. In some cases, the shoreline may occur along crown land or within a provincial park. If possible, field assessors should break segments at all major changes in jurisdiction to allow for better management of shore line segments. If a segment break is not included at a change in jurisdiction, the jurisdiction with the predominant length of shoreline should be listed here and the secondary jurisdiction should be noted in the comments field.	
	COMMENTS	Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Segment Class	SEGMNT_NUM	Shoreline Segment Number		Numeric	The shoreline segment number is a field that identifies the shore segment. Typically, shore segments begin a 1 and continue until the entire shoreline has been mapped. A shore segment is an area of with similar land use, shore type, vegetation, and substrates.	
	SHORE_TYPE	Shore Type		Categorical	Shore type is a categorical field that describes the predominant shore type that occurs along the length of the shore segment (i.e., the highest percentage of the linear shoreline length). Shore types include Cliff/Bluff, Rocky Shore, Gravel, Sand, Stream Mouth, Wetland, and Other. If other is selected, comments should be included to describe the shore type observed.	
	SHORE_MODI	Shore Type Modifier		Categorical	The shore type modifier field is used to describe significant shoreline activities that influence the shoreline. The field is categorical and choices include Log Yard, Small Marina (6-20 slips), Large Marina (greater than 20 slips), Railway, Roadway, None, and Other. If other is selected, the comments field should be used to identify the modifier. If the field is left blank, users should assume that there is no shoreline modifier.	
	SLOPE	Slope		Categorical	Slope is a categorical determination of the slope or gradient of the shoreline. Categories include Low (less than 5%), Moderate (5-20%), Steep (20-60%), Very Steep (>60%), and Bench. A bench is a shoreline that rises, typically steep or very steep, has a flat area typically greater than 15 horizontal meters, and then becomes steep or very steep again. On bluff shore types, where the shoreline rises sharply and then flattens, the categorical statement should describe the steep portion of the shoreline (i.e., do not use bench).	

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Segment Class	LAND_USE	Land Use		Categorical	Land use is a categorical field that is used to describe the dominant land use observed along the segment. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use can be determined based upon a combination of field observation, review of zoning and bylaw maps, and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories.	
	LEV_OF_IMP	Level of Impact		Categorical	Level of impact is a categorical field that is used to describe the general disturbances that are observed along the shoreline. Disturbances are considered any anthropogenic influence that has altered shoreline including foreshore substrates, vegetation, or the shoreline (e.g., retaining walls). Level of impact is considered both looking at the length of the shore line (i.e., along the segment) and the depth of the shore zone area to between 15 to 50 m back. In more rural settings, typically the assessment area is greater (i.e., 50 m) and in more developed shorelines, typically the assessment area is less (i.e., 15 m). In cases of roadways or railways, one should generally assess the location of the rail or roadway along the segment. To facilitate interpretation of this category, air photo interpretation is recommended to better estimate disturbance. Disturbance categories include High (>40%), Medium (10-40%), Low (<10%), or None. Consistency of determination is very important and assessors should consistently use the same criteria to determine the level of impact.	
	LIVEST_ACC	Livestock Access		Categorical	Livestock access is a categorical field that is used to determine whether livestock, such as cattle, have access to the foreshore. Choices include Yes or No or blank. If the field is left blank, one should assume that cattle do not have access.	
	DISTURBED	Percentage of the Shoreline that is Disturbed		Numeric	Percentage of the shoreline that is disturbed is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.	%
	NATURAL_	Percentage of the Shoreline that is Natural		Numeric	Percentage of the shoreline that is natural is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.	%
	PHOTONUM	Photo Number		Alphanumeric	Photo number is a field that is used to enter in digital or still photos taken during the assessment.	
	TAPE_NUMB	Tape Number		Alphanumeric	Original Video tape number	
	VIDEO_TIME	Video Time		Alphanumeric	Delineates that start and stop time of the video segments. Assessors may also just enter in the start time of the segment, as it is generally inferred that the start time of one segment corresponds with the stop time of a previous segment.	
	CMMNT_CLAS	Class Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the class data fields above.	
Shore Type	CLIFF_BLUF	Cliff and/or Bluff Shore Type		Numeric	The Cliff / Bluff field contains the percentage of the segment, based upon the shore segment length that is a cliff or bluff shore type. A cliff shore type is typically very steep with substantial vertical elements. A bluff shore type is typically steep or very steep, and then flat for a substantial distance, typically formed by the fast recession of water levels during glacial periods.	%
	ROCKY	Rocky Shore Type	Low Rocky Shoreline and/or Vegetated Shoreline	Numeric	The Rocky Shoreline field contains the percentage of the segment, based upon the shore segment length that is rocky. Rocky shores consist mostly of boulders and bedrock, with components of large cobble and some gravels. These shores tend to occur on steeper shorelines. Previous versions of the data dictionary called these shorelines low rocky shorelines or possible (but less so) vegetated shorelines.	%

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Shore Type	GRAVEL2	Gravel Shore Type	Gravel Beach Shore Type	Numeric	The Gravel shore type field contains the percentage of the segment, based upon the shore segment length that is a gravel beach. Gravel beach shorelines tend to occur on Low or Moderate slopes, and substrates are predominantly gravels and cobbles. These shore types may also contain small percentages of gravels and or bedrock. Often times, gravels beaches and rocky shores occur along one segment, with gravel shore types occurring in depositional areas (i.e., in bays) and rocky shores (i.e., at points) occurring in erosion areas.	%
	SAND2	Sand Shore Type	Sand Beach Shore Type	Numeric	The Sand shore type field contains the percentage of the shoreline, based upon the shore segment length that is a sand beach. Sand beach shorelines tend to occur in low gradient shorelines and are predominated by sands and small gravels. These shore types may also contain some gravel shoreline areas in places that are more exposed to wind and wave action (e.g., points).	%
	STREAM_MOU	Stream Mouth Shore Type	Alluv_Fan or Alluvial Fan	Numeric	The Stream Mouth shore type field contains the percentage of the shoreline, based upon the shore segment length that is a stream mouth. A stream mouth is defined as the space where there is a confluence between a lake and a stream or a river and the stream has direct influence on sediment movements and deposition or is part of the active floodplain. Typically, the stream mouth segment is larger for rivers and smaller for creeks. A separate segment should be created for significant fisheries streams, such as those known to contain spawning populations of anadramous salmon.	%
	WETLAND	Wetland Shore Type		Numeric	The Wetland shore type field contains the percentage of the shoreline, based upon the shore segment length that is a shore marsh wetland. A wetland segment typically occurs on low gradient sites, the littoral zones is wide and shallow, substrates are predominantly silts, organics, or clays, and there is emergent vegetation present. The Wetlands of British Columbia defines a shore marsh as a seasonally or permanently flooded non tidal mineral wetland that is dominated by emergent grass like vegetation. The BC Wetland book contains descriptions of some of the wetland shore types that may be observed along lake shorelines	%
	OTHER	Other Shore Type		Numeric	The Other shore type field allows assessors to enter in shore types that do not fit into one of the general categories above. If the other shore type field is used, assessors should add comments to describe the shore type and provide justification for use of the other field. Examples of other shore types may include constructed boat access canals.	%
	STYPE_COMM	Shore Type Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the shore type data fields above.	
Land Use	AGRICULTUR	Agriculture Land Use		Numeric	The agriculture land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for crop based agricultural or as active livestock range lands (i.e., extensive holding areas, large numbers of cattle). Livestock pastures that are not active rangelands (i.e., a few cows or horses) are not considered an agriculture land use (see rural).	%
	COMMERCIAL	Commercial Land Use		Numeric	The Commercial Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for commercial purposes. Commercial purposes include retail, hotels, food establishments, marinas with fuel, stores, etc. Commercial areas tend to occur along highly impacted shorelines.	%
	CONSERVATION	Conservation Land Use		Numeric	The Conservation Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for conservation of critical or important habitats. Examples of conservation shorelines include lands held by the Land Conservancy, biological reserves, etc. Conservation lands cannot occur on privately held shorelines, unless conservation covenants or other agreements are in place to protect areas in perpetuity.	%
	FORESTRY	Forestry Land Use		Numeric	The Forestry Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for forestry. These areas are typically Crown Lands that are part of active cut blocks. Log Yards are not considered a Forestry Land use as they are Industrial.	%
	INDUSTRIAL	Industrial Land Use		Numeric	The Industrial Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for industrial purposes. Examples of industrial purposes include log yards, processing facilities, lumber mills, etc. These shorelines are typically heavily impacted.	%

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Land Use	INSTITUTIO	Institutional Land Use		Numeric	The Institutional Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for institutional purposes. Examples of institutional land uses include schools, public libraries, etc.	%
	MULTI_FAMI	Multi-Family Land Use	LU_URB_RES or Urban Residential Land Use	Numeric	The Multi-Family Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for multi-family residences. Multi-family developments are typically condominiums or town homes.	%
	NATURAL_AR	Natural Areas		Numeric	The Natural Areas Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly natural crown lands. These areas do not occur in provincial parklands and cannot be privately held.	%
	PARK	LU_PARK or Park			The Park Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly natural areas parklands. These parks areas can be provincial, federal, or municipal parks. These parks tend to be predominantly natural and are different from urban parks, which are used intensively for recreational purposes (e.g., public beaches).	%
	RECREATION	Recreation Land Use		Numeric	The Recreation Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for recreational purposes. Examples include public or private campgrounds, areas of known cabin rentals, etc. In some cases recreational shoreline may also be referred to as single family land uses, depending upon how much are known about them. Generally, if a shoreline contains privately held cabins that are rented out occasionally, these should be referred to as single family land uses rather than recreational.	%
	RURAL	Rural Land Use		Numeric	The Rural Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for rural purposes. These shorelines are typically large lots, private estates, or hobby farms. Differentiation between rural and single family land use can be difficult when lots are narrow but deep (i.e., appear dense on the shoreline but extend quite far back). When doubt exists between a rural designation and a single family land use, assessors should be consistent in their judgments and refer back to local government zoning or bylaws to help decide on the appropriate land use type.	%
	SINGLE_FAM	Single Family Residential	LU_URB_RES or Urban Residential Land Use	Numeric	The Single Family Residential Land Use is the percentage of the shoreline, based upon the shore segments length that is predominantly used for single family residential purposes. Typically, single family residential occurs in more densely developed areas. However, seasonal use cottages or cabins can often be considered single family residential areas if the dwellings have associated outbuildings, docks, and other features consistent with more densely developed areas.	%
	URBAN_PARK	LU_PARK or Park			The Urban Park Land Use is the percentage of the shoreline, based upon the shore segments length that is predominantly used as an urban park. Examples of this land use include public beaches, picnic areas, etc. Shorelines dominated by this land use tend to have limited riparian vegetation and contain extensive areas of turf in the under story.	%
	LANDU_COMM	Land Use Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the shore type data fields above.	%
Substrates	MARL	Marl Substrate	SUB_FINES or Fine Substrates	Numeric	The Marl substrate field allows assessors to enter the relative percentage of marl occurring along the shoreline. Marl is a substrate that is typically white in color associated with clear lakes and consists of loose clay, precipitated calcium carbonate, mollusk/invertebrate shells, and other impurities.	%
	MUD	Mud Substrates	SUB_FINES or Fine Substrates	Numeric	The Mud substrate field allows assessors to enter the relative percentage of mud occurring along the segment. Mud is a substrate that is typically dark in color and consists of a mixture of silts, clays, and finely decayed organic material that is not typically discernable.	%
	ORGANIC	Organic Substrates	SUB_FINES or Fine Substrates	Numeric	The Organic substrate field allows assessors to enter the relative percentage of organic materials that occur along the shoreline. Organic substrates are typically associated with wetland sites and consist of detritus material that is identifiable to some extent (e.g., sticks, leaves, etc.).	%
	FINES	Fine Substrates	SUB_FINES or Fine Substrates	Numeric	The Fines substrate field allows assessors to enter the relative percentage of fines that occur along the shoreline. Fines consist of silts and clays and these substrates are typically less than 1 mm in size. Fines are differentiated from mud because there is little to no organic content.	%

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Substrates	SAND	Sand Substrates	SUB_FINES or Fine Substrates	Numeric	The Sand substrates field allows assessors to enter the relative percentage of sands that occur along the shoreline. Sands are any particle that contains granular particles visible to the naked eye. These particles are typically .06 to 2 mm in size.	%
	GRAVEL	Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Grave substrates field allows assessors to enter the relative percentage of gravels that occur along the shoreline. Gravels are particles that range from 2 mm to approximately 64 mm. Thus, they are the size of a lady bug to the size of a tennis ball or orange. This field should only be used when substrates are difficult to identify and assessors cannot determine whether fine and course gravels.	%
	GRAVEL_FIN	Fine Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Fine Gravel substrates field allows assessors to enter the relative percentage of fine gravels that occur along the shoreline. Fine gravels are particles that are 2 mm to approximately 16 mm or the size of a ladybug to the size of a grape. This field should only be used when assessors have good visibility and can confidently identify fine gravels. If this field is used, the generally gravel category should <i>not</i> be used.	%
	GRAVEL_COA	Coarse Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Coarse Gravel substrates field allows assessors to enter the relative percentage of course gravels that occur along the shoreline. Coarse gravels are particles that are 16 mm to approximately 64 mm or the size of a grape to the size of a tennis ball or orange. This field should only be used when assessors have good visibility and can confidently identify coarse gravels. If this field is used, the generally gravel category should <i>not</i> be used.	%
	COBBLE	Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Cobble substrates field allows assessors to enter the relative percentage of cobbles that occur along the shoreline. Cobbles are particles that are 64 to 256 mm in size (Tennis ball to basketball).	%
	COBBLE_FIN	Fine Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Fine Cobble substrates field allows assessors to enter the relative percentage of fine cobbles that occur along the shoreline. Fine cobbles are particles that are 64 to 128 mm in size (tennis ball to coconut). This field should only be used when assessors have good visibility and can confidently identify fine cobbles. If this field is used, the general cobble category should <i>not</i> be used.	%
	COBBLE_COA	Coarse Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Coarse Cobble substrates field allows assessors to enter the relative percentage of course cobbles that occur along the shoreline. Coarse cobbles are particles that are 128 to 256 mm in size (coconut to basketball). This field should only be used when assessors have good visibility and can confidently identify coarse cobbles. If this field is used, the general cobble category should <i>not</i> be used.	%
	BOULDER	Boulder Substrates	SUB_BOULDE or Boulder Substrates	Numeric	The Boulder substrates field allows assessors to enter the relative percentage of boulders that occur along the shoreline. Boulders are particles that are greater than 256 mm in size (bigger than a basketball). These substrates can not typically be lifted by one person as they are too heavy.	%
	BEDROCK	Bedrock Substrates	SUB_BEDROC or Bedrock Substrates	Numeric	The Bedrock substrates field allows assessors to enter the relative percentage of bedrock that occurs along the shoreline. Bedrock is consider any rock where blocks are larger than 4 m or is solid, un-weathered underlying rock.	%
	EMBEDDEDNE	Embeddedness	COMPACTION or Compaction	Categorical	Embeddedness is a categorical field that allows assessors to enter the approximate embeddedness of substrates. Embeddedness is a measure of the degree to which boulders, cobbles and other large materials are covered by fine sediments. Categories for embeddedness include None (0%), Low (0 to 25%), Medium (25-75%), High (>75%), or Unknown. When assessors are unclear of the embeddedness they should either complete measurements of foreshore substrates or leave the field as unknown.	
	SHAPE_1	Shape of Substrates		Categorical	Shape is a categorical field that allows assessors to identify the shape of larger particles such as cobble or boulders. Angular shapes refer to naturally occurring angular rock material that has not been substantially weathered. Blast rock refers to angular blast rock materials, such as rip rap. Smooth materials are rocks that are generally rounded. This field should be used to describe the predominant substrates that occur along the shoreline (e.g., if 85 % of the substrates are round and smooth, and 10% are blast rock, the field should be used to describe the 85%).	
	COMMNT_SUB	Substrate Comments		Categorical	The comments field allows assessors to enter applicable information that is not included in the data field above.	

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Vegetation Band 1	B1_CLASS	Vegetation Band 1 Land Cover Class	RIP_CLASS of Riparian Class	Categorical	The Vegetation Band 1 Land Cover Class is a description of the predominant vegetation class present. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 4. The Coniferous Class occurs where tree cover is at least 20% of the shore zone area and at least 80% of the trees are coniferous. The Broadleaf Class occurs where the tree cover is at least 20% and at least 65% of the trees are broadleaf or deciduous. The Mixed Forest Class occurs where tree cover is at least 20% and there are no more than 80% coniferous trees and no more than 65% broadleaf trees. The Shrubs Class occurs where tree coverage is less than 10% and there shrubs cover at least of 20%. Shrubs are defined as multi-stemmed woody perennial plants. The Herbs / Grasses Class occur where there is at less than 10% tree coverage and less than 20% of shrubs. The Exposes Soil Class occurs where recent disturbance, either anthropogenic or natural, has occurred and mineral soils are exposes. The Landscape Class refers to urbanized areas where most natural vegetation has been replaced by at least 30% coverage of ornamental trees, shrubs, and other vegetation. The Lawn Class occurs in urbanized areas where turf grasses cover at least 30% of the shore zone area and landscaping with ornamental shrubs or trees is less than 30% coverage. The Natural Wetland Class occurs where shore marshes dominate the shore zone area and they have not been significantly influenced by human disturbance. The Disturbed Wetland Class occurs where shore marshes predominate the shore zone area and they have experience significant disturbance (i.e., greater than 30%). The Row Crops Class occurs in agricultural areas where crops are growing. If sites are agricultural, but are not used for row crops (e.g., pasture lands), they should be described as Herbs/Grasses and comments should be used to indicate the agricultural nature of the shore segment. Un-vegetated Sites occur where there is less than 5% vegetation cover and at least 50% of the vegetation cover is mosses or lichens. Un-vegetated sites tend to occur on rocky, exposed shorelines.	
	B1_STAGE	Vegetation Band 1 Stage	RIP_STAGE or Riparian Stage	Categorical	The Vegetation Band 1 Stage is a description of the structural stage of the dominant vegetation. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 3 and the Field Manual for Describing Terrestrial Ecosystems. The Sparse Stage describes sites that are in the primary or secondary stages of succession, with vegetation consisting mostly of lichens and mosses, and the total shrub coverage is less than 20% and tree coverage is less than 10%. The Grass Herb Stage describes sites where shore zones are dominated by grasses and herbs, as a result of persistent disturbance of natural conditions (e.g., grasslands). The Low Shrubs stage describes sites that are dominated by shrubby vegetation less than 2 m in height. The Tall Shrubs Stage is dominated by vegetation that is 2 to 10 m in height and seedlings and advance regeneration may be present. The Pole / Sapling Stage describes sites that contain trees greater than 10 m in height, typically densely stocked, and there is little evidence of self thinning or vertical structure. The Young Forest Stage describes sites that are typically less than 40 years old (but could be as great as 50 to 80 years depending upon the forest community), self thinning is evident, and the forest canopy has begun to differentiate into distinct layers. The Mature Forest Stage describes sites that are typically 40 to 80 years old (but could be as high as 140 years), and the under story is well developed with a second cycle of shade trees. The Old Forest Stage describes sites that are typically greater than 80 years old and the stands are structurally complex. Old Forests contain abundant coarse woody debris at varying stages of decay. Old Forests are at least 80 years in age, but may be as old as 250 years and should be considered relative to the forest community assessors are in.	
	B1SHRUB_CO	Vegetation Band 1 Shrub Coverage	SHOR_COVER or Shore Cover	Categorical	The Shrub Coverage categorically describes shrub coverage within the shore zone. Sparse sites have less than 10% shrub coverage. Moderate shrub coverage occurs on sites that have between 10 to 50% coverage. Abundant shrub coverage occurs on sites that have greater than 50% shrub coverage.	
	B1TREE_COV	Vegetation Band 1 Tree Coverage	SHOR_COVER or Shore Cover	Categorical	The Tree Coverage categorically describes Tree coverage within the shore zone. Sparse sites have less than 10% Tree coverage. Moderate Tree coverage occurs on sites that have between 10 to 50% coverage. Abundant Tree coverage occurs on sites that have greater than 50% Tree coverage.	

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Vegetation Band 1	B1_DISTRIB	Vegetation Band 1 Distribution		Categorical	The Distribution field is used to describe whether the vegetation band described is continuous along the entire shore segment. Categories include Continuous and Patchy (for sites where the dominant vegetation band occurs in patches along the segment). An example of a patchy distribution is a shore segment where most areas are extensively landscape, with the exception of a few shore lots which remain relatively natural. In this case, the dominant landscaped area would be described and comments would be used to identify residual natural areas.	
	B1_BANDWI	Vegetation Band 1 Bandwidth		Numeric	The Vegetation Band 1 Bandwidth field is used to provide an estimate of the approximate width of the band being described. In cases where bandwidth varies along the segment, a representative width should be used to describe the shore segment. The intent of this field is to provide a general description of the width of the vegetation band that is being described and users of the database need to consider this when assessing data within the database.	
	B1_OVERHAN	Overhanging Vegetation		Numeric	The Overhanging Vegetation field is used to describe the percentage of the shore segment length that contains significant overhanging vegetation. Overhanging vegetation should be considered as if the lake was at full pool or the mean annual high water level.	
	AQUATIC_VE	Aquatic Vegetation		Numeric	The Aquatic Vegetation field is used to describe the percentage of the shoreline that contains emergent, submergent, and floating aquatic vegetation.	
	SUBMERGENT	Submergent Vegetation Quantity		Numeric	The Submergent Vegetation field is used to describe the percentage of the shoreline segment that contains submergent vegetation. Submergent vegetation includes species such as milfoil, <i>Potamogeton</i> spp., etc.	
	SUBMERG_VE	Submergent Vegetation Presence		Categorical	The Submergent Vegetation Presence field is used to indicate whether submergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	EMERGENT_V	Emergent Vegetation Quantity		Numeric	The Emergent Vegetation field is used to describe the percentage of the shoreline segment that contains emergent vegetation. Emergent vegetation includes species such as cattails, bulrushes, varies sedges, etc.	
	EMERGED_VE	Emergent Vegetation Presence		Categorical	The Emergent Vegetation Presence field is used to indicate whether emergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	FLOATING_V	Floating Vegetation Quantity		Numeric	The Floating Vegetation field is used to describe the percentage of the shoreline segment that contains floating vegetation. Floating vegetation includes species such as pond lilies, etc.	
	FLOATING_1	Floating Vegetation Presence		Categorical	The Floating Vegetation Presence field is used to indicate whether floating vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	AVEG_CMT	Aquatic Vegetation Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
	B1_COMMNT	Vegetation Band 1 Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Vegetation Band 2	B2_CLASS	Vegetation Band 2 Class	UP_CLASS or Upland Class	Categorical	See Vegetation Band 1 Class for a description.	
	B2_STAGE	Vegetation Band 2 Stage	UP_STAGE or Upland Stage	Categorical	See Vegetation Band 1 Stage for a description.	
	B2SHRUB_CO	Vegetation Band 2 Shrub Cover	UP_SHORE_COVER or Upland Shore Cover	Categorical	See Vegetation Band 1 Shrub Cover for a description.	
	B2TREE_COV	Vegetation Band 2 Tree Cover	UP_SHORE_COVER or Upland Shore Cover	Categorical	See Vegetation Band 1 Tree Cover for a description.	

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Vegetation Band 2	B2_DISTRIB	Vegetation Band 2 Distribution	UP_BANDWI or Upland Bandwidth	Categorical	See Vegetation Band 1 Distribution for a description.	
	B2_BANDWID	Vegetation Band 2 Width		Categorical	See Vegetation Band 2 Width for a description.	
	B2_COMMNT	Vegetation Band 2 Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Littoral Zone	LITTORAL_Z	Littoral Zone Width Categories		Categorical	The Littoral Zone Width Category provides a general classification of the littoral zone. Wide littoral zones are greater than 50 m. Moderate littoral zones are 10 to 50 m in width, and Narrow littoral zones are less than 10 m wide.	
	LWD	Large Woody Debris Presence		Categorical	The Large Woody debris presence field allows assessors to indicate whether LWD is present along the segment. Categories include Less than 5 Pieces, 5 to 25 Pieces, and Greater than 25 Pieces.	
	LWD_NUMBER	Large Woody Debris Count		Numeric	The Large Woody debris count field allows assessors to enter the total number of large woody debris pieces counted along the shore segment. Only significant pieces of large woody debris, which are contributing to fish habitat, should be counted.	
	WIDTH_LITT	Littoral Width	LITTORAL_W or Littoral Width	Numeric	The Littoral Width field allows assessors to enter the average littoral width of the segment. This field can be determined using air photo interpretation or field measurements. Typically, the field is rounded to the nearest 5 m as the number is intended to be representative of the segment.	
	COMMNT_LIT	Littoral Zone Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Modifications	RETAIN_WAL	Retaining Wall Count		Numeric	The Retaining Wall Count field is the total number of retaining walls occurring along the segment. Retaining walls should only be counted if they are within 5 to 10 m of the high water level. Retaining walls must have a vertical element that is greater than 30 cm and must be retaining earth to some degree. On steep sloping sites, more than one retaining wall may be present (i.e., the property is tiered). In these cases each retaining wall is counted.	#
	PERRETAIN_	Percent Retaining Wall	RET_WAL_TY	Numeric	The Percent Retaining Wall field indicates that approximate percentage of the shore segment length where retaining walls occur.	%
	DOCKS	Docks Count		Numeric	The Docks Count field is the total number of pile supported or floating docks or swimming platforms that occur along the segment. Properties may have more than one dock present and each different structure is considered a separate dock. For instance, a property could have one swimming float and one dock.	#
	DOCKS_KM	Docks Per Kilometer		Numeric	The Docks per Kilometer field is determined during post processing. This field is calculated by dividing the total number of docks observed by the total length of the shore segment.	#
	BOAT_HOUSE	Boat House Count		Numeric	The Boat House Count field is used to count boat houses that occur along the segment. Boat Houses are structures that are specifically designed to house boats or watercraft. Boat Houses can either be located on land or as structures over the water. If only structures over the water are counted, assessors should be consistent and make note of this so end users are aware of what definition was used for a boat house. If structures on land are considered as boat houses, a rail or boat launch should be present that land owners use to launch the boat to the lake. Garages that house boats should not be counted as boat houses because there is not an associated launch structure.	#
	GROYNES	Groyne Count		Numeric	The Groyne Count field is used to count any structure that is perpendicular to the shoreline that is impacting regular sediment drift along the shoreline. Groynes can be constructed out of concrete, rock, piles, wood, or other materials. Docks or other structures that are acting as groynes, and affecting sediment movement should be included in the groyne count. Rock lines that are too small to significantly impact sediment movement should not be counted as a groyne.	#
	GROYNES_KM	Groynes per Kilometer		Numeric	The Groynes per Kilometer field is determined during post processing of data. This field is calculated by dividing the total number of groynes observed by the total length of the shore segment.	#

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Modifications	BOAT_LAUNC	Boat Launch Count		Numeric	The Boat Launch Count field is the total number of boat launches that were observed along the shoreline. Generally, only permanent boat launches are counted (e.g., made of concrete). However, on small systems assessors may choose to count gravel boat launches as these may be the only type present. Assessors should document criteria used to determine what constitutes a boat launch during the assessment.	#
	PERRAIL_MO	Percent Rail Modifier		Numeric	The Percent Rail Modifier field is used to describe the percentage of the linear shore segment length that contains railways in close proximity to the shoreline.	%
	PERROAD_MO	Percent Road Modifier		Numeric	The Percent Road Modifier field is used to describe the percentage of the linear shore segment length that contains a roadway in close proximity to the shoreline.	%
	MARIN_RAIL	Marine Rail Count		Numeric	The Marine Rail Count field is the total number of marine rails that occur along a shore segment. Marine Rails are a track system that is used to remove boats from a lake during the winter months.	#
	MARINAS	Marina Count		Numeric	The Marinas Field is the total number of large and small marinas that were documented along the shoreline. A marina is considered to be any pile supported or floating structure that has slips for 6 or more boats.	#
	SUB_MODIFI	Substrate Modification Presence	BEACH_GROO or Beach Grooming	Categorical	The Substrate Modification Presence field is used to document whether substrate modification is occurring along the shore segment. Substrate modification includes any type of importation of sands, significant movement of natural substrates (e.g., to construct groynes), or earthworks.	
	PERSUB_MOD	Percent Substrate Modification		Numeric	The Percent Substrate Modification field is the estimated percentage of the shore segment where substrate modification has occurred.	%
	COMMNT_MOD	Modifications Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Flora and Fauna	VETERANS	Veteran Trees		Categorical	The Veteran Tree field is a categorical field to describe the number of veteran trees that occur along the shore segment. Veteran trees are defined as a tree that is significantly older than the dominant forest cover and provides increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.	
	SNAGS	Snags		Categorical	The Snags field is a categorical field to describe the number of dead standing snags that occur along the shore segment. Snags are defined as dead standing trees that provide increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.	
	CMMNT_FLRA	Flora Comments		Alphanumeric	The flora comments field allows users to enter in comments regarding flora observed within the shore segment.	
	CMMNT_FAUN	Fauna Comments			The fauna comments field allows users to enter in comments regarding fauna observed within the shore segment.	

Appendix B – Data Base and Field Code Version Consolidation



Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Type	Definition	Rationale for Removal
Segment Class and Shore Type	VEG_SHORE	Vegetated Shore	Numeric or Category	A vegetated shore is a shoreline that is well vegetated, to the high water level.	Vegetated shore was removed because it differs from the other shore types, which tend to be more description of physical properties of the shoreline. Because a vegetated shore typically occurs on a rocky shore or gravel shore, it is better to describe lake side vegetation elsewhere in the database and leave the shore type to describe more physical attributes of the shoreline.
Riparian or Upland Vegetation	RIP_QUALIF or UP_QUALIF	Riparian or Upland Qualifier	Category	The Riparian Qualifier field was used to qualify the Riparian Class and Stage. Categories included Agriculture, Natural, Urban/Residential, Recreation, Disturbed, Unknown. Refer to Module 4 of the Sensitive Habitat Inventory and Mapping for definitions.	This field was removed from the dictionary because additional categories were added to the Vegetation Class and Stage for Bands 1 and 2. This was done to reduce redundancy in the dictionary and improve clarity.
Littoral Zone	ALLUV_FAN	Alluvial Fan	Category	The Alluvial Fan field was used to describe whether the segment contained an alluvial fan.	The Stream Mouth shore type was added to the dictionary to replace the Alluvial Fan field. Due to the importance of stream mouths as rearing and staging areas for salmonids, the shore type was used because these extremely sensitive features can be better identified.
Modifications	BEACH_GROO	Beach Grooming	Category	The Beach Grooming field identifies whether substrate modification has occurred to enhance beach conditions.	This field was removed from the dictionary and replaced with the SUB_MODI or Substrate Modification Field because it better describes the actual activity. Also, a PERSUB_MODI or Percent Substrate Modification field was added to help quantify substrate modification that is occurring.
Riparian or Upland Vegetation	RIP_BANKSL or UP_BANKSL	Upland or Riparian Bank Slope	Numeric	The Riparian or Upland Bankslope field was used to identify the slope of the riparian (now Vegetation Band 1) or upland areas (Vegetation Band 2) described (as a percentage).	This field was added with categories to the Segment Class as SLOPE. Categories were used rather than a slope percentage because assessors do not typically exit the boat to measure the slope. Because the idea is to gain a broad understanding of the slope for a segment, it was determined that slope categories were more appropriate for the level of detail of the assessment.
Riparian or Upland Vegetation	RIP_VET or UP_VET	Riparian or Upland Veterans	Category	The Veteran Tree field is a categorical field to describe the number of veteran trees that occur along the shore segment.	This field was added to the Flora and Fauna section and is intended to describe both the Riparian and Upland Sections. This was done to reduce redundancy in the database and make interpretation easier.
Substrates	COMPACTION	Compaction of Substrates	Category	Compaction is a measure of the degree of compaction or relative looseness of bed material. See the Sensitive Habitat Inventory and Mapping Module 3 for a better description of Compaction.	In lake systems, compaction is better discussed in terms of substrate embeddedness. Generally, the two measures are correlated to some extent (i.e., a high compaction is equivalent to a high level of embeddedness). As embeddedness of substrates is a better description and easier to measure using binoculars from a boat, the field was changed to this.

Appendix C – SHIM Lake v. 2.6 Data Dictionary



Shim Lake 2008
June 23, 2008

Lake_Shoreline	Line Feature, Label 1 = Segmnt_Num, Label 2 = Aquatic_Veg Lake shore Separator
LAKE REFERENCE	Separator
Lake_Name	Text, Maximum Length = 100 Normal, Normal
Lake_level	Numeric, Decimal Places = 2 Minimum = 0, Maximum = 3000, Default Value = 0 Normal, Normal
Sechi_depth	Numeric, Decimal Places = 1 Minimum = 0, Maximum = 50, Default Value = 0 Normal, Normal
Organization	Text, Maximum Length = 50 Normal, Normal
Date	Date, Auto generate Create, Year-Month-Day Format Normal, Normal
Time	Time, Auto generate Create, 24 Hour Format Normal, Normal
Crew	Text, Maximum Length = 50 Normal, Normal
Weather	Menu, Normal, Normal
Light Rain [L]	
Heavy Rain [H]	
Snow/Sleet [N]	
Over cast [OV]	
Clear [S]	
Partly Cloudy [PC]	
Other [O]	
Air_Temp	Numeric, Decimal Places = 1, degrees centigrade Minimum = -25, Maximum = 45, Default Value = 0 Normal, Normal
Water_Temp	Numeric, Decimal Places = 1, degrees celsius Minimum = -2, Maximum = 29, Default Value = 0 Normal, Normal
Jurisdiction	Text, Maximum Length = 100, Jurisdiction Normal, Normal
Comments	Text, Maximum Length = 100 Normal, Normal
	Separator
SEGMENT CLASS	Separator
Segmnt_Num	Numeric, Decimal Places = 1, Unique Identification number for segment Minimum = 0, Maximum = 99999, Default Value = 0 Required, Required
Shore_Type	Menu, Required, Normal
Cliff/Bluff	
Rocky Shore	
Gravel	
Sand	
Stream Mouth	
Wetland	
Other	
Shore_Modifier	Menu, Normal, Normal
Log Yard	
Marina_small (6-20)	
Marina_large (20+)	
Railway	
Road	
None Default	
Other	
Slope	Menu, Normal, Normal, general slope of shore landward
Bench	
Low (0-5)	
Moderate (5-20)	
Steep (20-60)	
Very Steep (60+)	
Land_Use	Menu, Normal, Normal, observed
Agriculture	
Commercial	
Conservation	
Forestry	
Industrial	
Institution	
Multi Family	
Natural Area	
Park	
Recreation	

Rural	
Single Family	
Urban Park	
Lev_of_Imp	Menu, Normal, Normal, Level of Impact
None Default	
Low (<10%)	
Medium (10-40%)	
High (>40%)	
Livest_Acc	Menu, Normal, Normal, Stream segmnet accessible to live-stock
Yes	
No Default	
Disturbed	Numeric, Decimal Places = 0, Percent of segment disturbed Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Natural	Numeric, Decimal Places = 0, Percent of segment natural Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
PhotoNum	Text, Maximum Length = 100, Roll and print number of photograph Normal, Normal
Tape_Numb	Text, Maximum Length = 100, Original Video Tape Number Normal, Normal
Video_Time	Text, Maximum Length = 100, Time stamp on original video tape Normal, Normal
Cmmnt_Clas	Text, Maximum Length = 100, Comments for Segment Normal, Normal
	Separator
SHORE TYPE	Separator
Cliff/Bluff	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Rocky	Numeric, Decimal Places = 0, Rocky Shore Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Gravel	Numeric, Decimal Places = 0, Gravel Shore Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Sand	Numeric, Decimal Places = 0, Sand Beach Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Stream_mouth	Numeric, Decimal Places = 0, Stream mouth Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Wetland	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Other	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Stype_comm	Text, Maximum Length = 100, Comments for Segment Normal, Normal
	Separator
LAND USE	Separator
Agriculture	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Commercial	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Conservation	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Forestry	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Industrial	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Institution	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Multi Family	Numeric, Decimal Places = 0, Percent mult family residential (condo) Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Natural Area	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Park	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal

Recreation	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Rural	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Single Family	Numeric, Decimal Places = 0, Percent single family residential Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Urban Park	Numeric, Decimal Places = 0, Percent Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Landu_Commnt	Text, Maximum Length = 100, Comment Land use Normal, Normal
	Separator
SUBSTRATE	Separator
Marl	Numeric, Decimal Places = 0, Clay limestone Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Mud	Numeric, Decimal Places = 0, Percent Mud Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Organic	Numeric, Decimal Places = 0, Percent Organic Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Fines	Numeric, Decimal Places = 0, Percent Fines Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Sand	Numeric, Decimal Places = 0, Percent Sand Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Gravel	Numeric, Decimal Places = 0, Percent Gravel Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Gravel_Fine	Numeric, Decimal Places = 0, Percent Fine Gravel Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Gravel_Coarse	Numeric, Decimal Places = 0, Percent Coarse Gravel Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Cobble	Numeric, Decimal Places = 0, Percent Cobble Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Cobble_Fine	Numeric, Decimal Places = 0, Percent Fine Cobble Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Cobble_Coarse	Numeric, Decimal Places = 0, Percent Coarse Cobble Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Boulder	Numeric, Decimal Places = 0, Percent Boulder Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Bedrock	Numeric, Decimal Places = 0, Percent Bedrock Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Embeddedness	Menu, Normal, Normal, Level of substrate embeddedness
None	
Low (0-25%) [L]	
Medium (25-75%) [M]	
High (75%+) [H]	
Unknown	Default
Shape	Menu, Normal, Normal, man made refers to angularity
angular	
blast rock	
smooth	
Commnt_Sub	Text, Maximum Length = 100, Comment for Substrates Normal, Normal
	Separator
VEGETATION BAND1	Separator
Bl_Class	Menu, Normal, Normal, Riparian Class
Coniferous forest [VNF]	
Broadleaf forest [VBF]	
Mixed forest [VMF]	
Shrubs [VSH]	
Herbs/grasses [VHB]	
Exposed soil [NEL]	
Landscaped [LS]	
Lawn [L]	
Natural wetland [WN]	

Disturbed wetland [DWN]
 Row Crops [NAG]
 Unvegetated
 B1_Stage Menu, Normal, Normal, Structural Stage
 Sparse [1]
 Grass/Herb [2]
 low shrubs <2m [3a]
 tall shrubs 2-10m [3b]
 sapling >10m [4]
 young forest [5]
 mature forest [6]
 old forest [7]
 Mixed age
 B1Shrub_Cover Menu, Normal, Normal, Shrub Cover
 None []
 Sparse (<10%) []
 Moderate (10-50%) []
 Abundant (>50%) []
 B1Tree_Cover Menu, Normal, Normal, Tree Cover
 None []
 Sparse (<10%) []
 Moderate (10-50%) []
 Abundant (>50%) []
 B1_Distribution Menu, Normal, Normal, Riparian Distribution
 Patchy []
 Continuous []
 B1_Bandwi Numeric, Decimal Places = 0, Band lwidth
 Minimum = 0, Maximum = 9999, Default Value = 0
 Normal, Normal
 B1_Overhang Numeric, Decimal Places = 0, % Overhang for segment
 Minimum = 0, Maximum = 100, Default Value = 0
 Normal, Normal
 Aquatic_Veg Numeric, Decimal Places = 0, Length of aquatic vegetation in segment
 Minimum = 0, Maximum = 100, Default Value = 0
 Normal, Normal
 Submergent veg Numeric, Decimal Places = 0, % submergent vegetation in segment
 Minimum = 0, Maximum = 100, Default Value = 0
 Normal, Normal
 Submerg_Veg Menu, Normal, Normal, Submerged Aquatic Vegetation
 Yes
 No Default
 Emergent vegetation Numeric, Decimal Places = 0, % emergent vegetation
 Minimum = 0, Maximum = 100, Default Value = 0
 Normal, Normal
 Emerged_Veg Menu, Normal, Normal, Emergent Aquatic Vegetation
 Yes
 No Default
 Floating vegetatio Numeric, Decimal Places = 0, % floating vegetation
 Minimum = 0, Maximum = 100, Default Value = 0
 Normal, Normal
 Floating_Veg Menu, Normal, Normal, Floating Vegetation presence
 Yes
 No Default
 AVeg_Cmt Text, Maximum Length = 100, Aquatic Vegetation Comment
 Normal, Normal
 B1_Commnt Text, Maximum Length = 100, Comment Band 1 vegetation
 Normal, Normal
 Separator
 VEGETATION BAND2 Separator
 B2_Class Menu, Normal, Normal, Vegetation Class
 Coniferous forest [VNF]
 Broadleaf forest [VBF]
 Mixed forest [VMF]
 Shrubs [VSH]
 Herbs/grasses [VHB]
 Exposed soil [NEL]
 Landscaped [LS]
 Lawn [L]
 Natural wetland [WN]
 Disturbed wetland [DWN]
 Row Crops [NAG]
 Rock [NNB]
 B2_Stage Menu, Normal, Normal, Structural Stage
 Sparse [1]
 Grass/Herb [2]
 low shrubs <2m [3a]
 tall shrubs 2-10m [3b]
 sapling >10m [4]
 young forest [5]

mature forest [6]	
old forest [7]	
Mixed age	
B2Shrub_Cover	Menu, Normal, Normal, Shrub Cover
None []	
Sparse (<10%) []	
Moderate (10-50%) []	
Abundant (>50%) []	
B2Tree_Cover	Menu, Normal, Normal, Tree Cover
None []	
Sparse (<10%) []	
Moderate (10-50%) []	
Abundant (>50%) []	
B2_Distribution	Menu, Normal, Normal, B2 Vegetation Distribution
Patchy []	
Continuous []	
B2_Bandwidth	Numeric, Decimal Places = 0, B2 vegetation Bandwidth Minimum = 0, Maximum = 9999, Default Value = 0 Normal, Normal
B2_Commnt	Text, Maximum Length = 100, B2 vegetation Comment Normal, Normal Separator
<hr/>	
LITTORAL_ZONE	Separator
Littoral_Z	Menu, Normal, Normal, Littoral Zone
Narrow (<10m)	
Moderate (10-50m)	
Wide (>50m)	
LWD	Menu, Normal, Normal, Count of Large Woody Debris
No Default	
<5	
5-25	
>25	
LWD_Number	Numeric, Decimal Places = 0, Number of LWD units Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Width_Littoral	Numeric, Decimal Places = 0, Width of Littoral area Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Commnt_Lit	Text, Maximum Length = 100, Comment for Littoral zone Normal, Normal Separator
<hr/>	
MODIFICATIONS	Separator
Retain_Wal	Numeric, Decimal Places = 0, Retaining walls per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
PerRetain_Wall	Numeric, Decimal Places = 0, Percent retaining wall on segment Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Retain_Mat	Menu, Normal, Normal
Bio_Eng	
Concrete	
Mixed	
Stonework	
Wood	
Metal	
Tires	
Rock	
Other	
Docks	Numeric, Decimal Places = 0, Docks per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
Docks_km	Numeric, Decimal Places = 0, Docks per km Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Boat_House	Numeric, Decimal Places = 0, Docks per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
Groynes	Numeric, Decimal Places = 0, Groynes per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
Groynes_km	Numeric, Decimal Places = 0, Groynes per km Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Boat_Launch	Numeric, Decimal Places = 0, Number of Boat launches Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
PerRail_mod	Numeric, Decimal Places = 0, % of segment with a railway Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal

PerRoad_mod	Numeric, Decimal Places = 0, % of segment with a road Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Marin_Rail	Numeric, Decimal Places = 0, Marine Railways per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
Marinas	Numeric, Decimal Places = 0, Marinas per segment Minimum = 0, Maximum = 99999999, Default Value = 0 Normal, Normal
Sub_modification	Menu, Normal, Normal, Substrate modification / grooming
Yes	
No	
PerSub_mod	Numeric, Decimal Places = 0, % of segment with substrate alteration Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
Commnt_Mod	Text, Maximum Length = 100, Comments on modification Normal, Normal
	Separator
FLORA & FAUNA	Separator
Veterans	Menu, Normal, Normal, Number of Veterans
No	
Default	
<5	
5-25	
>25	
Snags	Menu, Normal, Normal, Presence of Snags
No	
Default	
<5	
5-25	
>25	
Cmmnt_Flra	Text, Maximum Length = 100, Flora Comment Normal, Normal
Cmmnt_Faun	Text, Maximum Length = 100, Fauna Comment Normal, Normal
Site	Point Feature, Label 1 = HWM, Label 2 = Land_Use Site Description
Lake_Name	Text, Maximum Length = 100 Normal, Normal
Crew	Text, Maximum Length = 50 Normal, Normal
Date	Date, Auto generate Create, Year-Month-Day Format Normal, Normal
Weather	Menu, Normal, Normal
Light Rain [L]	
Heavy Rain [H]	
Snow/Sleet [N]	
Over cast [OV]	
Clear [S]	
Partly Cloudy [PC]	
Other [O]	
Jurisdiction	Text, Maximum Length = 100, Jurisdiction Normal, Normal
PID_Folio number	Text, Maximum Length = 50, Property Identifier Normal, Normal
HWM	Numeric, Decimal Places = 1, High water mark Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
Lake_Level	Numeric, Decimal Places = 0 Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
Length_frontage	Numeric, Decimal Places = 1, frontage length Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
Land_Use	Menu, Normal, Normal
SF	
MF	
C	
Veg_removal	Menu, Normal, Normal, vegetation removal age
historic	
recent	
NA	
Natural	Numeric, Decimal Places = 0, % natural vegetation state Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
Landscaped	Numeric, Decimal Places = 0, % landscaped vegetation state Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
no_vegetation	Numeric, Decimal Places = 0, % no vegetation Minimum = 0, Maximum = 99999, Default Value = 0

Disturbed	Normal, Normal Numeric, Decimal Places = 0, % site state disturbed Minimum = 0, Maximum = 99999, Default Value = 0
PhotoNum	Normal, Normal Text, Maximum Length = 100, Roll and print number of photograph
Comments	Normal, Normal Text, Maximum Length = 100
Modification	Point Feature, Label 1 = Point_number, Label 2 = Type_Modification
Point_number	Normal, Normal Numeric, Decimal Places = 1, unique point identification number Minimum = 0, Maximum = 99999, Default Value = 0
PID_Folio number	Normal, Normal Text, Maximum Length = 50, Property Identifier
Lot_number	Normal, Normal Text, Maximum Length = 50, Property Identifier
Type_Modification	Menu, Normal, Normal, Code for feature
Boat House	
Boat_Launch	
Buoy	
Catchbasin [CB]	
Dam [HOD]	
Detention Pond [DP]	
Dock [DK]	
Dredging [HBDD]	
Effluent [E]	
Fences [HOF]	
Fill_Pile [FP]	
FloodGate [FG]	
Garbage/Pollution [WP]	
Gravel Pit [GP]	
Groyne [Gy]	
Hydro_thermal	
Infill	
Livestock access [LC]	
Log_Dump [LD]	
Logging [LG]	
Marina	
Outbuilding [OB]	
PipeCrossing [PL]	
Pump Station [PS]	
Retain Wall/Bank Stb [EHB]	
Rip_Rap [RR]	
Road [R]	
Trail [TR]	
Utility_Crossing [UC]	
Water Withdrawal [FUP]	
Other [O]	
Type_Material	Menu, Normal, Normal
Asphalt [AS]	
Bark_Mulch [BM]	
Bio-engineered [BI]	
Concrete [C]	
Dyke [DY]	
Gabions [GB]	
Gravel [G]	
Metal [Mt]	
Mixed [Mx]	
Pilings [P]	
Rip_rap [RR]	
Sandbags [SB]	
Stonework [S]	
Synthetic [Sy]	
Treated_Wood [TW]	
Wood [W]	
Other [O]	
High_Water	Menu, Normal, Normal, Above or below high water level
Above	
Below	
At	
Unknown	Default
Sed_Movement	Menu, Normal, Normal, Sediment movement
Erosion	
Accretion	
Unknown	
NA	
Conditions	Menu, Normal, Normal, Did it meet conditions
Yes	

No	
Unknown	Default
Age_Modification	Menu, Normal, Normal, Age of modification
Historic	
Recent	
Unknown	Default
Construction	Menu, Normal, Normal, state of modification
complete	
ongoing	
Length	Numeric, Decimal Places = 2, Feature length Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Width	Numeric, Decimal Places = 2, Width of Feature Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Height	Numeric, Decimal Places = 2, Height of feature Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
<hr/>	
WATER ACT	Separator
WA_approval	Menu, Normal, Normal, Received Water Act approval
Yes	
No	
Unknown	
NA	Default
WA_Notification	Menu, Normal, Normal, Received Water Act Notification
Yes	
No	
Unknown	
NA	Default
Size_Compliant	Menu, Normal, Normal
Yes	
No	
Unknown	Default
Mat_Compliant	Menu, Normal, Normal, Material Compliant
Yes	
No	
Unknown	Default
SM_Compliant	Menu, Normal, Normal, Sediment movement compliant
Yes	
No	
Unknown	Default
Roof_Compliant	Menu, Normal, Normal
Yes	
No	
Unknown	Default
BMP	Menu, Normal, Normal, Conforms with Best Management Practices
Yes	
No	
Unknown	Default
EIA	Menu, Normal, Normal
Yes	
No	
Unknown	Default
WAComments	Text, Maximum Length = 100, Water Act Comments Normal, Normal Separator
<hr/>	
LAND ACT	Separator
Land_Act	Menu, Normal, Normal
Yes	
No	
Unknown	
NA	Default
LASize_Compliant	Menu, Normal, Normal, Land Act Size Compliant
Yes	
No	
NA	Default
LAMat_Compliant	Menu, Normal, Normal, Material Compliant
Yes	
No	
NA	Default
LASM_Compliant	Menu, Normal, Normal, Land Act Sediment movement compliant
Yes	
No	
NA	Default
LARoof_Compliant	Menu, Normal, Normal
Yes	
No	
NA	Default

Slip_Compliant	Menu, Normal, Normal
Yes	
No	
NA Default	
PVT_MCompliant	Menu, Normal, Normal, pvt moorage compliant
Yes	
No	
NA Default	
LA_EIA	Menu, Normal, Normal, Land Act EIA
Yes	
No	
NA Default	
<hr/>	
	Separator
DEVELOPMENT PERMIT	Separator
DP_Area	Menu, Normal, Normal, Development Permit compliant
Yes	
No	
Dev_Permit	Menu, Normal, Normal, Development Permit
Yes	
No	
Unknown Default	
DP_Compliant	Menu, Normal, Normal, Development Permit compliant
Yes	
No	
Unknown Default	
DP_EIA	Menu, Normal, Normal, Development Permit EIA
Yes	
No	
Unknown Default	
RAR	Menu, Normal, Normal
Accepted	
Submitted	
Not_Submitted	
Unknown Default	
PhotoNum	Text, Maximum Length = 100, Roll and print number of photograph
	Normal, Normal
Comments	Text, Maximum Length = 100
	Normal, Normal
Discharge	Point Feature
Point_number	Numeric, Decimal Places = 1, unique point identification number
	Minimum = 0, Maximum = 99999, Default Value = 0
	Normal, Normal
Lot_Number	Text, Maximum Length = 30, Parcel lot number
	Normal, Normal
Type_Discharge	Menu, Normal, Normal, Code for feature
Agricultural Runoff [WPA]	
HouseEffluent [WE]	
Landfill Leachates [WPML]	
Pollutant [WP]	
Pulp Mill/Effluent [WPP]	
Storm Drain [WPD]	
Septic Effluent [WPMP]	
Sewer [S]	
Tile Drain [WPI]	
Trench [WPE]	
Other [O]	
Culvert	Menu, Normal, Normal, Culvert material
Concrete [C]	
Steel [S]	
Wood [W]	
Iron [I]	
PVC [P]	
Asphalt coded [AD]	
Corrugated Steel [CS]	
Other [O]	
Headwall	Menu, Normal, Normal, Does a headwall exist
Concrete [C]	
Concrete Block [CB]	
Gabion [G]	
Sand bag [SB]	
Wood [W]	
Length	Numeric, Decimal Places = 2, Feature length
	Minimum = 0, Maximum = 1000, Default Value = 0
	Normal, Normal
Width	Numeric, Decimal Places = 2, Width of Feature
	Minimum = 0, Maximum = 1000, Default Value = 0
	Normal, Normal
Diameter	Numeric, Decimal Places = 2, Diameter of feature

	Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Height	Numeric, Decimal Places = 2, Height of feature Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Temperature	Numeric, Decimal Places = 2, Water temperature Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
PhotoNum	Text, Maximum Length = 100, Roll and print number of photograph Normal, Normal
Comments	Text, Maximum Length = 100 Normal, Normal
Waterbody	Point Feature, Label 1 = Point_number, Label 2 = Type_Water location of an adjacent waterbody
Point_number	Numeric, Decimal Places = 1, unique point identification number Minimum = 0, Maximum = 99999, Default Value = 0, Step Value = 1 Normal, Normal
Water_Name	Text, Maximum Length = 100, Waterbody Name Normal, Normal
Type_Water	Menu, Normal, Normal, Code for feature Tributary [HMT] Groundwater Seep Natural Springs [HMS] Beaver Pond [BP] Other [HM]
Inlet/Outl	Menu, Normal, Normal Inlet Outlet
Length	Numeric, Decimal Places = 2, Waterbody length Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Width	Numeric, Decimal Places = 2, Bankfull Width Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Depth	Numeric, Decimal Places = 2, Bankfull Depth Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Temperatur	Numeric, Decimal Places = 2, Water temperature Minimum = 0, Maximum = 100, Default Value = 0 Normal, Normal
PhotoNum	Text, Maximum Length = 100, Roll and print number of photograph Normal, Normal
Comments	Text, Maximum Length = 100 Normal, Normal
Erosion	Point Feature, Label 1 = Point_number, Label 2 = Source_Erosion
Point_number	Numeric, Decimal Places = 1, unique point identification number Minimum = 0, Maximum = 99999, Default Value = 0 Normal, Normal
Source_Erosion	Menu, Normal, Normal, Code for feature Bank Erosion [HCEB] Culvert [CV] Headwall [H] Lack of Riparian Veg [WDL] Livestock Access [WDC] Lakeside Grazing [WDG] Landslide Sloughing Other [O]
Severity	Menu, Normal, Normal Low (<5m sq) [L] Moderate (5-10m sq) [M] High (>10m sq) [H]
Exposure	Menu, Normal, Normal Clay [C] Till [T] Bedrock [B] Roots [R] Soil [S] Other [O]
Length	Numeric, Decimal Places = 2, Feature length Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Width	Numeric, Decimal Places = 2, Width of Feature Minimum = 0, Maximum = 1000, Default Value = 0 Normal, Normal
Height	Numeric, Decimal Places = 2, Height of feature Minimum = 0, Maximum = 1000, Default Value = 0

Slope	Normal, Normal Numeric, Decimal Places = 0 Minimum = 0, Maximum = 90, Default Value = 0
PhotoNum	Normal, Normal Text, Maximum Length = 100, Roll and print number of photograph
Comments	Normal, Normal Text, Maximum Length = 100
Flood plain	Point Feature, Label 1 = Point_number, Label 2 = Flood_plain location of flood plain
Point_number	Normal, Normal Numeric, Decimal Places = 1, unique point identification number Minimum = 0, Maximum = 99999, Default Value = 0, Step Value = 1
PID_number	Normal, Normal Text, Maximum Length = 50, Property Identifier
Flood_plain	Menu, Normal, Normal, Elevation level
200_yr	
MeanAH	
other	
Elevation	Normal, Normal Numeric, Decimal Places = 2, Height above sea level Minimum = 0, Maximum = 1000, Default Value = 0
Distance	Normal, Normal Numeric, Decimal Places = 2, Distance from building Minimum = 0, Maximum = 1000, Default Value = 0
Slope	Normal, Normal Numeric, Decimal Places = 1, slope to flood plain from lake Minimum = 0, Maximum = 100, Default Value = 0
Bearing	Normal, Normal Numeric, Decimal Places = 1, Bearing to building Minimum = 0, Maximum = 360, Default Value = 0
PhotoNum	Normal, Normal Text, Maximum Length = 100, Roll and print number of photograph
Comments	Normal, Normal Text, Maximum Length = 100, Description of point location
Photo	Point Feature, photo point location
PhotoNum	Normal, Normal Text, Maximum Length = 100, Photo number
Comments	Normal, Normal Text, Maximum Length = 100, Description of photo
Line_Modification	Line Feature, Modification Line feature
Type_Modification	Menu, Normal, Normal, Code for feature
Dredging [HBDD]	
Fences [HOF]	
Livestock crossing [LC]	
Log_Dump [LD]	
Logging [LG]	
Marina	
Railway	
Retain Wall/Bank Stb [EHB]	
Rip_Rap [RR]	
Road [R]	
Trail [TR]	
Other [O]	
Retain_Wal	Normal, Normal Numeric, Decimal Places = 0, Retaining walls per segment Minimum = 0, Maximum = 99999999, Default Value = 0
Docks	Normal, Normal Numeric, Decimal Places = 0, Docks per segment Minimum = 0, Maximum = 99999999, Default Value = 0
Groynes	Normal, Normal Numeric, Decimal Places = 0, Groynes per segment Minimum = 0, Maximum = 99999999, Default Value = 0
Impact	Menu, Normal, Normal, Level of Impact
Low	
Medium	
High	
High_Water	Menu, Normal, Normal, Above or below high water
Above	
Below	
PhotoNum	Normal, Normal Text, Maximum Length = 100, Roll and print number of photograph
Commnt_Mod	Normal, Normal Text, Maximum Length = 100, Comments on modification
1_Riparian	Line Feature

Rip_Class	Menu, Normal, Normal, Riparian Class
Coniferous forest [VNF]	
Broadleaf forest [VBF]	
Mixed forest [VMF]	
Shrubs [VSH]	
Herbs/grasses [VHB]	
Exposed soil [NEL]	
Landscaped [LS]	
Lawn [L]	
Natural wetland [WN]	
Disturbed wetland [DWN]	
Row Crops [NAG]	
Rock [NNB]	
Rip_Stage	Menu, Normal, Normal, Structural Stage
low shrubs <2m [3a]	
tall shrubs 2-10m [3b]	
sapling >10m [4]	
young forest [5]	
mature forest [6]	
old forest [7]	
Shor_Cover	Menu, Normal, Normal, Shoreline Cover
None []	
Sparse (<5%) []	
Moderate (5-20%) []	
Abundant (>20%) []	
Rip_Snag	Menu, Normal, Normal, Presence of Snags
No Default	
<5	
>=5	
Rip_Commnt	Text, Maximum Length = 100, Comment Riparian
	Normal, Normal

2_Riparian

	Line Feature
Rip_Class	Menu, Normal, Normal, Riparian Class
Coniferous forest [VNF]	
Broadleaf forest [VBF]	
Mixed forest [VMF]	
Shrubs [VSH]	
Herbs/grasses [VHB]	
Exposed soil [NEL]	
Landscaped [LS]	
Lawn [L]	
Natural wetland [WN]	
Disturbed wetland [DWN]	
Row Crops [NAG]	
Rock [NNB]	
Rip_Stage	Menu, Normal, Normal, Structural Stage
low shrubs <2m [3a]	
tall shrubs 2-10m [3b]	
sapling >10m [4]	
young forest [5]	
mature forest [6]	
old forest [7]	
Shor_Cover	Menu, Normal, Normal, Shoreline Cover
None []	
Sparse (<5%) []	
Moderate (5-20%) []	
Abundant (>20%) []	
Rip_Snag	Menu, Normal, Normal, Presence of Snags
No Default	
<5	
>=5	
Rip_Commnt	Text, Maximum Length = 100, Comment Riparian
	Normal, Normal

1_Substrate

	Line Feature, Label 1 = Substrate
Substrate	Menu, Normal, Normal
Mud	
Fines	
Gravel	
Gravel_Fine	
Gravel_Coarse	
Cobble	
Cobble_Fine	
Cobble_Coarse	
Boulder	
Bedrock	
Shape	Menu, Normal, Normal, man made refers to angularity
angular	

blast rock	
smooth	Default
Commnt_Sub	Text, Maximum Length = 100, Comment for Substrates Normal, Normal
2_Substrate	Line Feature
Substrate	Menu, Normal, Normal
Mud	
Fines	
Gravel	
Gravel_Fine	
Gravel_Coarse	
Cobble	
Cobble_Fine	
Cobble_Coarse	
Boulder	
Bedrock	
Shape	Menu, Normal, Normal, man made refers to angularity
angular	
blast rock	
smooth	Default
Commnt_Sub	Text, Maximum Length = 100, Comment for Substrates Normal, Normal
Sub_Veg	Line Feature, Label 1 = Comment
Comment	Text, Maximum Length = 30 Normal, Normal
Emerg_veg	Line Feature, Label 1 = Comment
Comment	Text, Maximum Length = 30 Normal, Normal

Appendix D – Brief GPS Overview



Global Positioning System (GPS)

Theory

What is GPS?

The Global Positioning System (GPS) is a satellite-based navigation system, providing position information, accurate to approximately 15m, anywhere on earth. Special methods can achieve position accuracy better than 1 mm. Satellites transmit radio signals, used by GPS receivers to compute positional information.

GPS System Configuration

24 Satellites orbit around the earth with a period of 12 hours. Because the orbits are inclined at 55 degrees to the equator, satellites are not seen to the North in Canada. Reception is difficult where the southern sky is obstructed (e.g., steep north-facing slopes, gullies, buildings in cities). Satellites operate on “sidereal time”, based on the earth’s rotation, so configurations repeat every 23h 56m (“solar time”). Certain times of the day are better or worse for GPS surveying; these times advance 4 minutes per day (~30 minutes per week).

Position Computation

How is it done?

GPS satellites broadcast a coded time signal;

GPS receiver computes a distance to the satellite, using the send-time, receive time, and the signal speed (speed of light):

GPS receivers calculate their position by intersecting ranges from four or more satellites (“triangulation”).

Sources of Error

Clock Errors

Receiver clocks have limited accuracy;

The observed “range” to the satellite (pseudorange) is biased by an unknown clock offset, translating to range errors of hundreds of kilometers.

Satellites have accurate atomic clocks (to a few trillionths of a second) but small errors cause range errors of a few meters.

Atmospheric

The signal is slowed down due to a magnetic effect as it travels through the atmosphere.

Common mode

Signal propagation and satellite errors are the same for receivers within the same general area.

Can be corrected using a reference receiver at a known location



Multipath

Signals reflect off nearby objects before reaching receiver antenna due to local site conditions

Increasing Accuracy of Position**Dilution of Precision (DOP) Mask**

DOP measures the geometry of the satellites relative to each other and to the receiver.

Low DOP = good geometry = more accurate (satellites are well spread in sky)

High DOP = poor geometry = less accurate (satellites are close together)

Obstructions (tree cover, buildings, etc.) cause higher DOPs.

GPS can be set to reject positions with DOPs too high (**PDOP limit=8 for SHIM**) to help ensure accuracy

Position Correction: Differential GPS

Position accuracy is increased by comparing the rover receiver (yours) with a reference receiver at a known location.

Without differential correction, the expected accuracy of GPS positions is about 20 metres.

Differential correction can be done either via post-processing or real-time (in the field).

Post-Processing Reference Data

After the survey is done, data from the field receiver and a reference receiver is downloaded to a computer and the positions are differentially corrected.

Real-Time GPS Surveying

Positions stored in the GPS receiver are corrected in the field, before downloading to the computer

Corrections are broadcast as soon as possible to users in a local area

Equipped GPS receivers can correct positions in real-time and store corrected positions in the field

GPS receivers can be configured to store uncorrected GPS data (for later post-processing) when real-time data is not available

Real-time corrections are slightly less accurate than post-corrected GPS, but the difference is not important for most mapping surveys (<1m).

Signal to Noise Ratio (SNR) Mask

Interference from trees, forest canopy, multipathing, and even GPS cable connections can cause signal attenuation. If the interfering components overwhelm the signal tracing can become difficult. The SNR is a comparison between the signal strength to the noise. **The SNR mask should be set to 3 for SHIM mapping however lowering the SNR mask to 0 allows for faster data collection with little difference to the accuracy of the collected data.**



From: RIC Standards Training using GPS Technology, September 1998.

Elevation Mask

Traveling through the atmosphere causes a great deal of noise to the GPS signal. The elevation mask allows GPS users to limit the length the signal travels through the atmosphere. **The elevation mask should be set to 15° according to RIC standards.**

From: RIC Standards Training using GPS Technology, September 1998.

Accuracy Requirements for SHIM

GPS-derived stream features must be within five metres of the true location, 95 percent of the time (to be compatible with 1:5000 scale municipal maps). Under typical conditions with local obstructions, forest cover, and other factors, five-metre accuracy is achievable only with the best GPS equipment and careful methods.

General Field Methods for Poor GPS Reception

Moving the antenna around within a meter can help re-acquire satellite signals, without affecting position accuracy.

Waiting for ten or twenty minutes (sometimes hours in extreme cases) can usually enable surveying.

Conventional methods can be used to supplement GPS methods during these reception “down” periods.

Adjusting the Receiver Configurations

Under forest canopy, configuring the receiver to accept weaker satellite signals will make GPS surveying possible in most situations.

Weaker signals (such as signals passing through foliage) may be less accurate than strong signals.

Using the manufacturer’s default configuration (e.g. SNR mask 6), the best GPS receivers are capable of accuracy better than 1 m in ideal conditions, but usually they work poorly in forest cover – if at all.

Reducing SNR to 0 allows collection of more data under forest canopy and does not degrade accuracy beyond acceptable limits (5 m, 95% confidence).

Using the Trimble Pathfinder

Upload the Data Dictionary from Pathfinder Office
Configure GPS

Field Mapping

Press on the power.

Select TerraSync Program

Select Data Collection from the main menu.



Select Create new file to create a new rover file. *Never re-open a rover file to add more information. You may lose your data or the file may become corrupted.*

Enter the file name. Decide on a file naming system and use it consistently (for example, Stream name / date: “FERG0601” for Fergus Creek, June 1st).

Select the Data Dictionary you will be using, which is generally the most recent Data Dictionary.

This opens the Start feature menu, from which you can choose to map point or line features.

Entering Shoreline Information

***Note:** Remember to pause logging before stopping to enter information into the data logger, and resume when you continue walking the stream centreline.*

Reference Information applies to the entire shoreline feature you are mapping. It is usually entered while standing at the start point, but the timing depends on crew preference. For example you may prefer to do it at the same time as entering characteristics for the first segment. In any case, the data logger will not let you end the stream feature until you have entered all the required information.



APPENDIX B

Data Tables

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	43.24%	125085
Disturbed	56.76%	164226
Total		289311.0

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	15.0	43377	28137	15240	64.9	35.1
Steep (20-60)	30.0	86679	59294	27385	68.4	31.6
Moderate (5-20)	15.8	45619	19046	26574	41.7	58.3
Low (0-5)	36.3	104946	15095	89851	14.4	85.6
Bench	3.0	8689	3513	5176	40.4	59.6
Total	100.0	289311	125085	164226	43.2	56.8

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	8.8%	25516	8806	16710	34.5%	65.5%
Commercial	1.9%	5429	830	4600	15.3%	84.7%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	1.1%	3146	237	2908	0.0%	0.0%
Multi Family	1.1%	3115	391	2724	12.6%	87.4%
Natural Area	0.2%	577	572	4	0.0%	0.0%
Park	14.0%	40375	36722	3653	91.0%	9.0%
Recreation	3.3%	9584	2469	7114	25.8%	74.2%
Rural	25.6%	74006	56015	17991	75.7%	24.3%
Single Family	32.3%	93322	14181	79141	15.2%	84.8%
Urban Park	5.4%	15549	2582	12966	16.6%	83.4%
Transportation	6.1%	17765	1172	16593	6.6%	93.4%
Institutional	0.3%	929	929	0	0.0%	0.0%
Total	100.0%	289311.0				



Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	23.3%	67271	44003	23267.5	65.4%	34.6%
Rocky Shore	14.5%	41904	30178	11725.4	72.0%	28.0%
Gravel Beach	43.3%	125375	39960	85415.1	31.9%	68.1%
Sand Beach	7.1%	20675	903	19772.3	4.4%	95.6%
Stream Mouth	2.8%	8105	2067	6038.3	25.5%	74.5%
Wetland	8.3%	24031	7988	16043.0	33.2%	66.8%
Other	0.7%	1965	0	1964.8	0.0%	100.0%
Total	100.00%	289325				

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	19.5%	56461
Submergent Vegetation	2.1%	6156
Emergent Vegetation	17.4%	50358
Floating Vegetation	0.3%	964

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	2718	11.43
Groynes	939	3.95
Boat Launch	222	0.93
Retaining Walls	1799	7.56
Marinas	41	0.17
Marine Rails	118	0.50



Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	8%	22668.9
Retaining Wall	20%	58461.0
Railway	0%	0.0
Substrate Modification	47%	137061.7
Total Shore Length		289311.0

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	58.47%	169166
Moderate	15.37%	44455
Low	24.97%	72251
None	1.19%	3439
	Shore Length	289311.0

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	141	74018.0	52.2%	67777.0	47.8%	141795.6
Moderate	153	43767.6	34.0%	84879.8	66.0%	128647.8
Low	20	7299.6	38.7%	11568.9	61.3%	18868.9
						289312.3

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
79.6%	20.4%	61.5%	38.5%	30.7%	69.3%	34.8%	65.2%
28850	7397	24291	15239	17413	39313	54531	102277

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	35656.3	85.60	5998.97	14.40	Very High	60181.27	70.5	25172.04	29.5
High	7	%	8	%	High	50378.74	51.7	47048.84	48.3
High	19692.2	48.67	20767.1	51.33	High	50378.74	%	47048.84	%
Moderate	8	%	1	%	Moderate	13833.06	17.4	65469.71	82.6
Moderate	6427.59	18.28	28730.5	81.72	Moderate	13833.06	%	65469.71	%
Low	9	%	99.43	%	Low	642.2212	3.0%	21023.04	97.0
Low	44.5996	0.57%	7798.9	97.50	Low	642.2212	3.0%	21023.04	%
Very Low	96.0935	2.50%	9	%	Very Low	49.95567	0.9%	5512.129	99.1
Very Low	5	2.50%	9	%	Very Low	49.95567	0.9%	5512.129	%



APPENDIX C AQUATIC HABITAT INDEX RESULTS



APPENDIX D

RDCO Electoral Area East Results

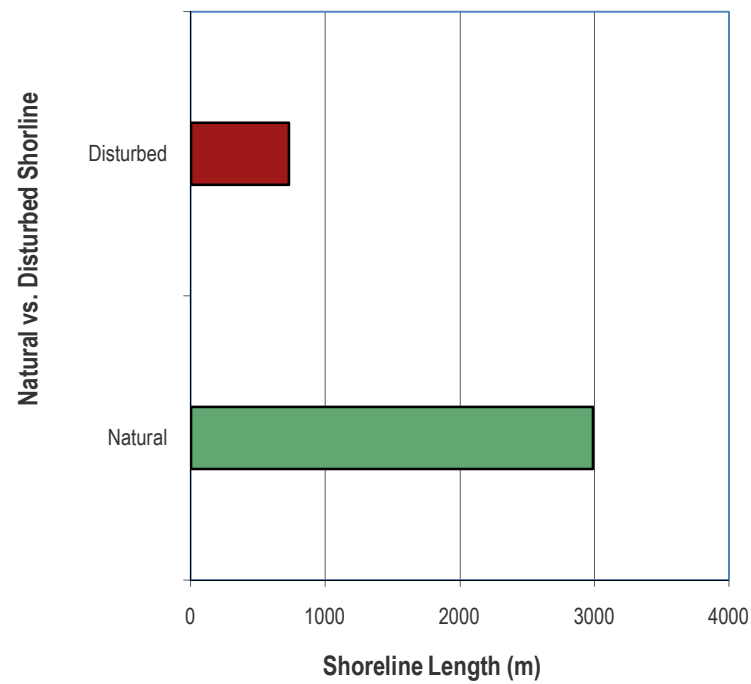


Figure 1: The percent of natural and disturbed shoreline.

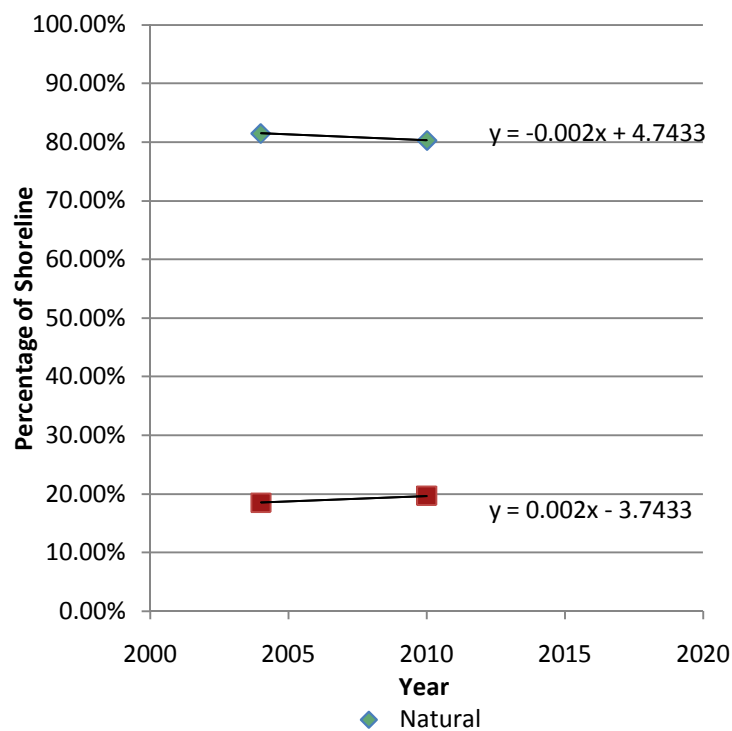


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	80.32%	2987	81.50%	3030.71
Disturbed	19.68%	732	18.50%	688.14
Total		3718.8		3718.8

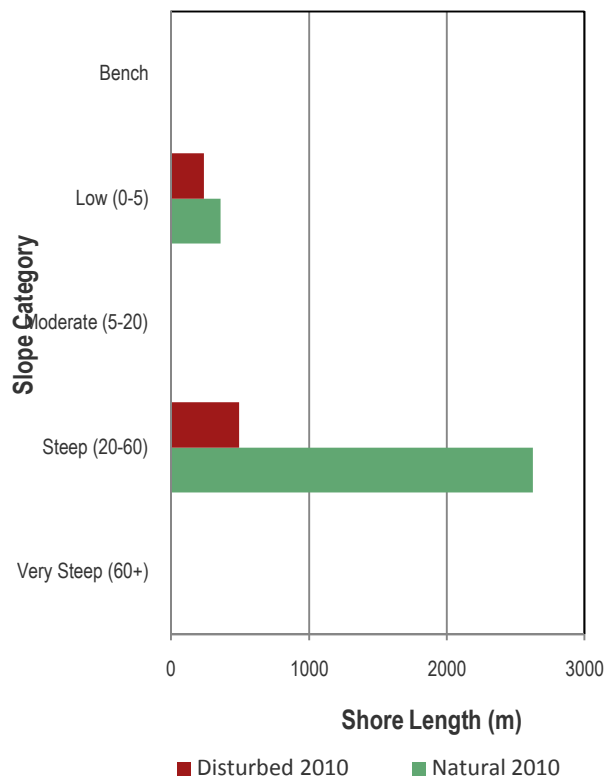


Figure 4: The length of natural and disturbed shorelines in each slope category.

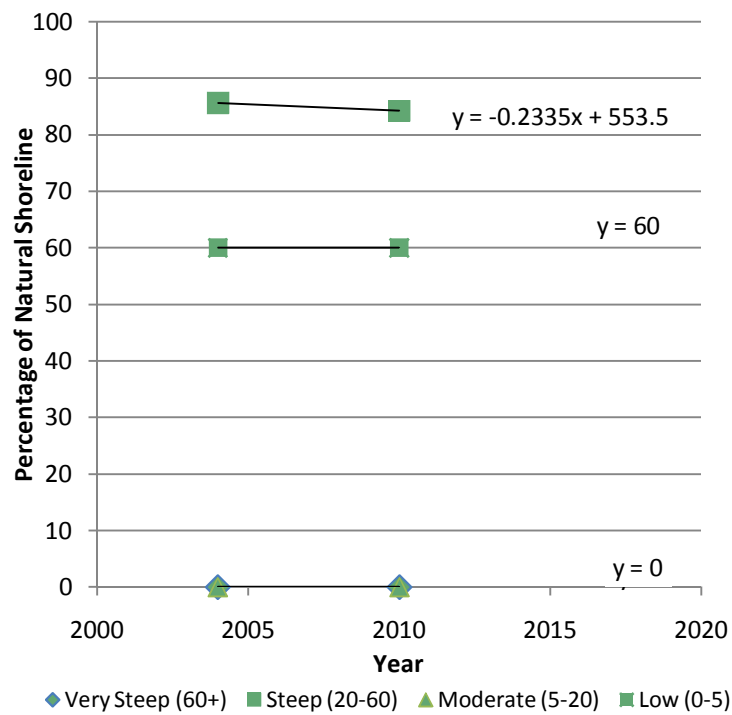


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0	0	0	0	0	0	Very Steep (60+)	0.0	0	0	0	0	0
Steep (20-60)	84	3122	2673	449	86	14	Steep (20-60)	84.0	3122	2629	493	84.2	15.8
Moderate (5-20)	0	0	0	0	0	0	Moderate (5-20)	0.0	0	0	0	0	0
Low (0-5)	16	597	358	239	60	40	Low (0-5)	16.0	597	358	239	60.0	40.0
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	3719	3031	688	81.5	18.5	Total	100.0	3719	2987	732	80.3	19.7



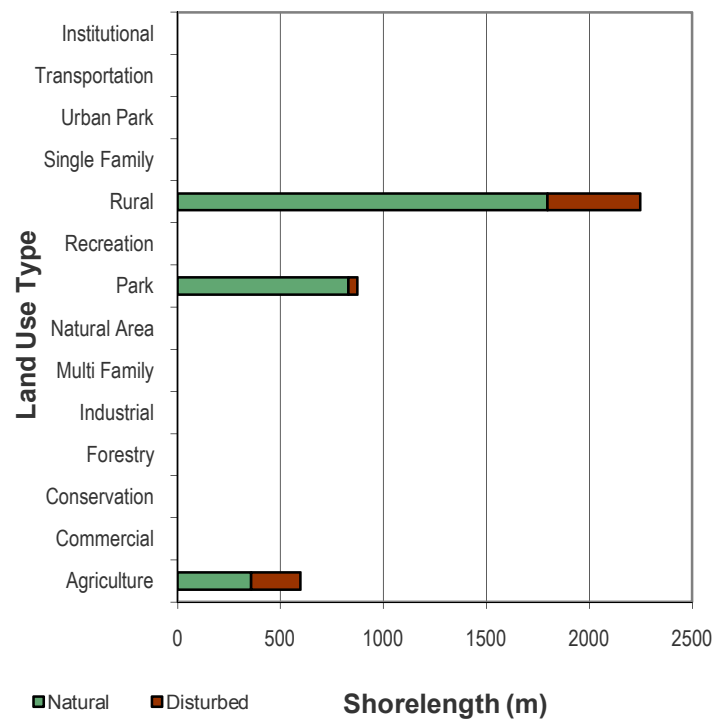


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	16.0%	597	358	239	60.0%	40.0%
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	0.0%	0	0	0	0	0
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0	0
Park	23.5%	875	831	44	95.0%	5.0%
Recreation	0.0%	0	0	0	0	0
Rural	60.4%	2247	1798	449	80.0%	20.0%
Single Family	0.0%	0	0	0	0	0
Urban Park	0.0%	0	0	0	0	0
Transportation	0.0%	0	0	0	0	0
Institutional	0.0%	0	0	0	0	0

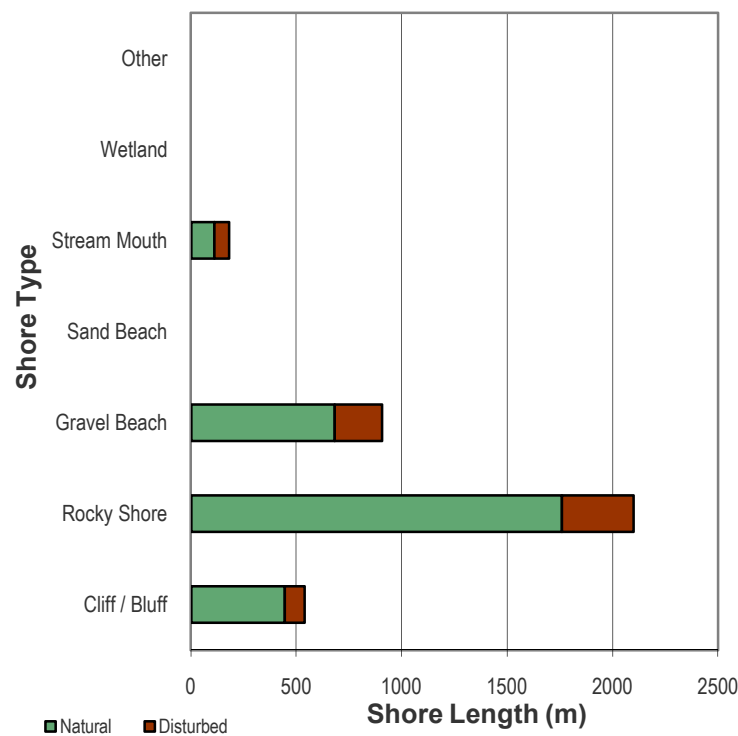


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	14.4%	537	443	94.3	82.4%	17.6%
Rocky Shore	56.4%	2098	1757	340.9	83.8%	16.2%
Gravel Beach	24.3%	905	680	225.1	75.1%	24.9%
Sand Beach	0.0%	0	0	0.0	0	0
Stream Mouth	4.8%	179	107	71.6	60.0%	40.0%
Wetland	0.0%	0	0	0.0	0	0
Other	0.0%	0	0	0.0	0	0
Total	100.00%	3719				

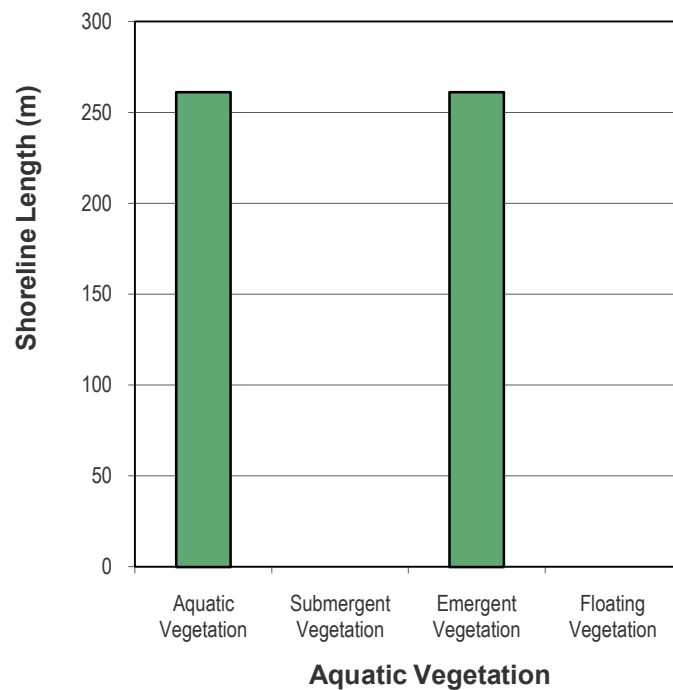


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	7.0%	261
Submergent Vegetation	0.0%	0
Emergent Vegetation	7.0%	261
Floating Vegetation	0.0%	0

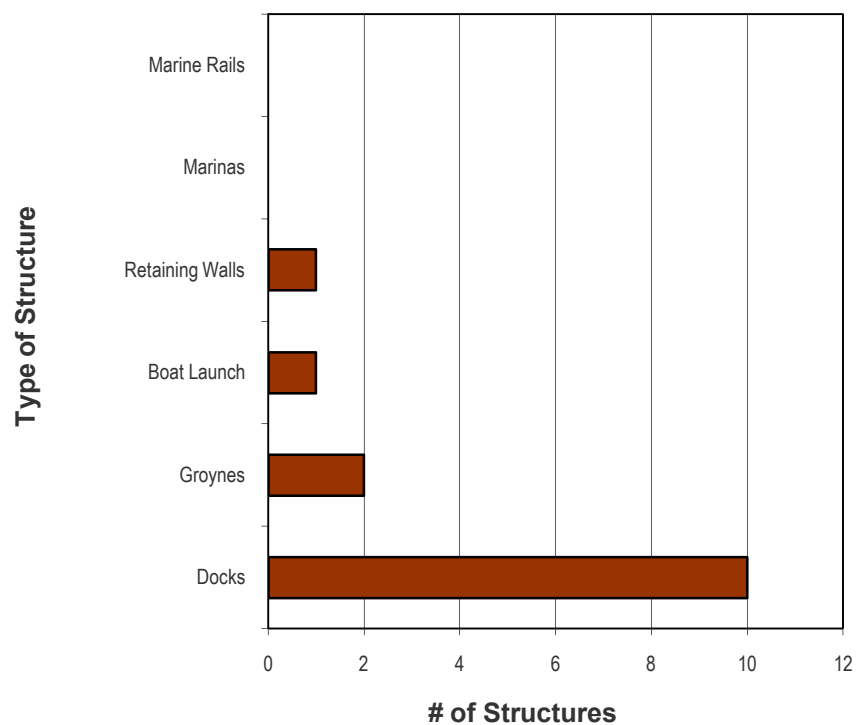


Figure 9: The total number of different types of modifications on Okanagan Lake

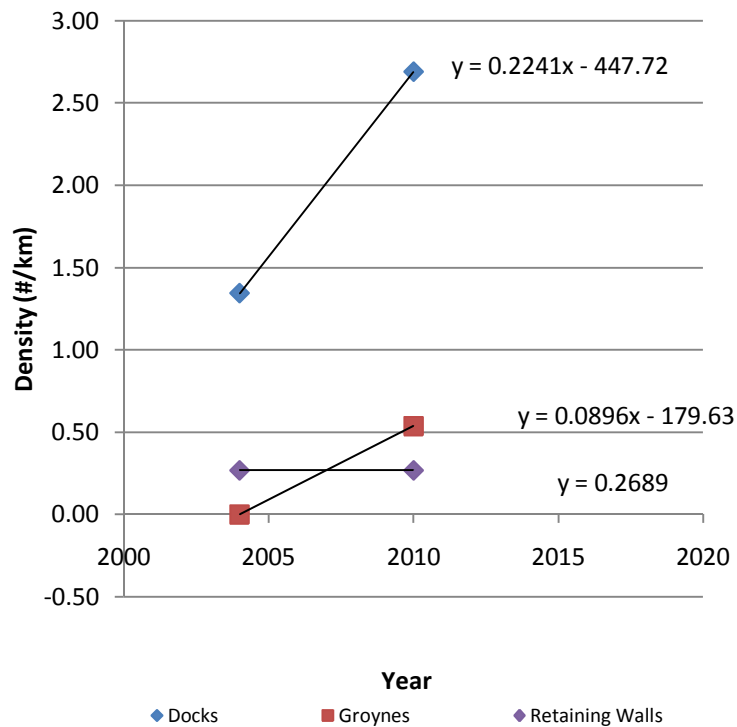


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

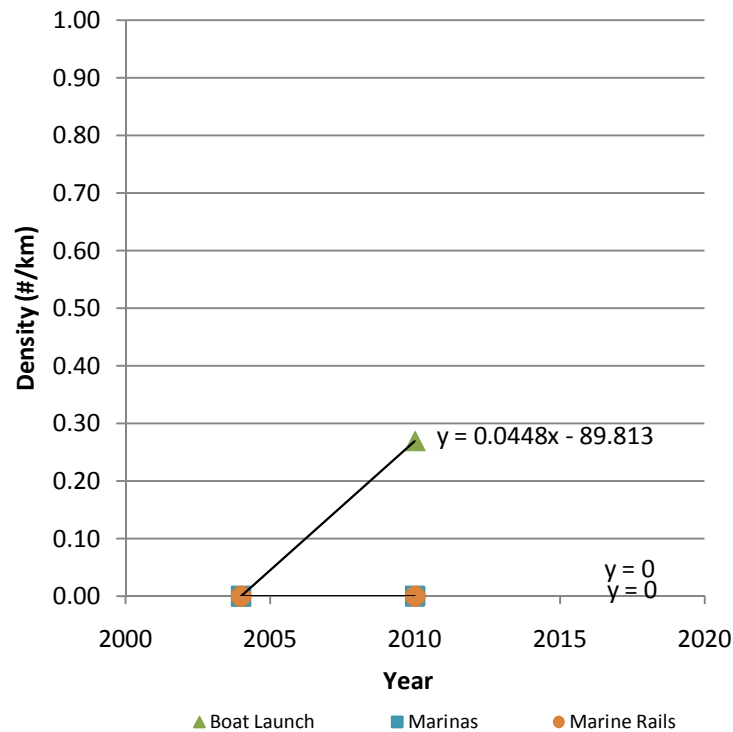
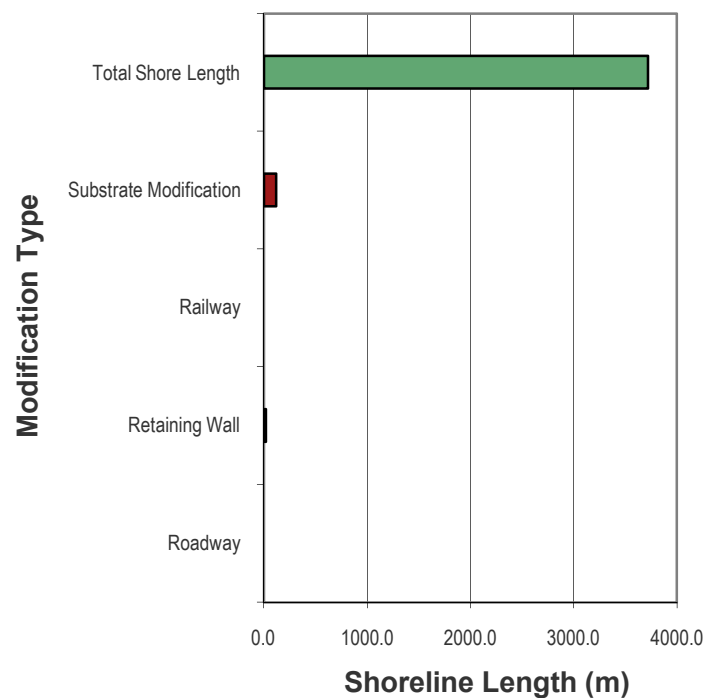


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

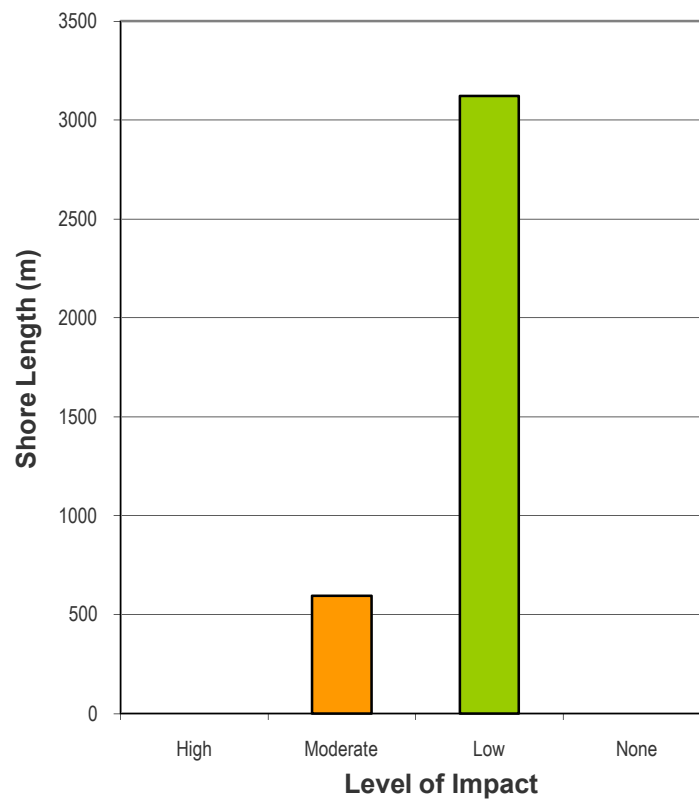
2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	5	1.34	Docks	10	2.69
Groynes	0	0.00	Groynes	2	0.54
Boat Launch	0	0.00	Boat Launch	1	0.27
Retaining Walls	1	0.27	Retaining Walls	1	0.27
Marinas	0	0.00	Marinas	0	0.00
Marine Rails	0	0.00	Marine Rails	0	0.00



. **Figure 12:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	0%	0.0
Retaining Wall	1%	22.5
Railway	0%	0.0
Substrate Modification	3%	120.7
Total Shore Length		3718.8



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

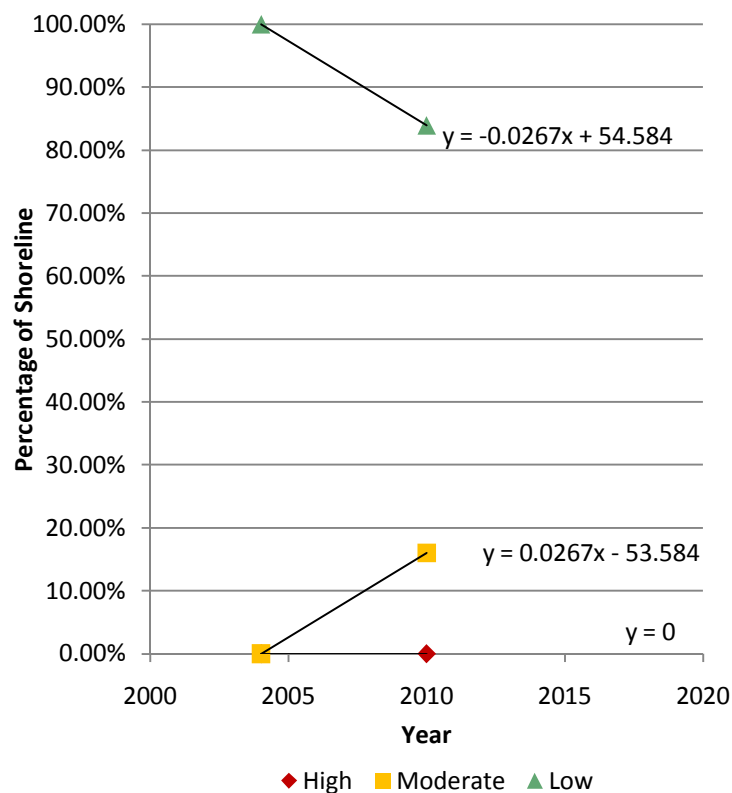


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	0.00%	0	High	0.00%	0
Moderate	0.00%	0	Moderate	16.04%	597
Low	100.00%	3719	Low	83.96%	3122
None	0.00%	0	None	0.00%	
				Shore Length	3718.8

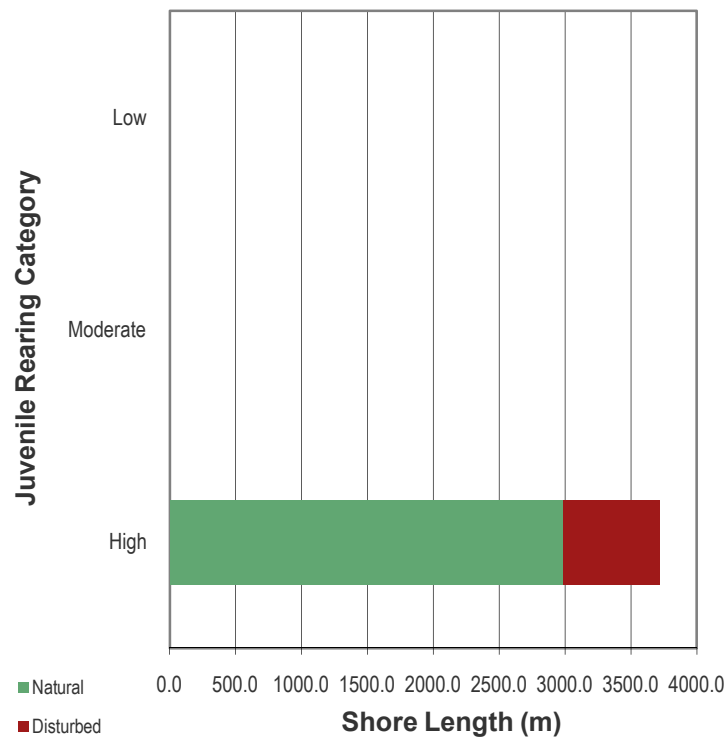


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

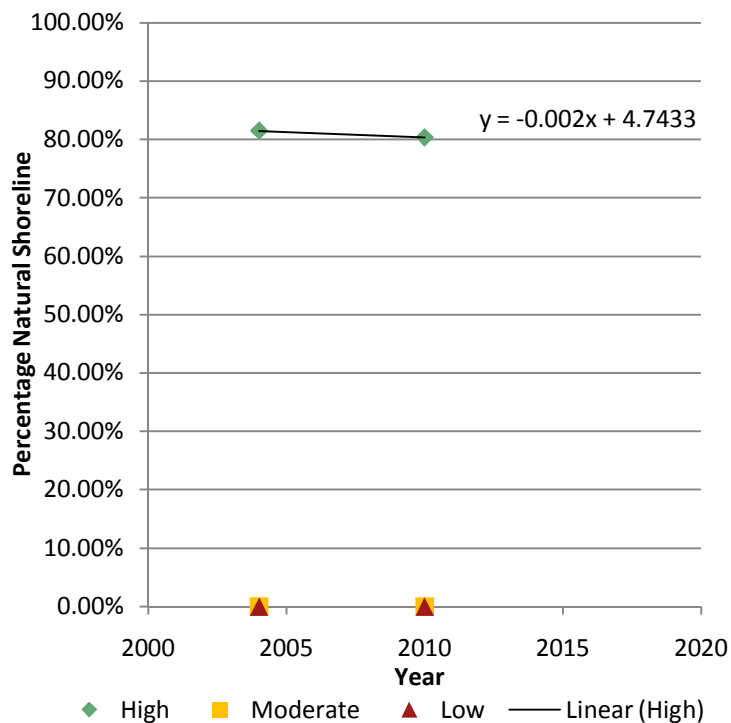


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	3	3030.7	81.50%	688.136	18.50%	3719.7	High	3	2987.0	80.3%	731.9	19.7%	3719.6
Moderate	0	0.0	0	0	0	0	Moderate	0	0.0	0	0.0	0	0
Low	0	0.0	0	0	0	0	Low	0	0.0	0	0.0	0	0

0

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
83.54%	16.46%	80.47%	19.53%	76.70%	23.30%	80.43%	19.57%	82.7%	17.3%	79.5%	20.5%	74.6%	25.4%	78.2%	21.8%
1313.78	258.945	1103.76	267.904	199.472	60.597	413.695	100.69	1300	273	1091	281	194	66	402	112



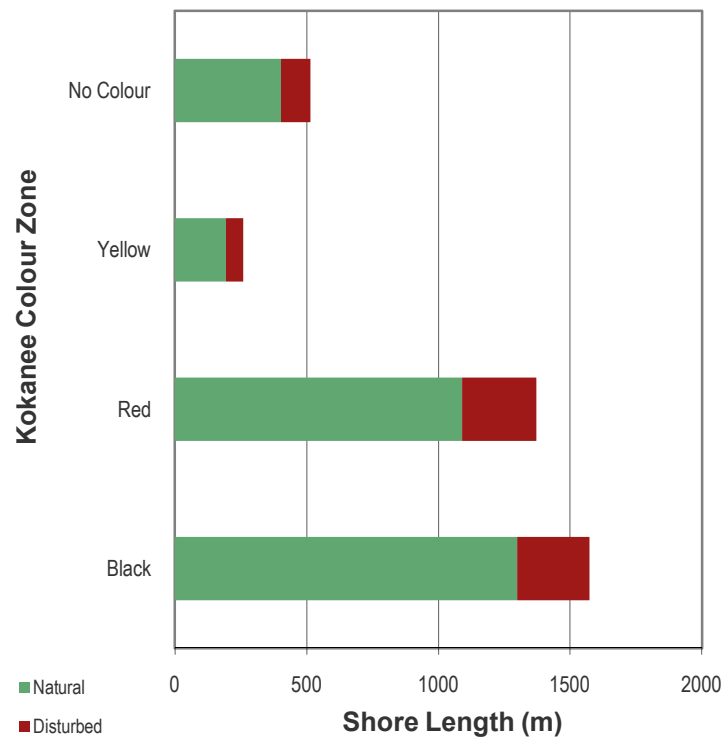


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

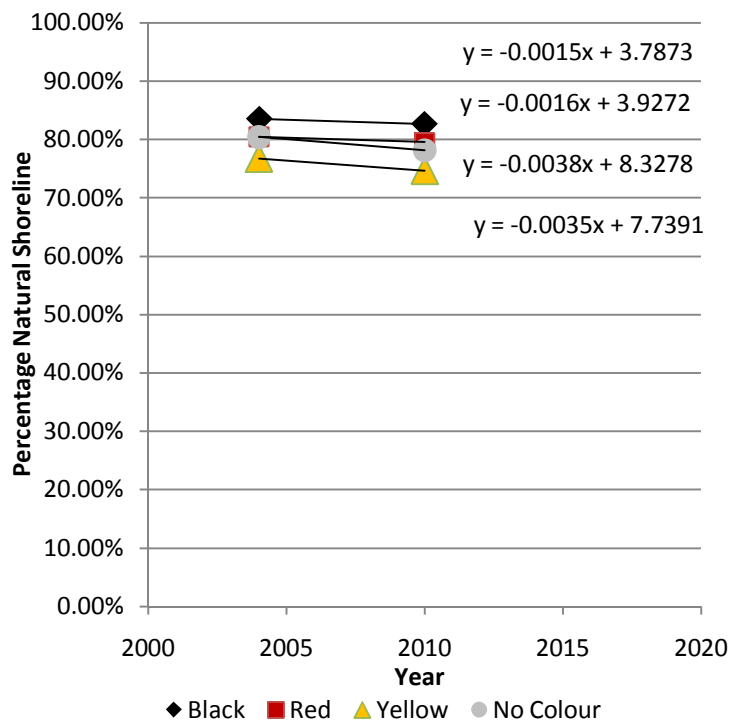


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

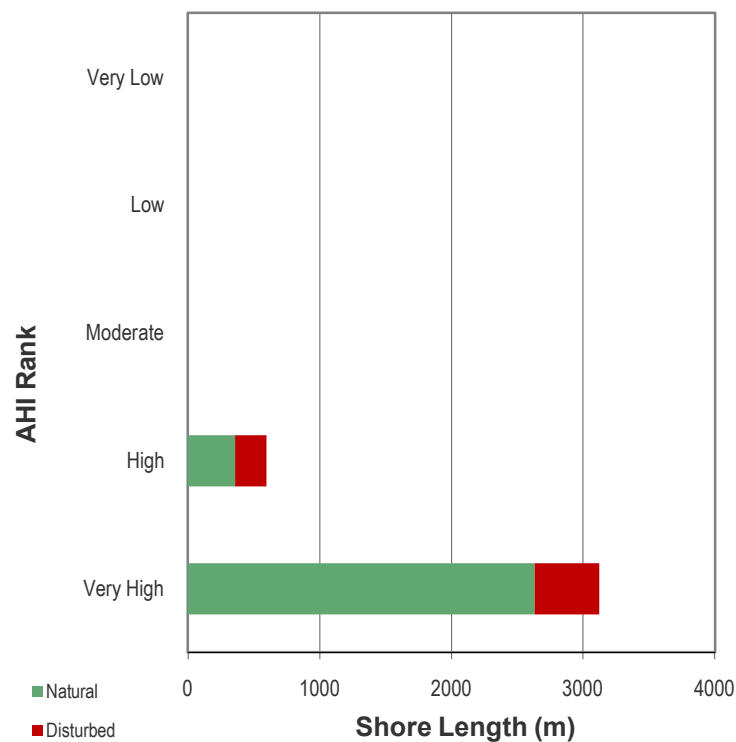


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

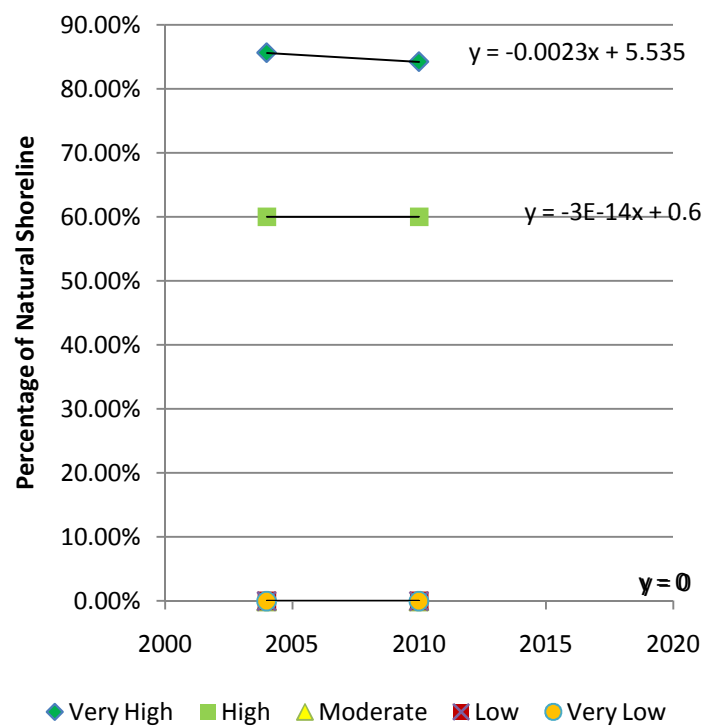


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very	2672.73	85.60	449.490	14.40	Very			493.229	
High	9	%	3	%	High	2629	84.2%	2	15.8%
		60.00	238.645	40.00		357.96		238.645	
High	357.968	%	3	%	High	8	60.0%	3	40.0%
Moderate	0	0	0	0	Moderate	0	0	0	0
Low	0	0	0	0	Low	0	0	0	0
Very Low	0	0	0	0	Very Low	0	0	0	0

APPENDIX E

RDCO West Results



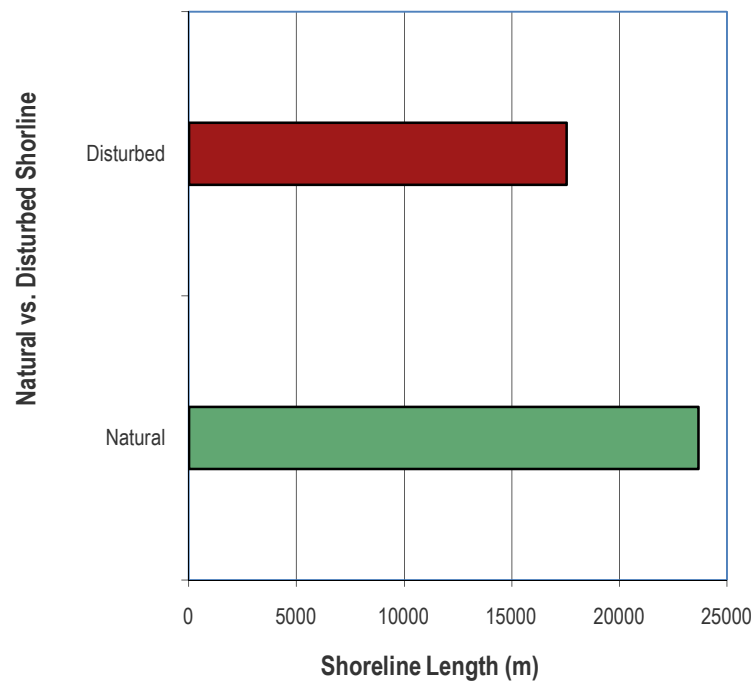


Figure 1: The percent of natural and disturbed shoreline.

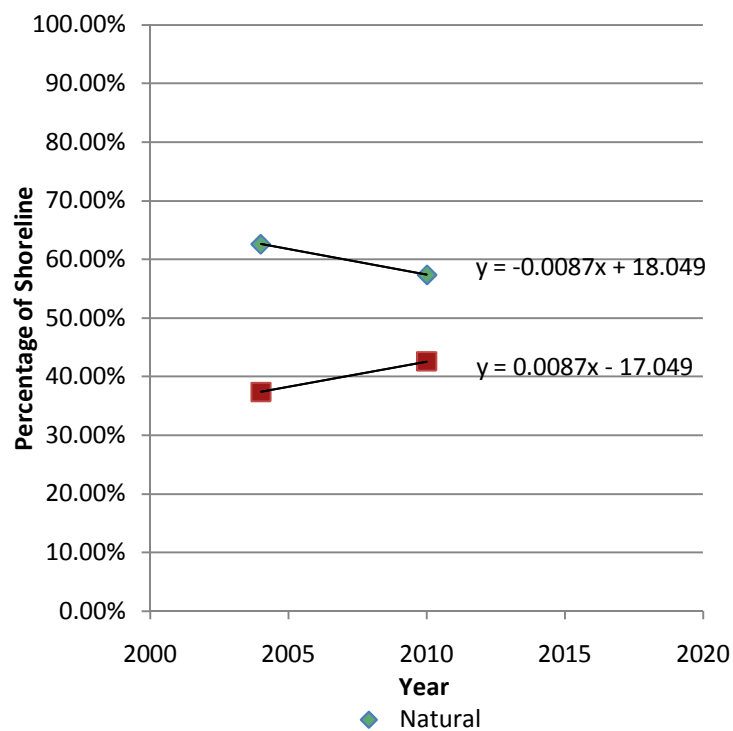


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	57.40%	23657	62.62%	25807.29
Disturbed	42.60%	17555	37.38%	15405.32
Total		41212.6		41212.6

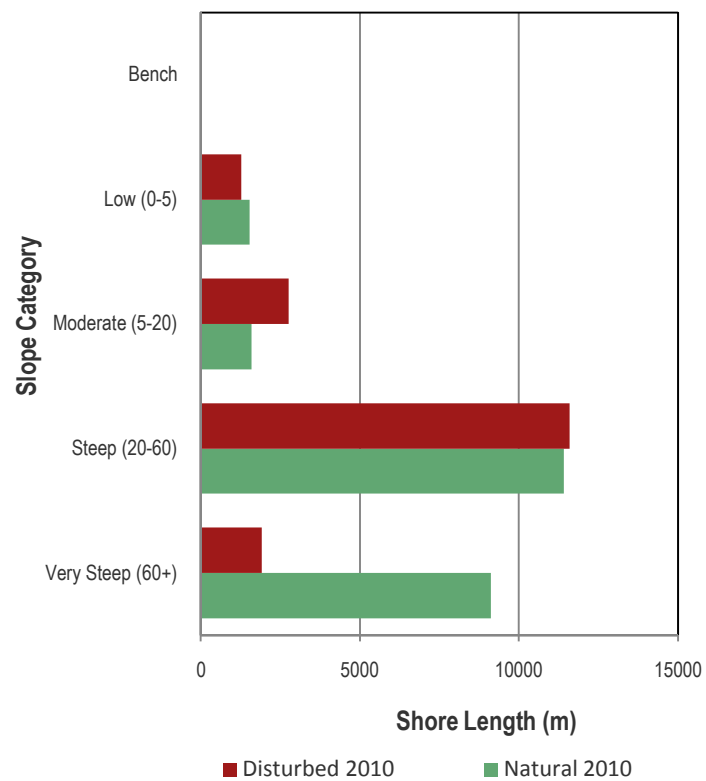


Figure 4: The length of natural and disturbed shorelines in each slope category.

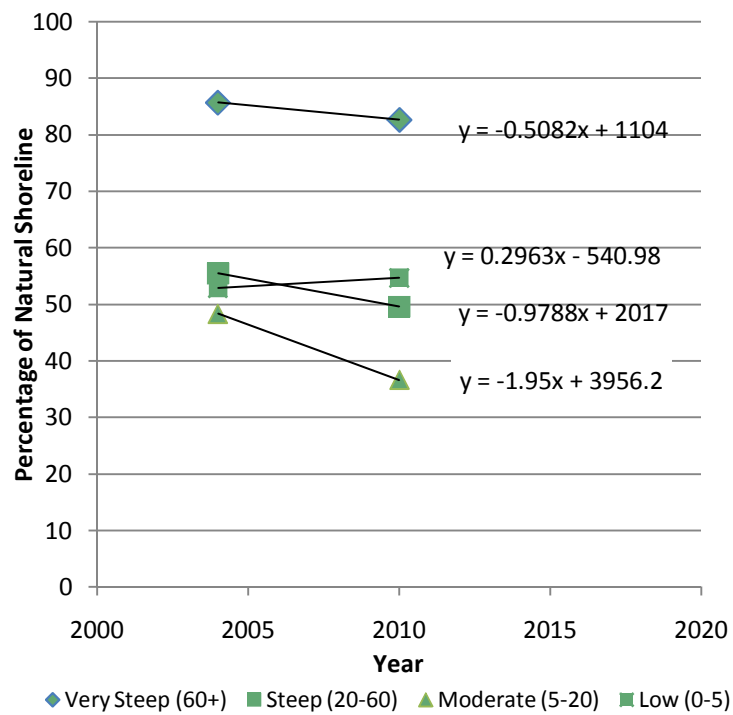


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	27	11035	9454	1581	86	14	Very Steep (60+)	26.8	11035	9118	1917	82.6	17.4
Steep (20-60)	56	23018	12765	10253	55	45	Steep (20-60)	55.9	23018	11413	11605	49.6	50.4
Moderate (5-20)	11	4369	2112	2257	48	52	Moderate (5-20)	10.6	4369	1601	2768	36.6	63.4
Low (0-5)	7	2791	1476	1315	53	47	Low (0-5)	6.8	2791	1525	1265	54.7	45.3
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	41213	25807	15405	62.6	37.4	Total	100.0	41213	23657	17555	57.4	42.6



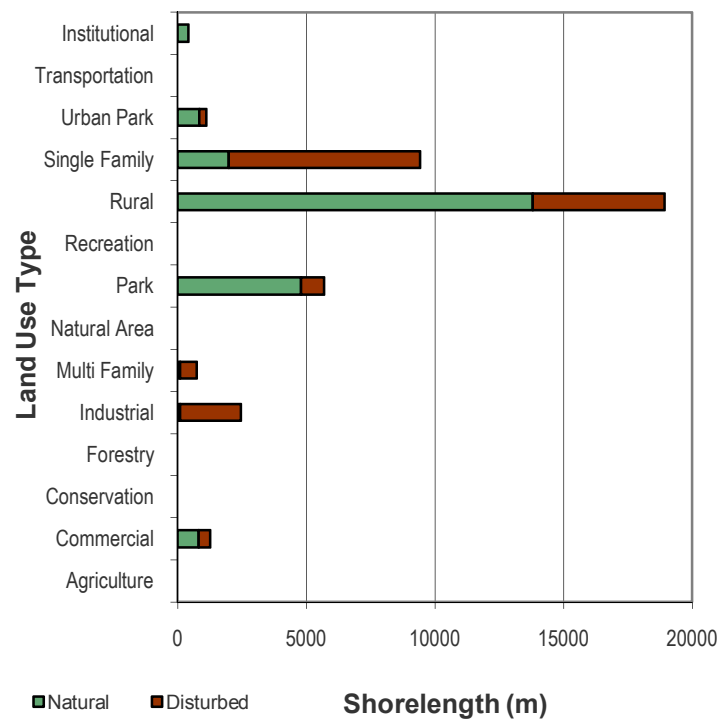


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	3.1%	1260	813	448	64.5%	35.5%
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	6.0%	2466	86	2380	3.5%	96.5%
Multi Family	1.8%	754	110	644	14.6%	85.4%
Natural Area	0.0%	0	0	0	0	0
Park	13.8%	5700	4808	892	84.4%	15.6%
Recreation	0.0%	0	0	0	0	0
Rural	45.9%	18918	13793	5125	72.9%	27.1%
Single Family	22.9%	9428	1999	7429	21.2%	78.8%
Urban Park	2.7%	1106	844	261	76.4%	23.6%
Transportation	2.8%	1151	121	1030	10.5%	89.5%
Institutional	1.0%	430	430	0	100.0%	0.0%
Total	100.0%	41212.6				

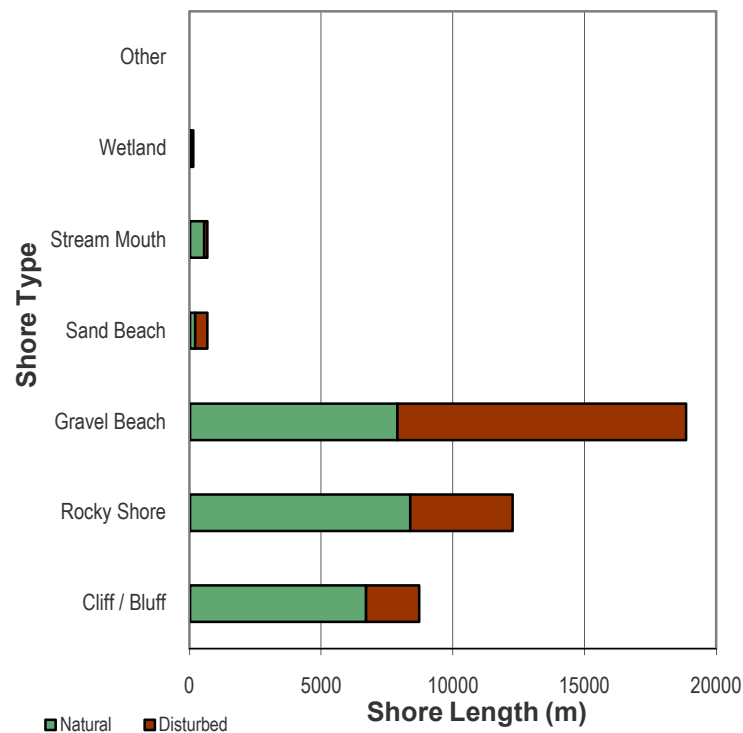


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	21.1%	8697	6673	2024.0	76.7%	23.3%
Rocky Shore	29.7%	12250	8361	3889.0	68.3%	31.7%
Gravel Beach	45.7%	18824	7859	10965.2	41.7%	58.3%
Sand Beach	1.6%	667	197	469.1	29.6%	70.4%
Stream Mouth	1.6%	657	544	113.6	82.7%	17.3%
Wetland	0.3%	118	24	94.2	20.0%	80.0%
Other	0.0%	0	0	0.0	0	0
Total	100.00%	41213				

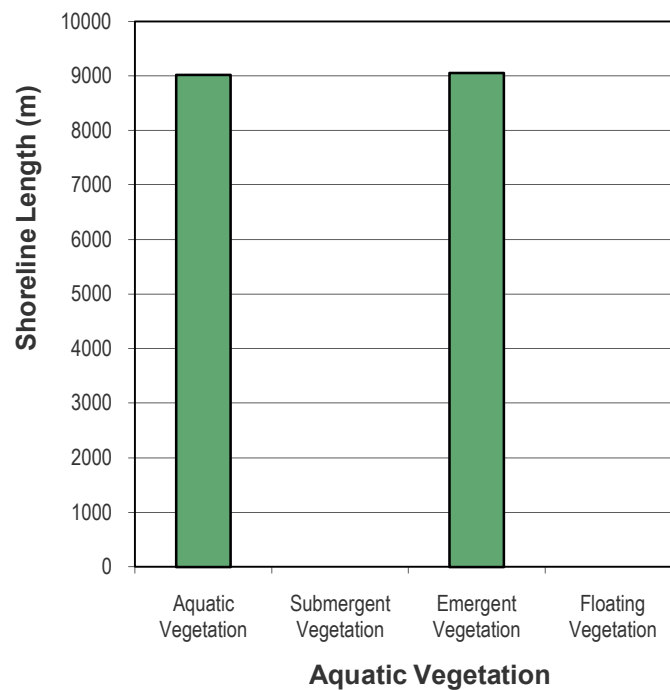


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	7.0%	261
Submergent Vegetation	0.0%	0
Emergent Vegetation	7.0%	261
Floating Vegetation	0.0%	0

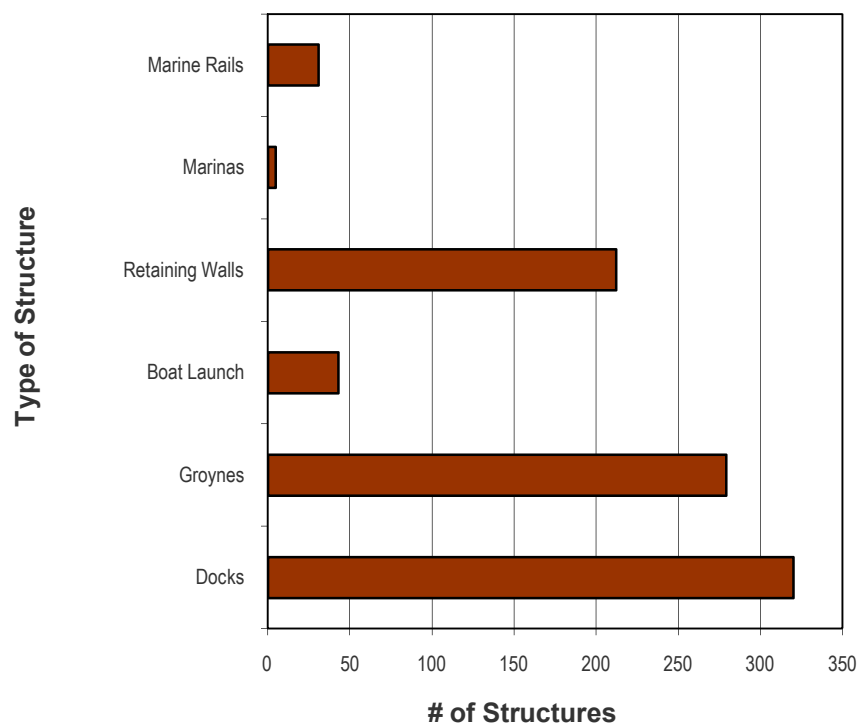


Figure 9: The total number of different types of modifications on Okanagan Lake

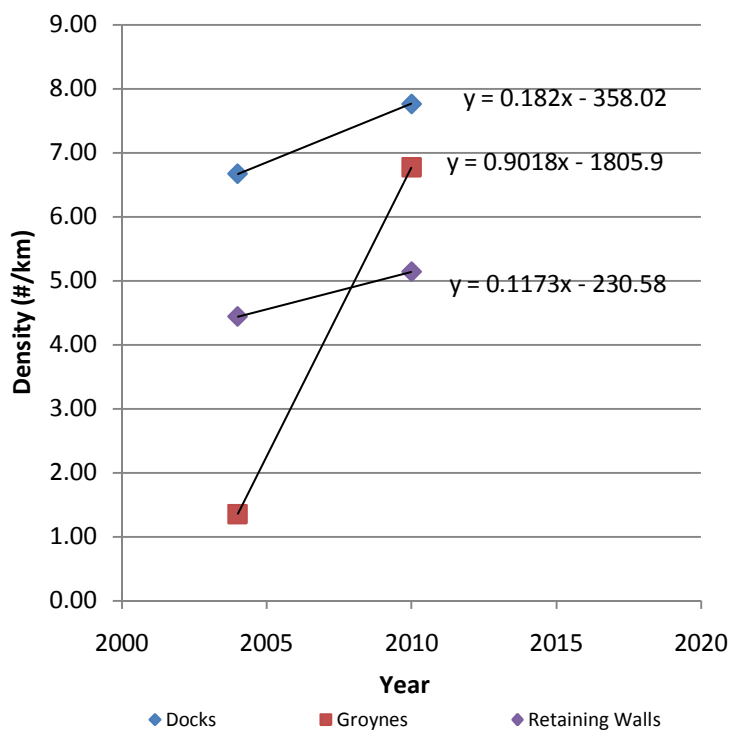


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

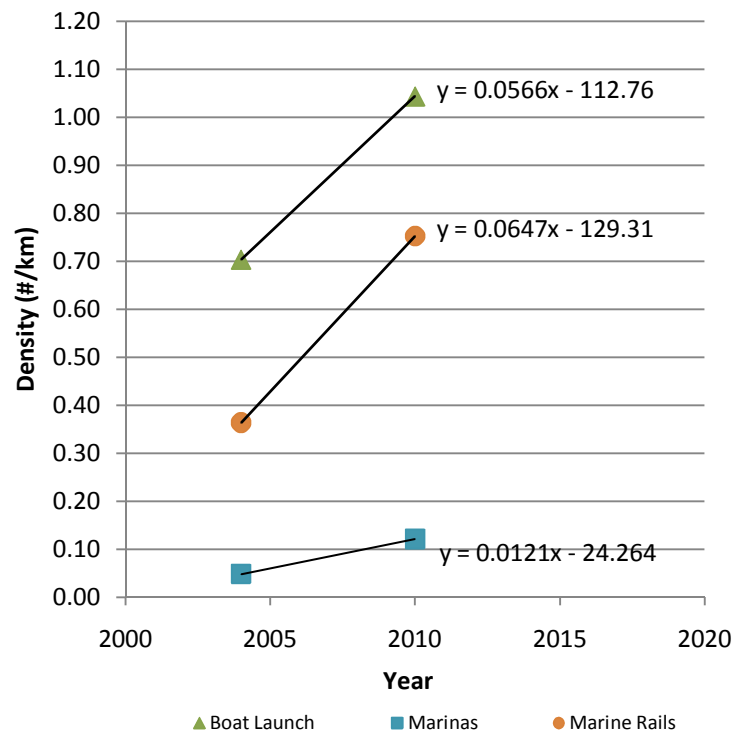


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	275	6.67	Docks	320	7.76
Groynes	56	1.36	Groynes	279	6.77
Boat Launch	29	0.70	Boat Launch	43	1.04
Retaining Walls	183	4.44	Retaining Walls	212	5.14
Marinas	2	0.05	Marinas	5	0.12
Marine Rails	15	0.36	Marine Rails	31	0.75

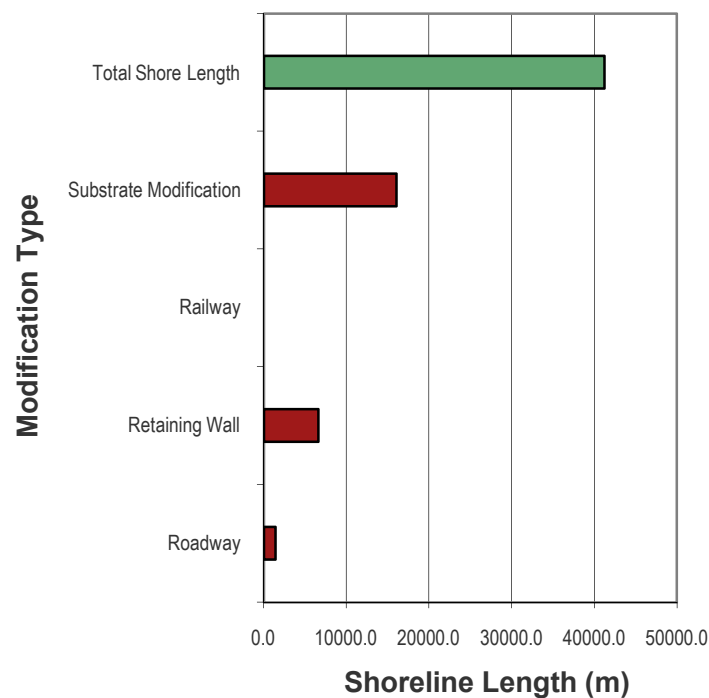
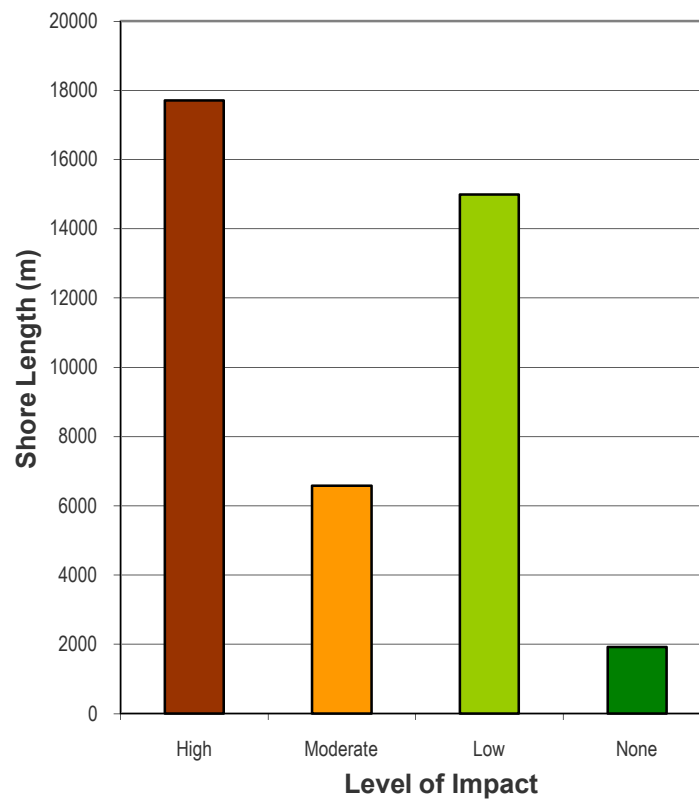


Figure 12: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	3%	1394.5
Retaining Wall	16%	6573.1
Railway	0%	0.0
Substrate Modification	39%	16024.3
Total Shore Length		41212.6



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

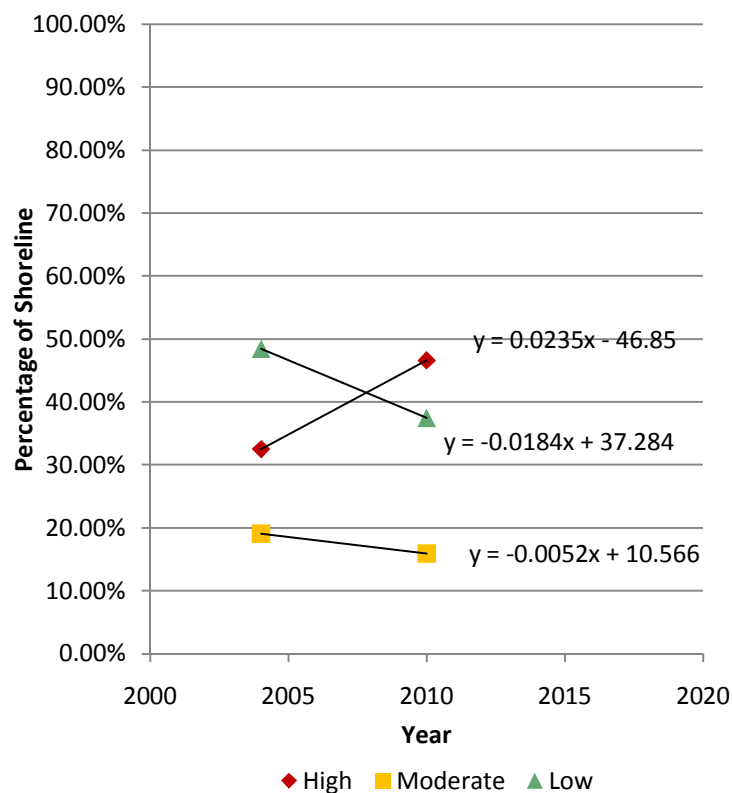


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	32.47%	13380	High	46.59%	19201
Moderate	19.06%	7856	Moderate	15.96%	6576
Low	48.47%	19976	Low	32.78%	13509
None	0.00%	0	None	4.67%	1926

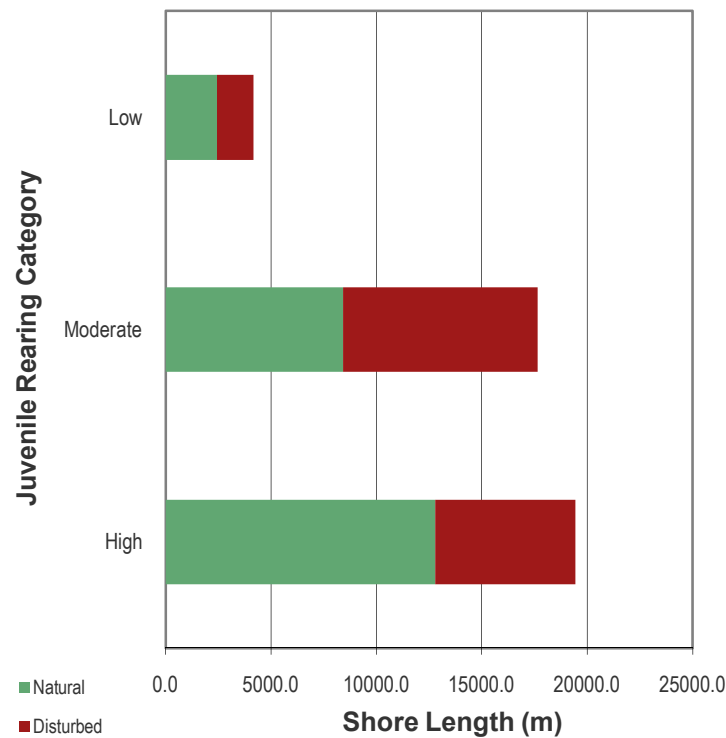


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

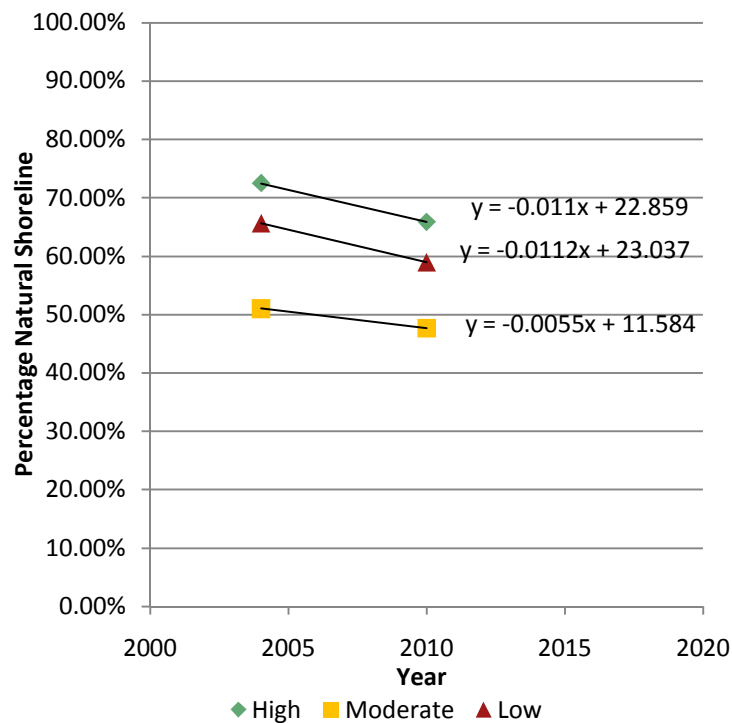


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	28	14081.3	72.51%	5339.19	27.49%	19421.2	High	28	12794.3	65.9%	6626.2	34.1%	19421.1
Moderate	23	9002.5	51.02%	8641.84	48.98%	17644.9	Moderate	23	8417.5	47.7%	9226.8	52.3%	17644.8
Low	7	2723.5	65.66%	1424.29	34.34%	4148.5	Low	7	2445.6	59.0%	1702.2	41.0%	4148.4
													41214.3

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
80.66%	19.34%	70.21%	29.79%	44.02%	55.98%	51.27%	48.73%	76.3%	23.7%	69.0%	31.0%	37.8%	62.2%	41.6%	58.4%
8751.56	2098.84	7906.34	3354.09	3913.83	4976.43	5235.56	4975.96	8280	2570	7768	3493	3362	5528	4247	5964



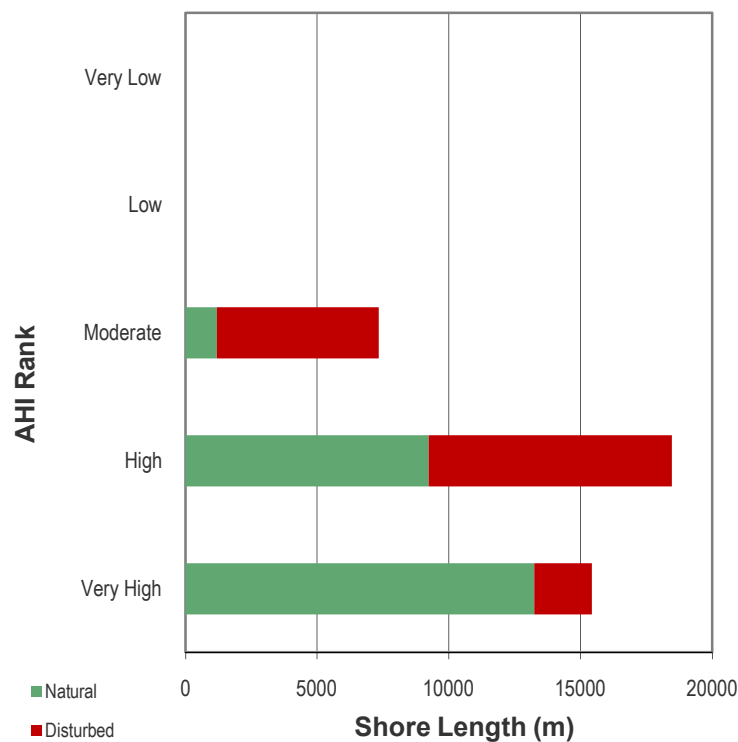


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

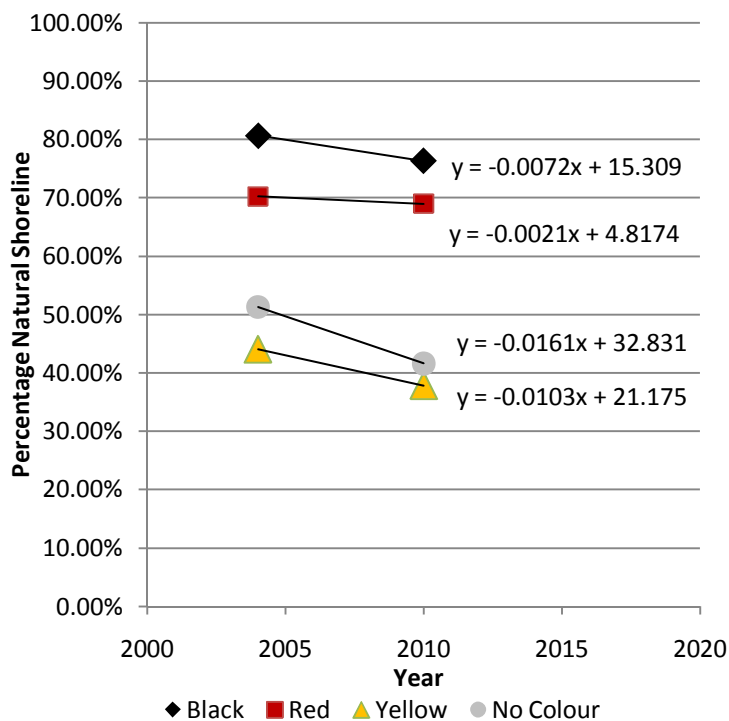


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

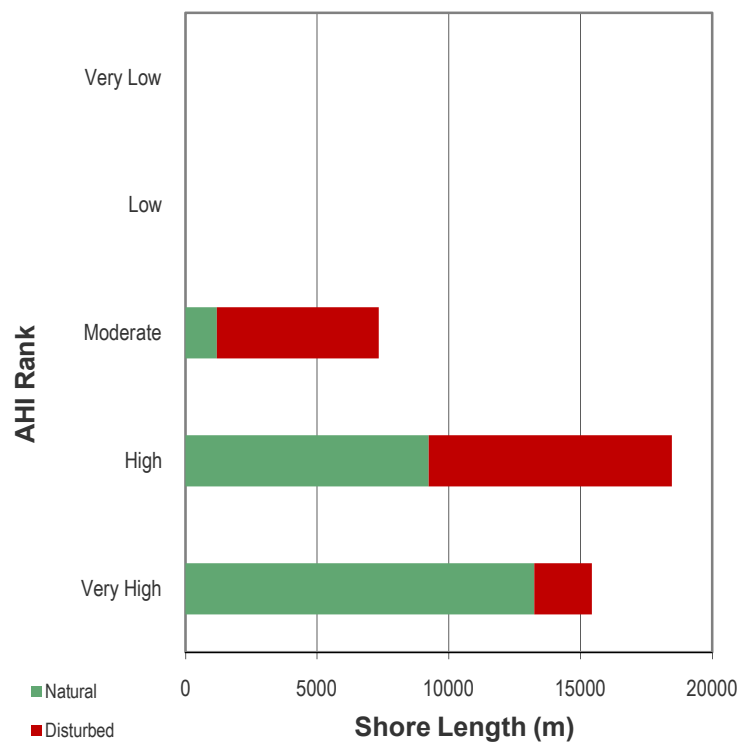


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

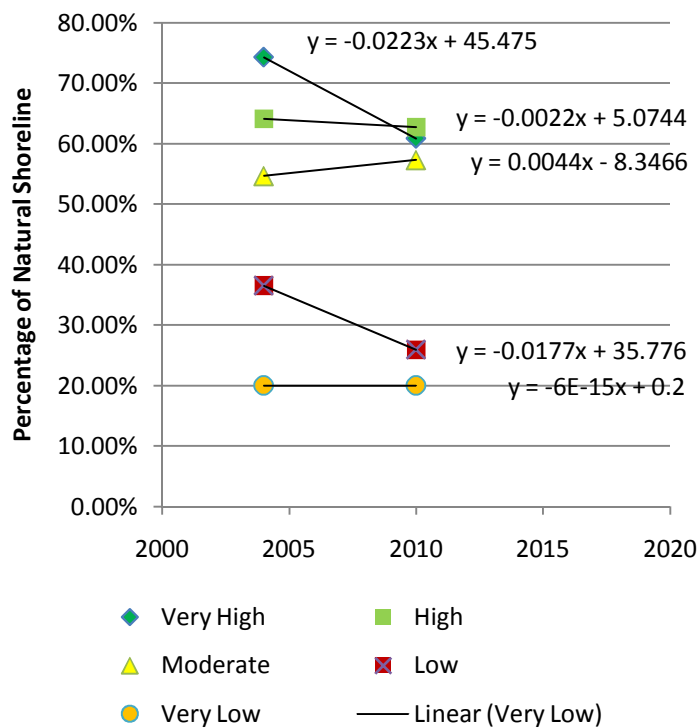


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	12197.2	74.27	4225.94	25.73	Very High	9997.68	60.9	6425.47	39.1
High	2	%	6	%	High	5	%	7	%
	5856.20	64.07	3283.71	35.93		5734.88	62.7	3405.03	37.3
High	9	%	1	%	High	3	%	7	%
	6888.48	54.64	5718.98	45.36		7224.16	57.3	5383.30	42.7
Moderate	4	%	9	%	Moderate	7	%	7	%
	567.666	36.54		63.46		402.967	25.9	1150.50	74.1
Low	6	%	985.809	%	Low	5	%	8	%
	297.716	20.00	1190.86	80.00		297.716	20.0	1190.86	80.0
Very Low	3	%	5	%	Very Low	3	%	5	%

APPENDIX F

RDOS Electoral Area F Results

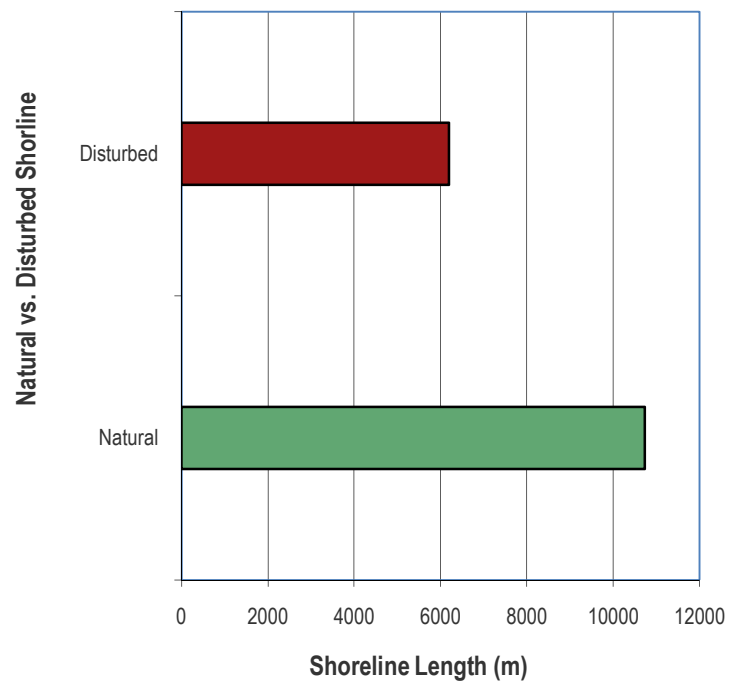


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	63.39%	10723
Disturbed	36.61%	6193
Total		16916.0



Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	2.8	482	477	5	99.0	1.0
Steep (20-60)	50.5	8547	7949	598	93.0	7.0
Moderate (5-20)	18.3	3096	1921	1175	62.0	38.0
Low (0-5)	28.3	4791	376	4415	7.8	92.2
Bench	0.0	0	0	0	0	0
Total	100.0	16916	10723	6193	63.4	36.6

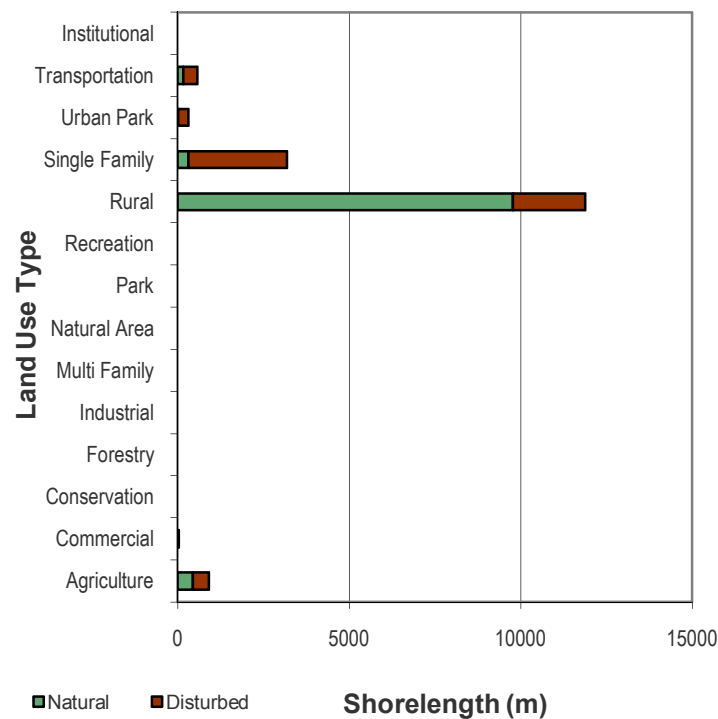


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	5.4%	919	449	471	48.8%	51.2%
Commercial	0.2%	33	2	31	5.0%	95.0%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	0.0%	0	0	0	0	0
Recreation	0.0%	0	0	0	0	0
Rural	70.3%	11886	9781	2105	82.3%	17.7%
Single Family	18.8%	3183	315	2867	9.9%	90.1%
Urban Park	1.8%	313	13	300	4.2%	95.8%
Transportation	3.4%	583	163	420	28.0%	72.0%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	16916.0				

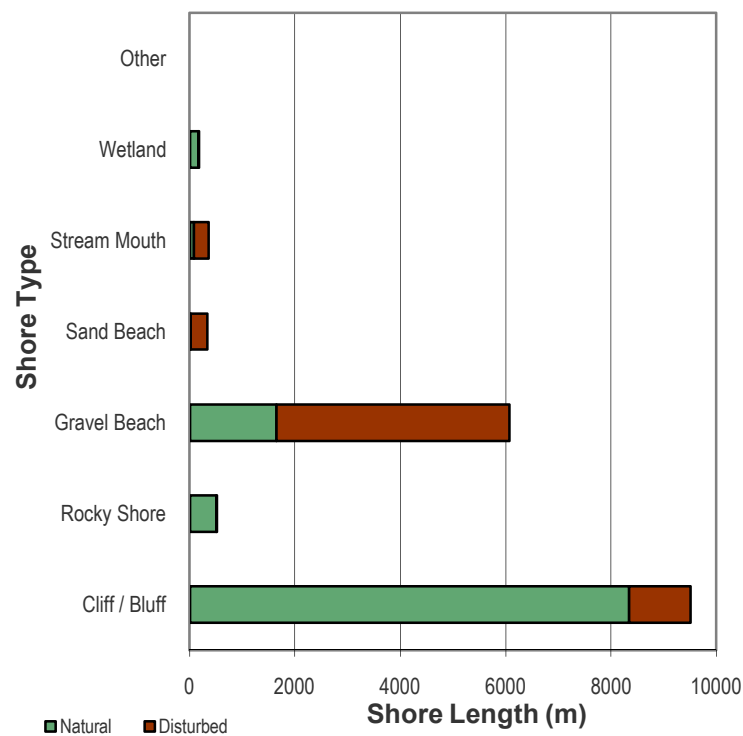


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	56.1%	9491	8336	1154.6	87.8%	12.2%
Rocky Shore	3.0%	508	502	5.1	99.0%	1.0%
Gravel Beach	35.8%	6063	1640	4423.4	27.0%	73.0%
Sand Beach	1.9%	327	16	310.3	5.0%	95.0%
Stream Mouth	2.1%	358	75	282.5	21.1%	78.9%
Wetland	1.0%	170	153	17.0	90.0%	10.0%
Other	0.0%	0	0	0.0	0	0
Total	100.00%	16916				

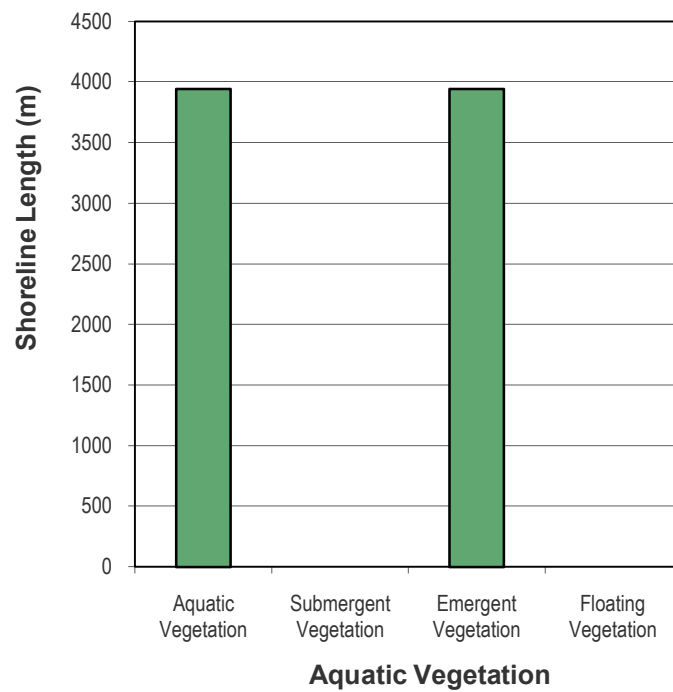


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	23.3%	3942
Submergent Vegetation	0.0%	0
Emergent Vegetation	23.3%	3942
Floating Vegetation	0.0%	0

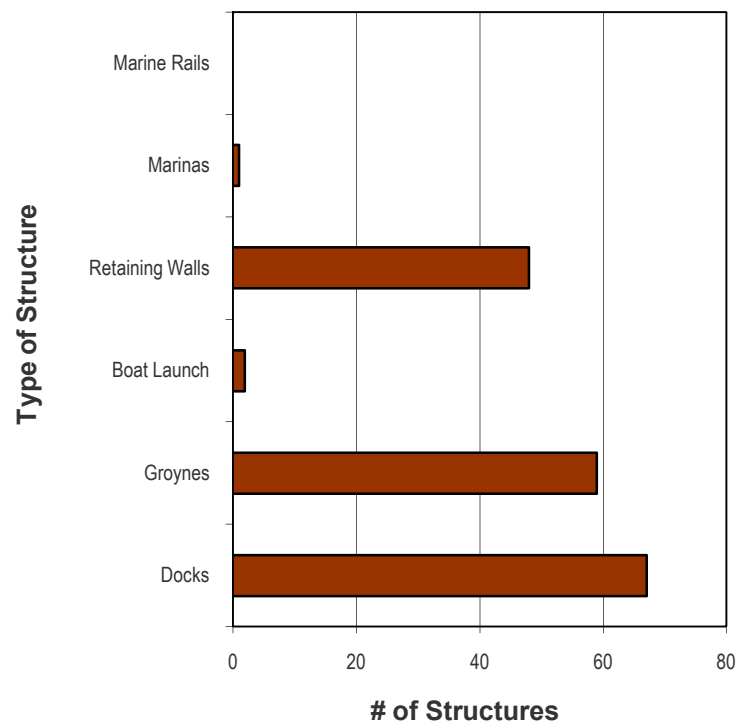
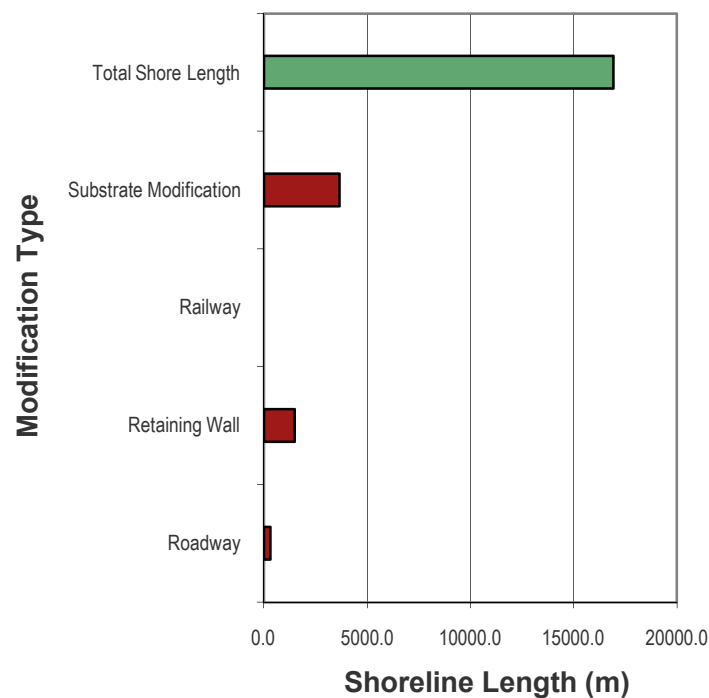


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

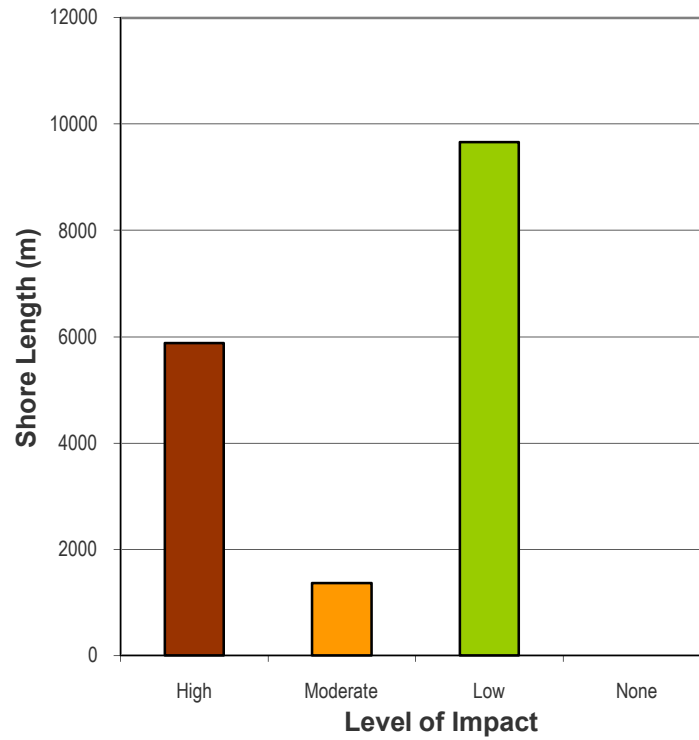
Type	Total #	# Per km
Docks	67	0
Groynes	59	0
Boat Launch	2	0
Retaining Walls	48	0
Marinas	1	0
Marine Rails	0	0



. **Figure 7:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	2%	303.7
Retaining Wall	9%	1480.2
Railway	0%	0.0
Substrate Modification	22%	3669.7
Total Shore Length		16916.0



. **Figure 8:** The shore length of different levels of impact on Okanagan Lake..

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing 2004 and 2010.

Level of Impact	% of Shoreline	Shore Length
High	34.79%	5886
Moderate	8.08%	1367
Low	57.12%	9663
None	0.00%	0
Shore Length		16916.0

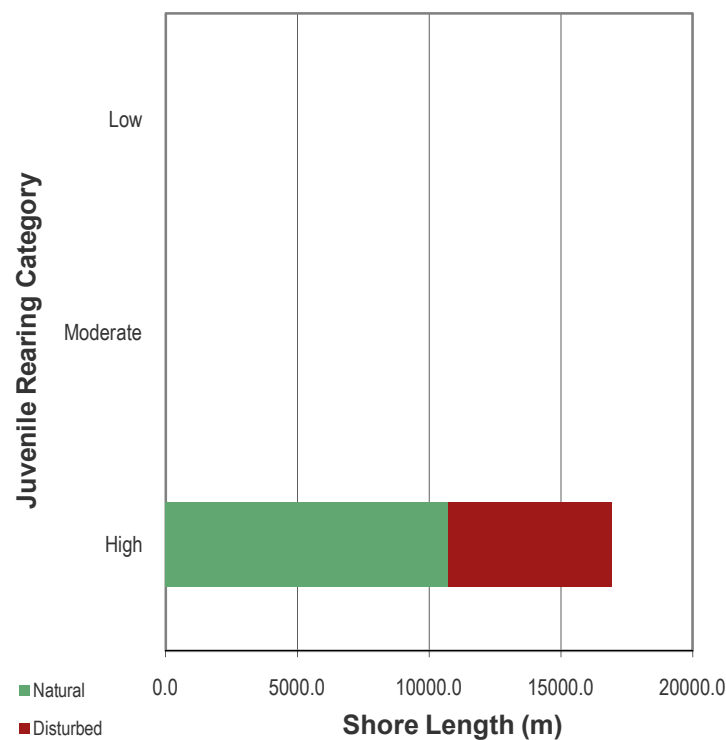


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

2004							2010			
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)	
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)
High	3	3030.7	81.50%	688.136	18.50%	3719.7	High	3	2987.0	80.3%
Moderate	0	0.0	0	0	0	0	Moderate	0	0.0	0
Low	0	0.0	0	0	0	0	Low	0	0.0	0

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	15	10723.1	63.4%	6193.0	36.6%	16916.7
Moderate	0	0.0	0	0.0	0	0
Low	0	0.0	0	0.0	0	0

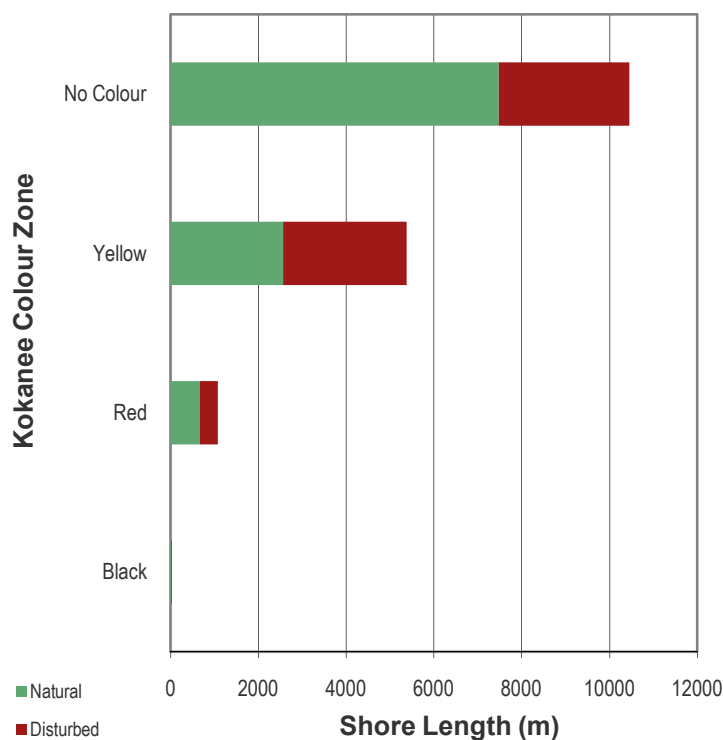


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
99.0%	1.0%	62.2%	37.8%	47.6%	52.4%	71.6%	28.4%
12	0	672	408	2561	2818	7479	2967

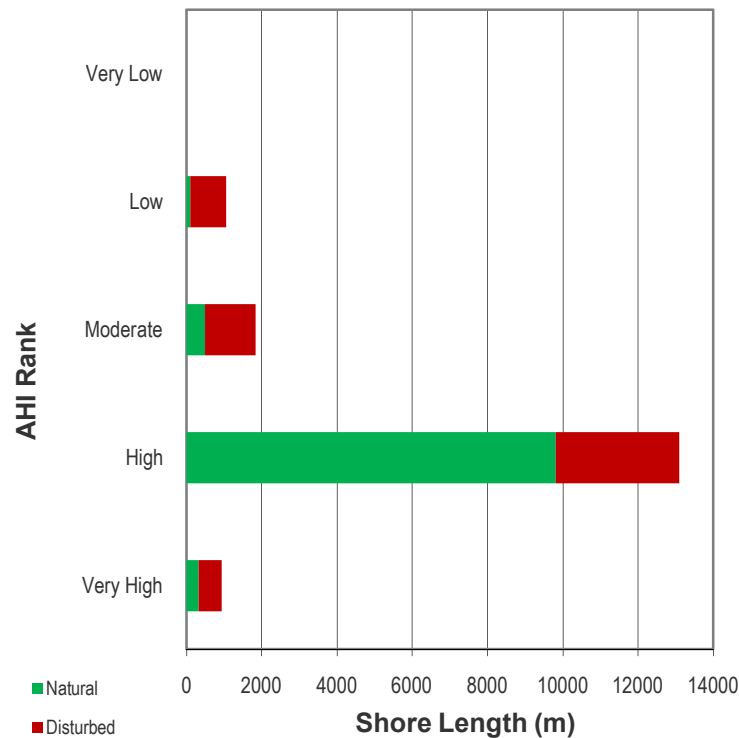


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	320.6796624	34.5%	608.3257707	65.5%
High	9803.772847	74.9%	3288.579931	25.1%
Moderate	493.2215971	26.8%	1347.537411	73.2%
Low	105.3911551	10.0%	948.5203957	90.0%
Very Low	0	0	0	0

APPENDIX G

RDOS Electoral Areas F Results

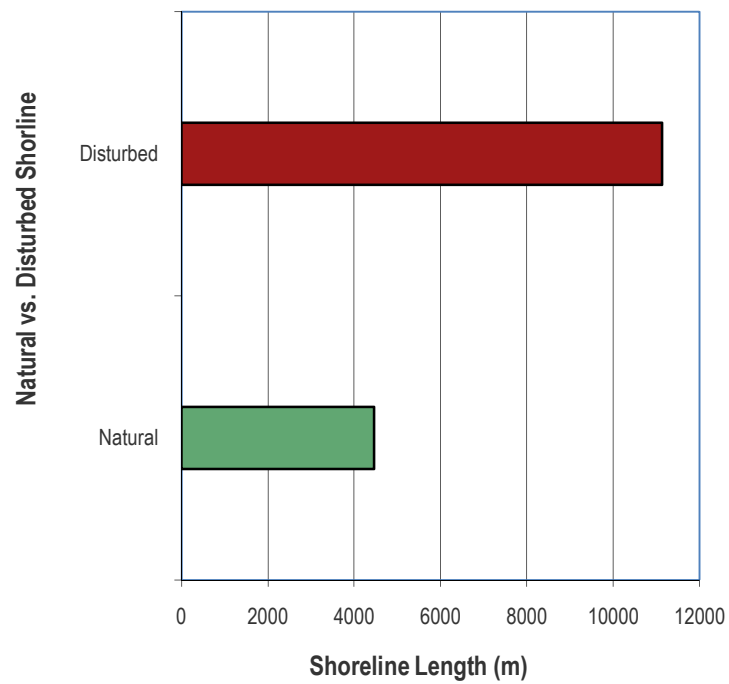


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	28.61%	4460
Disturbed	71.39%	11128
Total		15587.8

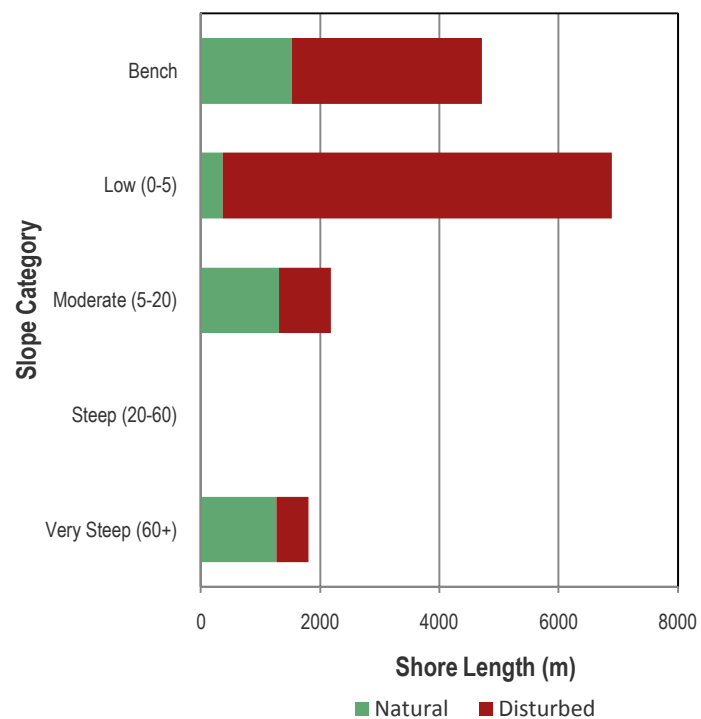


Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	11.6	1806	1264	542	70.0	30.0
Steep (20-60)	0.0	0	0	0	0	0
Moderate (5-20)	14.0	2178	1307	871	60.0	40.0
Low (0-5)	44.2	6891	364	6527	5.3	94.7
Bench	30.2	4713	1525	3188	32.4	67.6
Total	100.0	15588	4460	11128	28.6	71.4

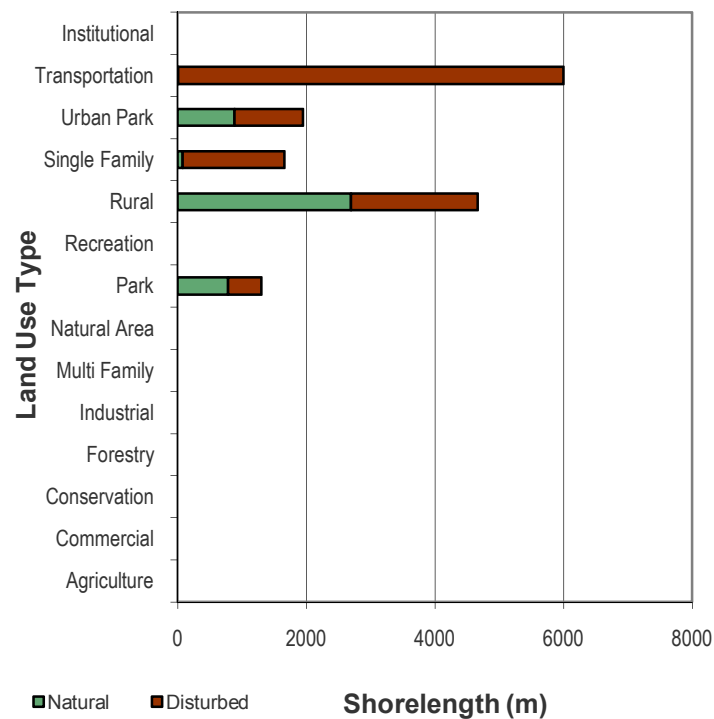


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	8.4%	1307	784	523	60.0%	40.0%
Recreation	0.0%	0	0	0	0	0
Rural	30.0%	4670	2696	1974	57.7%	42.3%
Single Family	10.7%	1663	83	1580	5.0%	95.0%
Urban Park	12.5%	1952	887	1065	45.4%	54.6%
Transportation	38.5%	5995	9	5986	0.2%	99.8%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	15587.8				

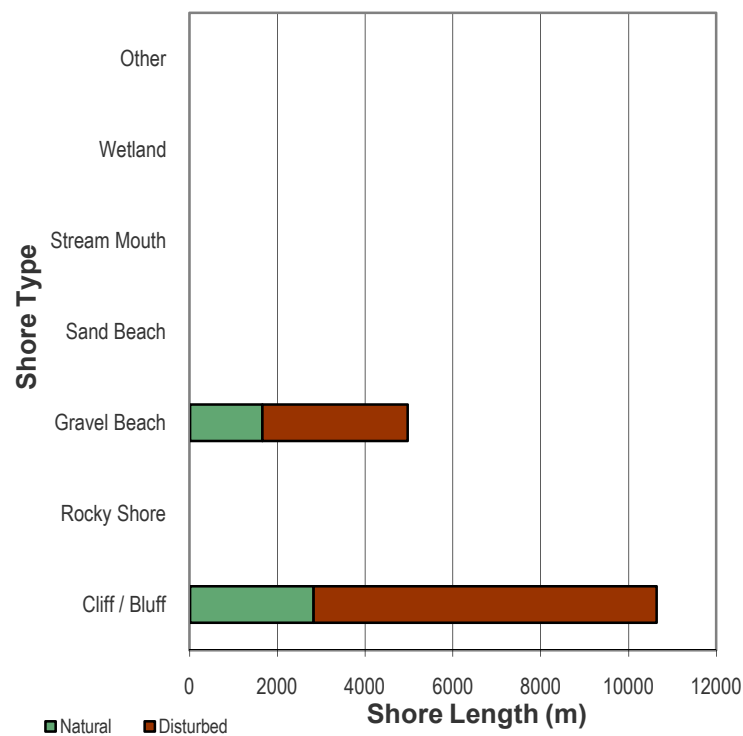


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	68.2%	10630	2815	7815.5	26.5%	73.5%
Rocky Shore	0.0%	0	0	0.0	0	0
Gravel Beach	31.8%	4958	1646	3312.2	33.2%	66.8%
Sand Beach	0.0%	0	0	0.0	0	0
Stream Mouth	0.0%	0	0	0.0	0	0
Wetland	0.0%	0	0	0.0	0	0
Other	0.0%	0	0	0.0	0	0
Total	100.00%	15588				

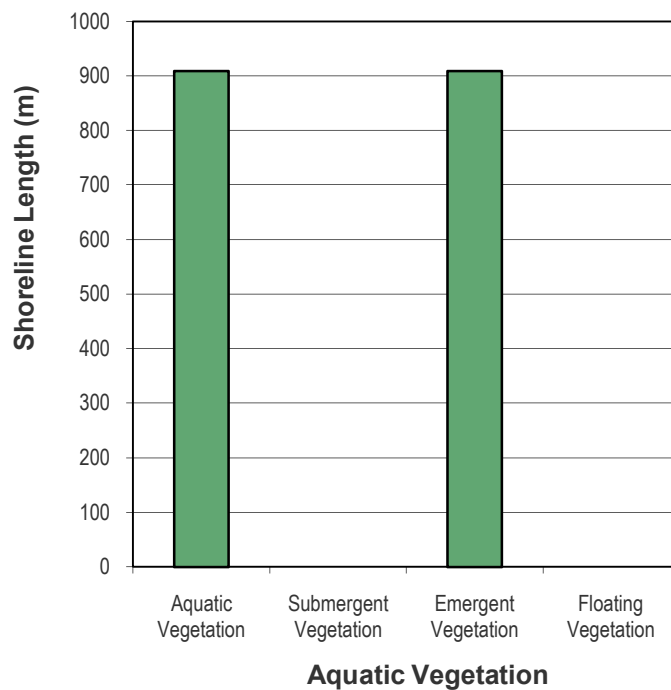


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	5.8%	908
Submergent Vegetation	0.0%	0
Emergent Vegetation	5.8%	908
Floating Vegetation	0.0%	0

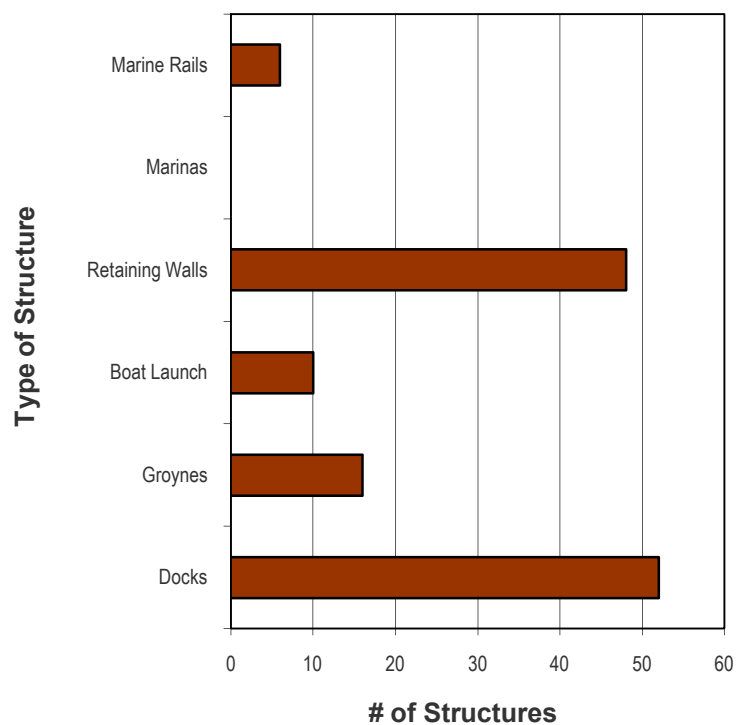
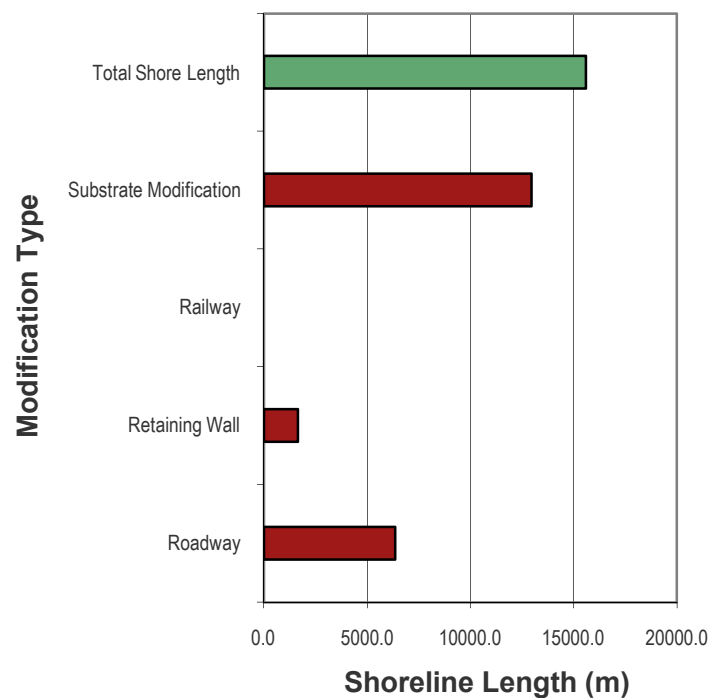


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	52	3.34
Groynes	16	1.03
Boat Launch	10	0.64
Retaining Walls	48	3.08
Marinas	0	0.00
Marine Rails	6	0.38



. **Figure 7:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	41%	6356.4
Retaining Wall	11%	1661.6
Railway	0%	0.0
Substrate Modification	83%	12970.7
Total Shore Length		15587.8

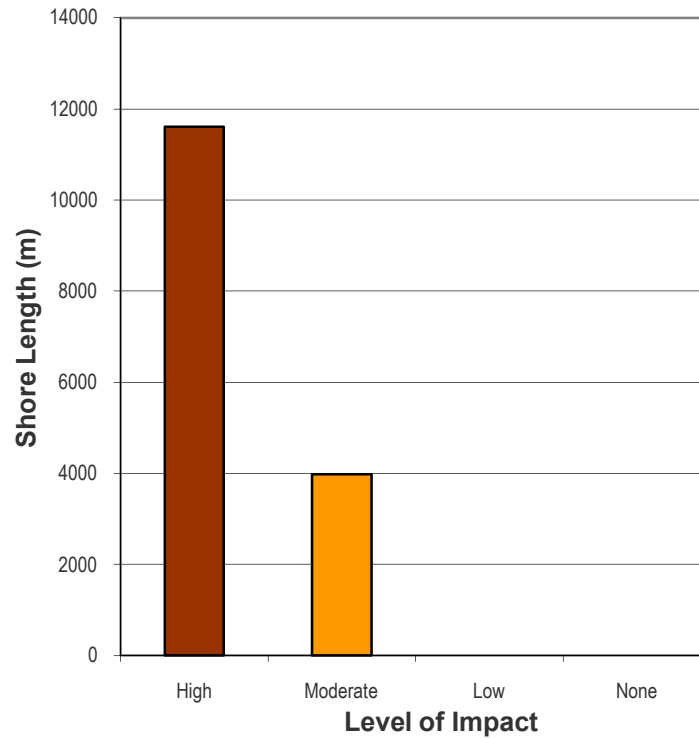


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	74.44%	11604
Moderate	25.56%	3984
Low	0.00%	0
None	0.00%	0
Shore Length		15587.8

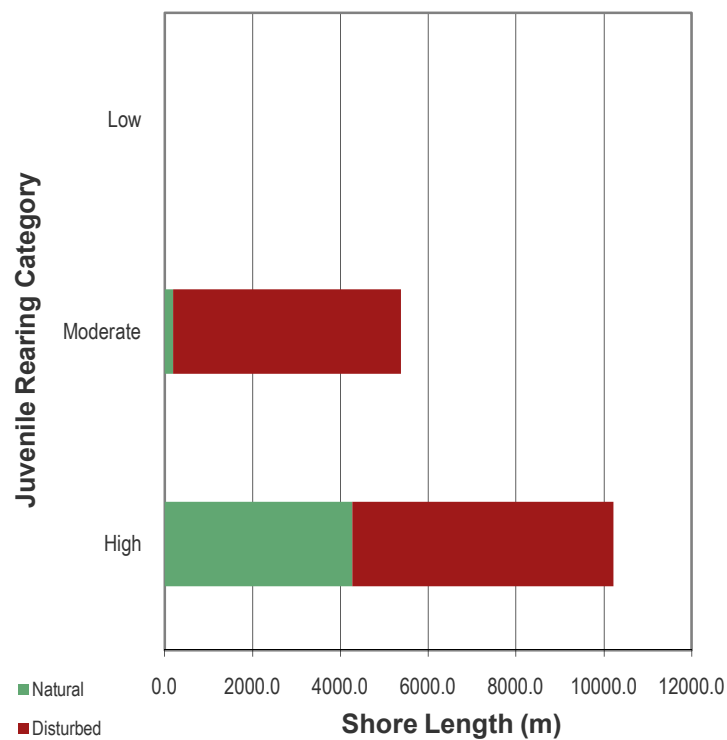


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	6	4267.8	41.8%	5944.0	58.2%	10212.2
Moderate	5	192.2	3.6%	5183.7	96.4%	5376.0
Low	0	0.0	0	0.0	0	0
						0

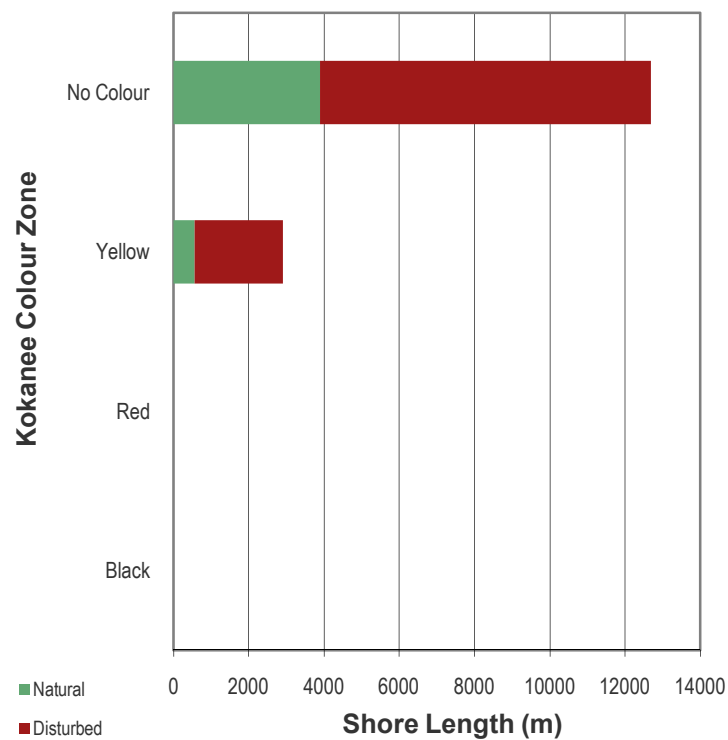


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	0	0	19.5%	80.5%	30.7%	69.3%
0	0	0	0	567	2344	3893	8784

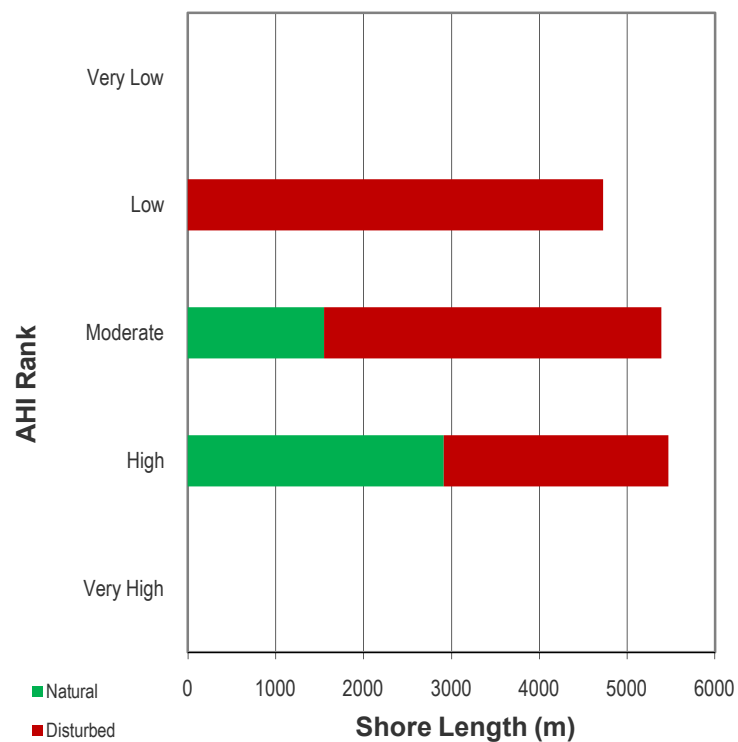


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	0	0	0	0
High	2911.269687	53.2%	2561.662495	46.8%
Moderate	1548.816961	28.7%	3840.412169	71.3%
Low	0	0.0%	4725.590691	100.0%
Very Low	0	0	0	0

APPENDIX H

City of Kelowna



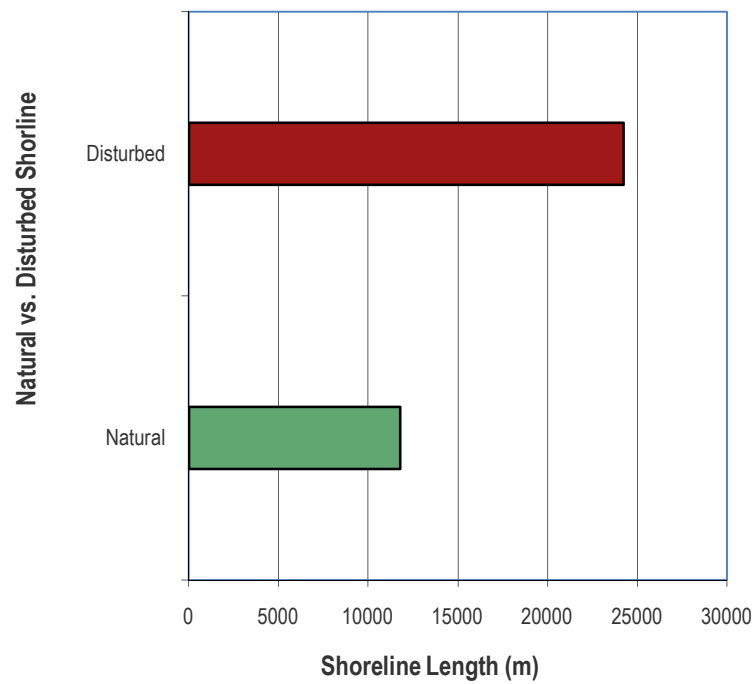


Figure 1: The percent of natural and disturbed shoreline.

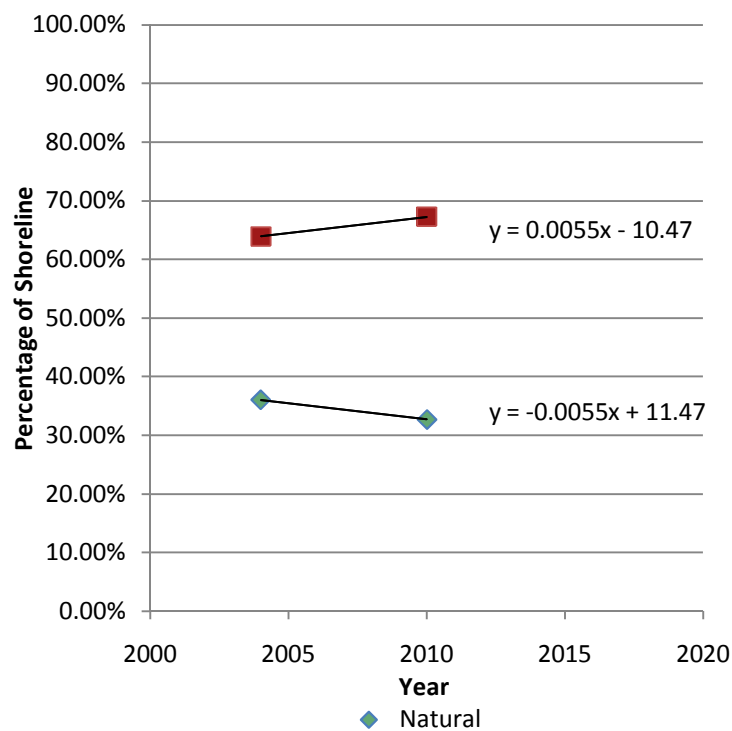


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	32.73%	11794	36.06%	12992.14
Disturbed	67.27%	24239	63.94%	23040.85
Total		36033.0		36033.0

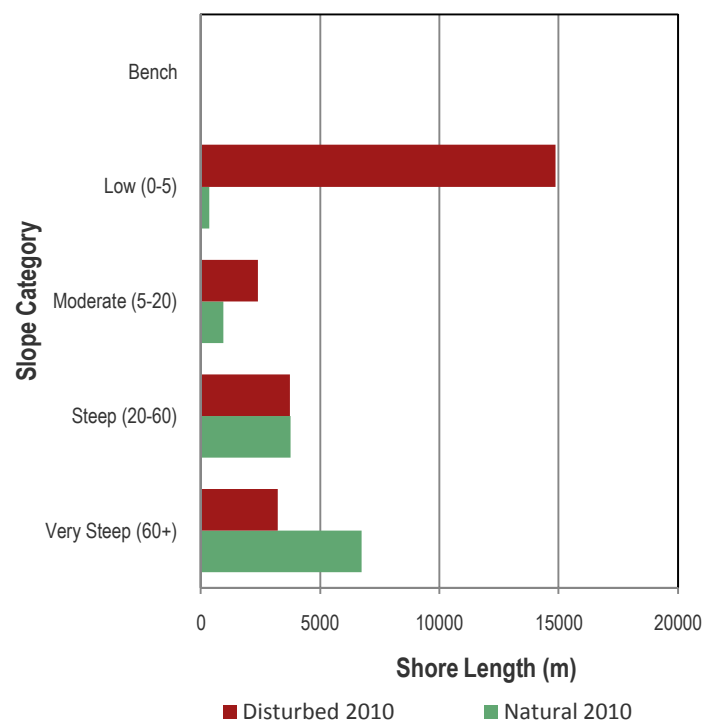


Figure 4: The length of natural and disturbed shorelines in each slope category.

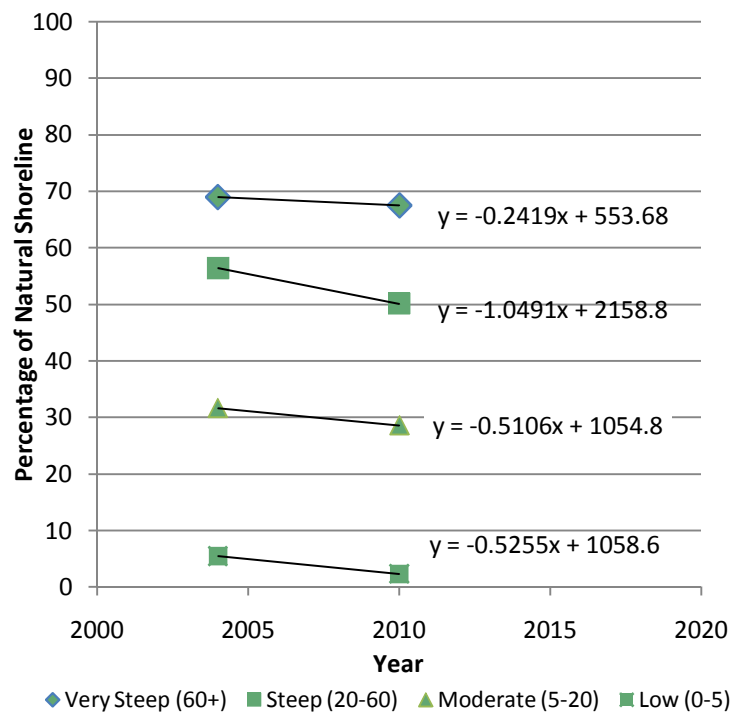


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	28	9974	6880	3095	69	31	Very Steep (60+)	27.7	9974	6735	3239	67.5	32.5
Steep (20-60)	21	7485	4222	3263	56	44	Steep (20-60)	20.8	7485	3751	3734	50.1	49.9
Moderate (5-20)	9	3340	1057	2283	32	68	Moderate (5-20)	9.3	3340	955	2386	28.6	71.4
Low (0-5)	42	15234	833	14400	5	95	Low (0-5)	42.3	15234	353	14881	2.3	97.7
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	36033	12992	23041	36.1	63.9	Total	100.0	36033	11794	24239	32.7	67.3



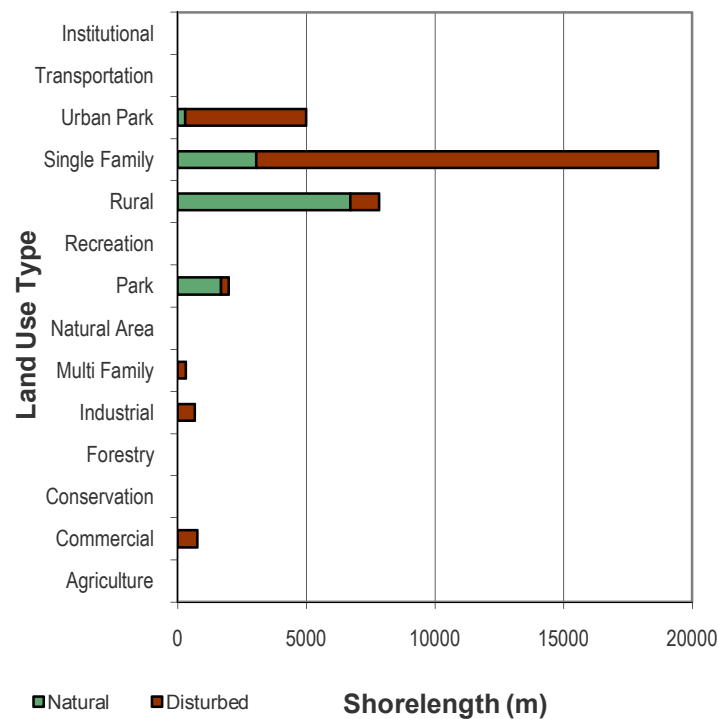


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	2.1%	761	0	761	0.0%	100.0%
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	1.9%	680	0	680	0.0%	100.0%
Multi Family	0.9%	333	0	333	0.0%	100.0%
Natural Area	0.0%	0	0	0	0	0
Park	5.5%	1990	1687	303	84.8%	15.2%
Recreation	0.0%	0	0	0	0	0
Rural	21.7%	7830	6714	1116	85.8%	14.2%
Single Family	51.9%	18692	3067	15625	16.4%	83.6%
Urban Park	13.9%	5008	301	4707	6.0%	94.0%
Transportation	2.1%	739	0	739	0.0%	100.0%
Institutional	0.0%	0	0	0	0	0

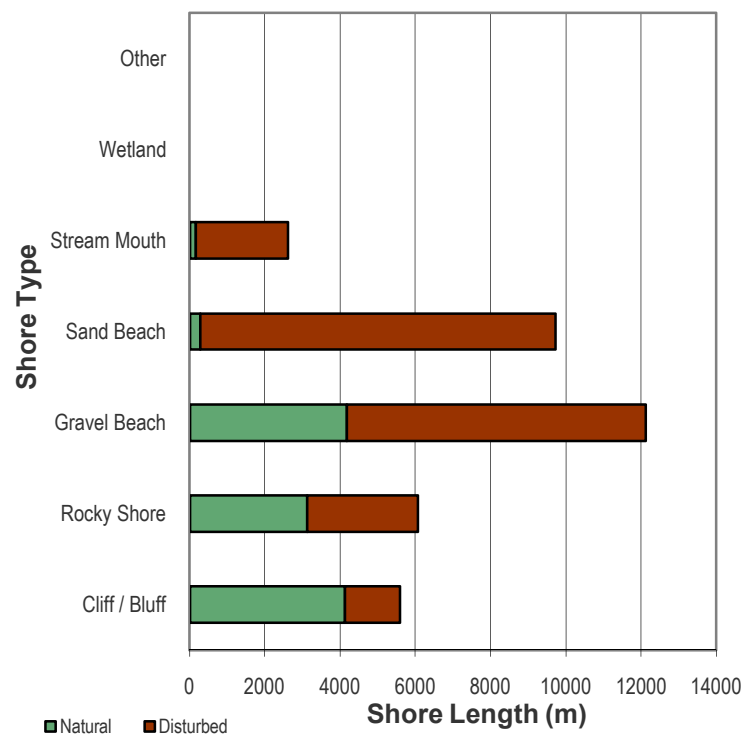


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	15.5%	5579	4106	1473.0	73.6%	26.4%
Rocky Shore	16.8%	6056	3118	2938.2	51.5%	48.5%
Gravel Beach	33.6%	12102	4163	7938.1	34.4%	65.6%
Sand Beach	26.9%	9706	268	9437.9	2.8%	97.2%
Stream Mouth	7.2%	2604	151	2452.8	5.8%	94.2%
Wetland	0.0%	0	0	0.0	0	0
Other	0.0%	0	0	0.0	0	0
Total	100.00%	36047				

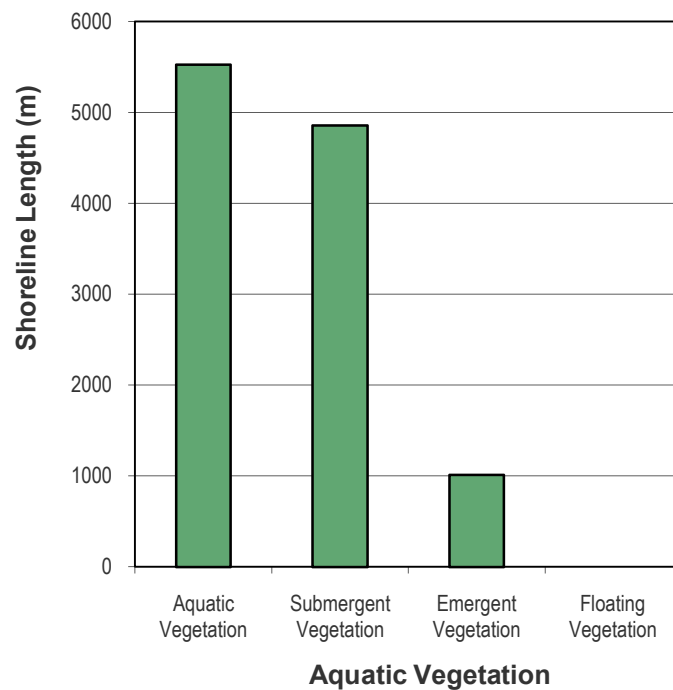


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	15.3%	5521
Submergent Vegetation	13.5%	4854
Emergent Vegetation	2.8%	1012
Floating Vegetation	0.0%	0

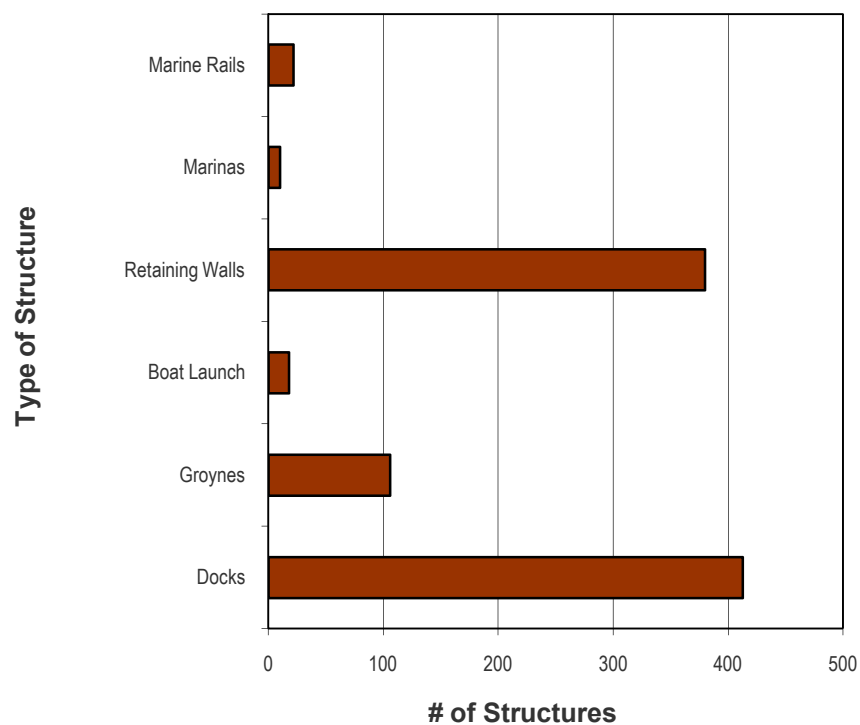


Figure 9: The total number of different types of modifications on Okanagan Lake

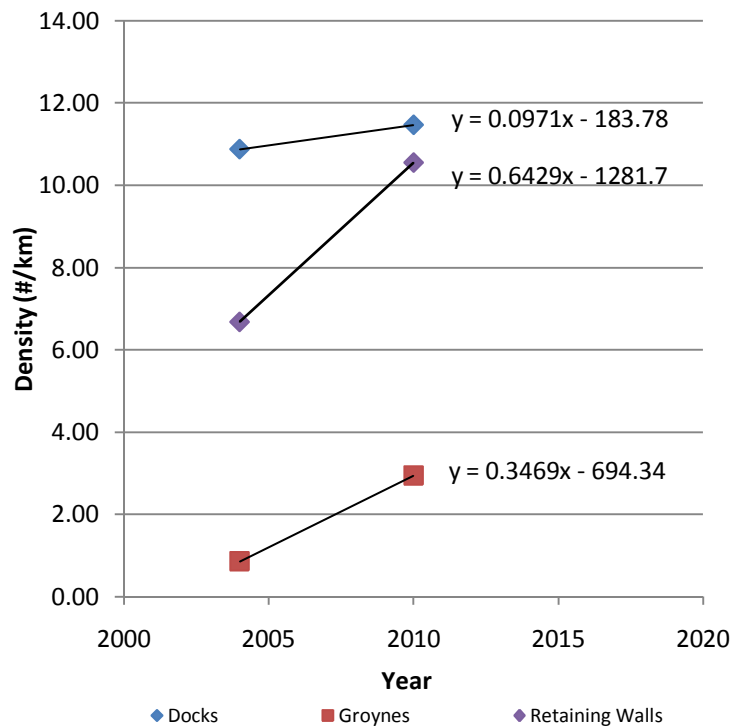


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

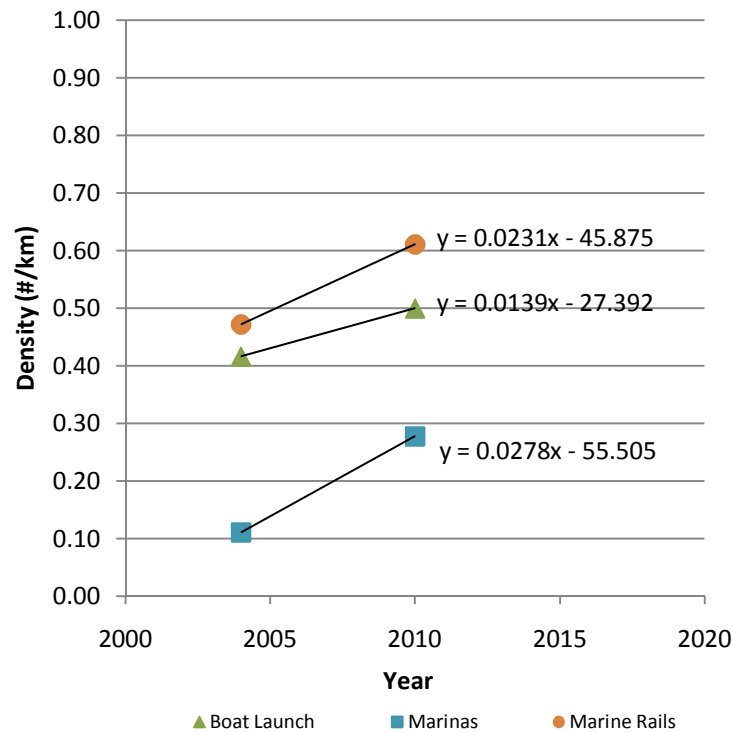
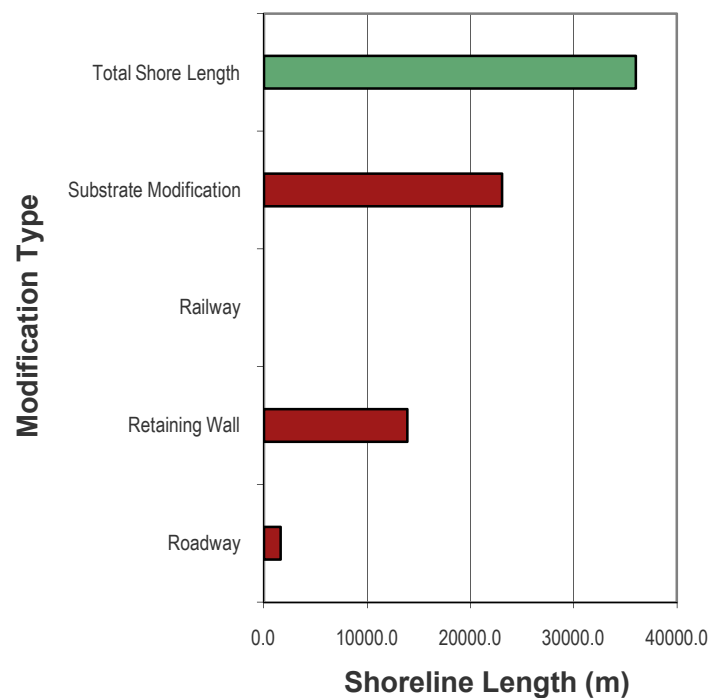


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

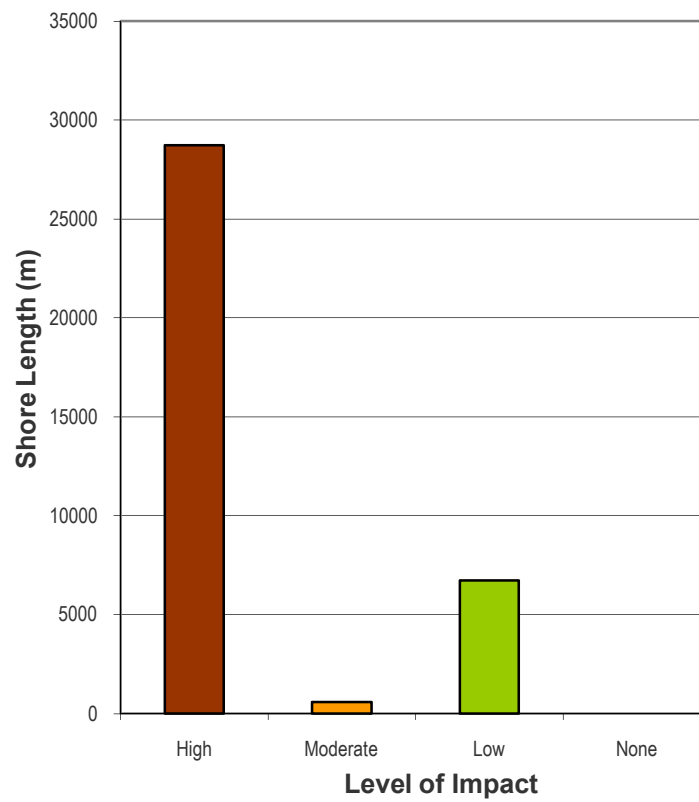
2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	392	10.88	Docks	413	11.46
Groynes	31	0.86	Groynes	106	2.94
Boat Launch	15	0.42	Boat Launch	18	0.50
Retaining Walls	241	6.69	Retaining Walls	380	10.55
Marinas	4	0.11	Marinas	10	0.28
Marine Rails	17	0.47	Marine Rails	22	0.61



. **Figure 12:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	5%	1634.4
Retaining Wall	39%	13903.4
Railway	0%	0.0
Substrate Modification	64%	23049.8
Total Shore Length		36033.0



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

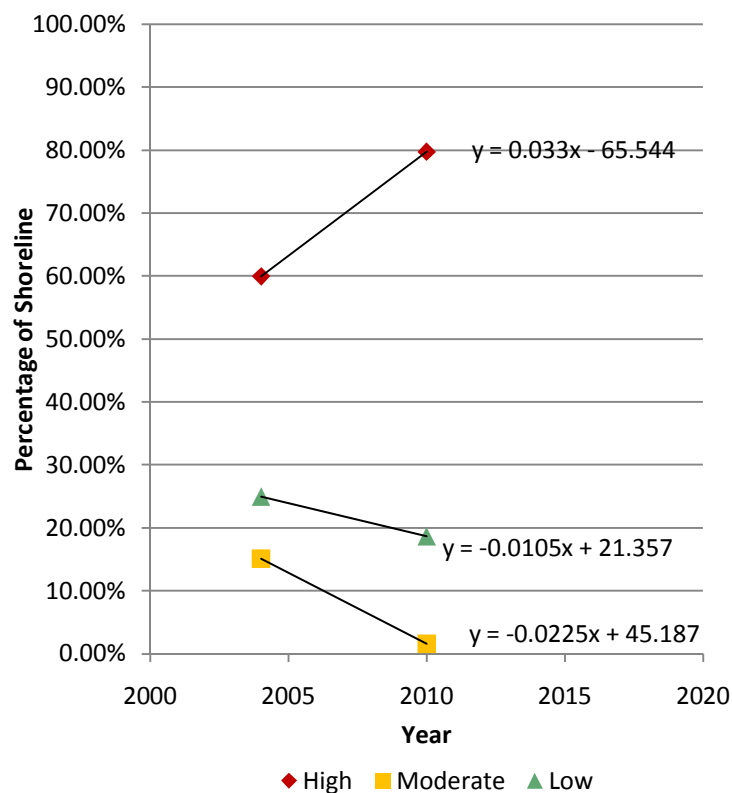


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	59.97%	21607	High	79.77%	28743
Moderate	15.07%	5431	Moderate	1.59%	572
Low	24.96%	8995	Low	18.64%	6718
None	0.00%	0	None	0.00%	
				Shore Length	36033.0

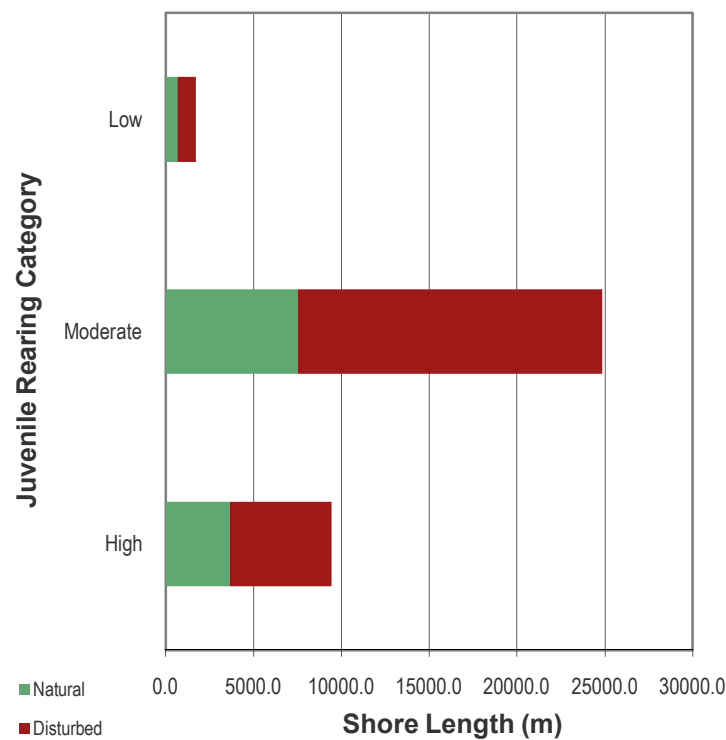


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

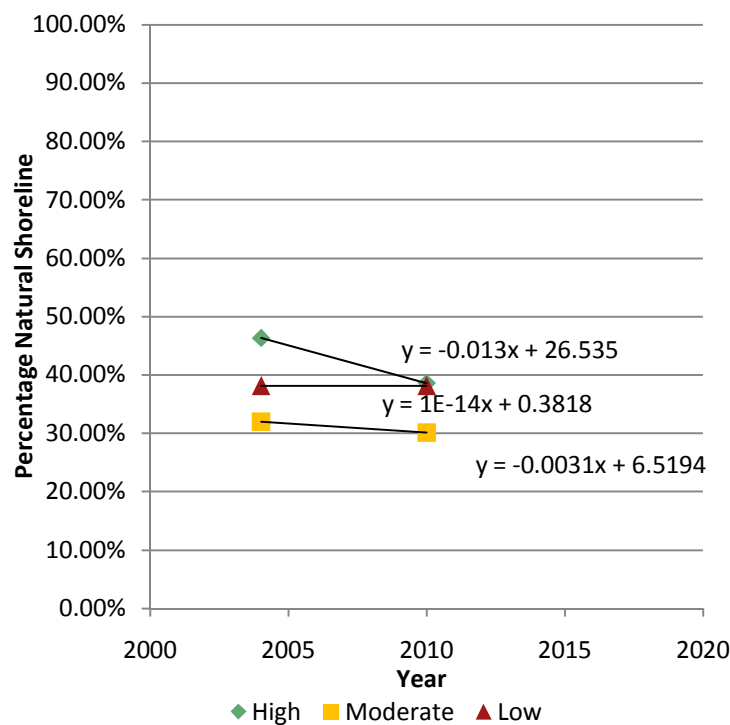


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High Moderate	16	4377.4	46.36%	5065.07	53.64%	9443.0	High Moderate	16	3640.4	38.6%	5802.1	61.4%	9442.9
	40	7954.7	32.00%	16907	68.00%	24862.0		40	7493.2	30.1%	17368.4	69.9%	24862.0
Low	3	660.0	38.18%	1068.8	61.82%	1729.2	Low	3	660.0	38.2%	1068.8	61.8%	1729.2
													36034.1

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
73.05%	26.95%	52.31%	47.69%	15.21%	84.79%	14.72%	85.28%	70.5%	29.5%	50.0%	50.0%	12.4%	87.6%	10.5%	89.5%
6817.99	2515.44	3096.27	2822.66	611.874	3410.72	2466.01	14292	6583	2750	2960	2959	499	3524	1752	15006



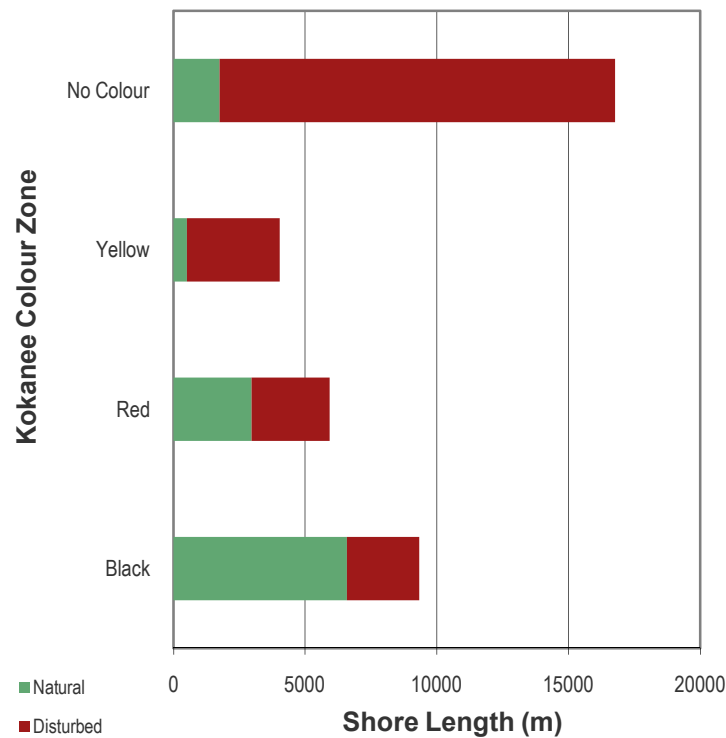


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

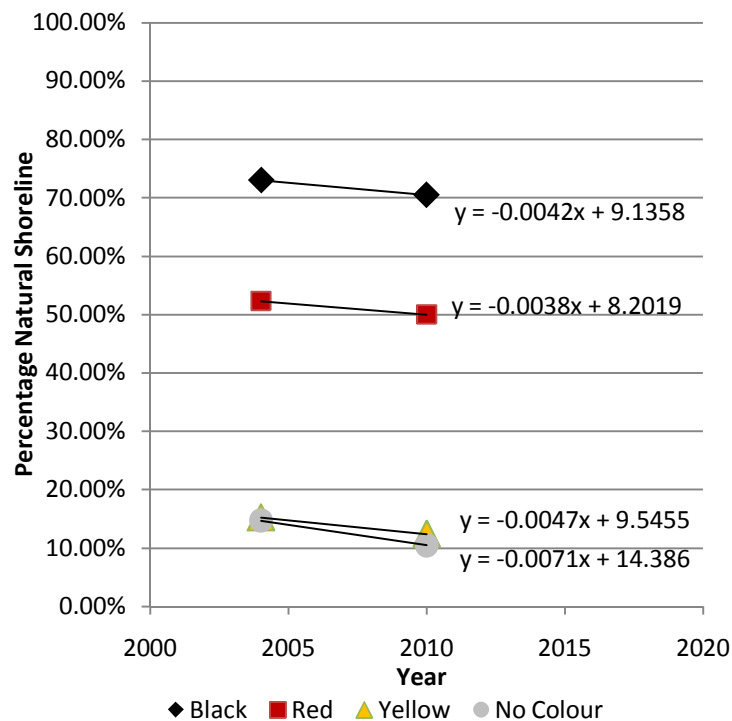


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

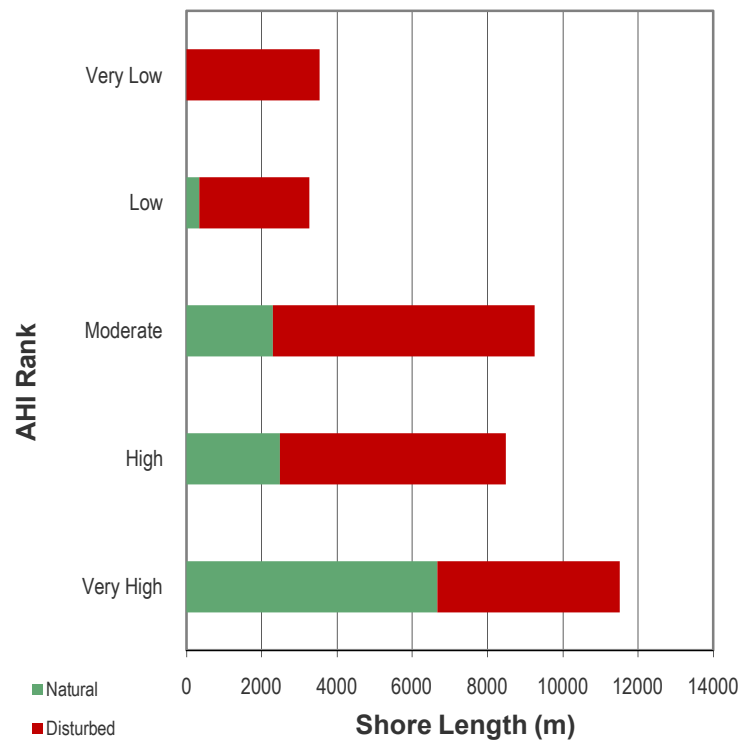


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

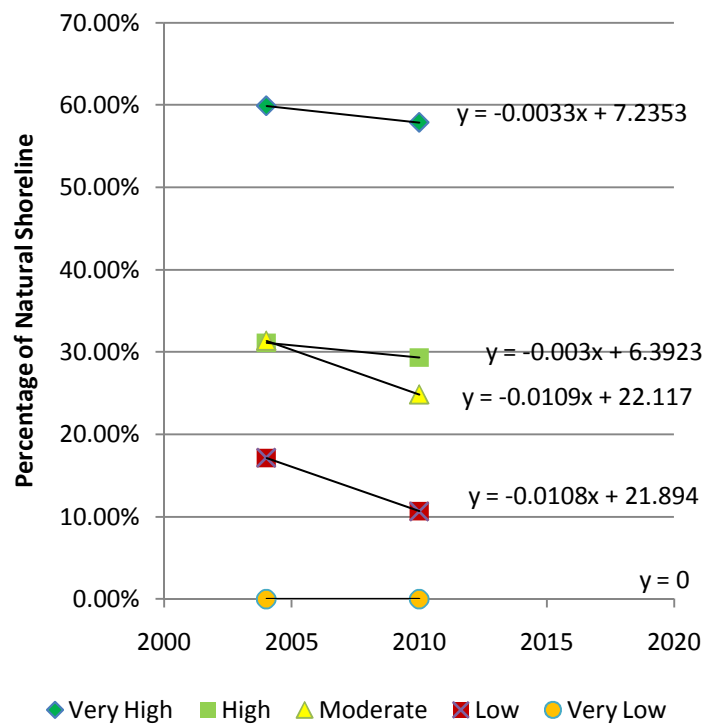


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	6889.05	59.88%	4616.19	40.12%	Very High	6660.44	57.9%	4844.80	42.1%
High	2643.64	31.13%	5847.58	68.87%	High	2489.05	29.3%	6002.18	70.7%
Moderate	2900.51	31.38%	6343.46	68.62%	Moderate	2297.07	24.8%	6946.91	75.2%
Low	558.928	17.16%	2698.94	82.84%	Low	347.048	10.7%	2910.82	89.3%
Very Low	0	0.00%	3534.65	100.00%	Very Low	0	0.0%	3534.65	100.0%

APPENDIX I

District of Lake Country Results



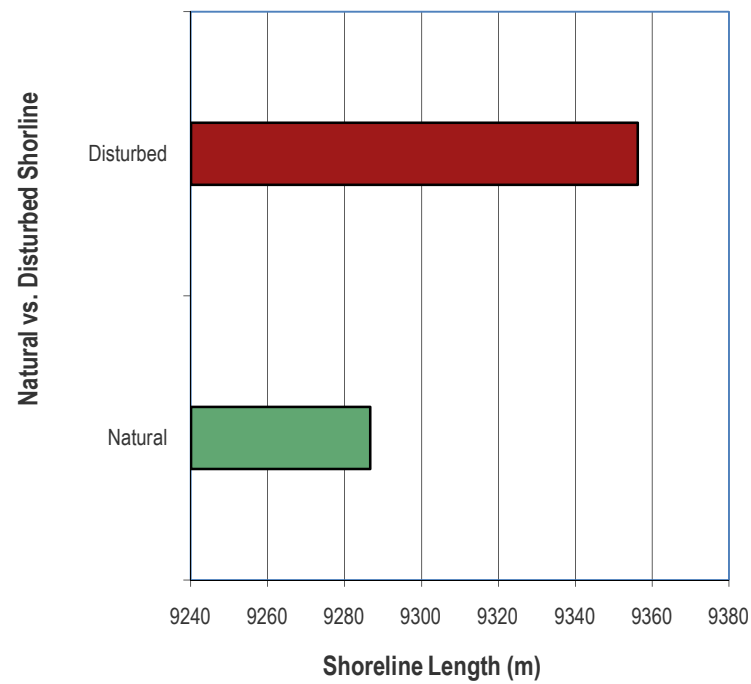


Figure 1: The percent of natural and disturbed shoreline.

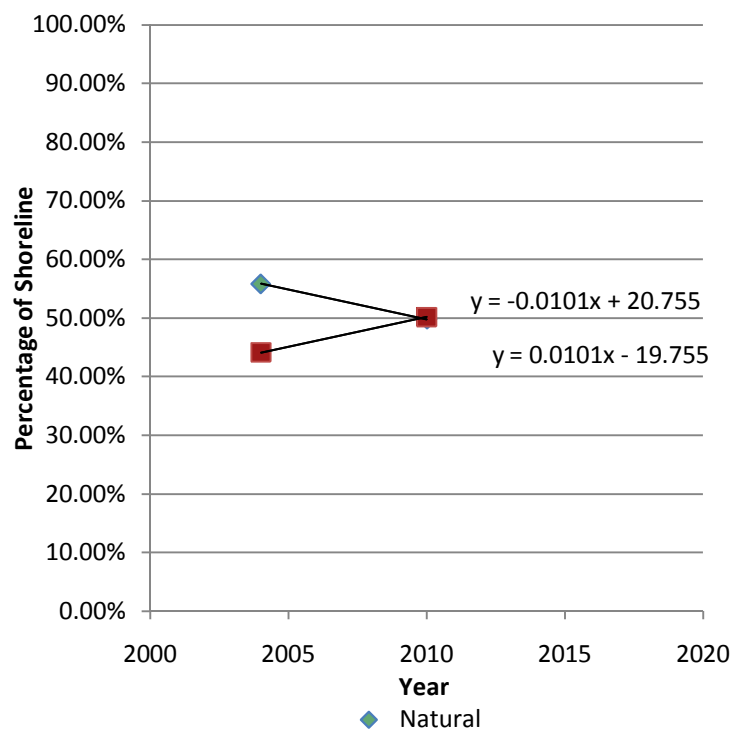


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	49.81%	9287	55.86%	10414.00
Disturbed	50.19%	9356	44.14%	8228.87
Total		18642.9		18642.9

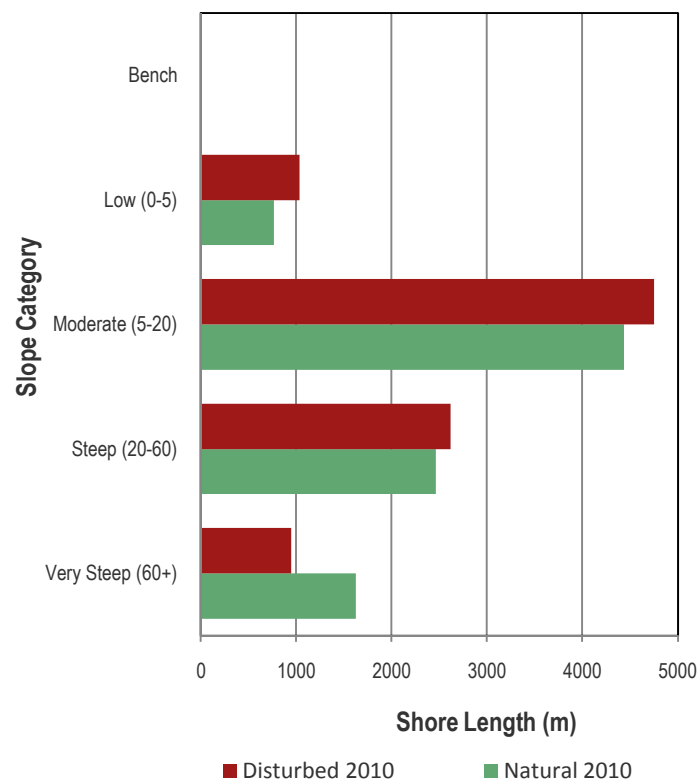


Figure 4: The length of natural and disturbed shorelines in each slope category.

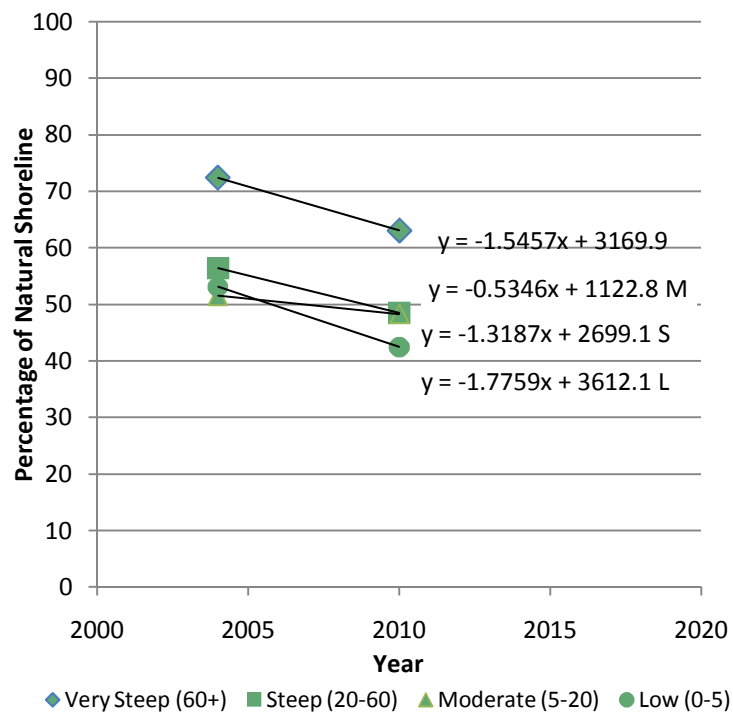


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	14	2572	1861	711	72	28	Very Steep (60+)	13.8	2572	1623	949	63.1	36.9
Steep (20-60)	27	5085	2867	2218	56	44	Steep (20-60)	27.3	5085	2464	2620	48.5	51.5
Moderate (5-20)	49	9186	4730	4456	51	49	Moderate (5-20)	49.3	9186	4436	4751	48.3	51.7
Low (0-5)	10	1800	956	844	53	47	Low (0-5)	9.7	1800	764	1036	42.4	57.6
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	18643	10414	8229	55.9	44.1	Total	100.0	18643	9287	9356	49.8	50.2



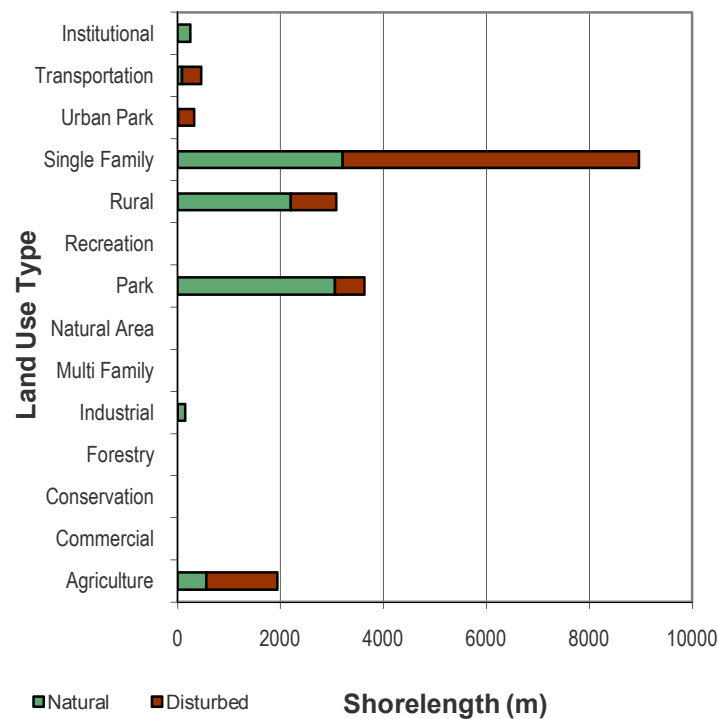


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	10.4%	1939	556	1383	28.7%	71.3%
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	0.0%	0	151	-151	0	0
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0	0
Park	19.5%	3630	3063	567	84.4%	15.6%
Recreation	0.0%	0	0	0	0	0
Rural	16.5%	3083	2206	877	71.6%	28.4%
Single Family	48.1%	8962	3212	5750	35.8%	64.2%
Urban Park	1.7%	317	6	311	1.9%	98.1%
Transportation	2.5%	459	92	367	20.0%	80.0%
Institutional	1.4%	252	252	0	100.0%	0.0%
Total	100.0%	18642.9				

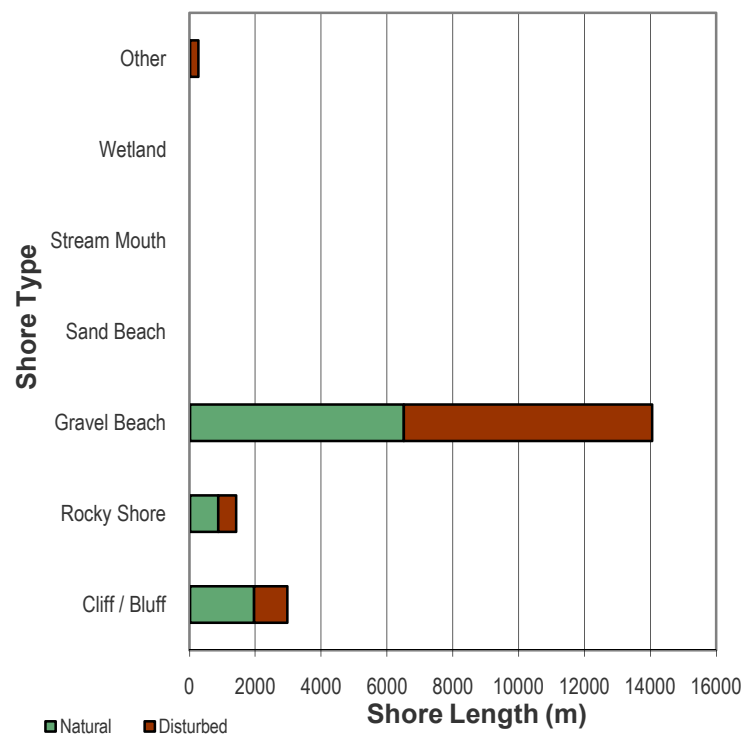


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	15.9%	2960	1936	1024.1	65.4%	34.6%
Rocky Shore	7.5%	1394	862	532.5	61.8%	38.2%
Gravel Beach	75.3%	14033	6489	7543.8	46.2%	53.8%
Sand Beach	0.0%	0	0	0.0	0	0
Stream Mouth	0.0%	0	0	0.0	0	0
Wetland	0.0%	0	0	0.0	0	0
Other	1.4%	256	0	255.7	0.0%	100.0%
Total	100.00%	18643				

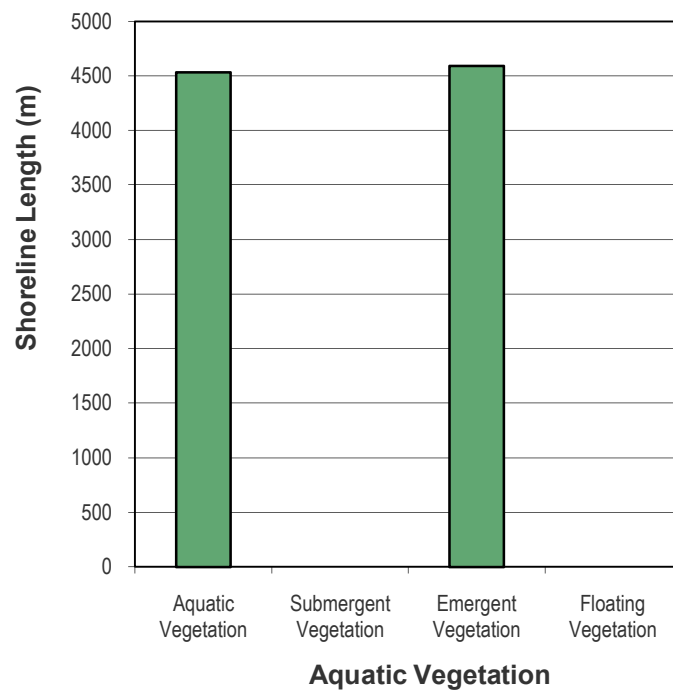


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	7.0%	261
Submergent Vegetation	0.0%	0
Emergent Vegetation	7.0%	261
Floating Vegetation	0.0%	0

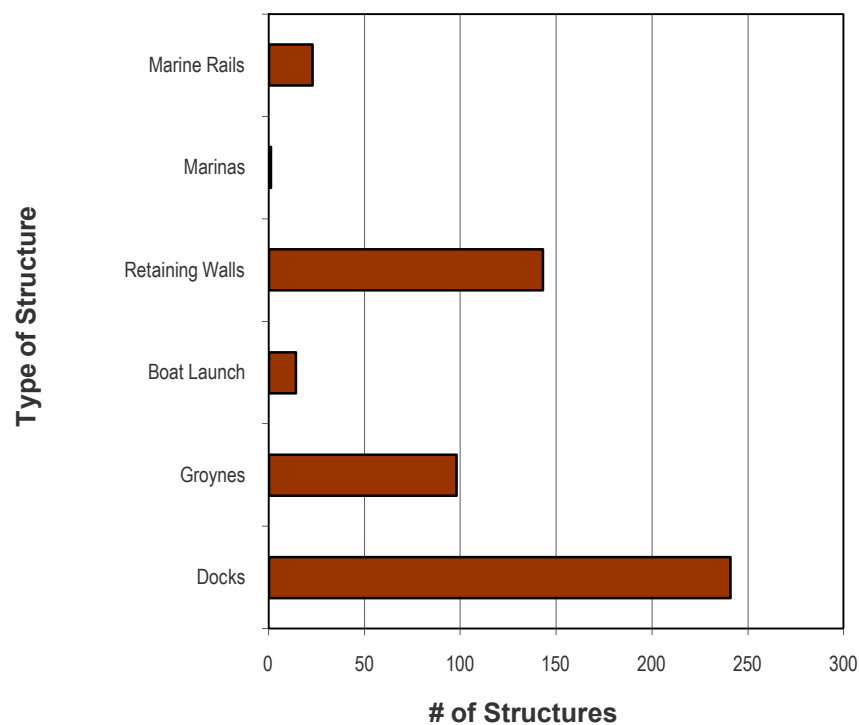


Figure 9: The total number of different types of modifications on Okanagan Lake

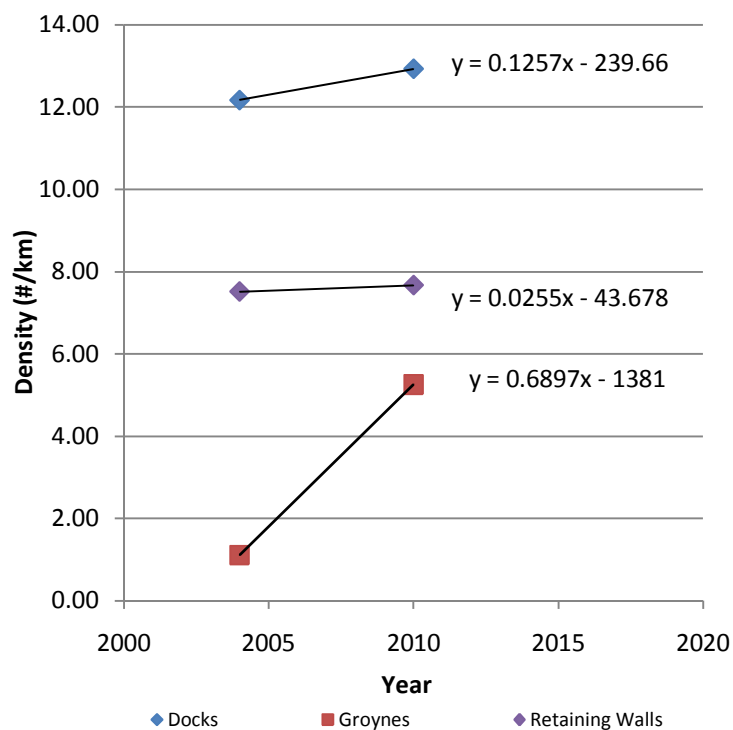


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

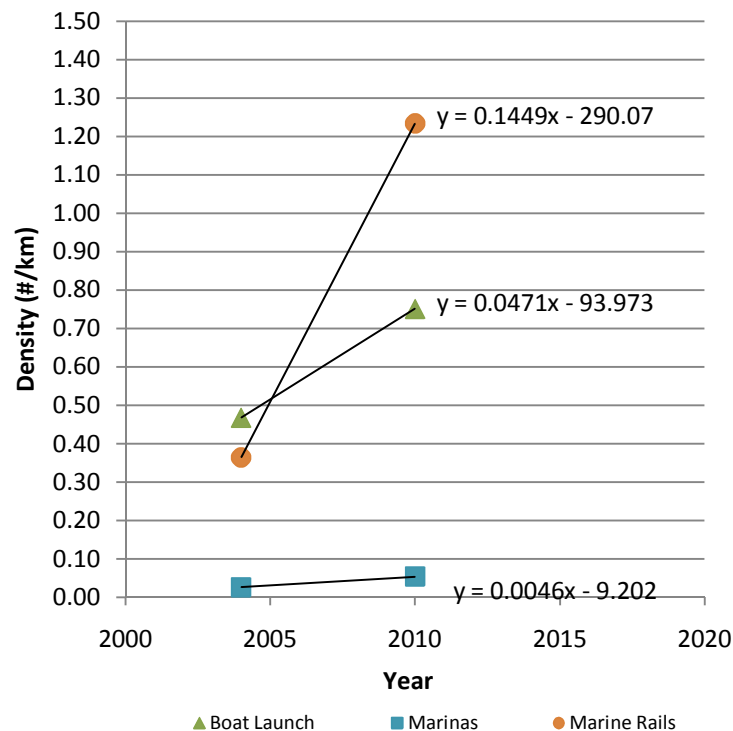
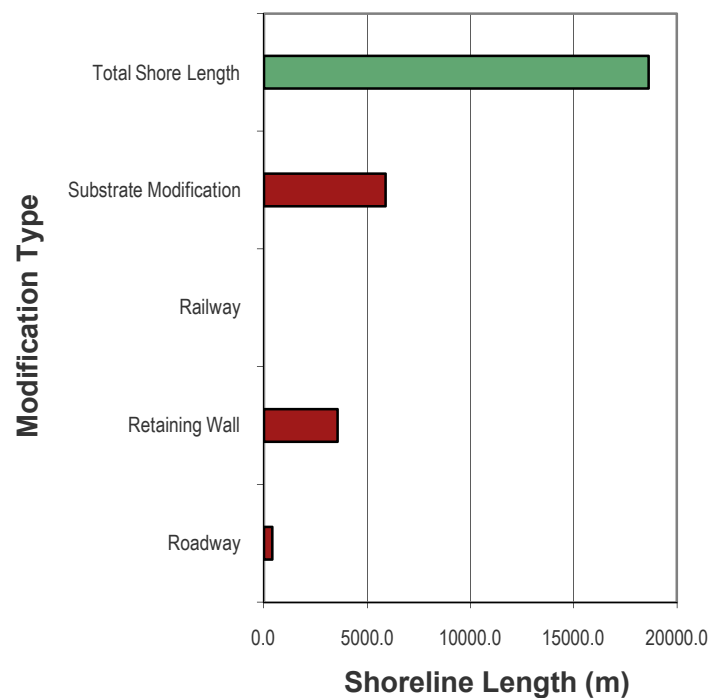


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

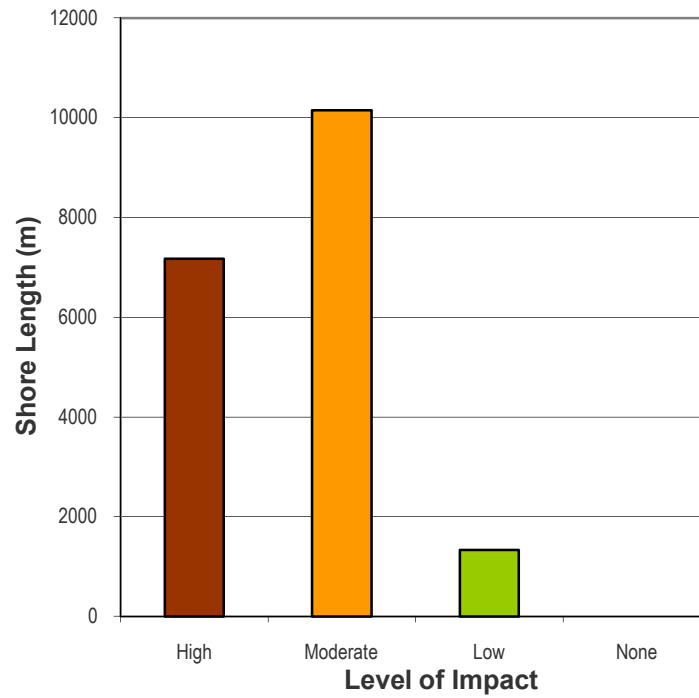
2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	468	12.17	Docks	241	12.93
Groynes	43	1.12	Groynes	98	5.26
Boat Launch	18	0.47	Boat Launch	14	0.75
Retaining Walls	289	7.52	Retaining Walls	143	7.67
Marinas	1	0.03	Marinas	1	0.05
Marine Rails	14	0.36	Marine Rails	23	1.23



. **Figure 12:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	2%	401.9
Retaining Wall	19%	3568.8
Railway	0%	0.0
Substrate Modification	32%	5908.8
Total Shore Length		18642.9



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

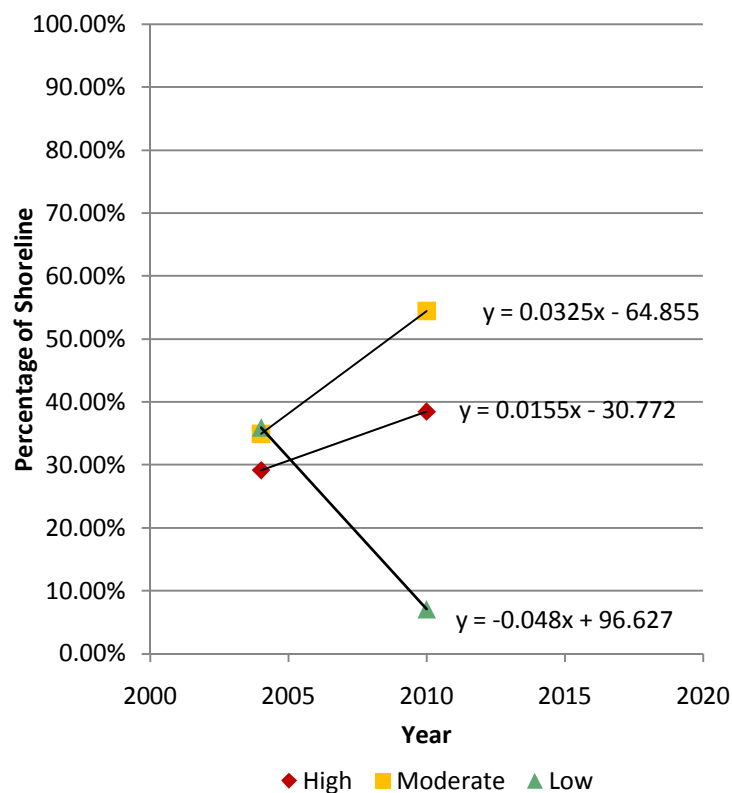


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	47.70%	18339	High	38.46%	7171
Moderate	22.75%	8746	Moderate	54.43%	10148
Low	29.55%	11361	Low	7.10%	1324
None	0.00%	0	None	0.00%	0
				Shore Length	18642.9

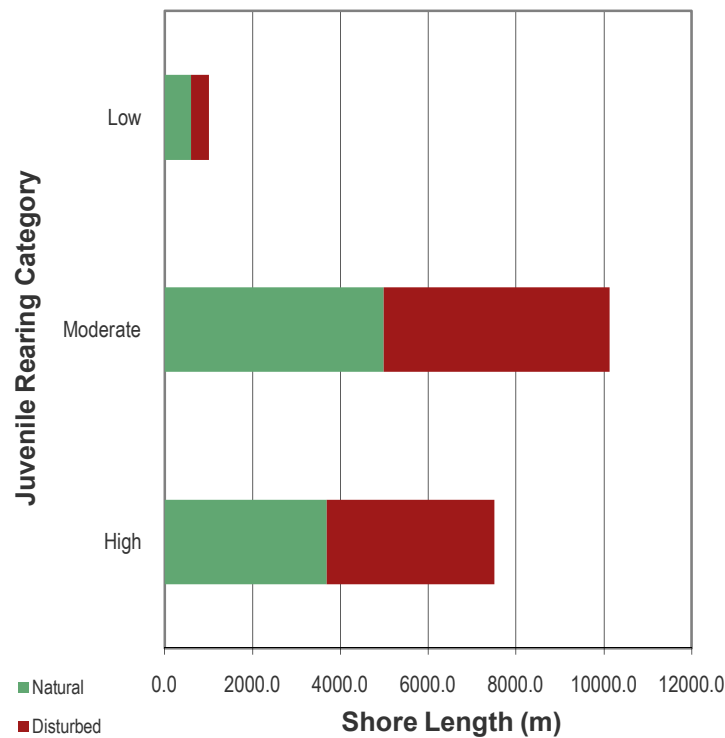


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

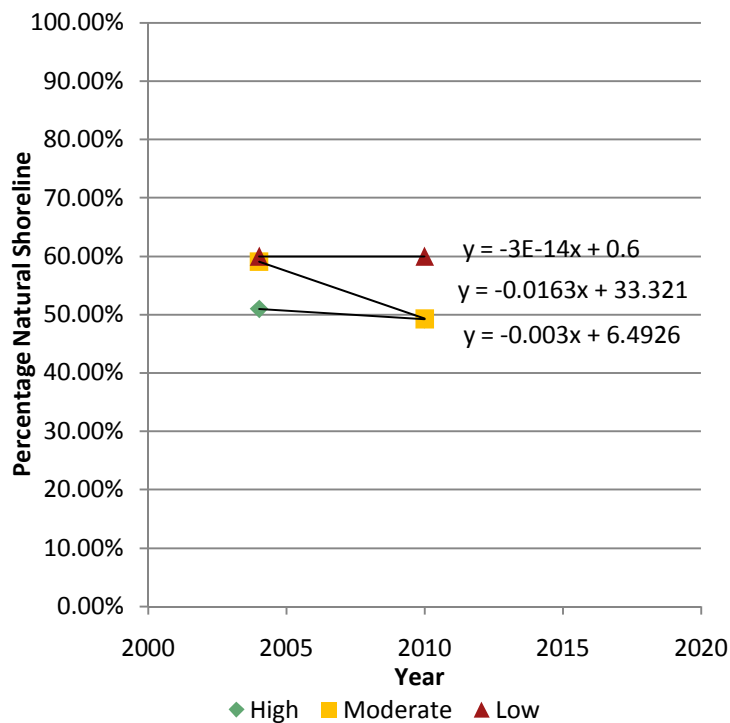


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High Moderate	16	3825.0	50.98%	3677.68	49.02%	7503.2	High Moderate	16	3690.6	49.2%	3812.1	50.8%	7503.2
	15	5984.1	59.06%	4147.96	40.94%	10132.7		15	4991.2	49.3%	5140.9	50.7%	10132.6
Low	1	604.9	60.00%	403.234	40.00%	1008.7	Low	1	604.9	60.0%	403.2	40.0%	1008.7
													18644.5

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
74.77%	25.23%	58.40%	41.60%	47.44%	52.56%	47.66%	52.34%	68.6%	31.4%	53.9%	46.1%	46.6%	53.4%	36.0%	64.0%
2021.68	682.318	4368.45	3111.67	1595.96	1768.05	2427.91	2666.84	1854	850	4032	3448	1568	1796	1833	3261



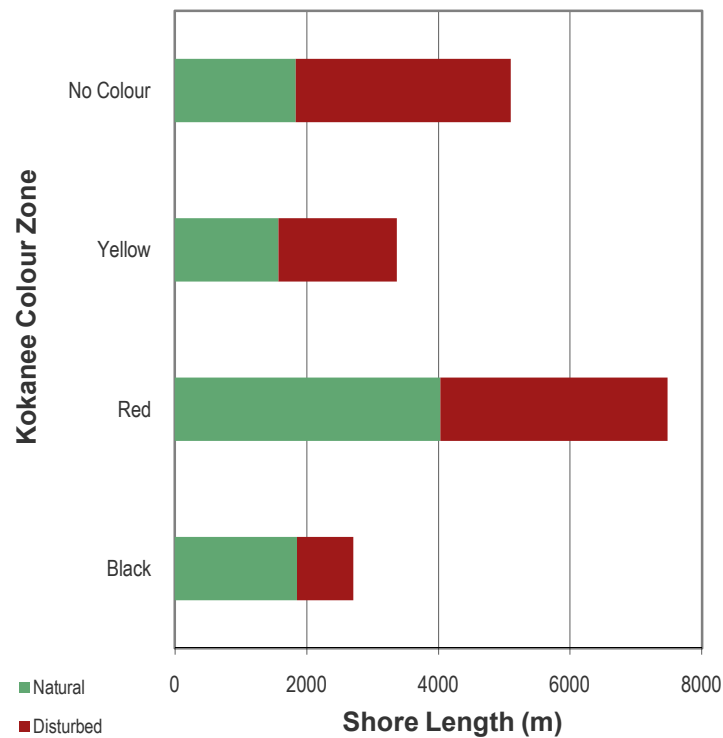


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

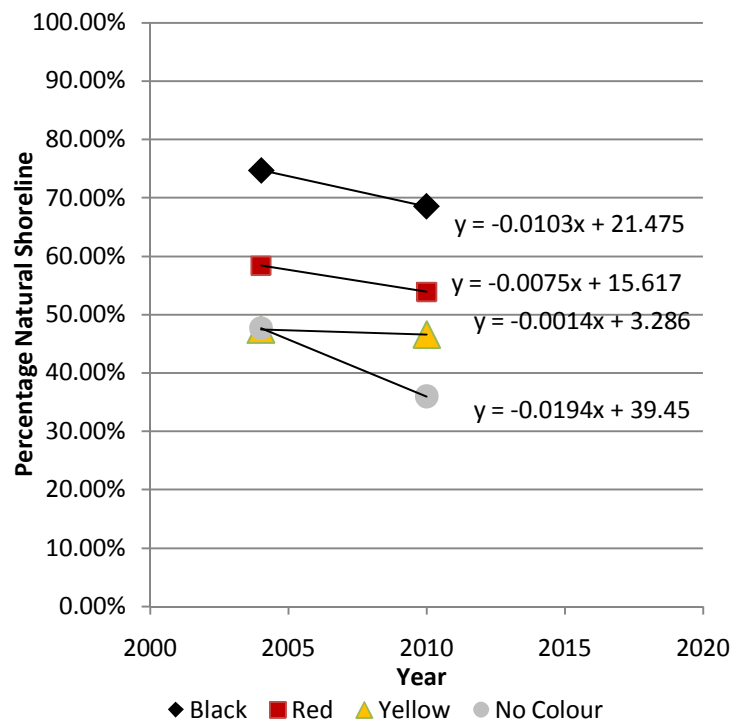


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

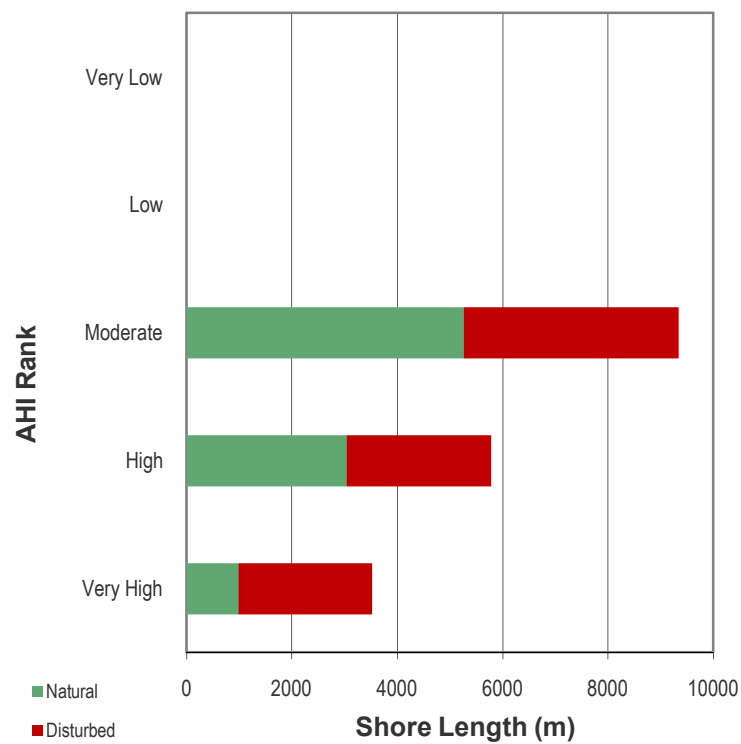


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

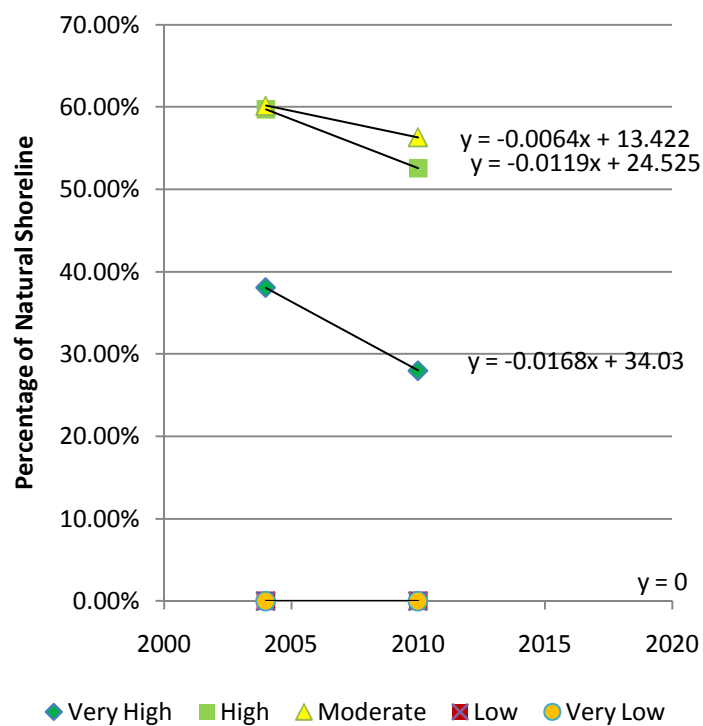


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	1339.42	38.07	2179.20	61.93	Very High	984.939		2533.69	
High	9	%	7	%	High	9	28.0%	6	72.0%
	3452.99	59.72	2328.87	40.28		3038.78		2743.08	
High	5	%	4	%	High	7	52.6%	2	47.4%
	5621.57	60.17	3720.79	39.83		5262.97		4079.39	
Moderate	5	%	2	%	Moderate	4	56.3%	2	43.7%
Low	0	0	0	0	Low	0	0	0	0
Very Low	0	0	0	0	Very Low	0	0	0	0



APPENDIX J

City of Vernon Results

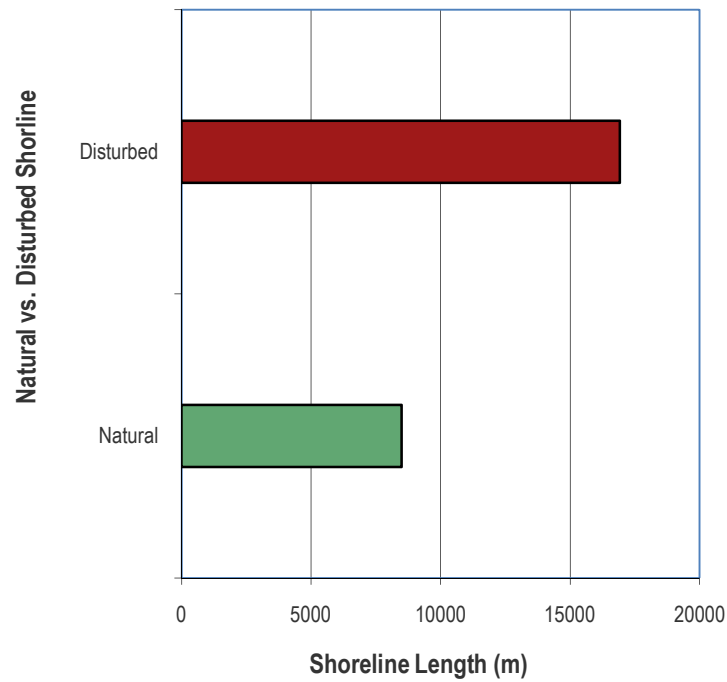


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	33.41%	8485
Disturbed	66.59%	16914
Total		25399.2

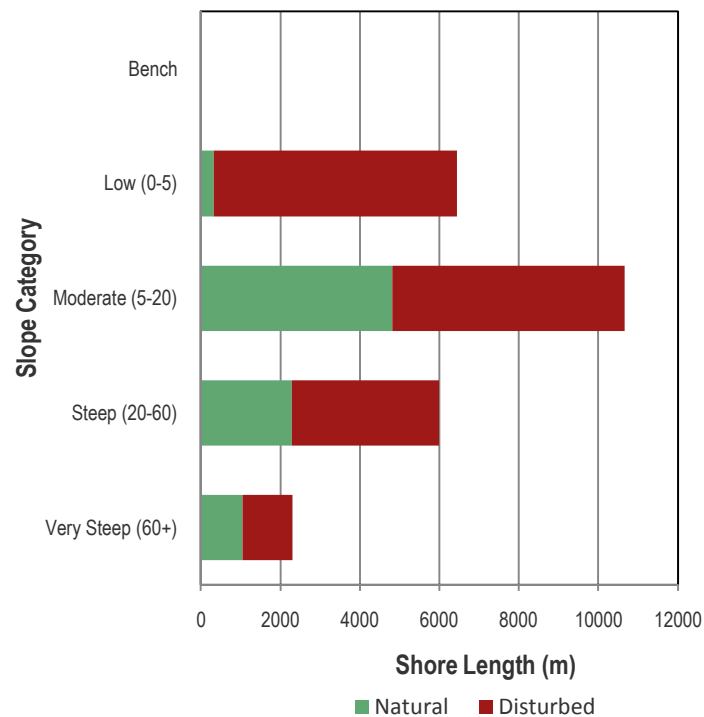


Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	9.1	2311	1053	1258	45.6	54.4
Steep (20-60)	23.6	5988	2294	3694	38.3	61.7
Moderate (5-20)	41.9	10654	4810	5844	45.1	54.9
Low (0-5)	25.4	6447	329	6118	5.1	94.9
Bench	0.0	0	0	0	0	0
Total	100.0	25399	8485	16914	33.4	66.6

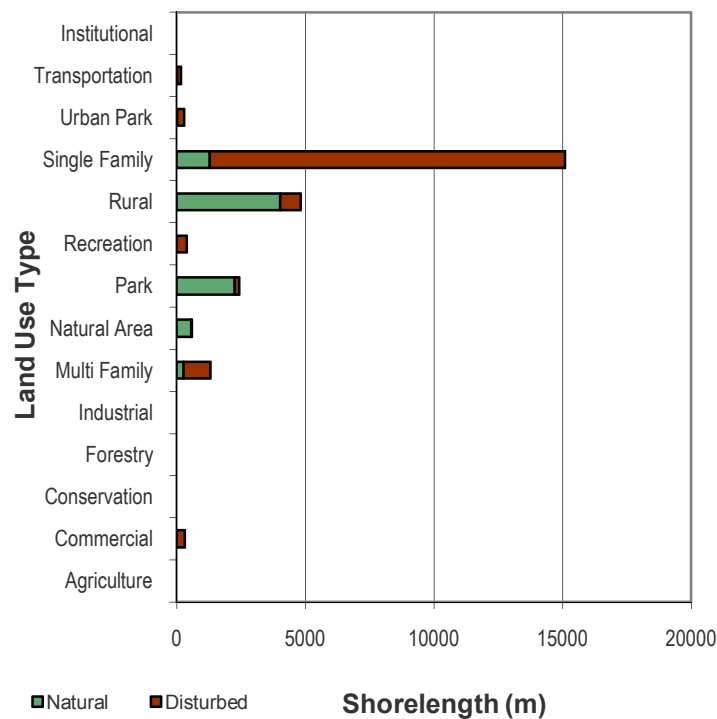


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	1.3%	318	0	318	0.0%	100.0%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	5.1%	1308	271	1037	20.7%	79.3%
Natural Area	2.3%	577	572	4	0.0%	0.0%
Park	9.6%	2437	2272	165	93.2%	6.8%
Recreation	1.5%	386	0	386	0.0%	100.0%
Rural	19.0%	4815	4016	798	83.4%	16.6%
Single Family	59.5%	15100	1300	13800	8.6%	91.4%
Urban Park	1.1%	291	28	263	9.7%	90.3%
Transportation	0.7%	170	25	144	15.0%	85.0%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	25399.2				

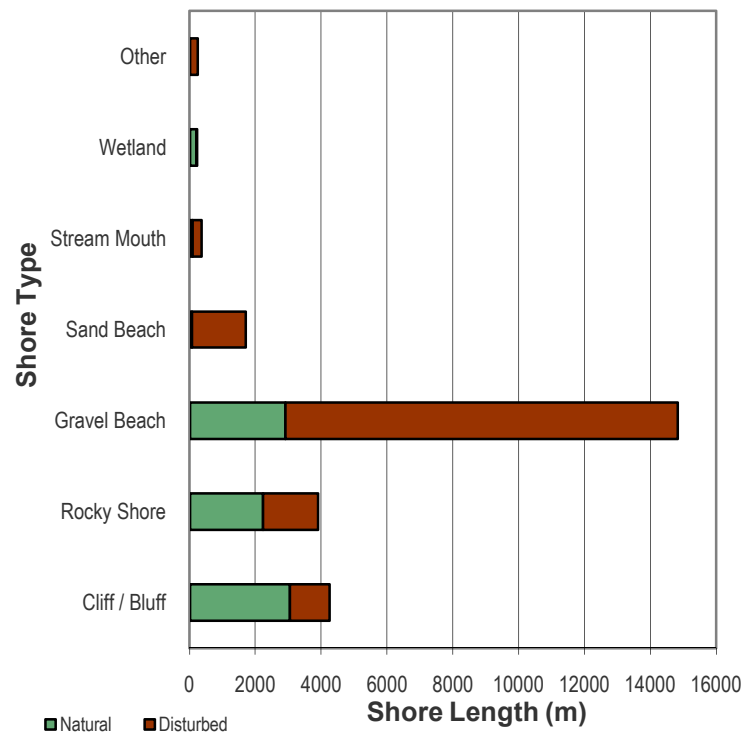


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	16.7%	4245	3031	1214.1	71.4%	28.6%
Rocky Shore	15.3%	3881	2214	1666.8	57.1%	42.9%
Gravel Beach	58.3%	14806	2897	11908.6	19.6%	80.4%
Sand Beach	6.6%	1682	66	1615.9	3.9%	96.1%
Stream Mouth	1.4%	345	83	262.6	23.9%	76.1%
Wetland	0.8%	205	194	10.2	95.0%	5.0%
Other	0.9%	236	0	235.7	0.0%	100.0%
Total	100.00%	25399				

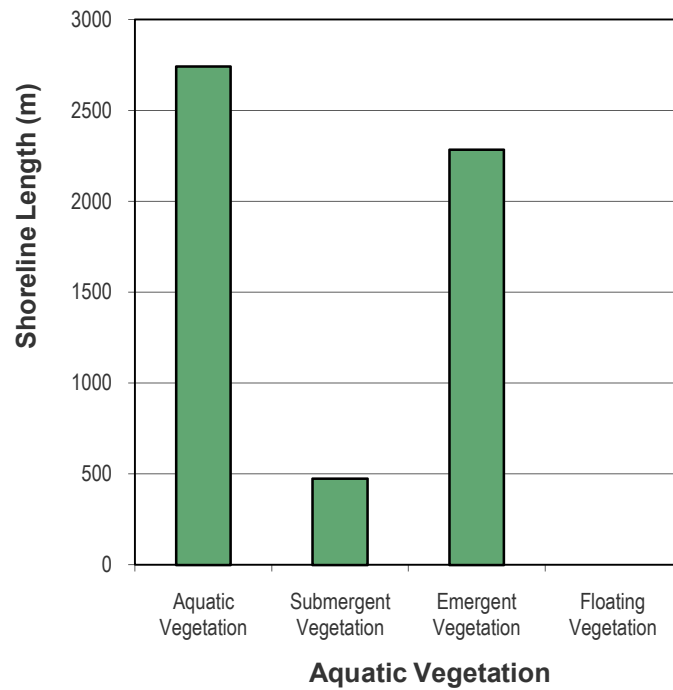


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	10.8%	2740
Submergent Vegetation	1.9%	473
Emergent Vegetation	9.0%	2281
Floating Vegetation	0.0%	0

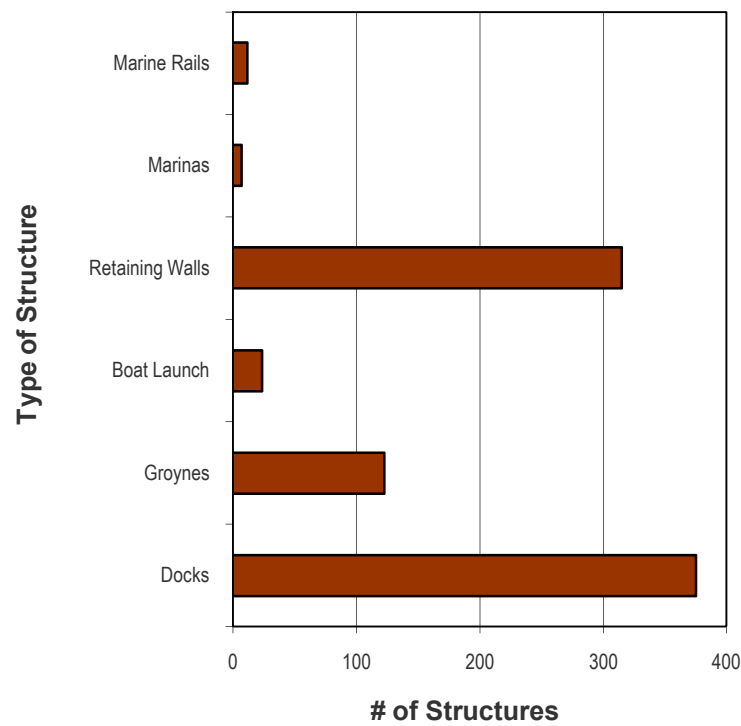
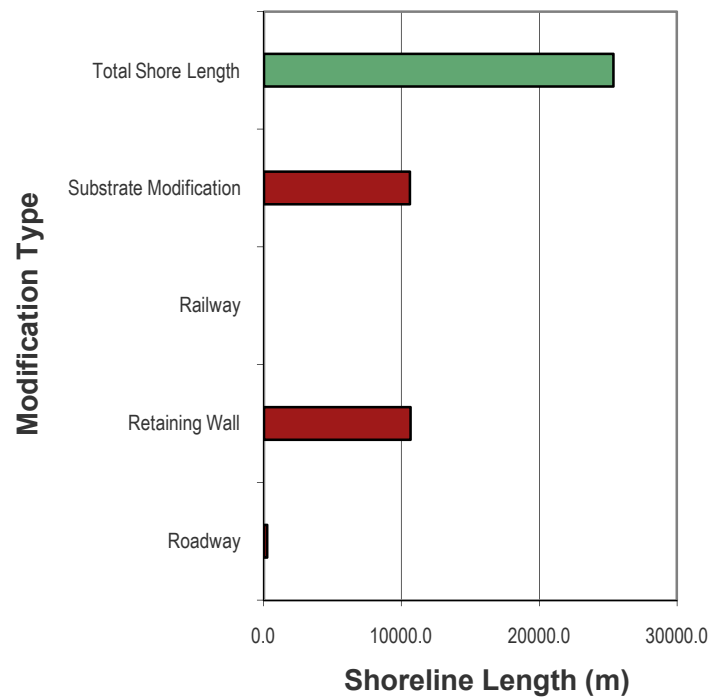


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	375	14.76
Groynes	123	4.84
Boat Launch	24	0.94
Retaining Walls	315	12.40
Marinas	7	0.28
Marine Rails	12	0.47



. **Figure 7:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	1%	262.6
Retaining Wall	42%	10650.3
Railway	0%	0.0
Substrate Modification	42%	10616.8
Total Shore Length		25399.2

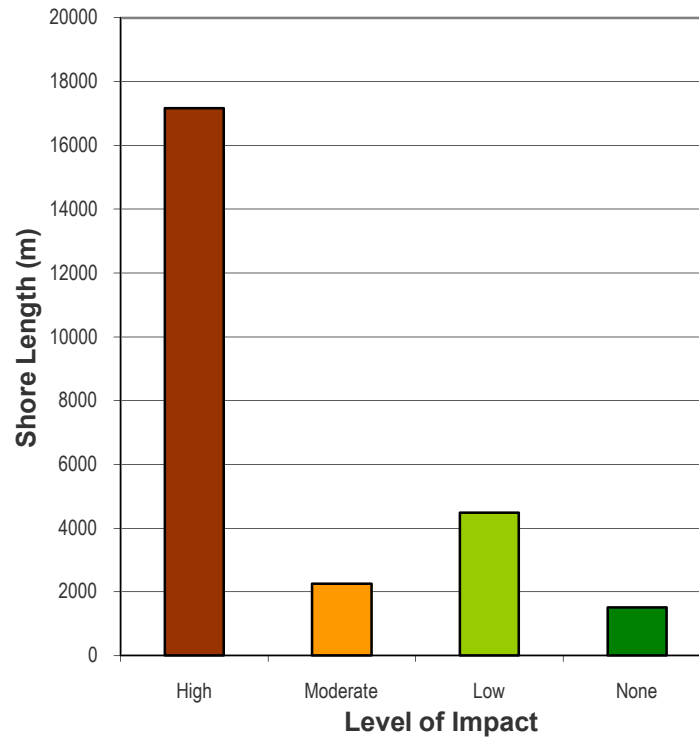


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	67.57%	17163
Moderate	8.84%	2245
Low	17.63%	4479
None	5.95%	1513
Shore Length		25399.2

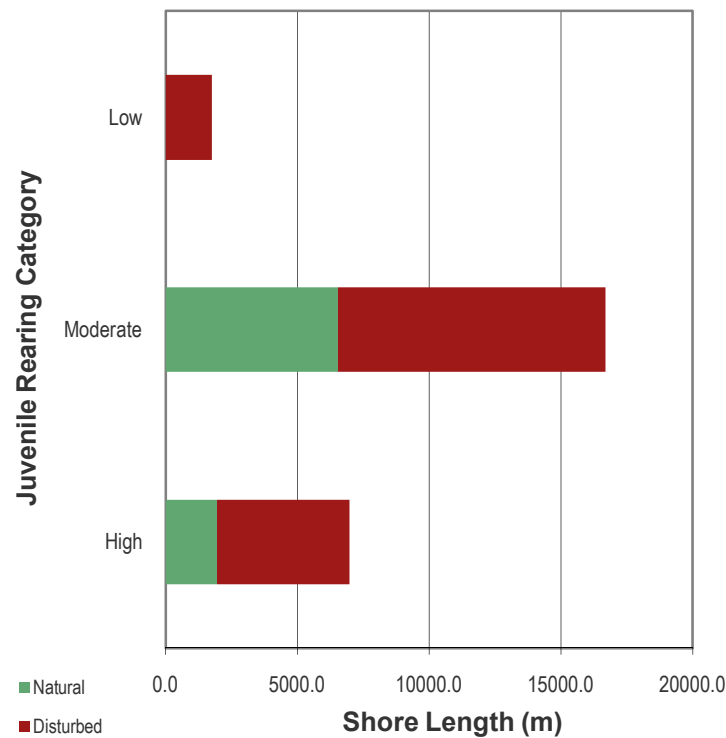


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	9	1940.8	27.9%	5022.9	72.1%	6964.1
Moderate	16	6544.3	39.2%	10150.8	60.8%	16695.5
Low	1	0.0	0.0%	1740.3	100.0%	1740.3

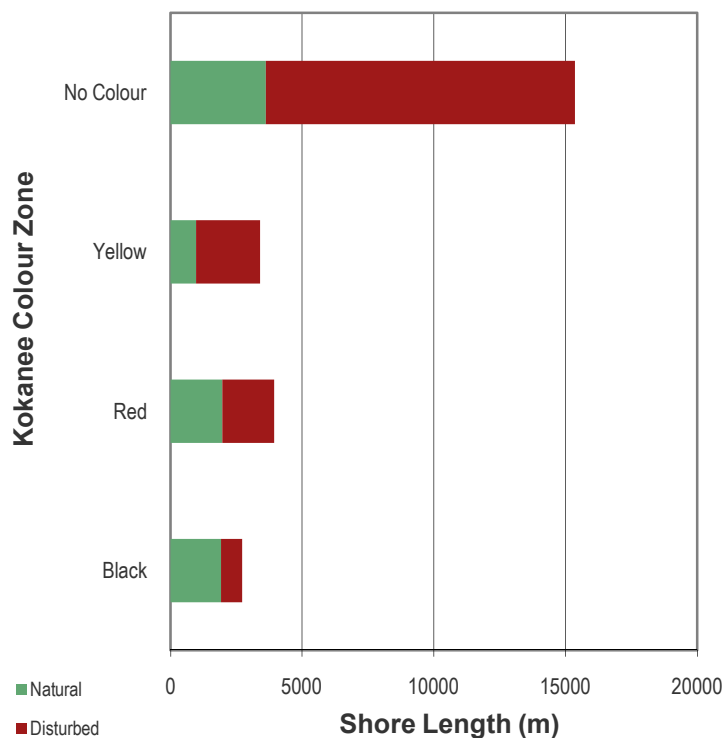


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
70.2%	29.8%	50.4%	49.6%	28.6%	71.4%	23.6%	76.4%
1914	813	1979	1948	970	2426	3622	11728

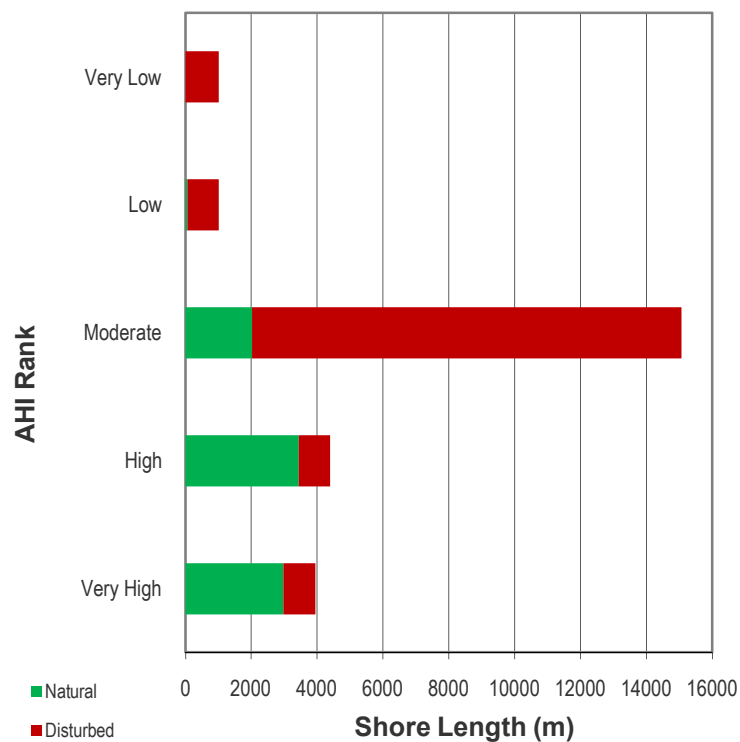


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	2964.63705	75.3%	974.3111025	24.7%
High	3438.13419	78.2%	956.0535876	21.8%
Moderate	2027.182177	13.5%	13028.15718	86.5%
Low	55.21455801	5.5%	954.8389129	94.5%
Very Low	0	0.0%	1000.678766	100.0%

APPENDIX K

Westbank First Nations Results



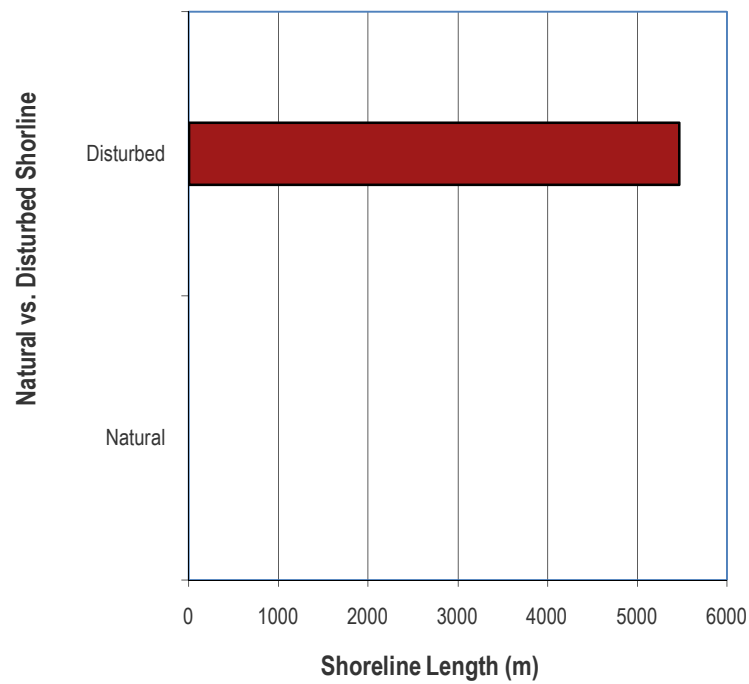


Figure 1: The percent of natural and disturbed shoreline.

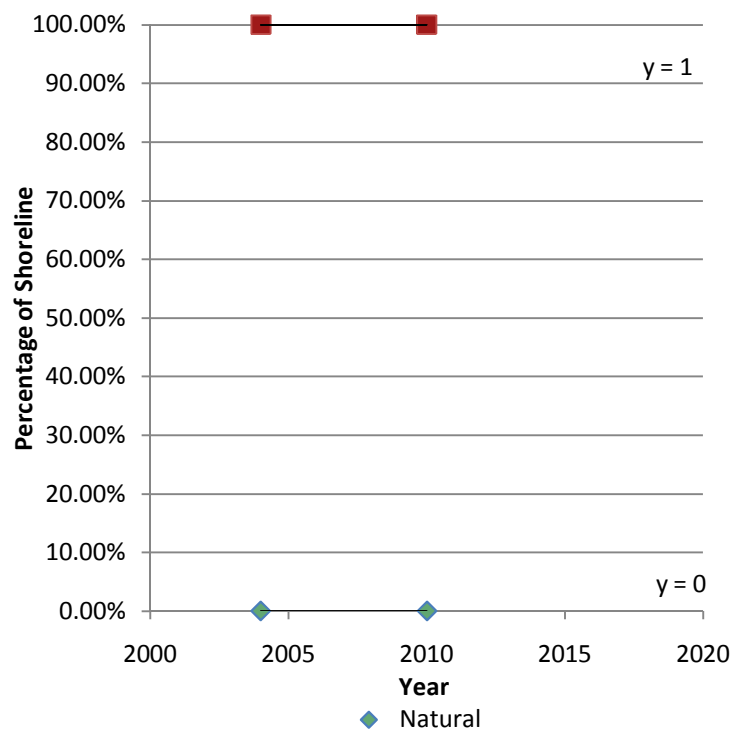


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	0.00%	0	0.00%	0.00
Disturbed	100.00%	5468	100.00%	5467.60
Total		5467.6		5467.6

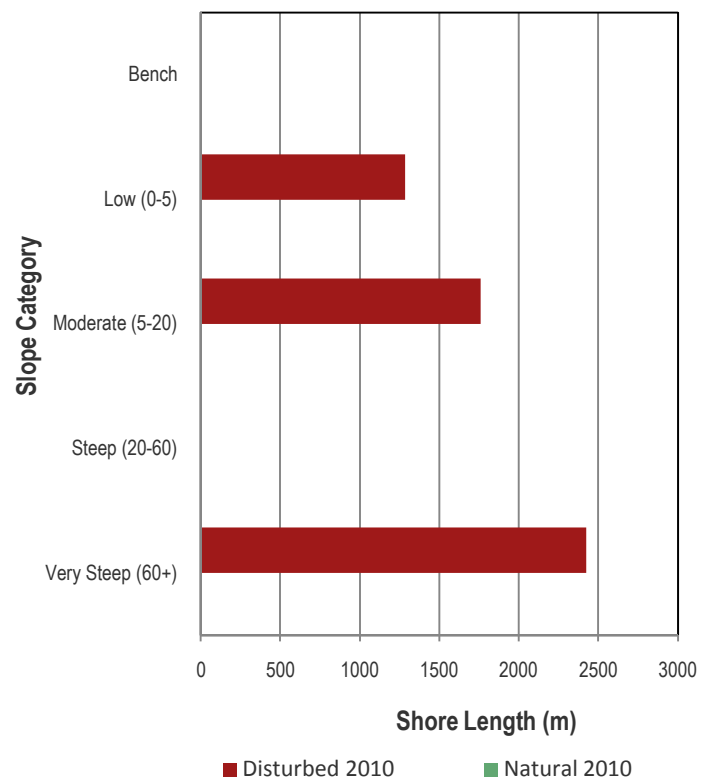


Figure 4: The length of natural and disturbed shorelines in each slope category.

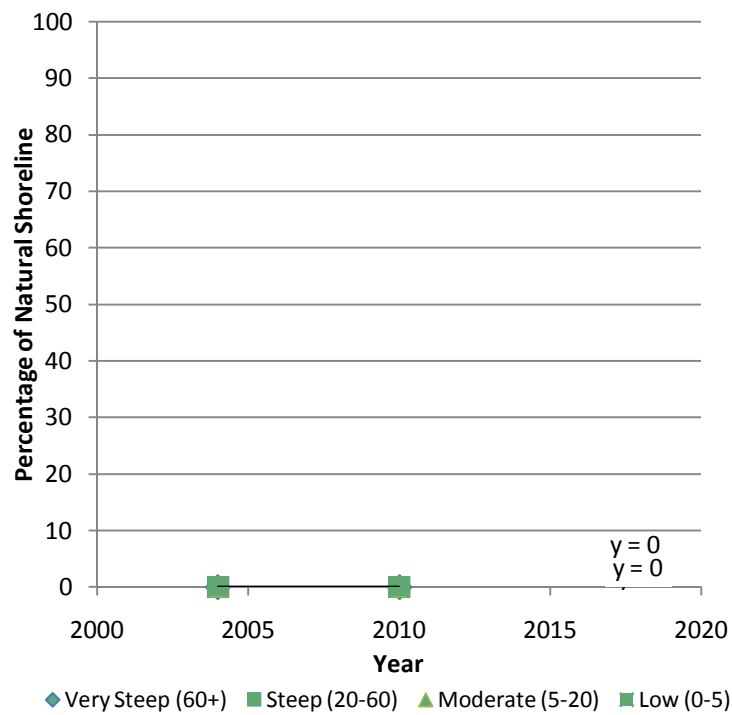


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	44	2422	0	2422	0	100	Very Steep (60+)	44.3	2422	0	2422	0.0	100.0
Steep (20-60)	0	0	0	0	0	0	Steep (20-60)	0.0	0	0	0	0	0
Moderate (5-20)	32	1762	0	1762	0	100	Moderate (5-20)	32.2	1762	0	1762	0.0	100.0
Low (0-5)	23	1283	0	1283	0	100	Low (0-5)	23.5	1283	0	1283	0.0	100.0
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	5468	0	5468	0.0	100.0	Total	100.0	5468	0	5468	0.0	100.0



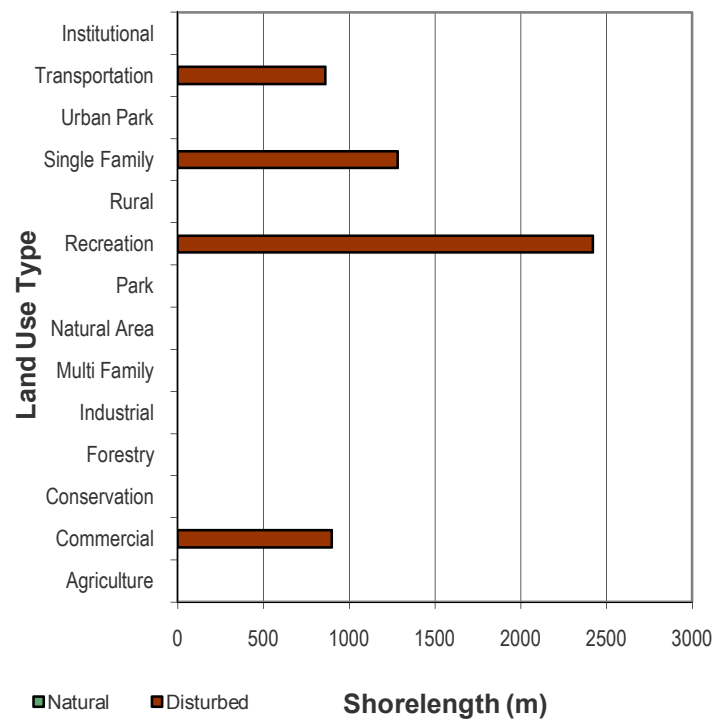


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	16.4%	899	0	899	0.0%	100.0%
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	0.0%	0	0	0	0	0
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0	0
Park	0.0%	0	0	0	0	0
Recreation	44.3%	2422	0	2422	0.0%	100.0%
Rural	0.0%	0	0	0	0	0
Single Family	23.5%	1283	0	1283	0.0%	100.0%
Urban Park	0.0%	0	0	0	0	0
Transportation	15.8%	863	0	863	0.0%	100.0%
Institutional	0.0%	0	0	0	0	0
Total	100.0%	5467.6				

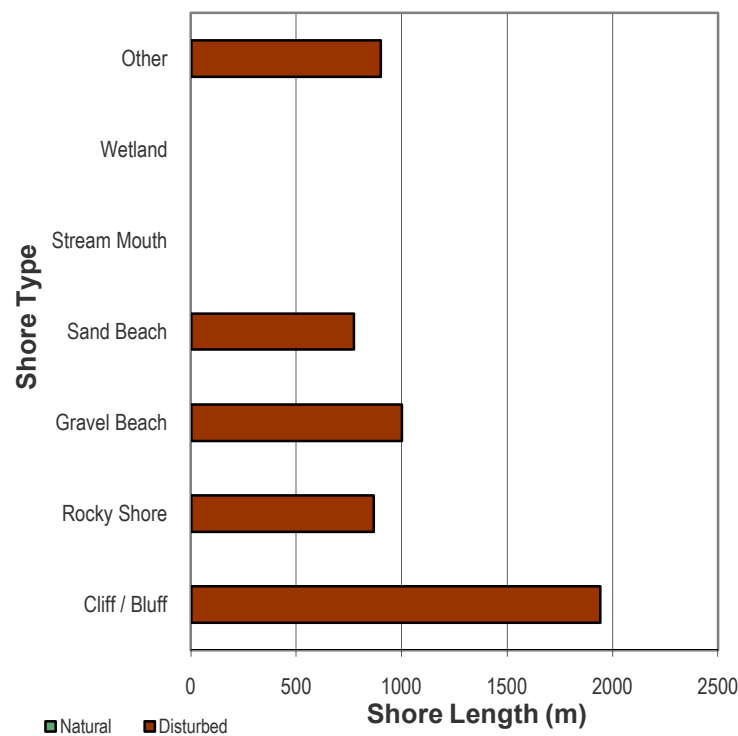


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	35.4%	1938	0	1937.9	0.0%	100.0%
Rocky Shore	15.8%	863	0	863.3	0.0%	100.0%
Gravel Beach	18.2%	998	0	997.8	0.0%	100.0%
Sand Beach	14.1%	770	0	770.0	0.0%	100.0%
Stream Mouth	0.0%	0	0	0.0	0	0
Wetland	0.0%	0	0	0.0	0	0
Other	16.4%	899	0	898.6	0.0%	100.0%
Total	100.00%	5468				

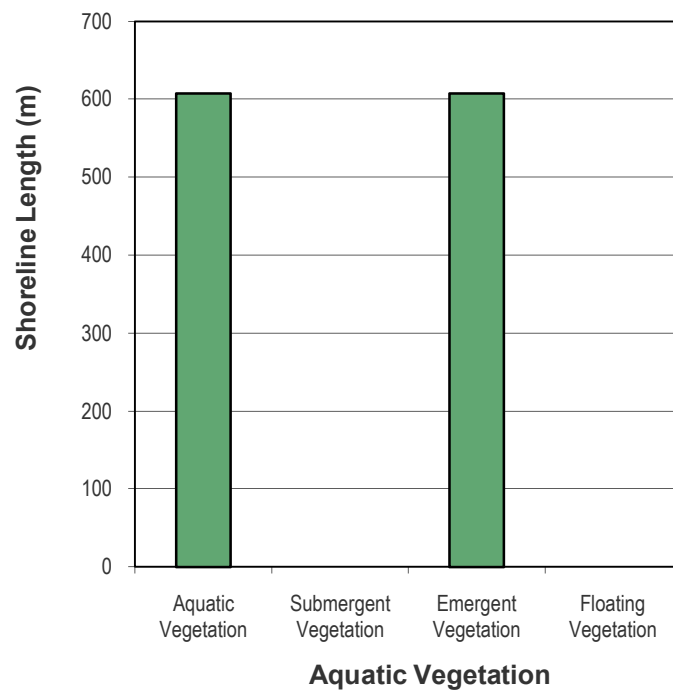


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	11.1%	607
Submergent Vegetation	0.0%	0
Emergent Vegetation	11.1%	607
Floating Vegetation	0.0%	0

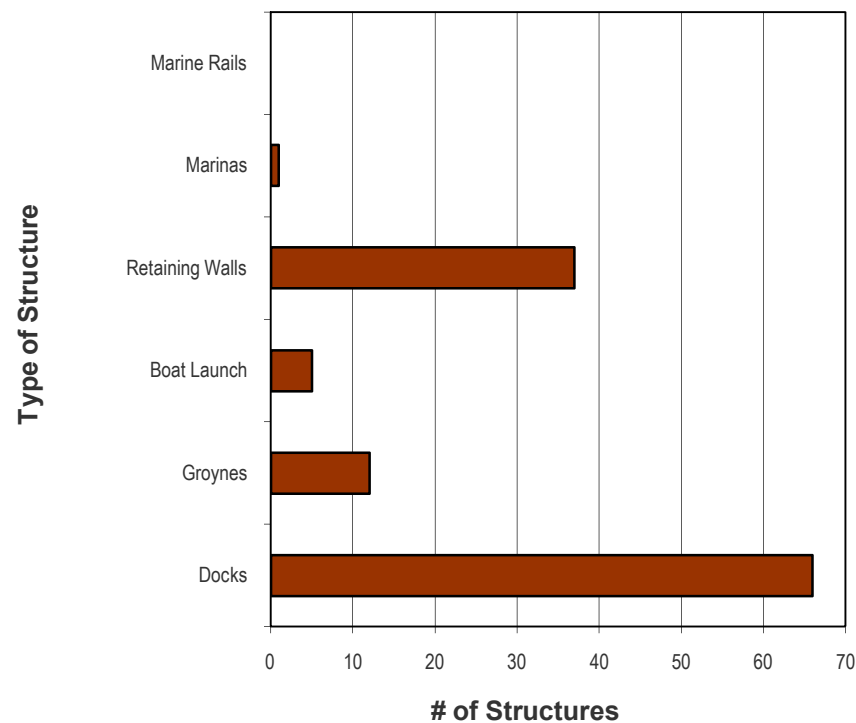


Figure 9: The total number of different types of modifications on Okanagan Lake

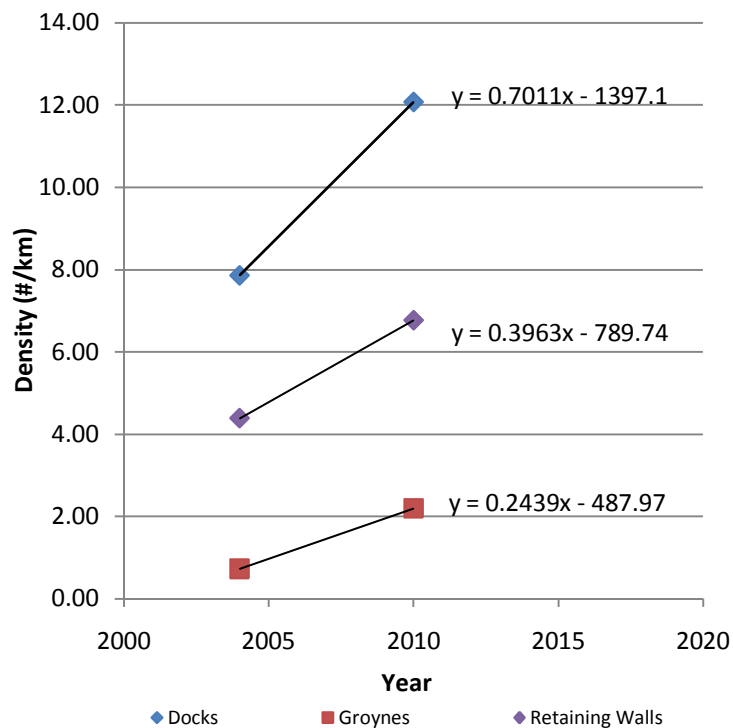


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

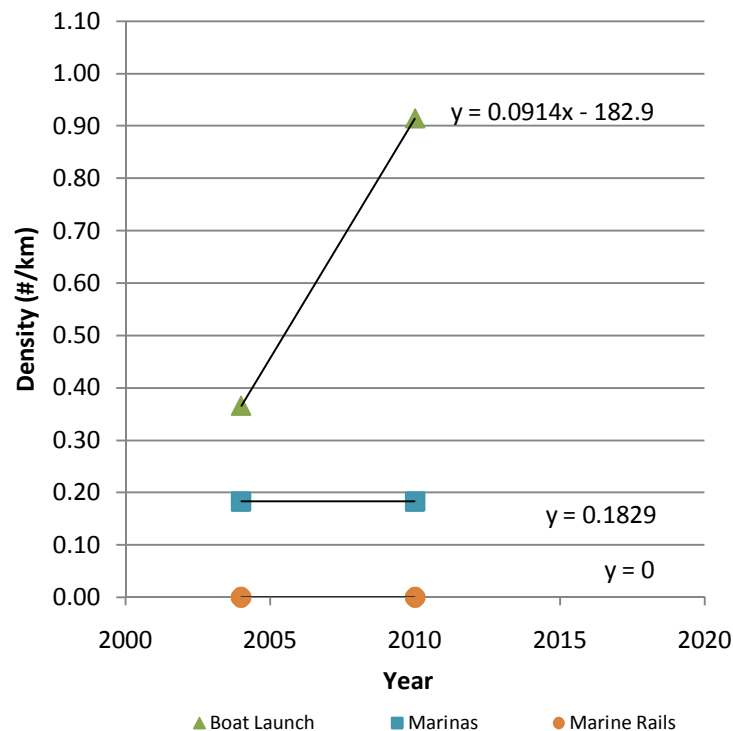
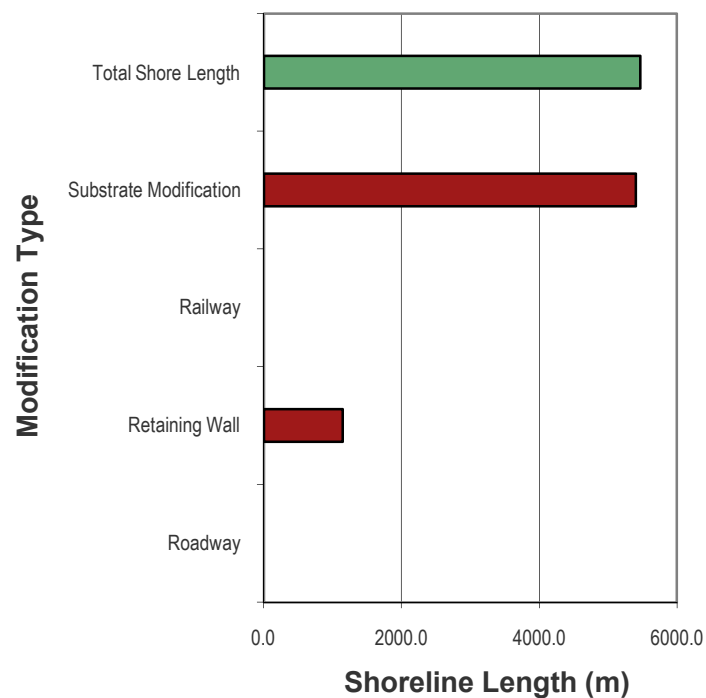


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

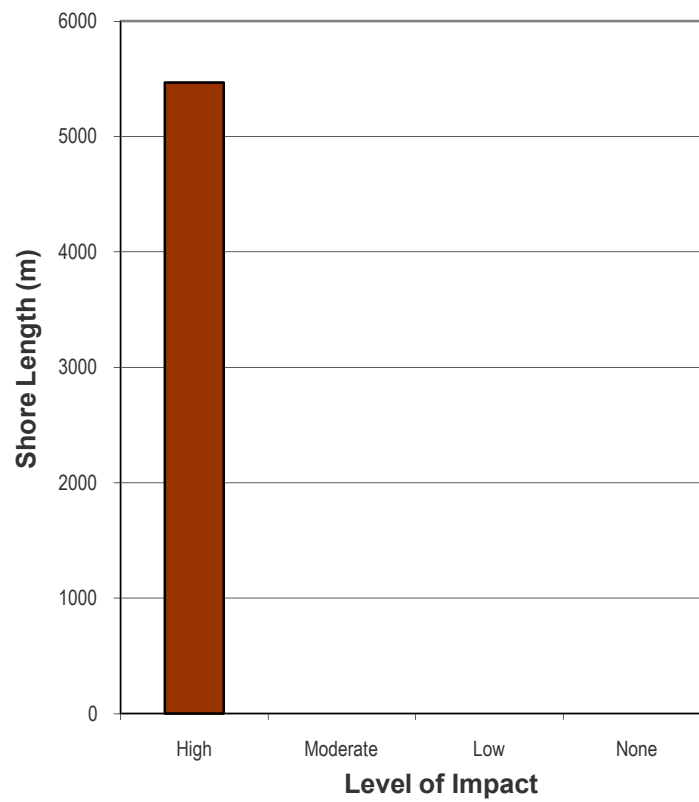
2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	43	7.86	Docks	66	12.07
Groynes	4	0.73	Groynes	12	2.19
Boat Launch	2	0.37	Boat Launch	5	0.91
Retaining Walls	24	4.39	Retaining Walls	37	6.77
Marinas	1	0.18	Marinas	1	0.18
Marine Rails	0	0.00	Marine Rails	0	0.00



. **Figure 12:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	0%	0.0
Retaining Wall	21%	1146.7
Railway	0%	0.0
Substrate Modification	99%	5403.4
Total Shore Length		5467.6



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

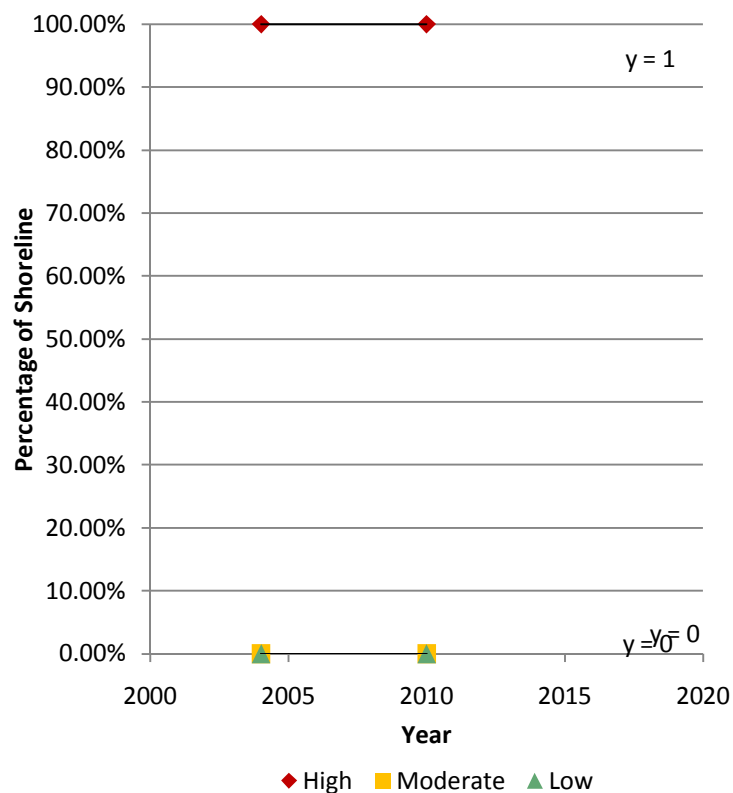


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	100.00%	5468	High	100.00%	5468
Moderate	0.00%	0	Moderate	0.00%	0
Low	0.00%	0	Low	0.00%	0
None	0.00%	0	None	0.00%	0
				Shore Length	5467.6

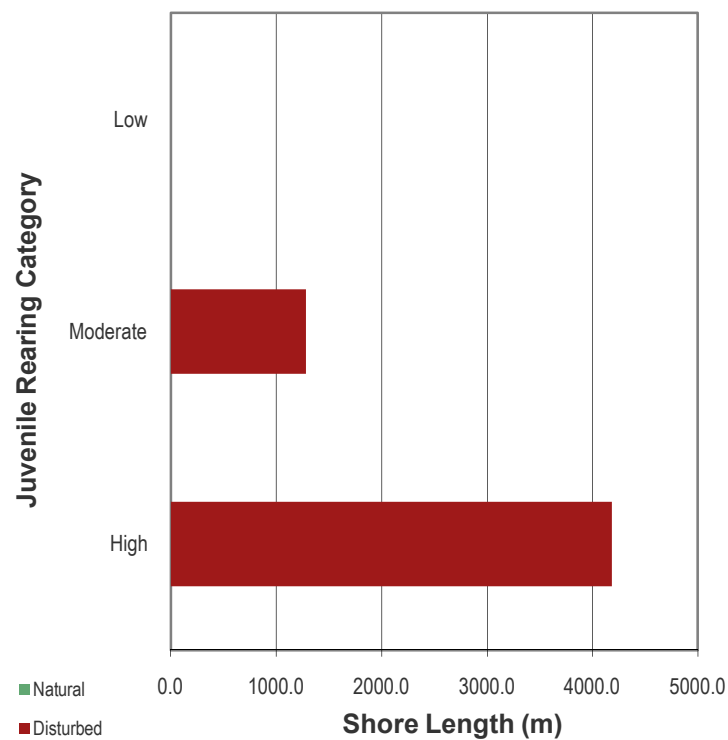


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

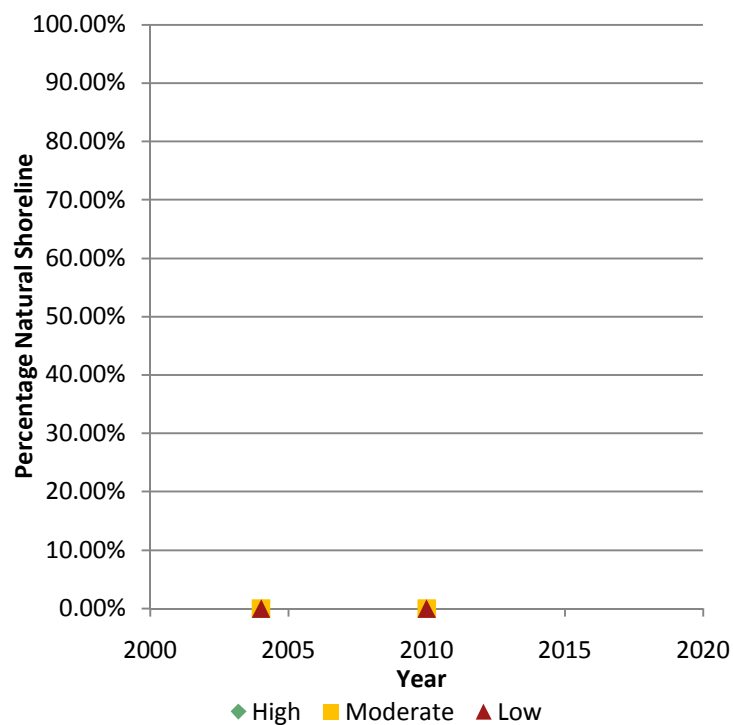


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	2	0.0	0.00%	4184.32	100.00%	4184.3	High	2	0.0	0.0%	4184.3	100.0%	4184.3
Moderate	1	0.0	0.00%	1283.29	100.00%	1283.3	Moderate	1	0.0	0.0%	1283.3	100.0%	1283.3
Low	0	0.0	0	0	0	0	Low	0	0.0	0	0.0	0	0

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	0	0	0.00%	100.00%	0.00%	100.00%	0	0	0	0	0.0%	100.0%	0.0%	100.0%
0	0	0	0	0	696.692	0	4770.91	0	0	0	0	0	697	0	4771



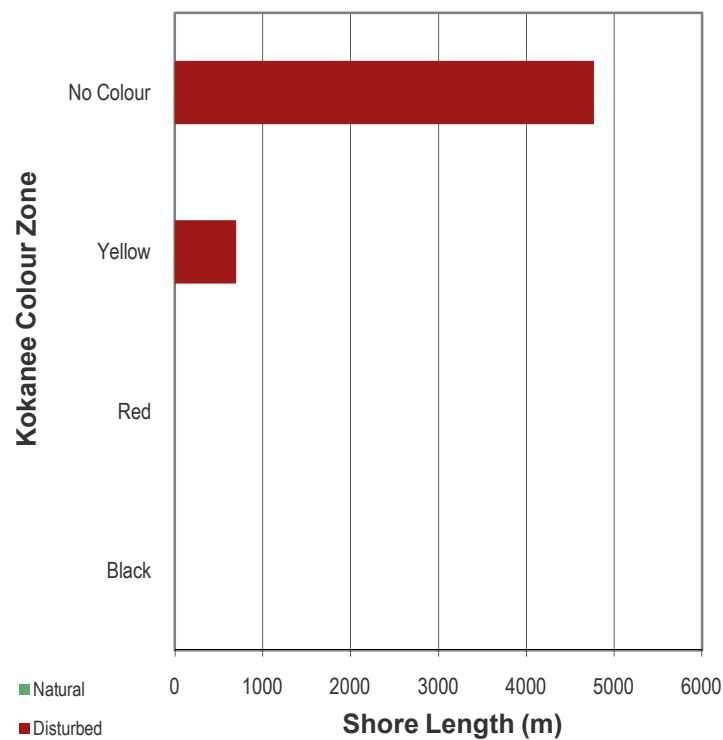


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

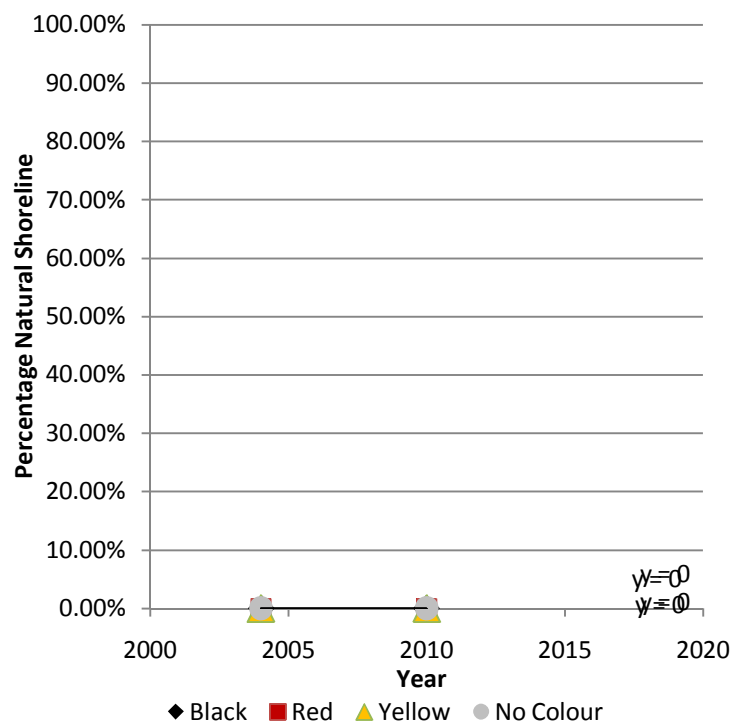


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

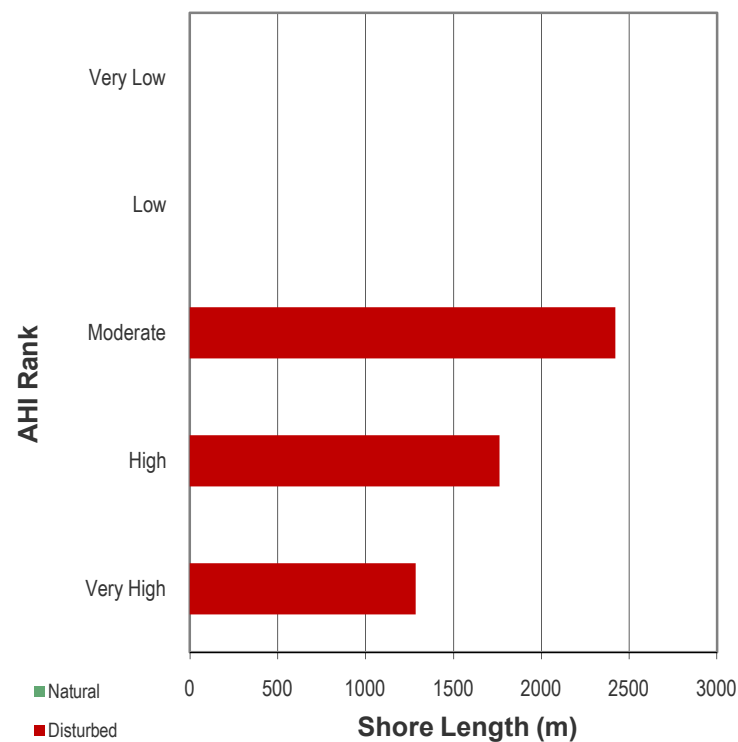


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

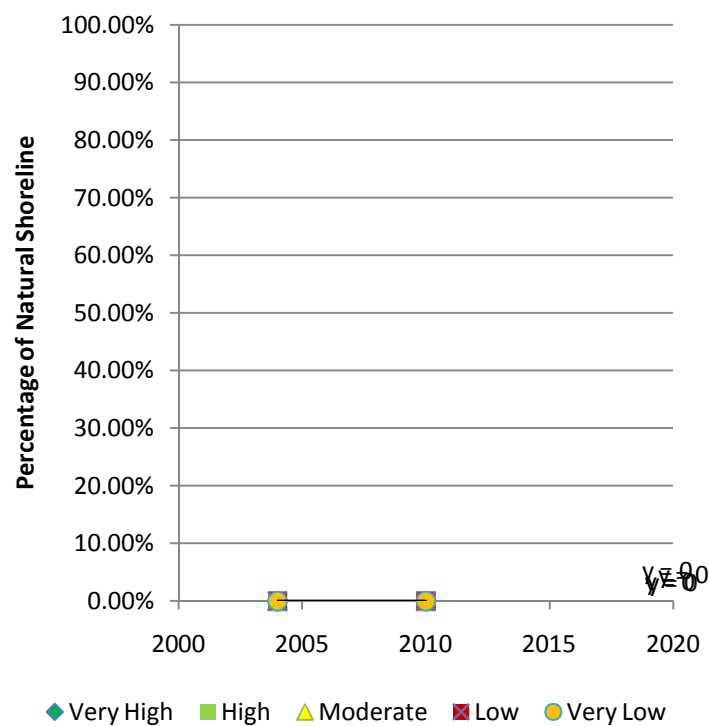


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	0	0.00%	1283.287	100.00%	Very High	0	0.0%	1283.287	100.0%
High	0	0.00%	1761.898	100.00%	High	0	0.0%	1761.898	100.0%
Moderate	0	0.00%	2422.418	100.00%	Moderate	0	0.0%	2422.418	100.0%
Low	0	0	0	0	Low	0	0	0	0
Very Low	0	0	0	0	Very Low	0	0	0	0



APPENDIX L

District of West Kelowna Results



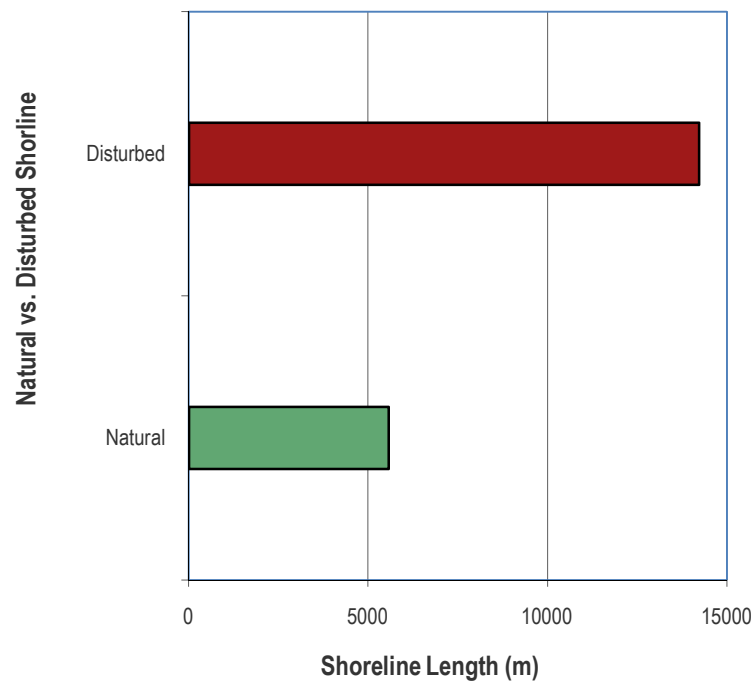


Figure 1: The percent of natural and disturbed shoreline.

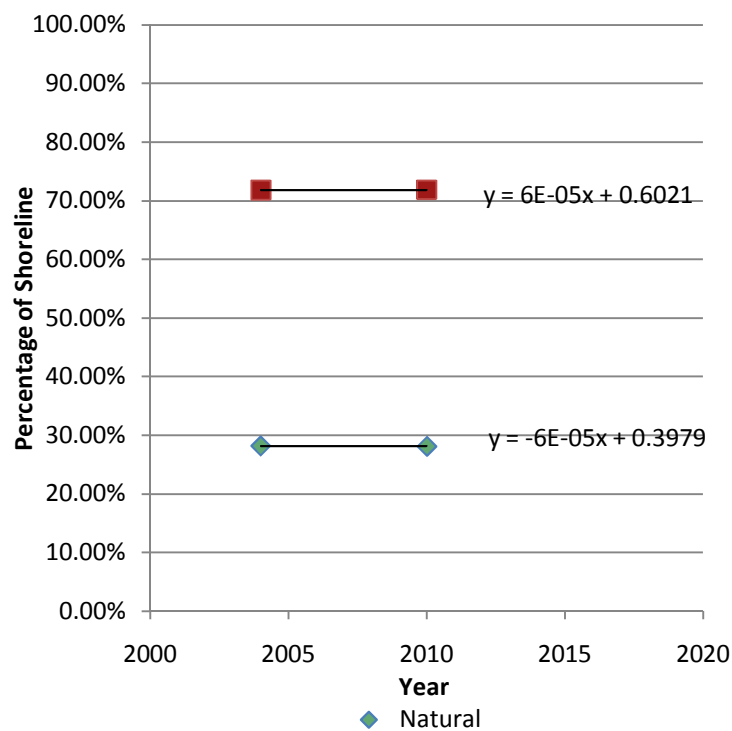


Figure 2: The percent of natural and disturbed shorelines in 2004 and 2010.

Table 1: The total shore length of percentage of shore length along Okanagan Lake in 2004 and 2010.

	2010		2004	
	% of Shoreline	Shore Length (m)	% of Shoreline	Shore Length (m)
Natural	28.16%	5575	28.19%	5582.35
Disturbed	71.84%	14227	71.81%	14219.89
Total		19802.2		19802.2

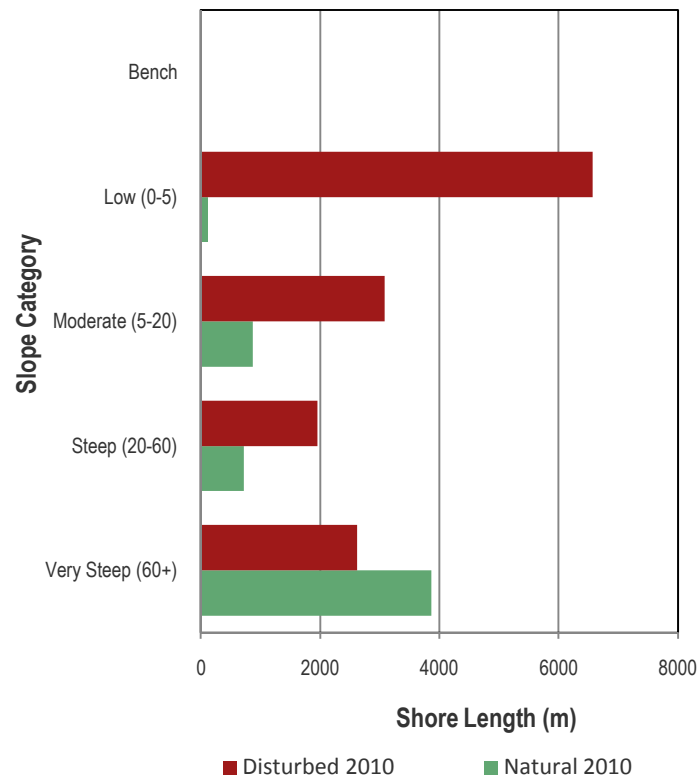


Figure 4: The length of natural and disturbed shorelines in each slope category.

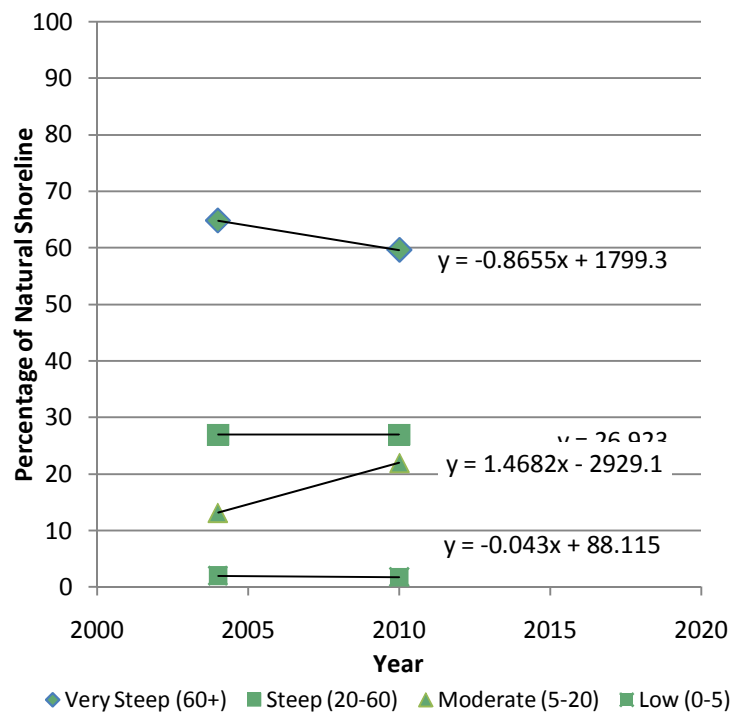


Figure 5: The percent of natural shoreline in each slope category in 2004 and 2010.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories on Okanagan Lake in 2004 and 2010.

2004							2010						
Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed	Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	33	6493	4207	2286	65	35	Very Steep (60+)	32.8	6493	3870	2623	59.6	40.4
Steep (20-60)	14	2677	721	1957	27	73	Steep (20-60)	13.5	2677	721	1957	26.9	73.1
Moderate (5-20)	20	3946	519	3426	13	87	Moderate (5-20)	19.9	3946	867	3079	22.0	78.0
Low (0-5)	34	6686	135	6551	2	98	Low (0-5)	33.8	6686	118	6568	1.8	98.2
Bench	0	0	0	0	0	0	Bench	0.0	0	0	0	0	0
Total	100.0	19802	5582	14220	28.2	71.8	Total	100.0	19802	5575	14227	28.2	71.8



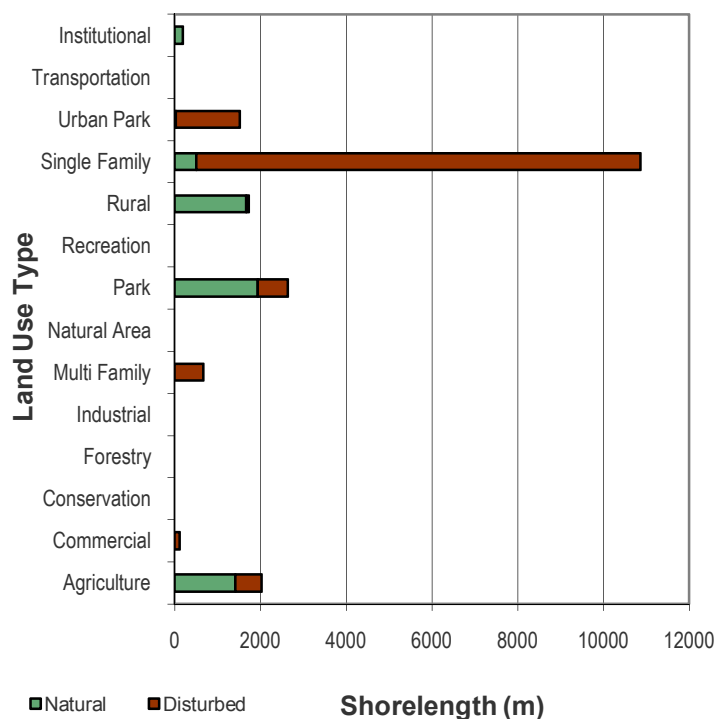


Figure 6: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake in 2004 and 2010.

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	10.3%	2036	1418	618	69.7%	30.3%
Commercial	0.6%	119	0	119	0.0%	100.0%
Conservation	0.0%	0	0	0	0	0
Forestry	0.0%	0	0	0	0	0
Industrial	0.0%	0	0	0	0	0
Multi Family	3.4%	672	0	672	0.0%	100.0%
Natural Area	0.0%	0	0	0	0	0
Park	13.4%	2646	1945	701	73.5%	26.5%
Recreation	0.0%	0	0	0	0	0
Rural	8.8%	1734	1672	62	96.4%	3.6%
Single Family	54.9%	10868	510	10358	4.7%	95.3%
Urban Park	7.7%	1529	30	1499	2.0%	98.0%
Transportation	0.0%	0	0	0	0	0
Institutional	1.0%	199	199	0	100.0%	0.0%
Total	100.0%	19802.2				

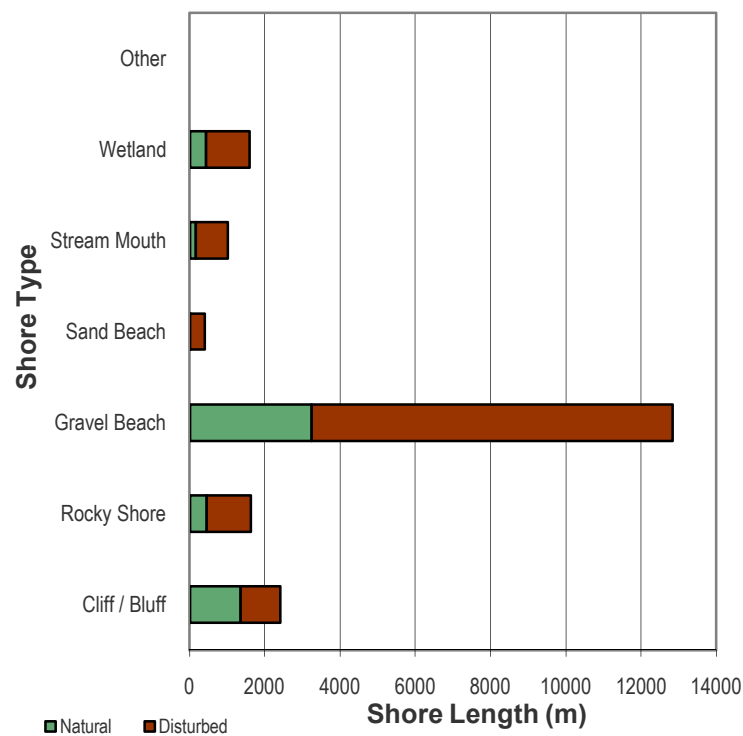


Figure 7: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake in 2004 and 2010.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	12.1%	2390	1340	1050.3	56.1%	43.9%
Rocky Shore	8.2%	1623	434	1189.8	26.7%	73.3%
Gravel Beach	64.7%	12813	3223	9590.3	25.2%	74.8%
Sand Beach	1.9%	384	5	378.6	1.3%	98.7%
Stream Mouth	5.1%	1009	156	852.9	15.4%	84.6%
Wetland	8.0%	1584	419	1164.8	26.5%	73.5%
Other	0.0%	0	0	0.0	0	0
Total	100.00%	19802				

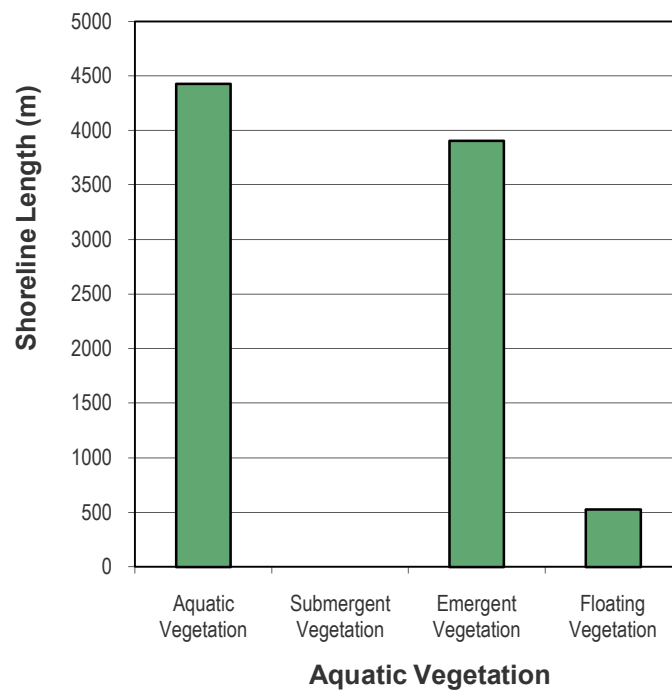


Figure 8: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake in 2004 and 2010.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	22.4%	4427
Submergent Vegetation	0.0%	0
Emergent Vegetation	19.7%	3902
Floating Vegetation	2.6%	524

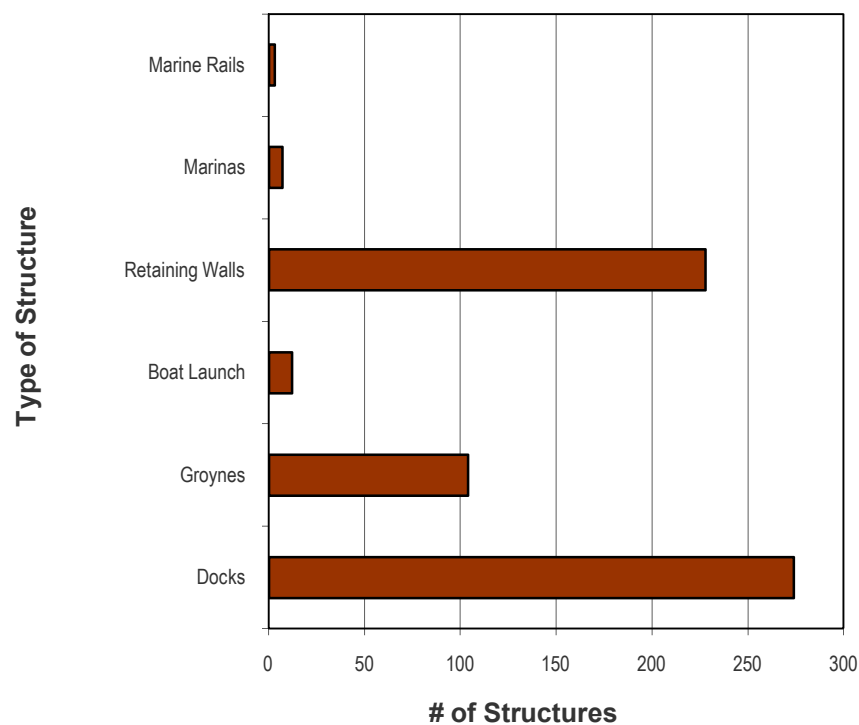


Figure 9: The total number of different types of modifications on Okanagan Lake

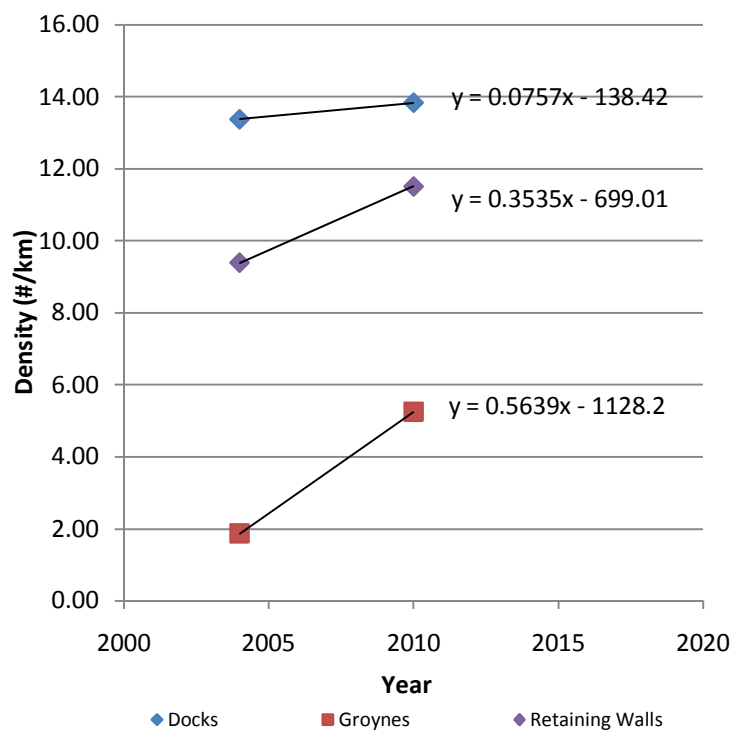


Figure 10: The density of docks, groynes, and retaining walls on Okanagan Lake in 2004 and 2010.

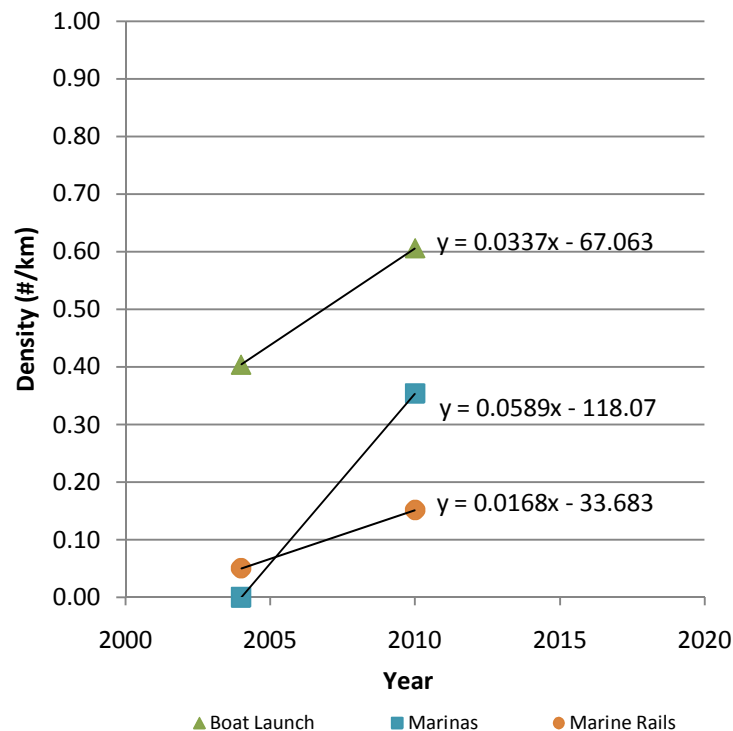


Figure 11: The density of boath launches, marinas, and marine rails on Okanagan Lake in 2004 and 2010.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake in 2004 and 2010.

2004			2010		
Type	Total #	# Per km	Type	Total #	# Per km
Docks	265	13.38	Docks	274	13.84
Groynes	37	1.87	Groynes	104	5.25
Boat Launch	8	0.40	Boat Launch	12	0.61
Retaining Walls	186	9.39	Retaining Walls	228	11.51
Marinas	0	0.00	Marinas	7	0.35
Marine Rails	1	0.05	Marine Rails	3	0.15

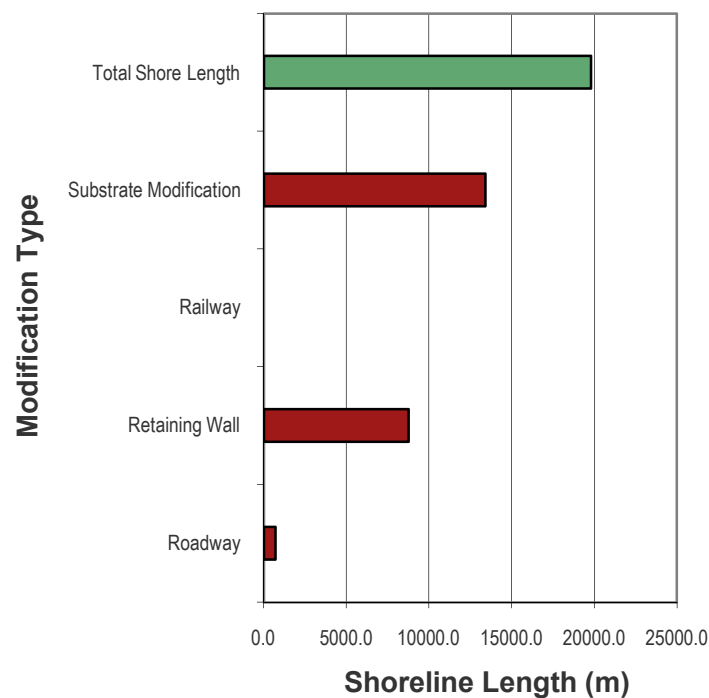
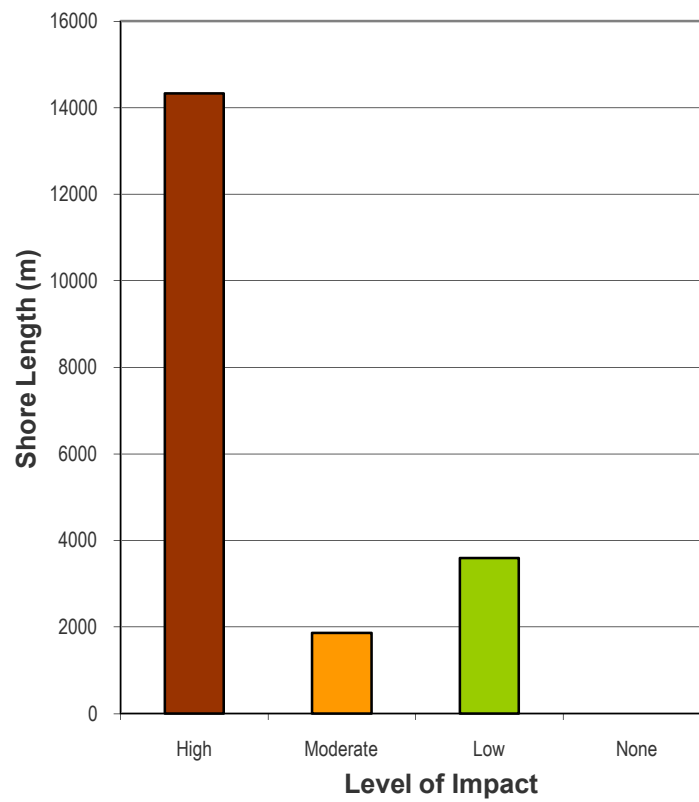


Figure 12: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake in 2004 and 2010.

Category	% of Shoreline	Shorelength (m)
Roadway	3%	693.1
Retaining Wall	44%	8782.3
Railway	0%	0.0
Substrate Modification	68%	13426.7
Total Shore Length		19802.2



. **Figure 13:** The shore length of different levels of impact on Okanagan Lake..

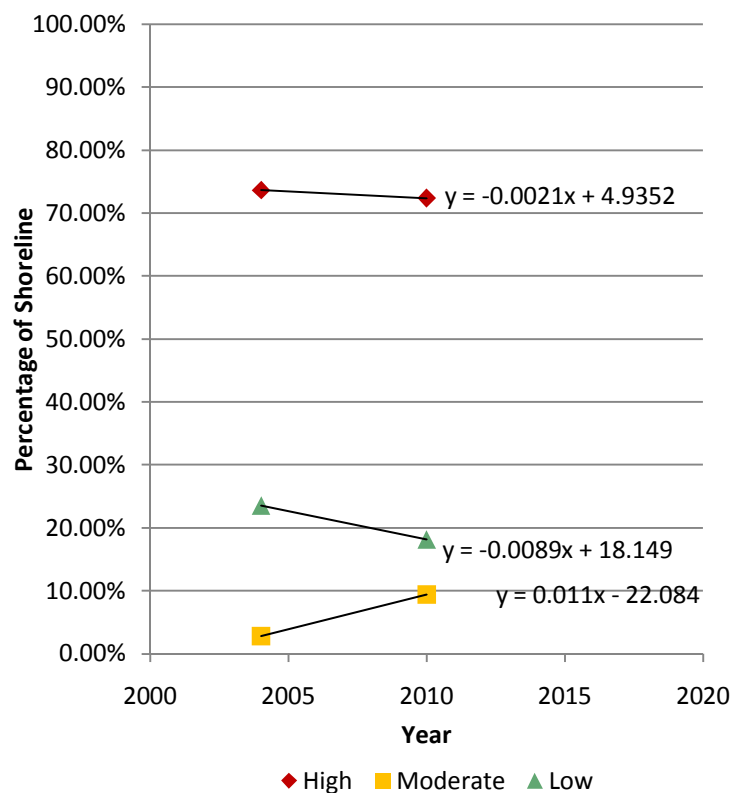


Figure 14: The percentage of the shoreline classified as High, Moderate or Low Level of Impact in 2004 and 2010 on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%)) in 2004 and 2010.

2004			2010		
Level of Impact	% of Shoreline	Shore Length	Level of Impact	% of Shoreline	Shore Length
High	73.63%	14580	High	72.37%	14331
Moderate	2.82%	559	Moderate	9.44%	1870
Low	23.55%	4663	Low	18.19%	3601
None	0.00%	0	None	0.00%	0

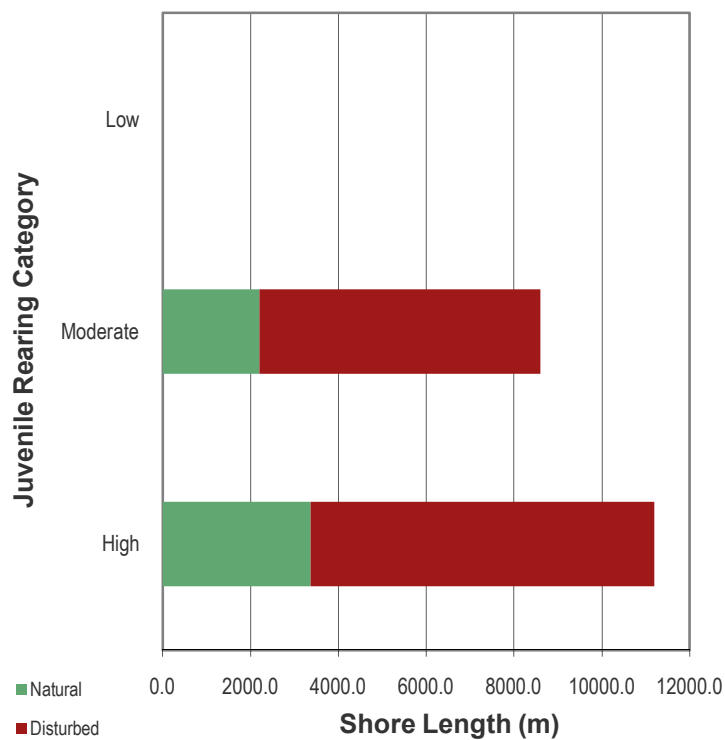


Figure 15: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

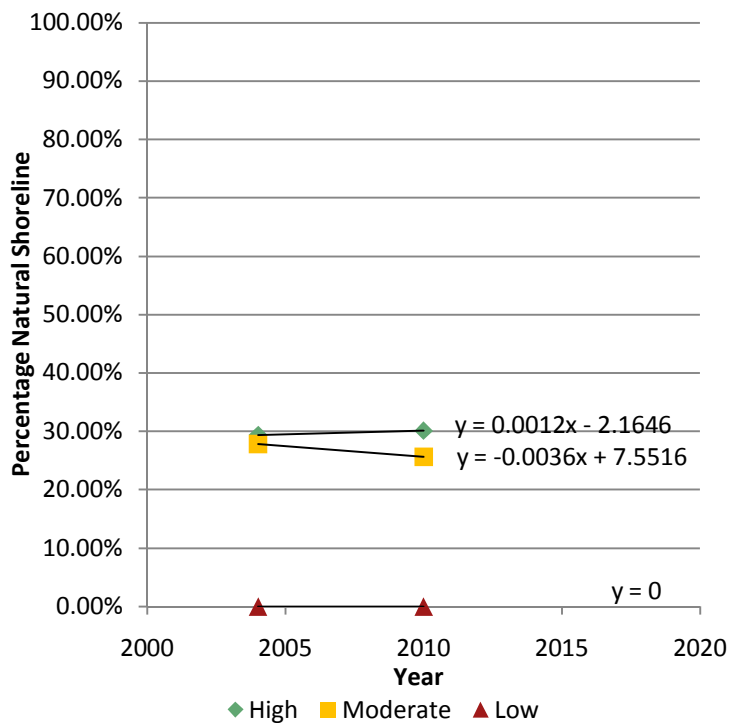


Figure 16: The percentage of High, Moderate, or Low Juvenile Rearing ranking in 2004 and 2010.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake in 2004 and 2010.

2004							2010						
Juvenile Rearing Category	# of Segments	Shore Length (m or %)					Juvenile Rearing Category	# of Segments	Shore Length (m or %)				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total			Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	14	3189.1	28.47%	8011.46	71.53%	11200.9	High	14	3369.6	30.1%	7831.0	69.9%	11200.9
Moderate	14	2393.2	27.82%	6208.42	72.18%	8601.9	Moderate	14	2205.9	25.6%	6395.7	74.4%	8601.9
Low	0	0.0	0	0	0	0	Low	0	0.0	0	0.0	0	0

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas in 2004 and 2010.

2004								2010							
Black		Red		Yellow		No Colour		Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	49.13%	50.87%	14.54%	85.46%	28.74%	71.26%	0	0	54.1%	45.9%	16.5%	83.5%	27.5%	72.5%
0	0	963.755	997.995	520.44	3060.12	4098.15	10161.8	0	0	1062	900	592	2988	3921	10339



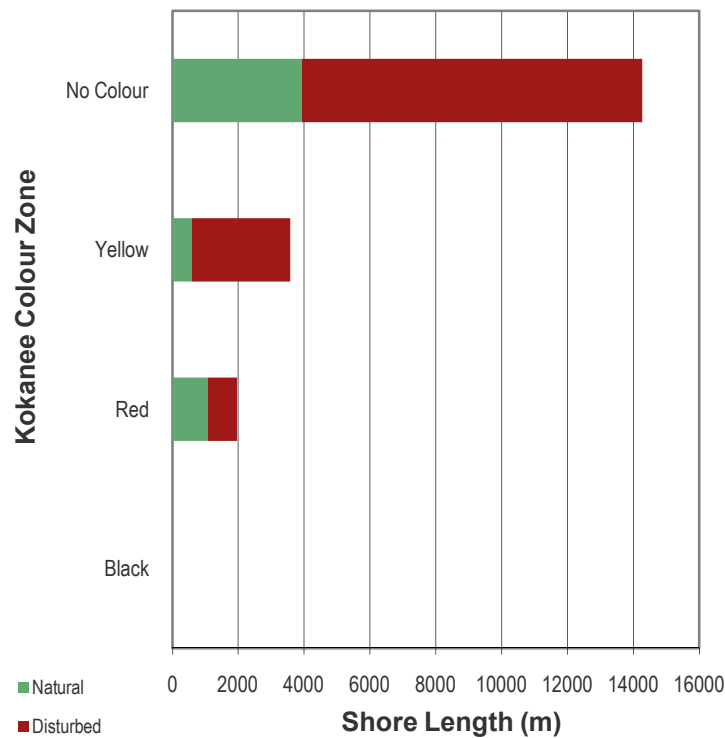


Figure 17: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

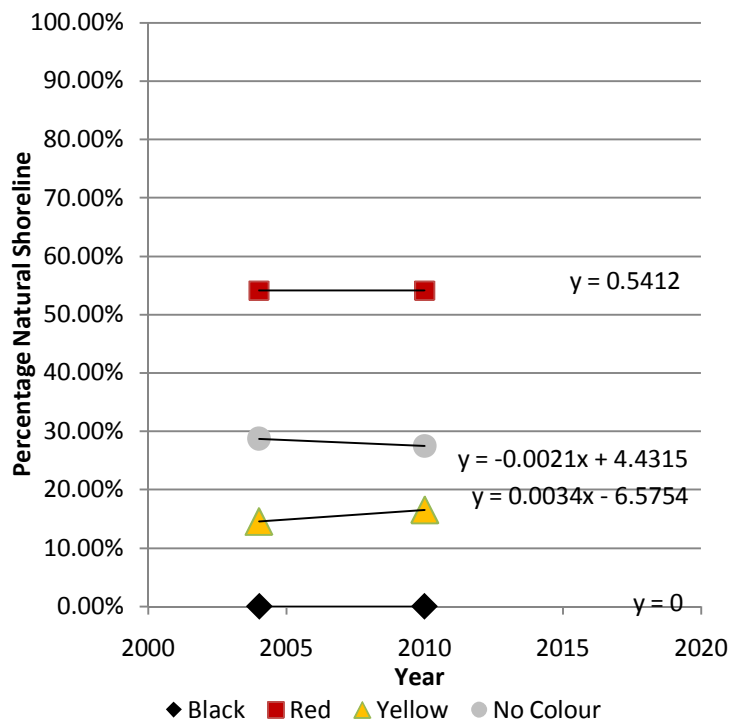


Figure 18: The percentage of natural shoreline in the different shore spawning kokanee zones in 2004 and 2010.

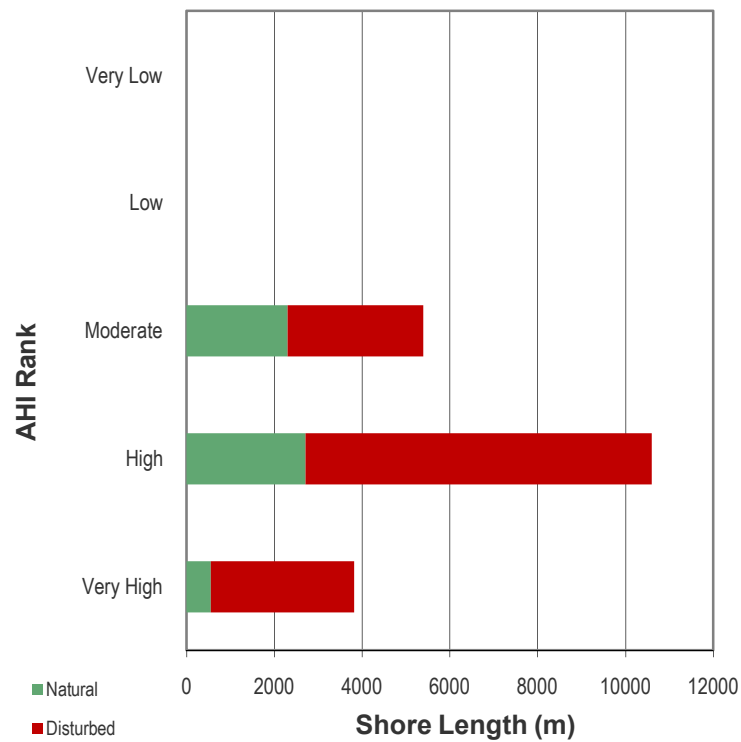


Figure 18: The length of natural and disturbed shoreline in the different AHI rankings.

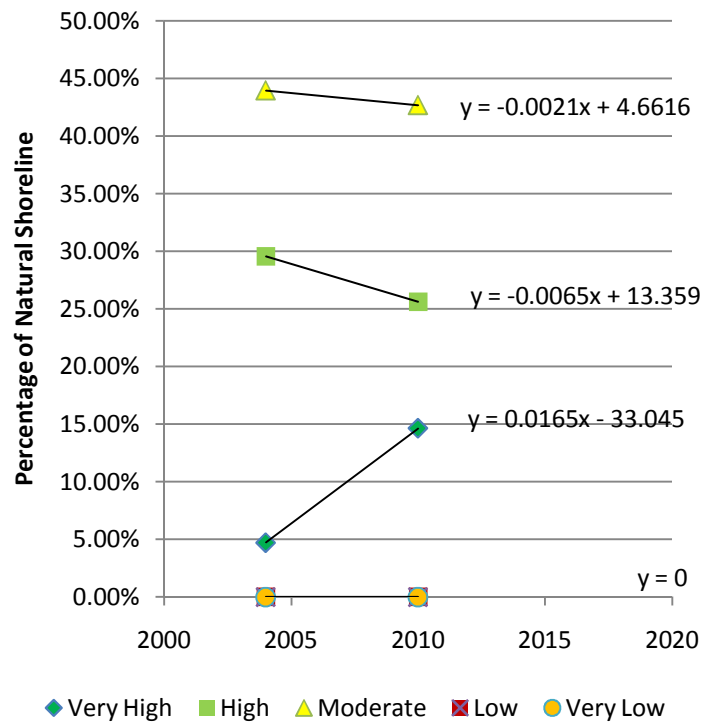


Figure 19: The length of natural shoreline in the different AHI rankings in 2004 and 2010.

Table 11: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings in 2004 and 2010.

2004					2010				
AHI Rank	Natural		Disturbed		AHI Rank	Natural		Disturbed	
	m	%	m	%		m	%	m	%
Very High	82.3466	2.16%	3731.19	97.84	Very High	558.200		3255.34	
High	3132.16	29.55	7468.76	70.45	High	2717.54	14.6%	7883.38	85.4%
High	6	%	2	%	High	2	25.6%	6	74.4%
Moderate	2367.83	43.95	3019.92	56.05	Moderate	2299.73		3088.03	
Low	8	%	5	%	Low	1	42.7%	2	57.3%
Very Low	0	0	0	0	Very Low	0	0	0	0
	0	0	0	0		0	0	0	0

APPENDIX M

District of Peachland Results

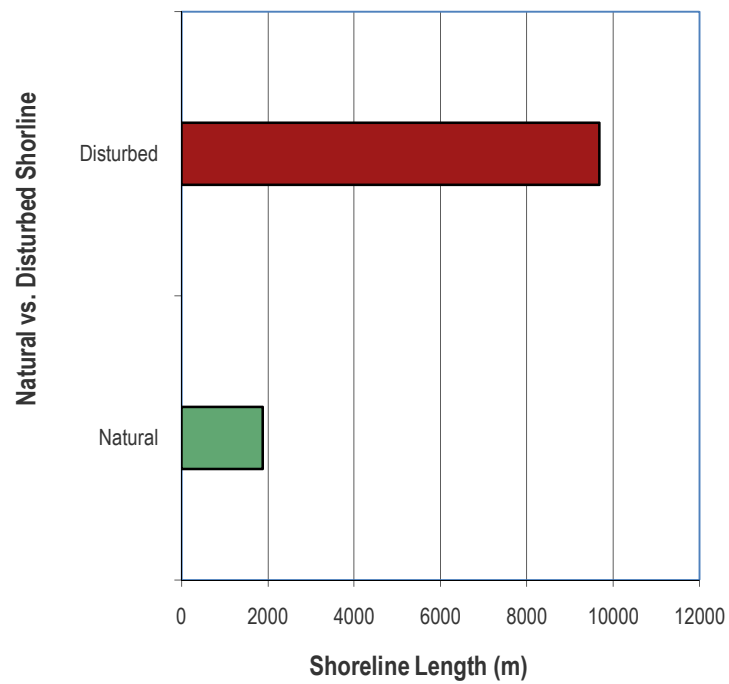


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	16.31%	1886
Disturbed	83.69%	9675
Total		11560.4

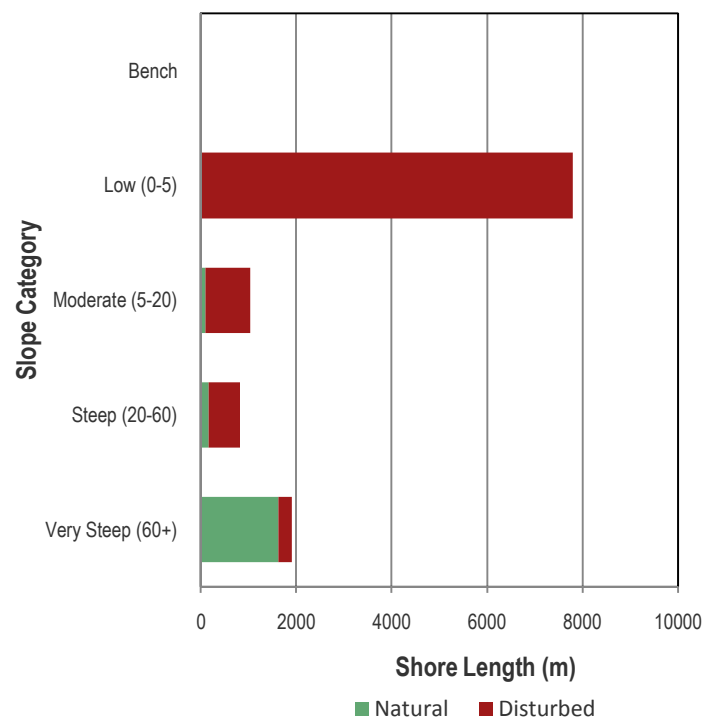


Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	16.5	1910	1623	286	85.0	15.0
Steep (20-60)	7.1	817	163	654	20.0	80.0
Moderate (5-20)	8.9	1030	99	931	9.6	90.4
Low (0-5)	67.5	7804	0	7804	0.0	100.0
Bench	0.0	0	0	0	0	0
Total	100.0	11560	1886	9675	16.3	83.7

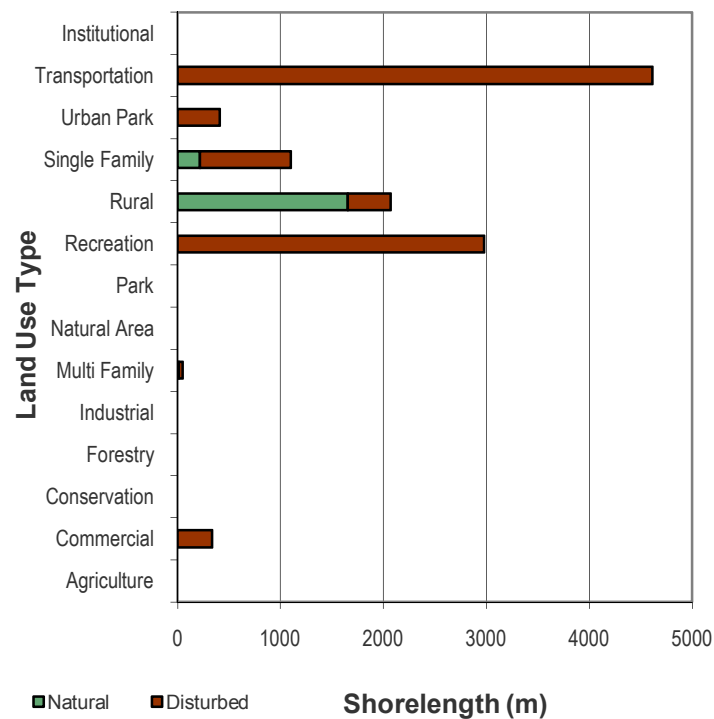


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	2.9%	335	0	335	0.0%	100.0%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.4%	49	10	40	20.0%	80.0%
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	0.0%	0	0	0	0	0
Recreation	25.8%	2977	0	2977	0.0%	100.0%
Rural	17.9%	2073	1656	417	79.9%	20.1%
Single Family	9.5%	1099	220	879	20.0%	80.0%
Urban Park	3.5%	410	0	410	0.0%	100.0%
Transportation	39.9%	4616	0	4616	0.0%	100.0%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	11560.4				

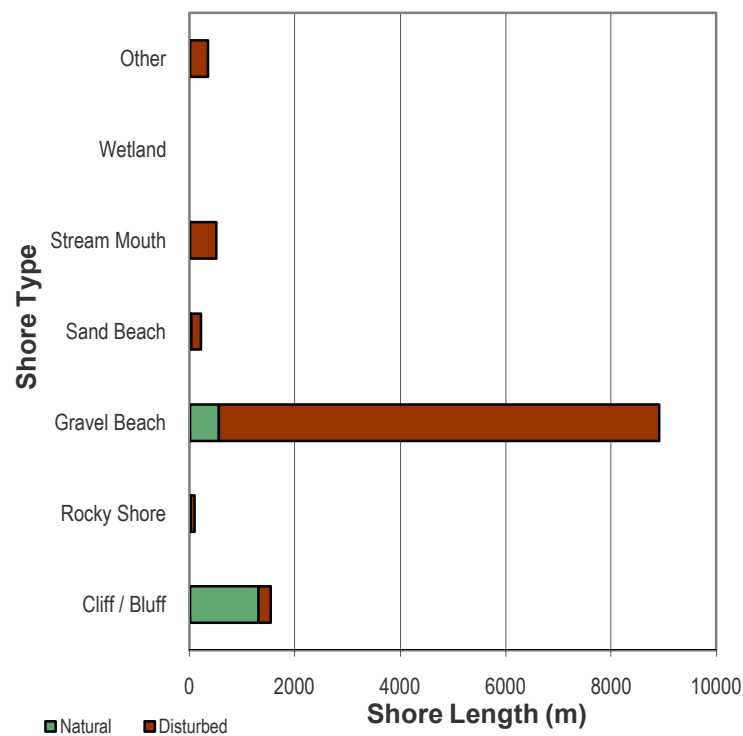


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	13.2%	1528	1299	229.2	85.0%	15.0%
Rocky Shore	0.7%	82	16	65.4	20.0%	80.0%
Gravel Beach	77.0%	8907	551	8355.7	6.2%	93.8%
Sand Beach	1.8%	206	20	186.2	9.6%	90.4%
Stream Mouth	4.4%	503	0	503.2	0.0%	100.0%
Wetland	0.0%	0	0	0.0	0	0
Other	2.9%	335	0	335.1	0.0%	100.0%
Total	100.00%	11560				

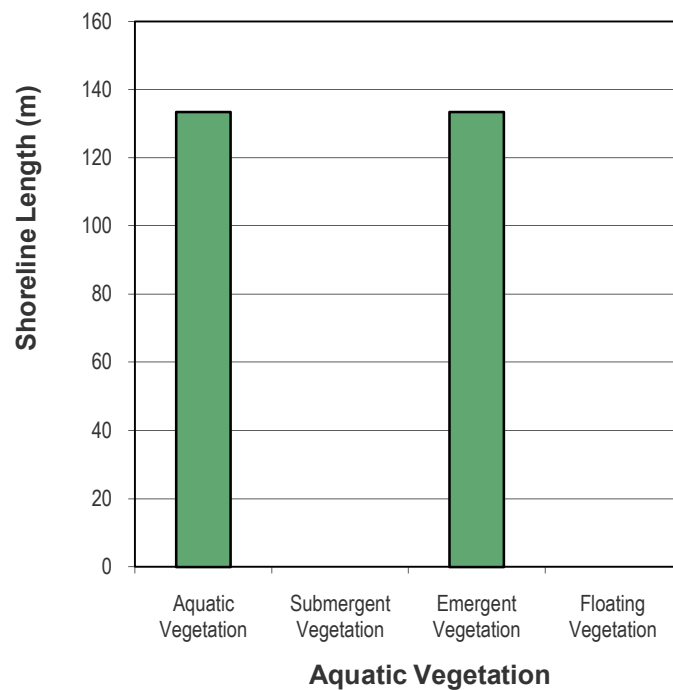


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	1.2%	133
Submergent Vegetation	0.0%	0
Emergent Vegetation	1.2%	133
Floating Vegetation	0.0%	0

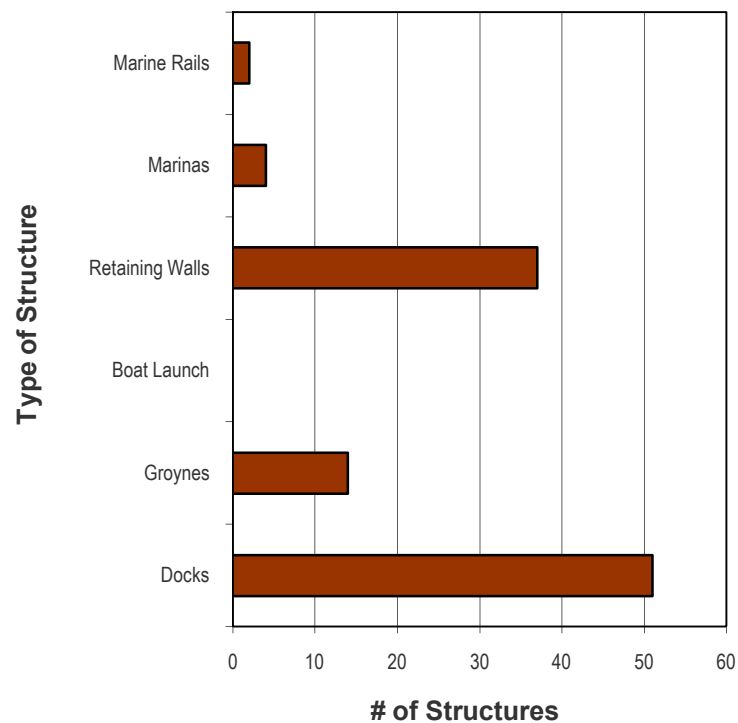


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	51	4.41
Groynes	14	1.21
Boat Launch	0	0.00
Retaining Walls	37	3.20
Marinas	4	0.35
Marine Rails	2	0.17

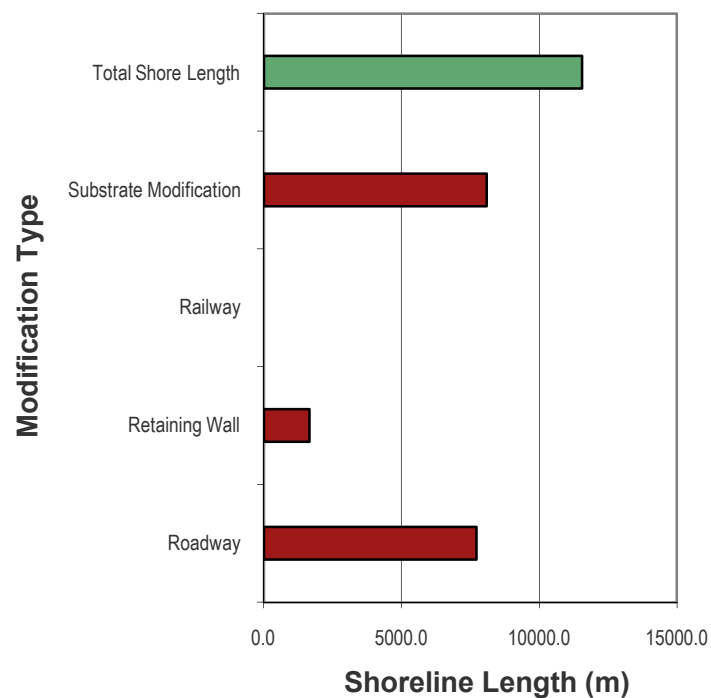


Figure 7: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	67%	7716.3
Retaining Wall	14%	1643.9
Railway	0%	0.0
Substrate Modification	70%	8083.2
Total Shore Length		11560.4

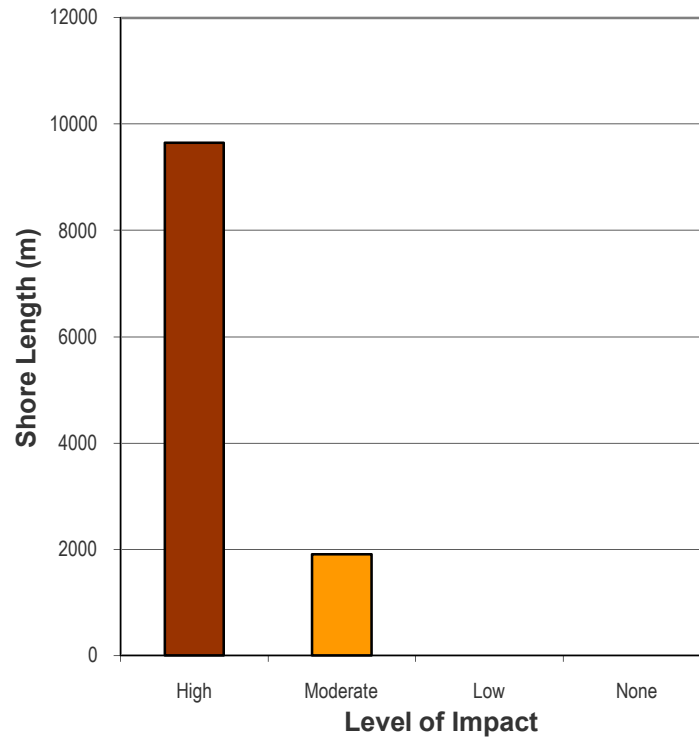


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	83.48%	9651
Moderate	16.52%	1910
Low	0.00%	0
None	0.00%	0
Shore Length		11560.4

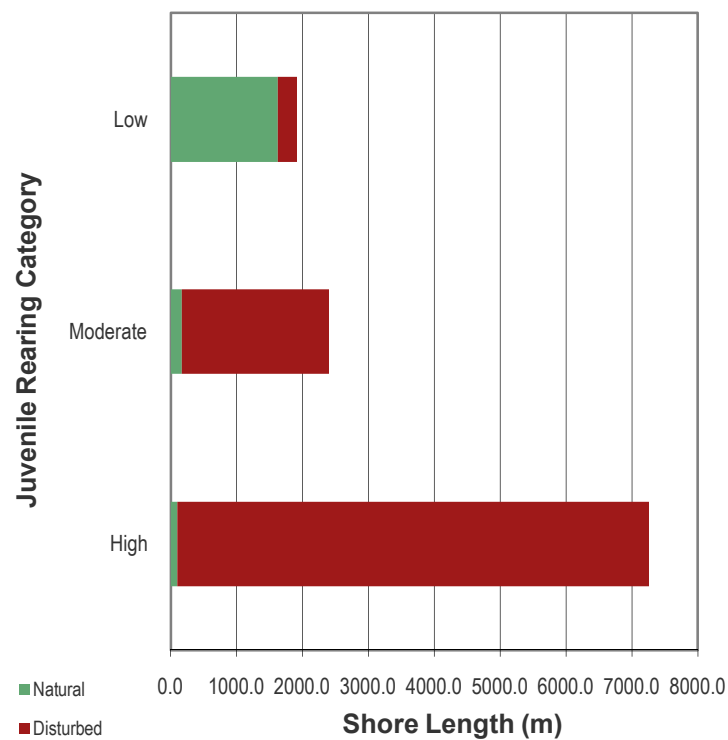


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	7	98.9	1.4%	7154.2	98.6%	7253.2
Moderate	5	163.5	6.8%	2234.0	93.2%	2397.6
Low	1	1623.3	85.0%	286.5	15.0%	1910.6
						11561.4

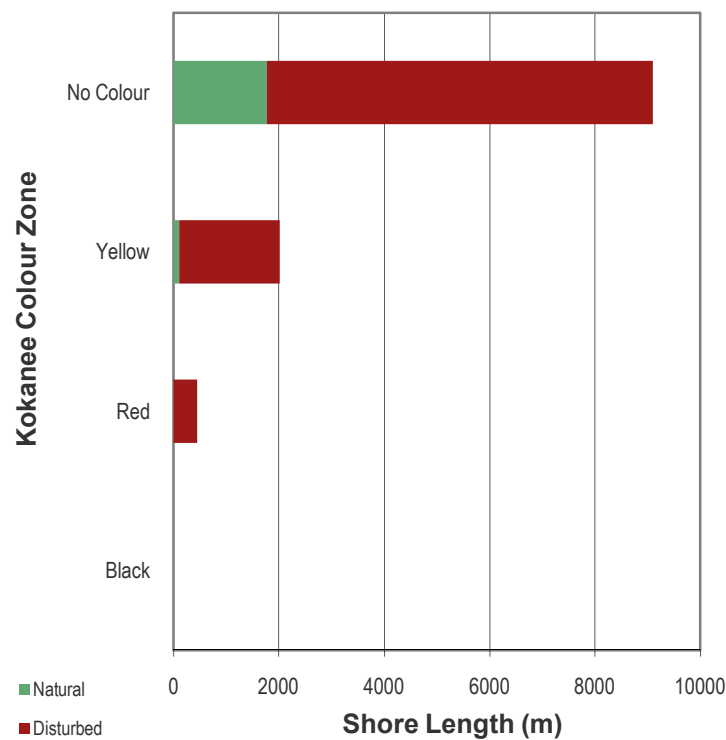


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	0.0%	100.0%	5.5%	94.5%	19.5%	80.5%
0	0	0	449	111	1905	1775	7321

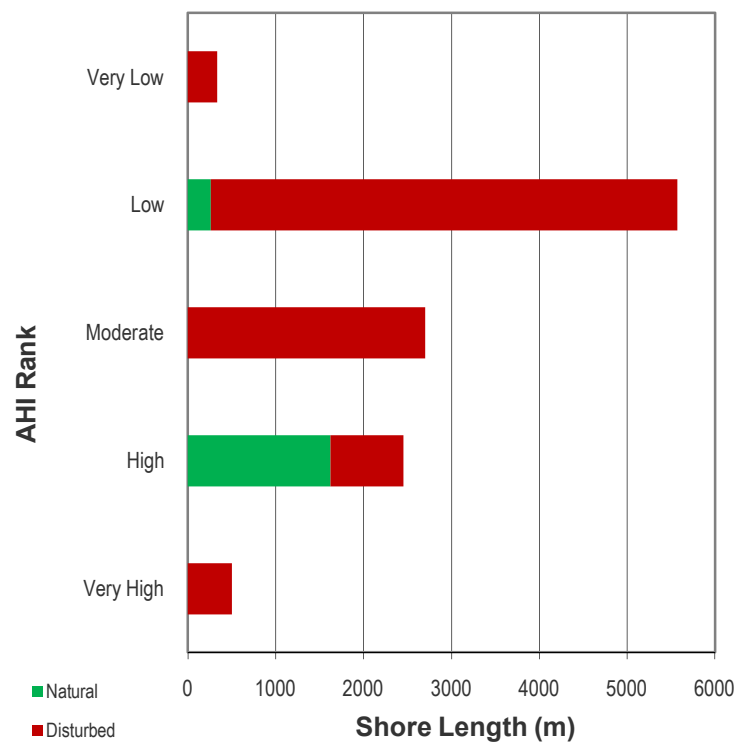


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	0	0.0%	503.1741675	100.0%
High	1623.284152	66.2%	828.1873874	33.8%
Moderate	0	0.0%	2699.933449	100.0%
Low	262.3905808	4.7%	5308.312174	95.3%
Very Low	0	0.0%	335.1389095	100.0%

APPENDIX N

Penticton Indian Band Results



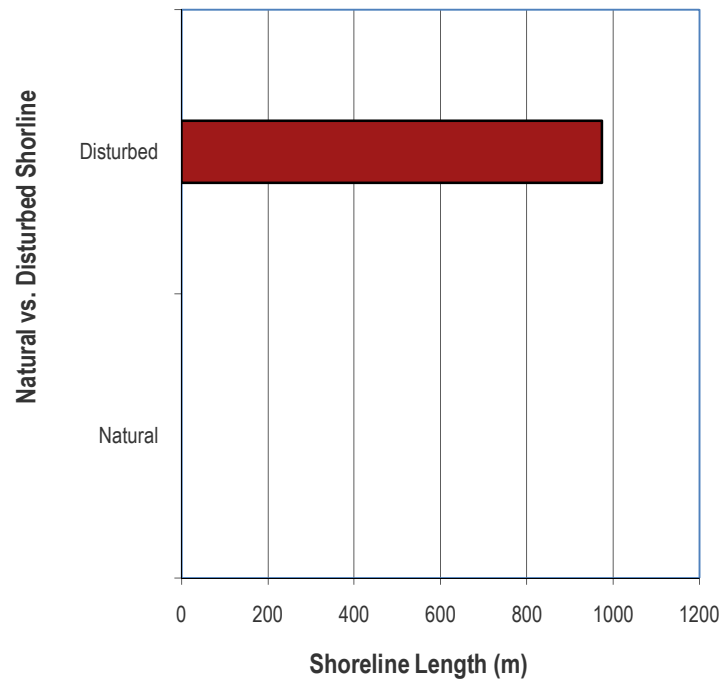


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	0.00%	0
Disturbed	100.00%	974
Total		974.0



Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0.0	0	0	0	0	0
Steep (20-60)	0.0	0	0	0	0	0
Moderate (5-20)	0.0	0	0	0	0	0
Low (0-5)	100.0	974	0	974	0.0	100.0
Bench	0.0	0	0	0	0	0
Total	100.0	974	0	974	0.0	100.0

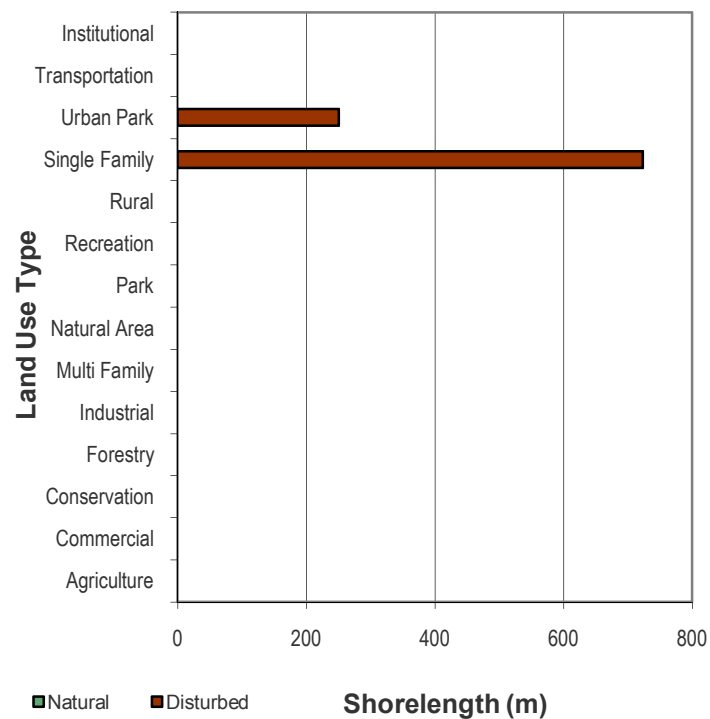


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	0.0%	0	0	0	0	0
Recreation	0.0%	0	0	0	0	0
Rural	0.0%	0	0	0	0	0
Single Family	74.3%	724	0	724	0.0%	100.0%
Urban Park	25.7%	250	0	250	0.0%	100.0%
Transportation	0.0%	0	0	0	0	0
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	974.0				

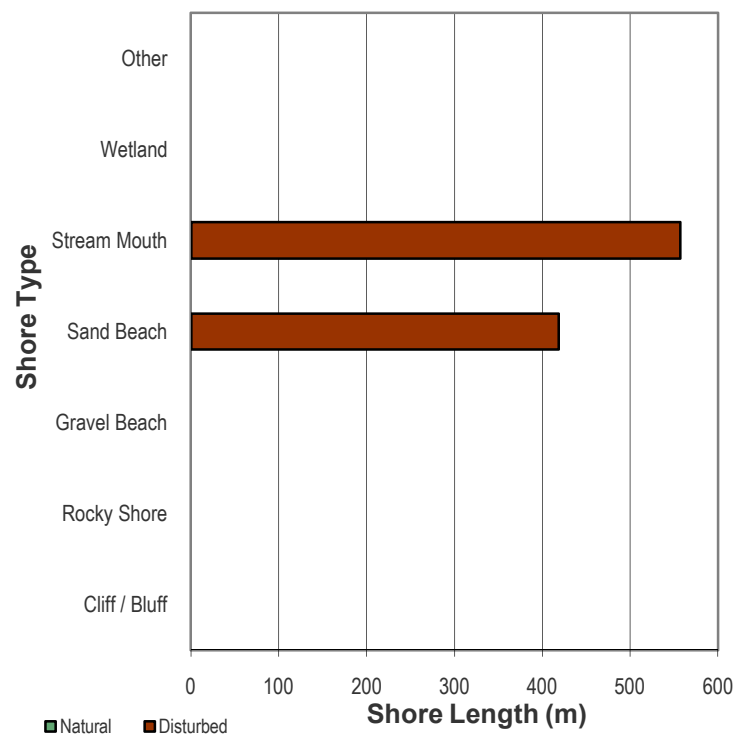


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	0.0%	0	0	0.0	0	0
Rocky Shore	0.0%	0	0	0.0	0	0
Gravel Beach	0.0%	0	0	0.0	0	0
Sand Beach	42.9%	418	0	417.8	0.0%	100.0%
Stream Mouth	57.1%	556	0	556.1	0.0%	100.0%
Wetland	0.0%	0	0	0.0	0	0
Other	0.0%	0	0	0.0	0	0
Total	100.00%	974				

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	0.0%	0
Submergent Vegetation	0.0%	0
Emergent Vegetation	0.0%	0
Floating Vegetation	0.0%	0

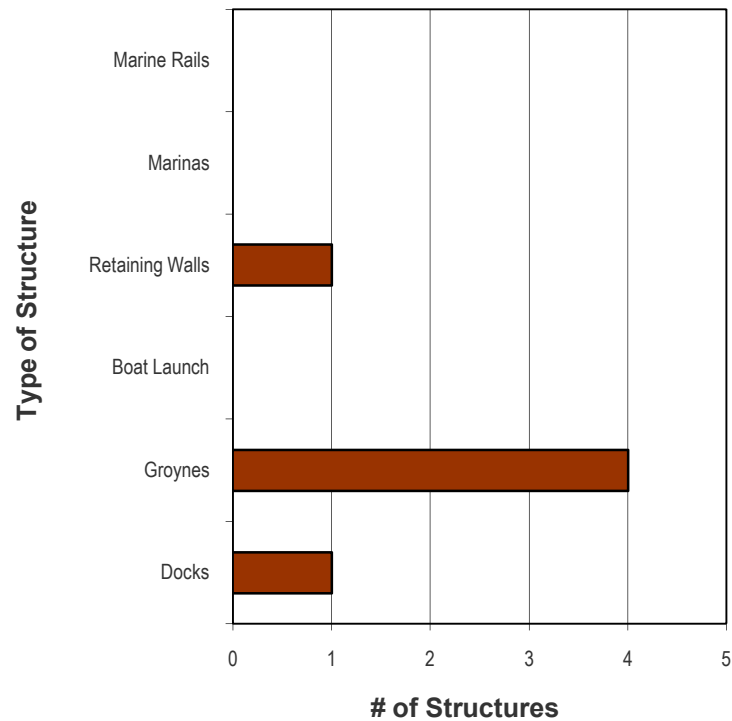


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	1	1.03
Groynes	4	4.11
Boat Launch	0	0.00
Retaining Walls	1	1.03
Marinas	0	0.00
Marine Rails	0	0.00

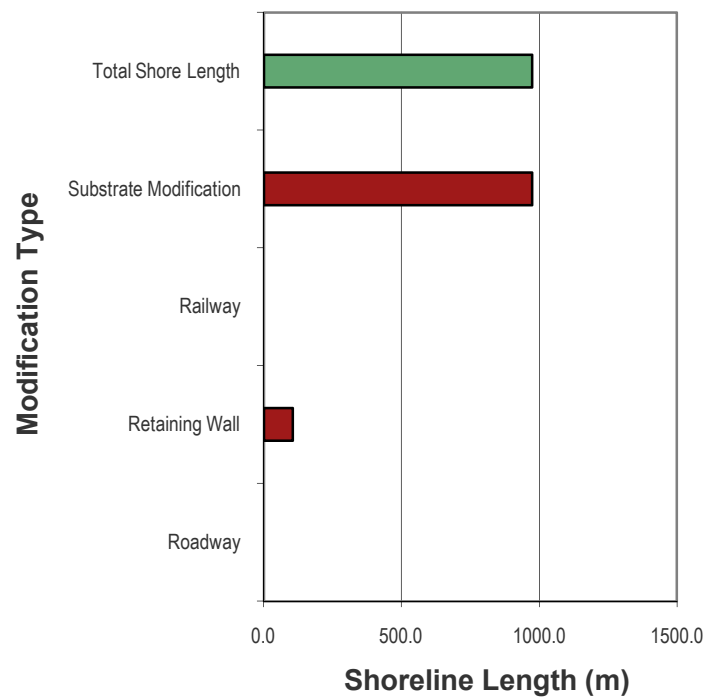


Figure 7: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	0%	0.0
Retaining Wall	11%	104.5
Railway	0%	0.0
Substrate Modification	100%	974.0
Total Shore Length		974.0

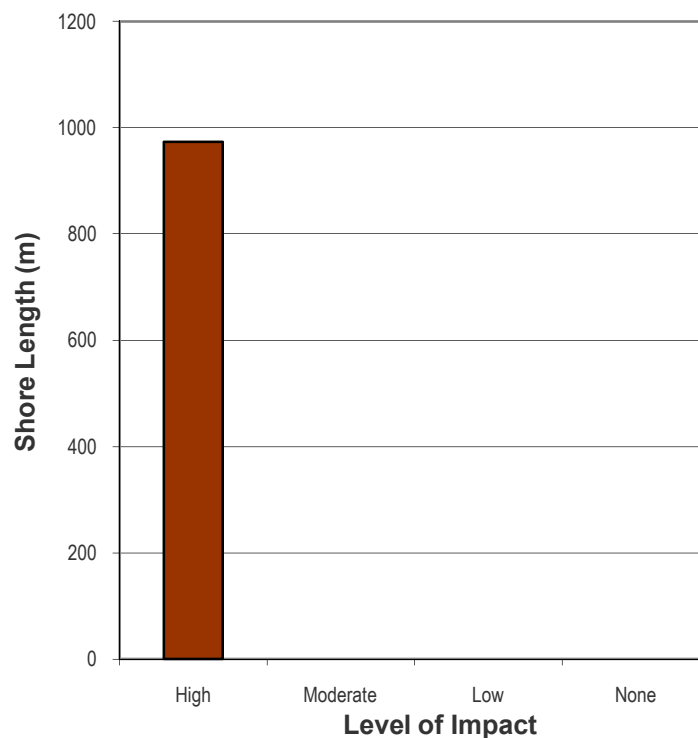


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	100.00%	974
Moderate	0.00%	0
Low	0.00%	0
None	0.00%	0
Shore Length		974.0

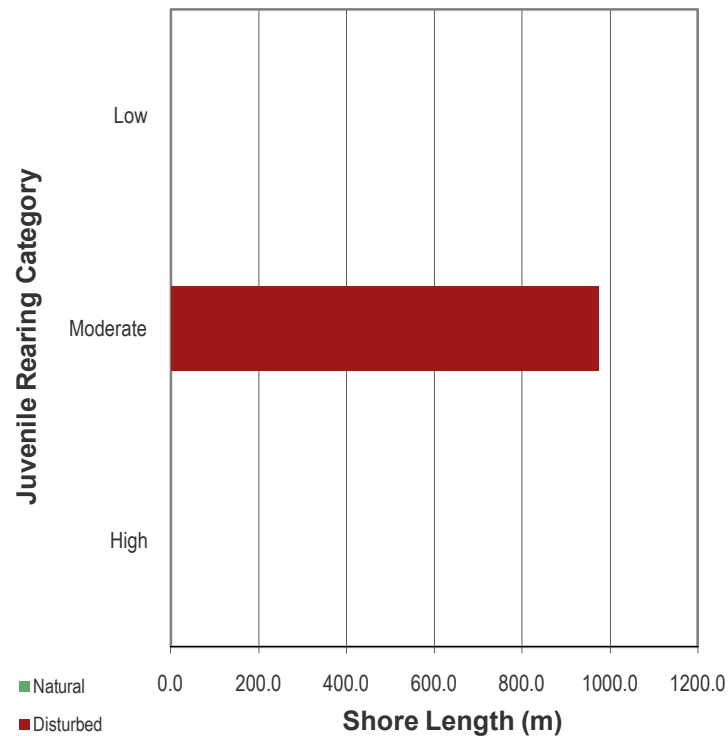


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	0	0.0	0	0.0	0	0
Moderate	2	0.0	0.0%	974.0	100.0%	974.0
Low	0	0.0	0	0.0	0	0
						0

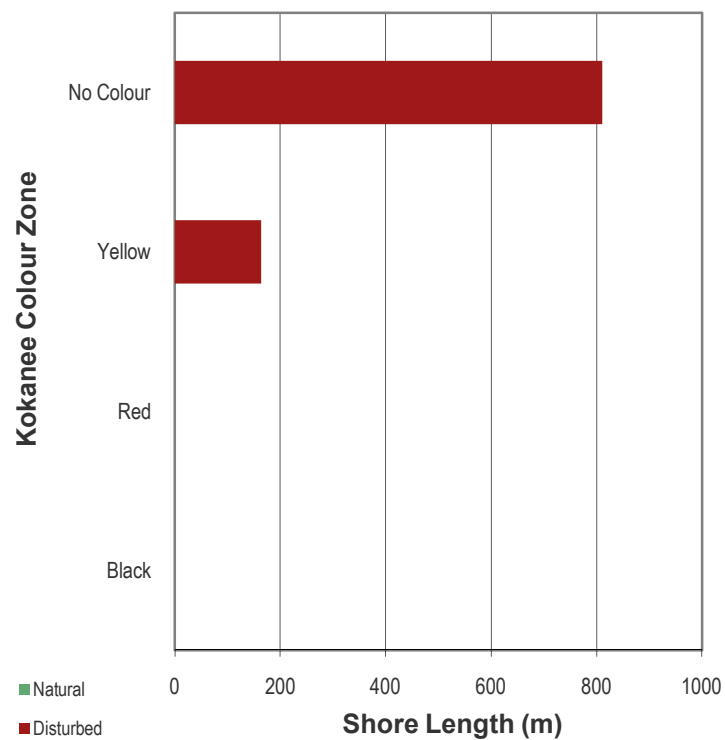


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	0	0	0.0%	100.0%	0.0%	100.0%
0	0	0	0	0	163	0	811

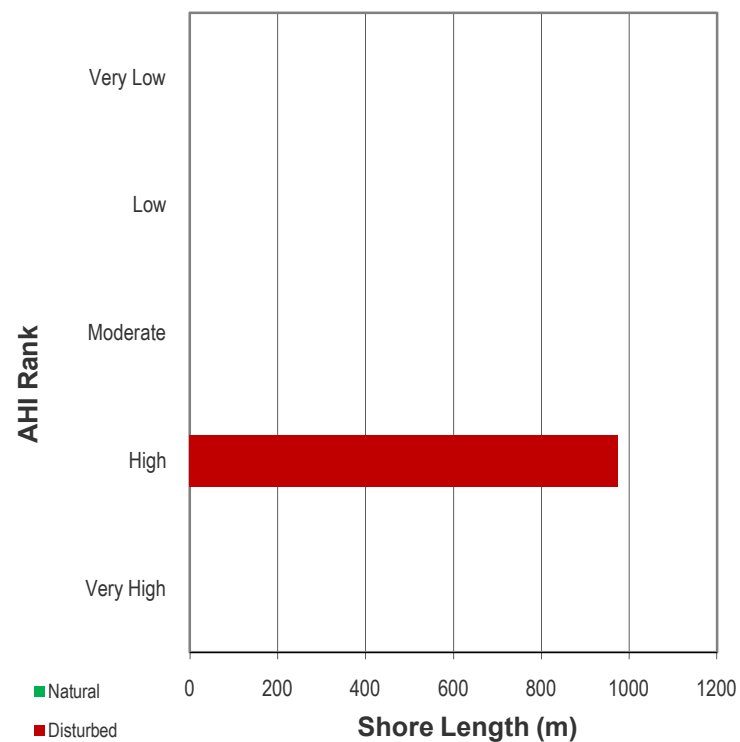


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	0	0	0	0
High	0	0.0%	973.9615286	100.0%
Moderate	0	0	0	0
Low	0	0	0	0
Very Low	0	0	0	0

APPENDIX O

Okanagan Indian Band Results



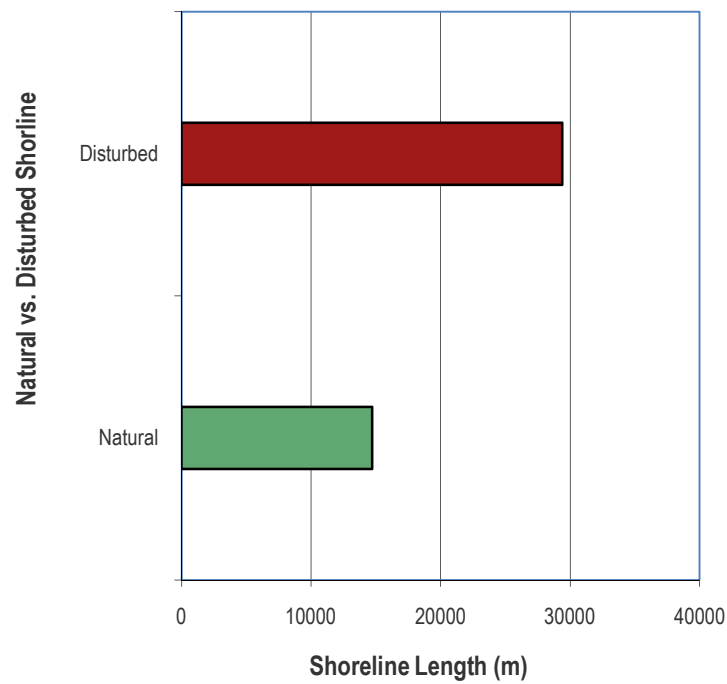


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	33.33%	14695
Disturbed	66.67%	29398
Total		44093.5

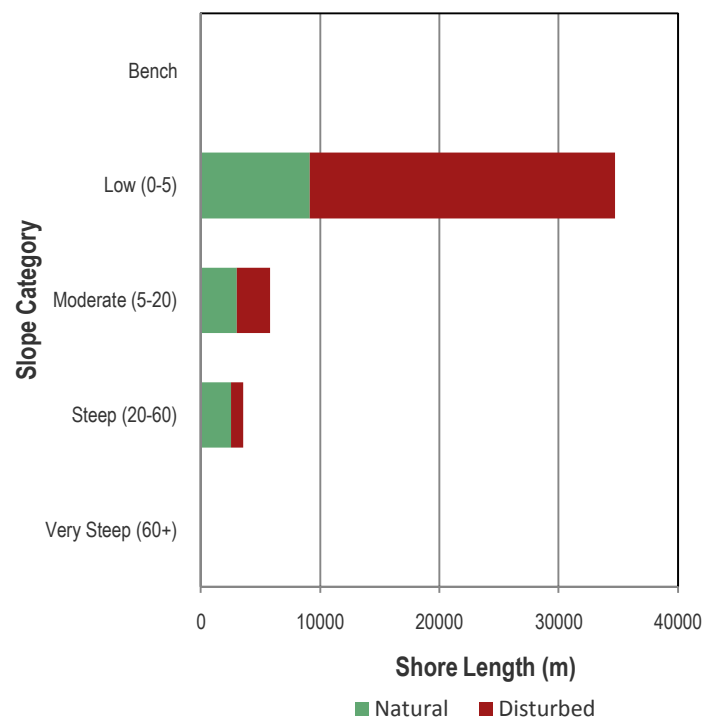


Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0.0	0	0	0	0	0
Steep (20-60)	8.0	3542	2557	985	72.2	27.8
Moderate (5-20)	13.2	5824	3027	2797	52.0	48.0
Low (0-5)	78.8	34728	9111	25617	26.2	73.8
Bench	0.0	0	0	0	0	0
Total	100.0	44093	14695	29398	33.3	66.7

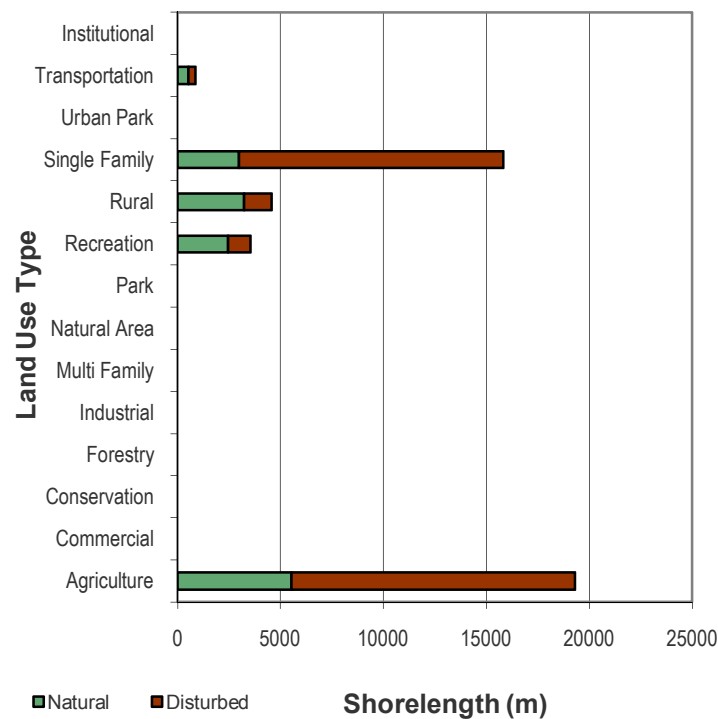


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	43.8%	19311	5525	13786	28.6%	71.4%
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	0.0%	0	0	0	0	0
Recreation	8.0%	3548	2455	1093	69.2%	30.8%
Rural	10.4%	4564	3220	1344	70.6%	29.4%
Single Family	35.9%	15817	2984	12833	18.9%	81.1%
Urban Park	0.0%	0	0	0	0	0
Transportation	1.9%	854	513	342	60.0%	40.0%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	44093.5				

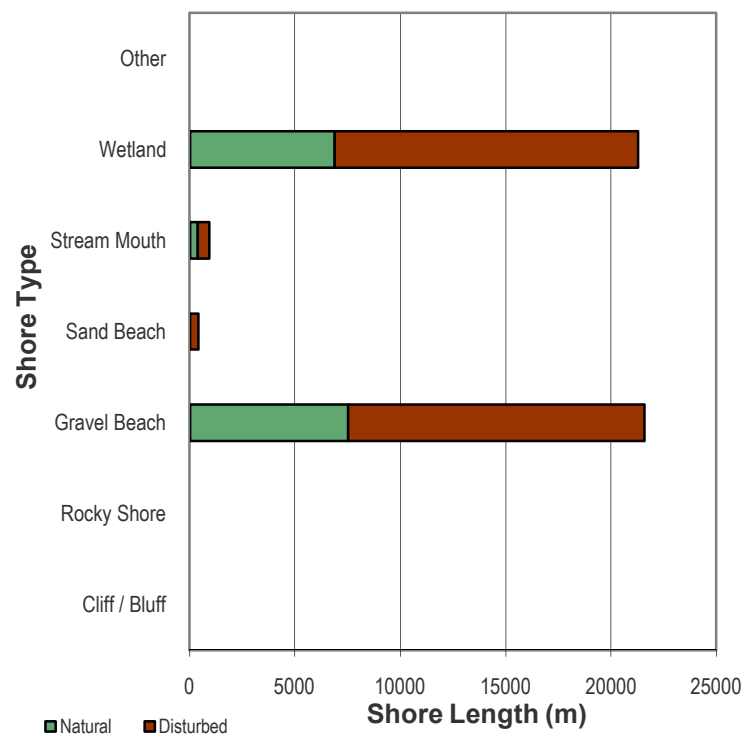


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	0.0%	0	0	0.0	0	0
Rocky Shore	0.0%	0	0	0.0	0	0
Gravel Beach	48.9%	21552	7486	14066.1	34.7%	65.3%
Sand Beach	0.9%	380	0	379.9	0.0%	100.0%
Stream Mouth	2.1%	922	351	570.6	38.1%	61.9%
Wetland	48.2%	21240	6859	14381.5	32.3%	67.7%
Other	0.0%	0	0	0.0	0	0
Total	100.00%	44093				

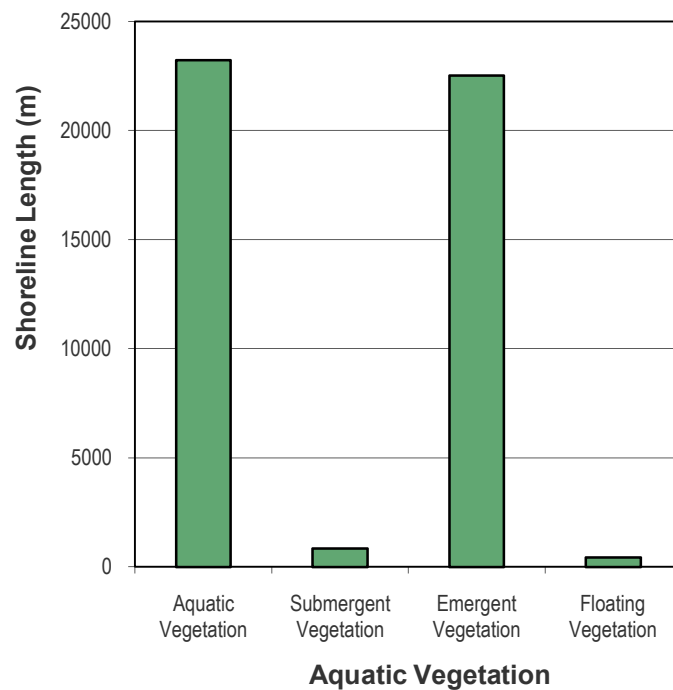


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	52.7%	23225
Submergent Vegetation	1.9%	829
Emergent Vegetation	51.1%	22510
Floating Vegetation	1.0%	439

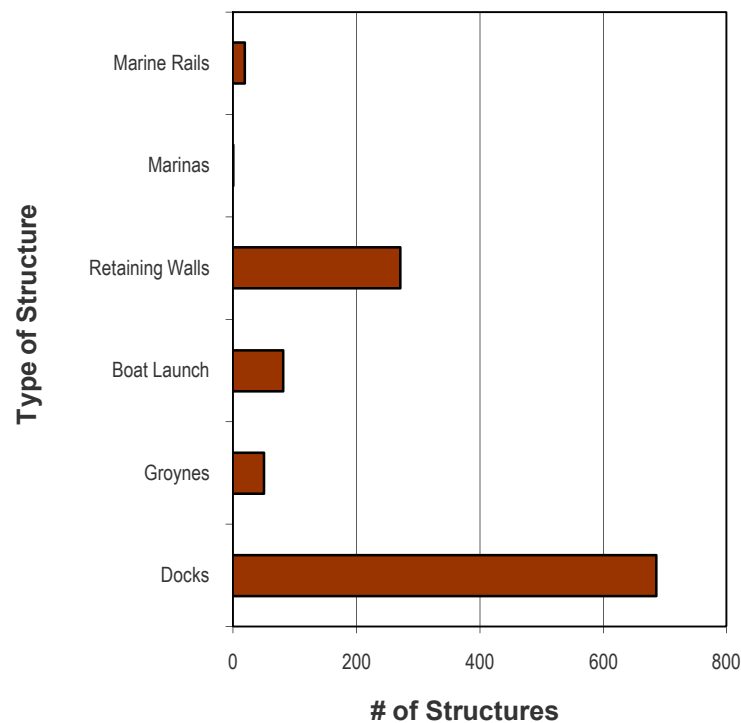
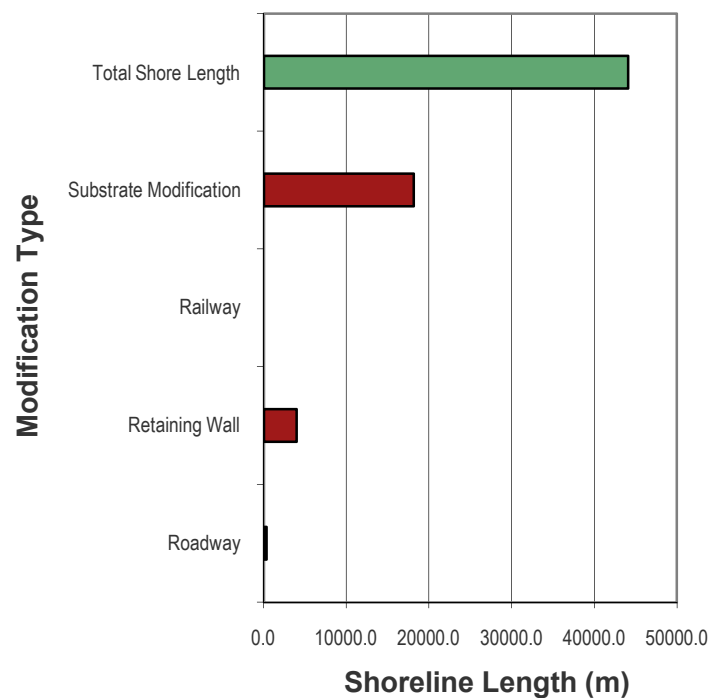


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	686	15.56
Groynes	51	1.16
Boat Launch	82	1.86
Retaining Walls	271	6.15
Marinas	1	0.02
Marine Rails	19	0.43



. **Figure 7:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	1%	341.7
Retaining Wall	9%	3983.8
Railway	0%	0.0
Substrate Modification	41%	18158.6
Total Shore Length		44093.5

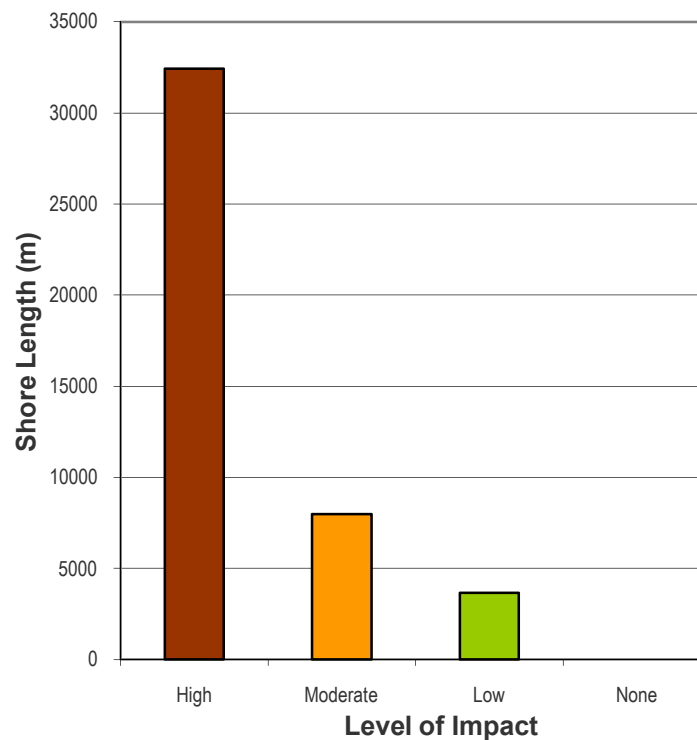


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	73.57%	32437
Moderate	18.09%	7977
Low	8.34%	3679
None	0.00%	0
Shore Length		44093.5

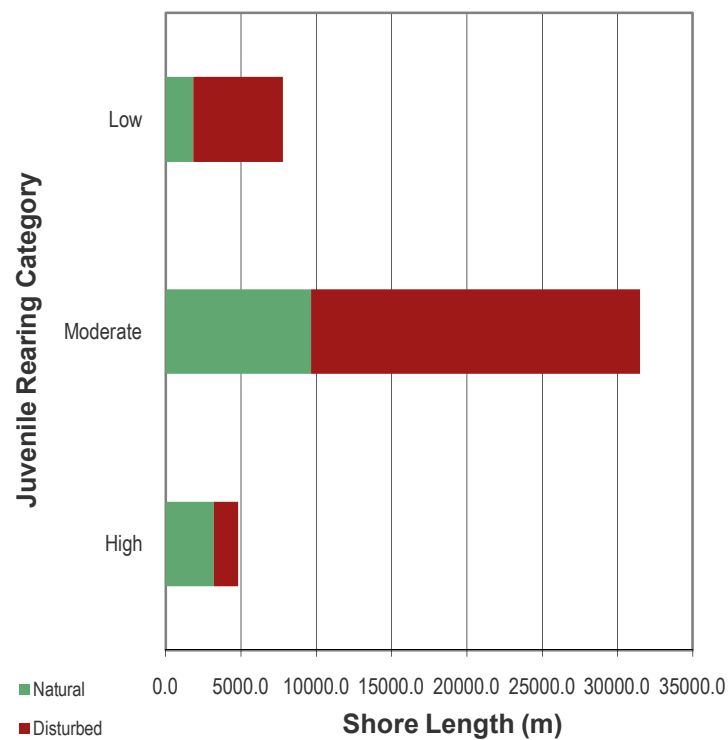


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	5	3210.7	66.6%	1609.2	33.4%	4820.6
Moderate	20	9632.6	30.6%	21875.9	69.4%	31508.8
Low	6	1852.1	23.9%	5912.9	76.1%	7765.3

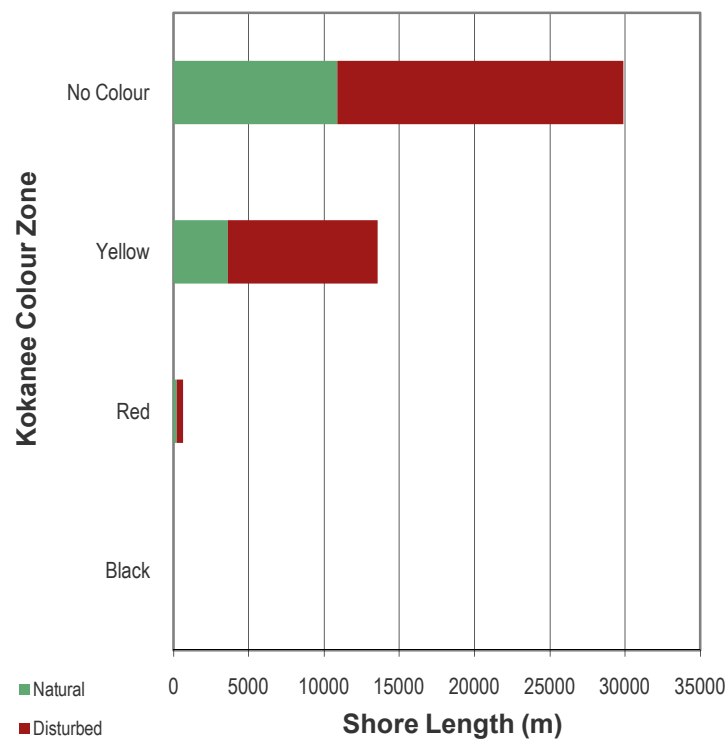


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	30.6%	69.4%	26.7%	73.3%	36.4%	63.6%
0	0	197	447	3624	9953	10874	18998

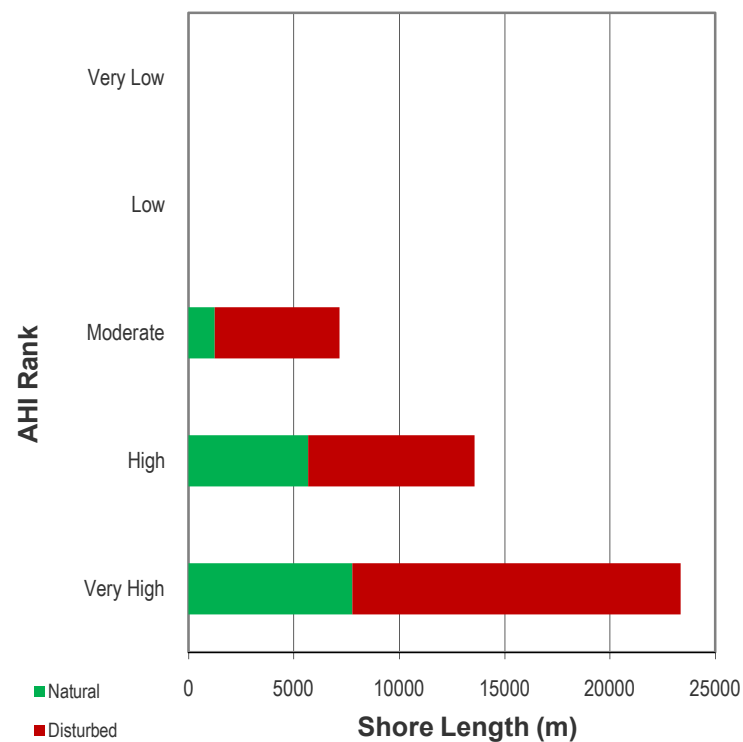


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	7770.43686	33.3%	15589.0952	66.7%
High	5690.751354	42.0%	7864.842609	58.0%
Moderate	1234.25726	17.2%	5944.077951	82.8%
Low	0	0	0	0
Very Low	0	0	0	0

APPENDIX P

City of Penticton



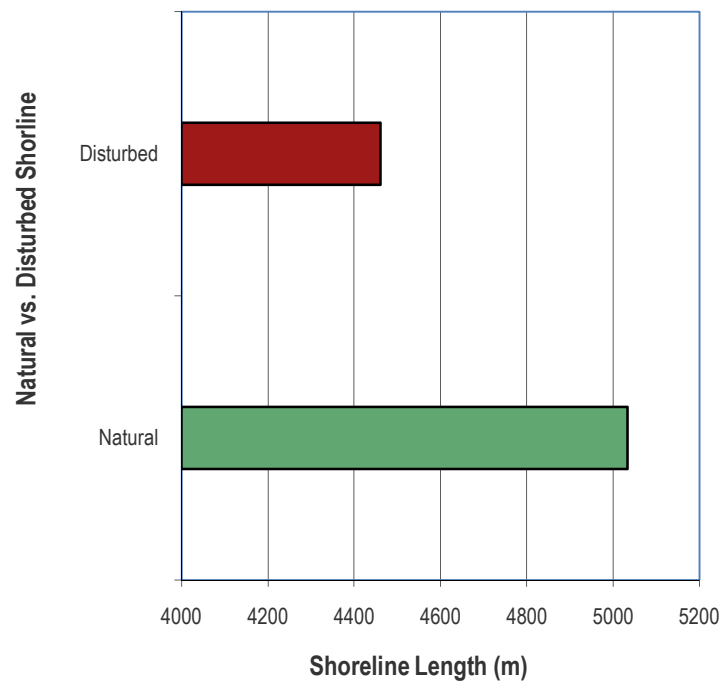


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	53.01%	5033
Disturbed	46.99%	4461
Total		9493.6



Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0.0	0	0	0	0	0
Steep (20-60)	54.4	5167	4505	662	87.2	12.8
Moderate (5-20)	2.5	234	23	211	10.0	90.0
Low (0-5)	36.3	3450	183	3267	5.3	94.7
Bench	6.8	642	321	321	50.0	50.0
Total	100.0	9494	5033	4461	53.0	47.0

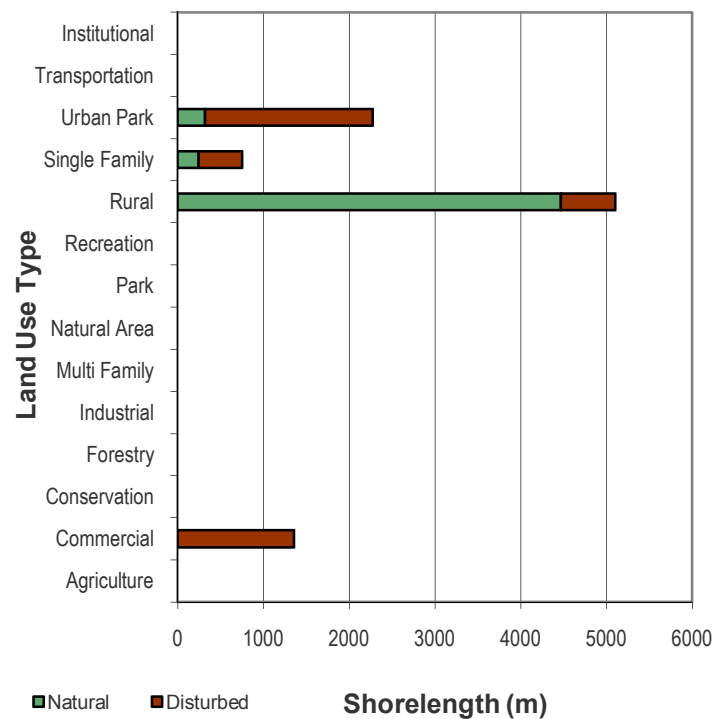


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	14.3%	1359	0	1359	0.0%	100.0%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	0.0%	0	0	0	0	0
Recreation	0.0%	0	0	0	0	0
Rural	53.8%	5105	4467	638	87.5%	12.5%
Single Family	7.9%	754	244	511	32.3%	67.7%
Urban Park	24.0%	2275	321	1953	14.1%	85.9%
Transportation	0.0%	0	0	0	0	0
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	9493.6				

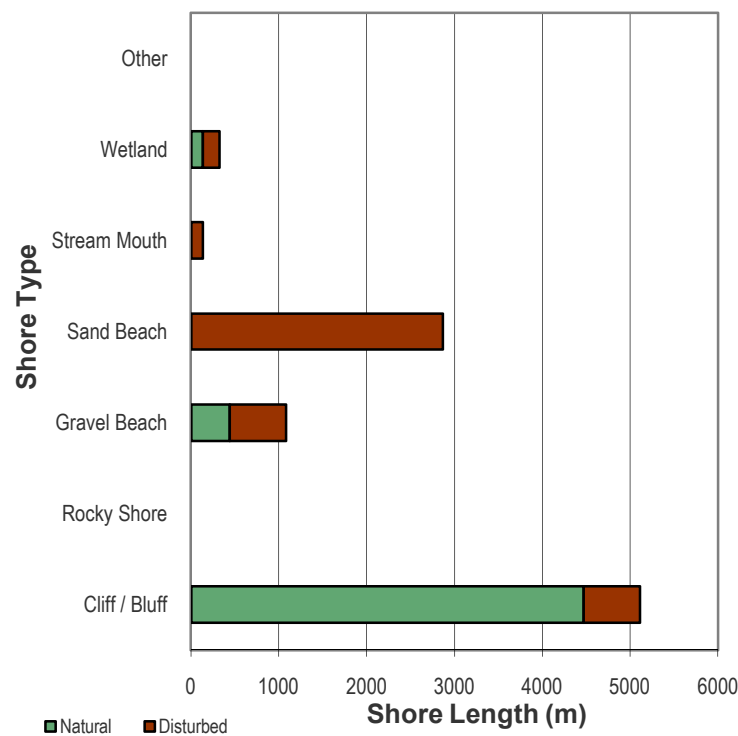


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	53.8%	5105	4467	637.6	87.5%	12.5%
Rocky Shore	0.0%	0	0	0.0	0	0
Gravel Beach	11.3%	1076	437	639.3	40.6%	59.4%
Sand Beach	30.2%	2864	0	2864.1	0.0%	100.0%
Stream Mouth	1.3%	128	0	127.6	0.0%	100.0%
Wetland	3.4%	321	128	192.5	40.0%	60.0%
Other	0.0%	0	0	0.0	0	0
Total	100.00%	9494				

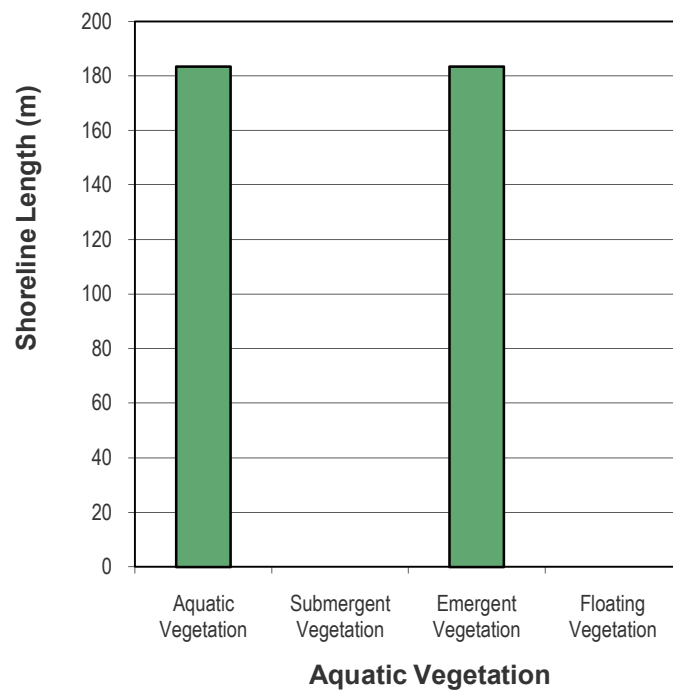


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	1.9%	183
Submergent Vegetation	0.0%	0
Emergent Vegetation	1.9%	183
Floating Vegetation	0.0%	0

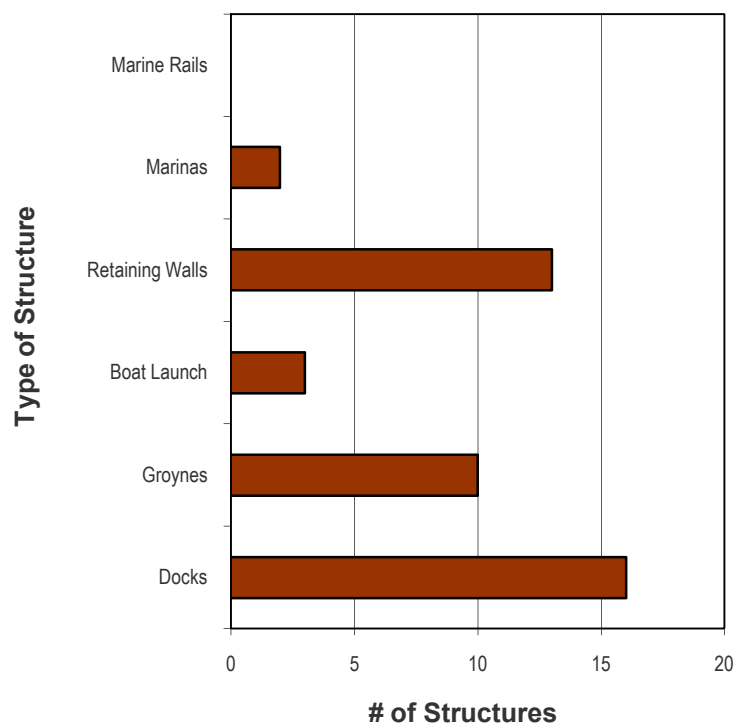


Figure 6: The total number of different types of modifications on Okanagan Lake

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	16	1.69
Groynes	10	1.05
Boat Launch	3	0.32
Retaining Walls	13	1.37
Marinas	2	0.21
Marine Rails	0	0.00

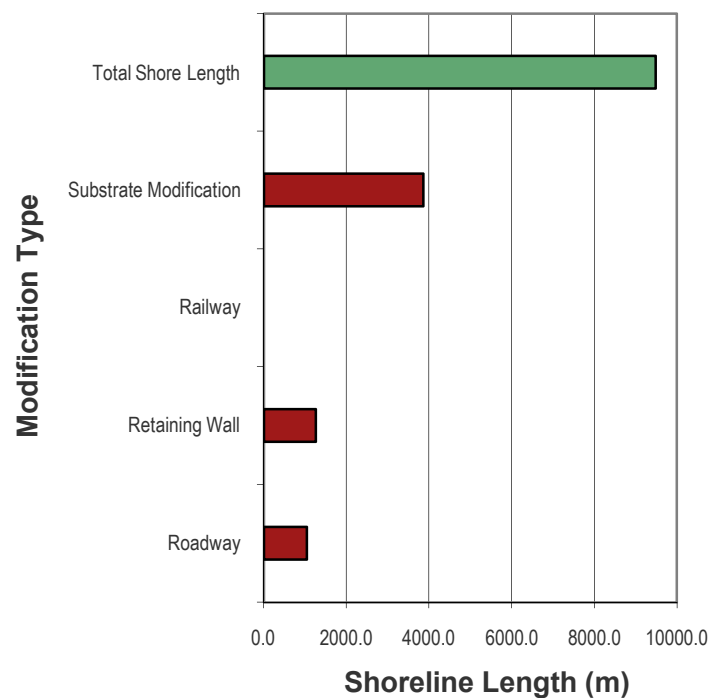


Figure 7: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	11%	1034.1
Retaining Wall	13%	1254.8
Railway	0%	0.0
Substrate Modification	41%	3862.6
Total Shore Length		9493.6

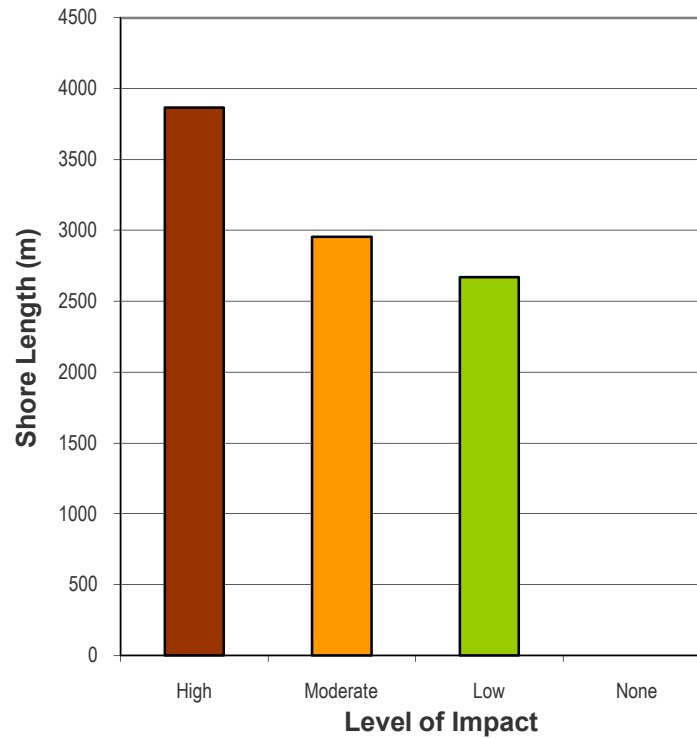


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	40.75%	3868
Moderate	31.11%	2954
Low	28.14%	2672
None	0.00%	0
Shore Length		9493.6

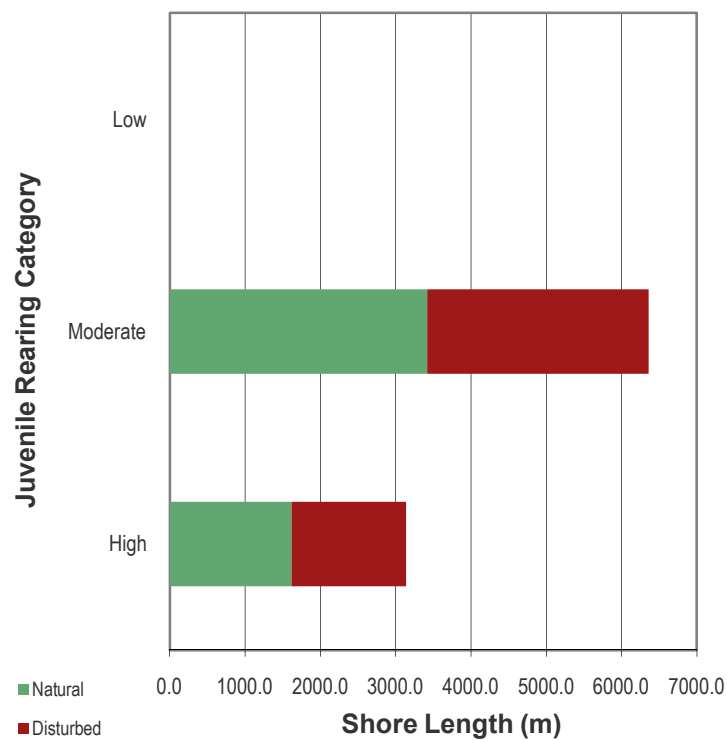


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	3	1618.9	51.7%	1514.6	48.3%	3134.0
Moderate	7	3413.6	53.7%	2946.5	46.3%	6360.7
Low	0	0.0	0	0.0	0	0

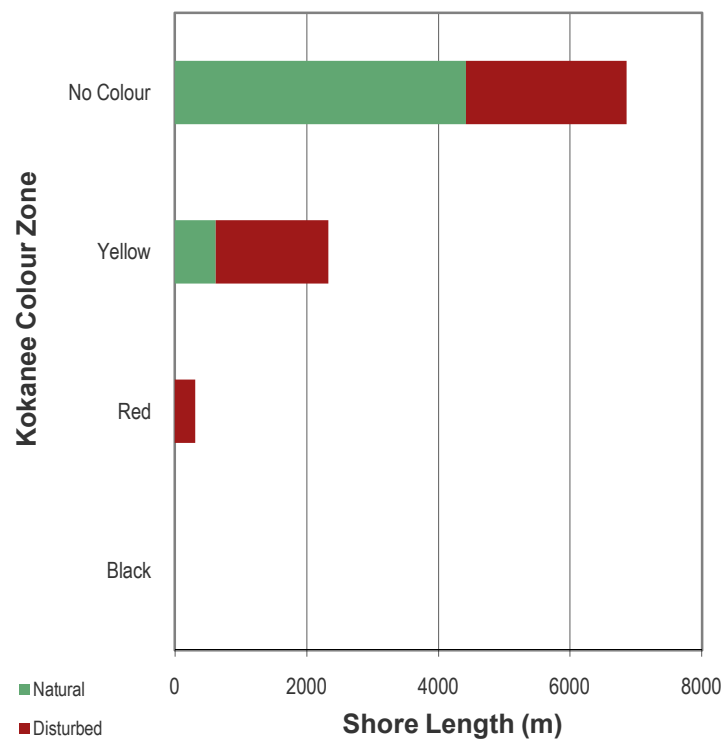


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	0.0%	100.0%	26.6%	73.4%	64.3%	35.7%
0	0	0	309	619	1706	4414	2446

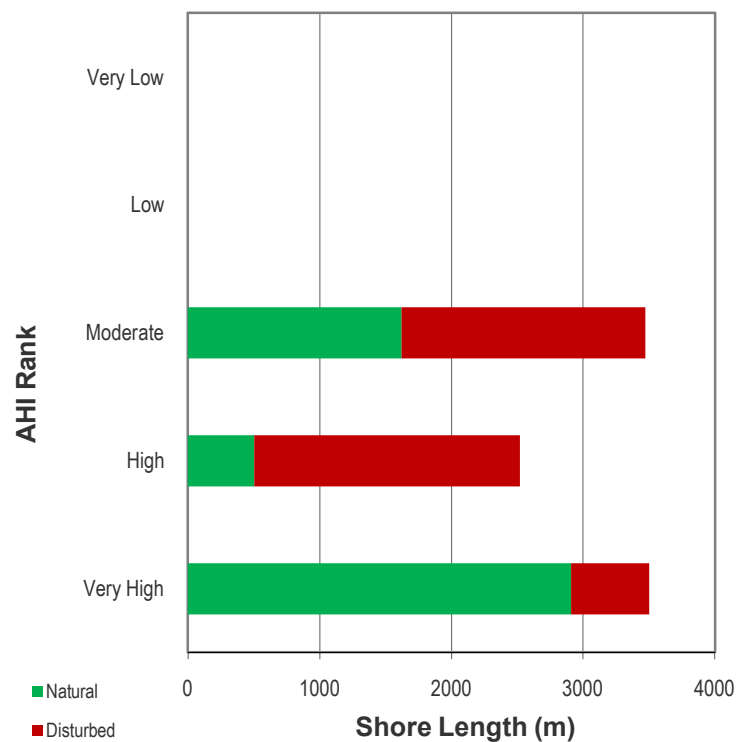


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	2909.064653	83.1%	593.4646899	16.9%
High	504.566172	20.0%	2015.771296	80.0%
Moderate	1618.908406	46.6%	1851.860402	53.4%
Low	0	0	0	0
Very Low	0	0	0	0

APPENDIX Q

BC Parks

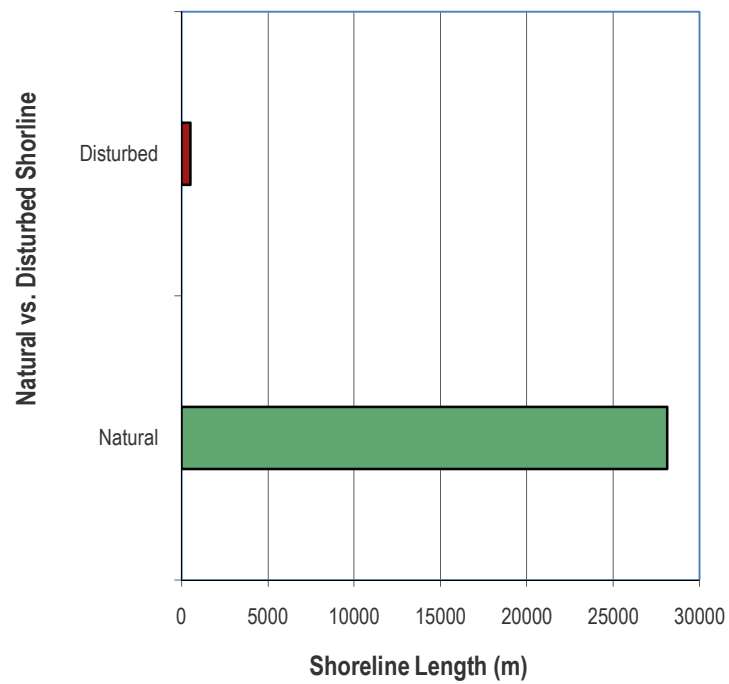


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	98.14%	28117
Disturbed	1.86%	532
Total		28649.2



Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0.0	0	0	0	0	0
Steep (20-60)	100.0	28649	28117	532	98.1	1.9
Moderate (5-20)	0.0	0	0	0	0	0
Low (0-5)	0.0	0	0	0	0	0
Bench	0.0	0	0	0	0	0
Total	100.0	28649	28117	532	98.1	1.9

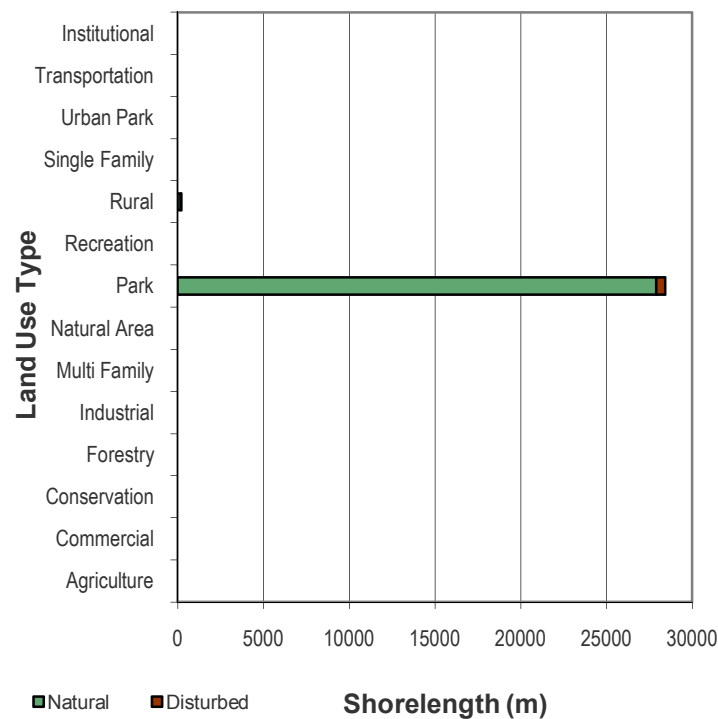


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0	0
Commercial	0.0%	0	0	0	0	0
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	99.3%	28445	27915	530	98.1%	1.9%
Recreation	0.0%	0	0	0	0	0
Rural	0.7%	205	202	2	99.0%	1.0%
Single Family	0.0%	0	0	0	0	0
Urban Park	0.0%	0	0	0	0	0
Transportation	0.0%	0	0	0	0	0
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	28649.2				

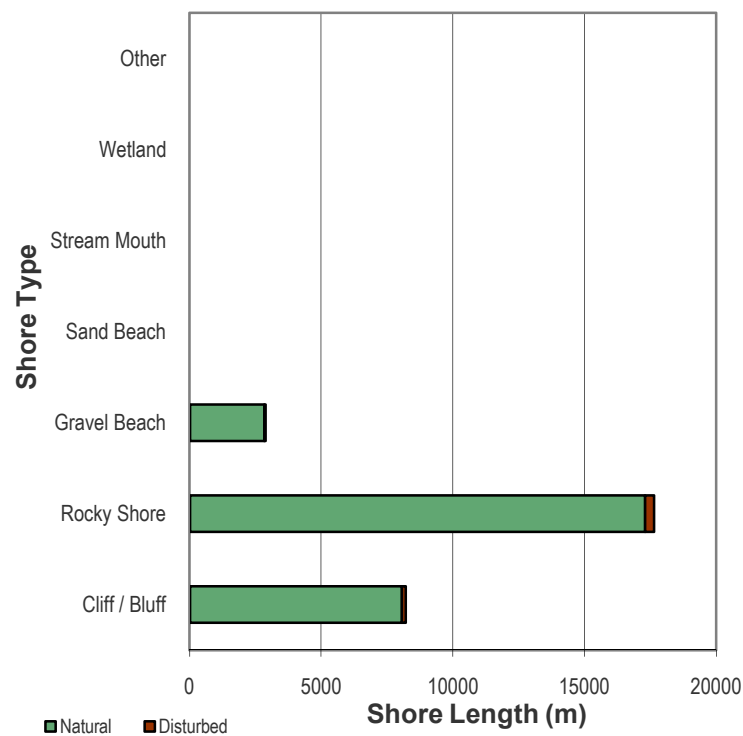


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	28.6%	8186	8030	155.5	98.1%	1.9%
Rocky Shore	61.4%	17599	17275	323.3	98.2%	1.8%
Gravel Beach	10.0%	2865	2812	53.2	98.1%	1.9%
Sand Beach	0.0%	0	0	0.0	0	0
Stream Mouth	0.0%	0	0	0.0	0	0
Wetland	0.0%	0	0	0.0	0	0
Other	0.0%	0	0	0.0	0	0
Total	100.00%	28649				

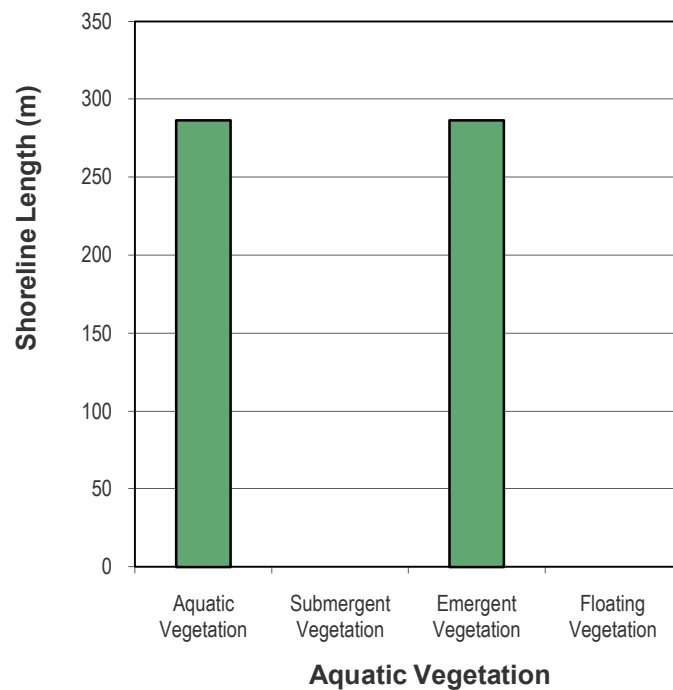


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	1.0%	286
Submergent Vegetation	0.0%	0
Emergent Vegetation	1.0%	286
Floating Vegetation	0.0%	0

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	0	0.00
Groynes	0	0.00
Boat Launch	0	0.00
Retaining Walls	0	0.00
Marinas	0	0.00
Marine Rails	0	0.00

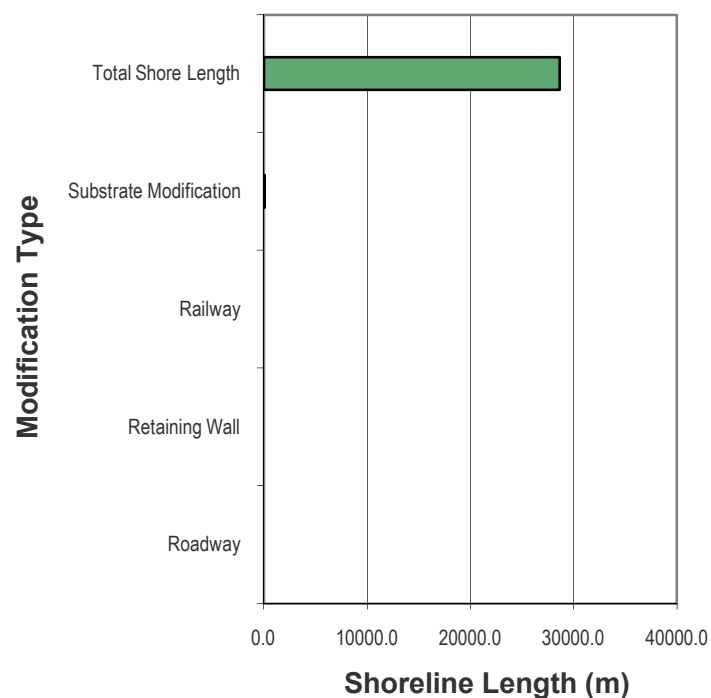


Figure 7: The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	0%	0.0
Retaining Wall	0%	0.0
Railway	0%	0.0
Substrate Modification	0%	40.9
Total Shore Length		28649.2

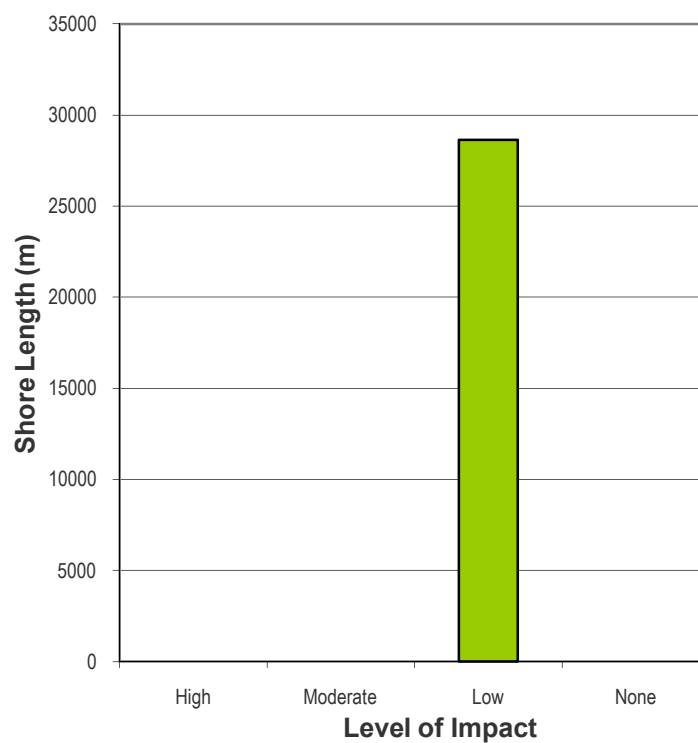


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	0.00%	0
Moderate	0.00%	0
Low	100.00%	28649
None	0.00%	0
Shore Length		28649.2

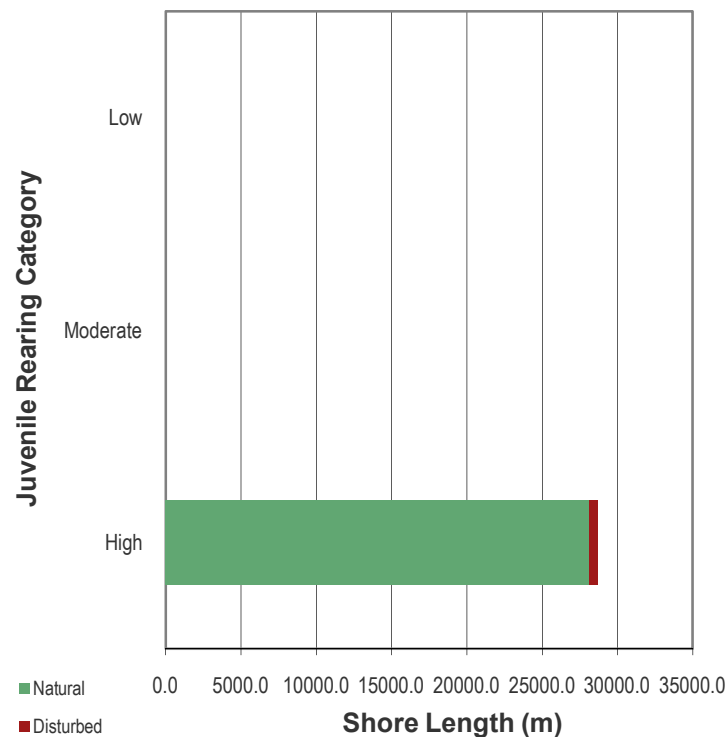


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	5	28117.1	98.1%	532.1	1.9%	28650.2
Moderate	0	0.0	0	0.0	0	0
Low	0	0.0	0	0.0	0	0
						0

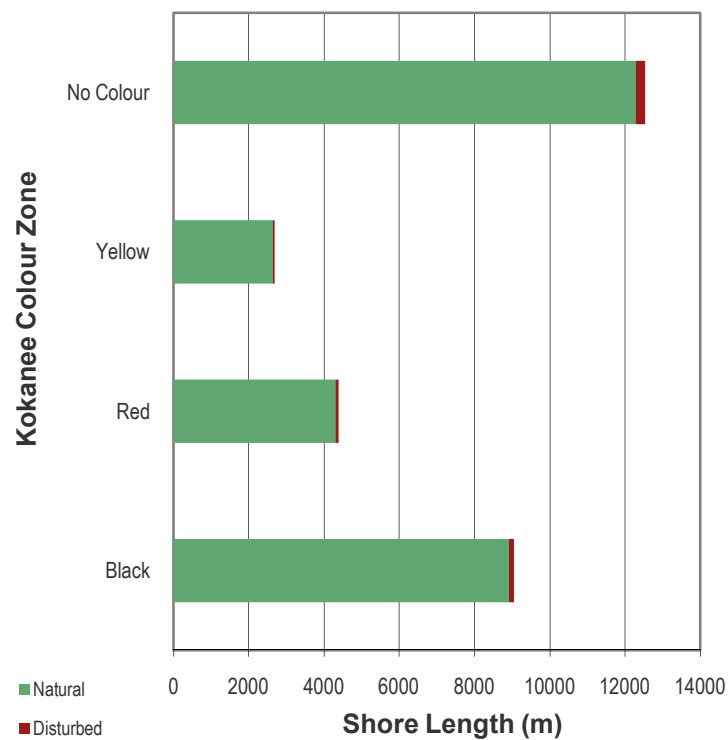


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
98.4%	1.6%	98.0%	2.0%	98.0%	2.0%	98.0%	2.0%
8907	141	4294	87	2635	54	12281	251

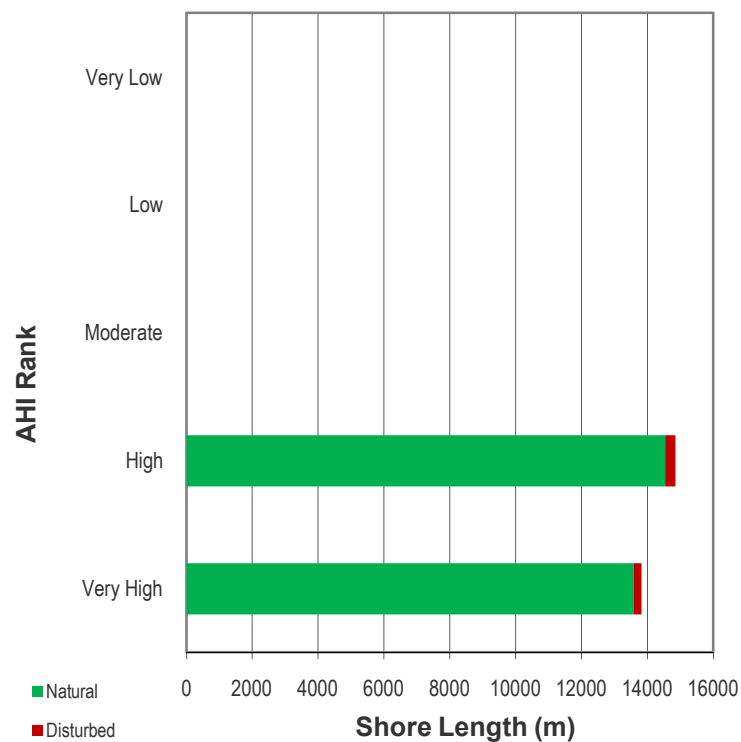


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	13578.67185	98.3%	235.3764334	1.7%
High	14538.4353	98.0%	296.7027612	2.0%
Moderate	0	0	0	0
Low	0	0	0	0
Very Low	0	0	0	0

APPENDIX R

District of Summerland Results



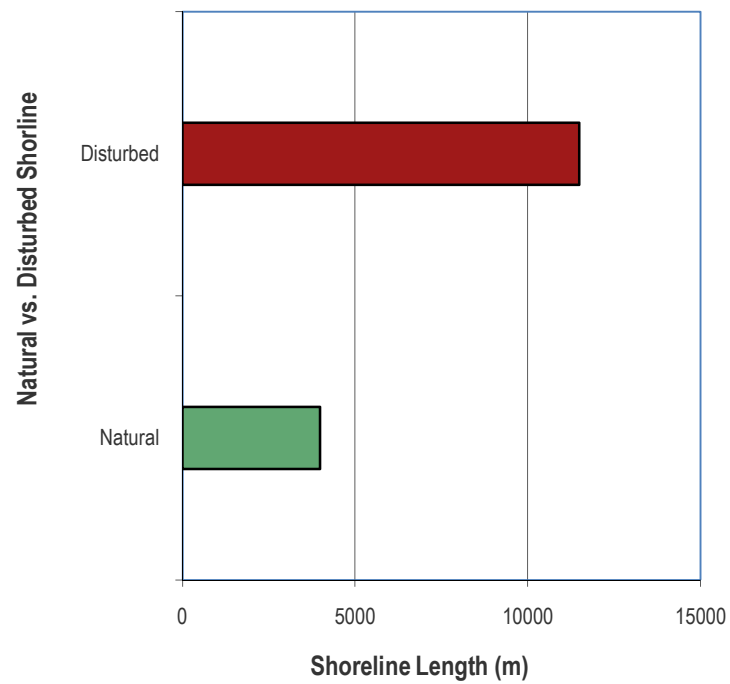


Figure 1: The percent of natural and disturbed shoreline.

Table 1: The total shore length of percentage of shore length along Okanagan Lake

	% of Shoreline	Shore Length (m)
Natural	25.78%	3988
Disturbed	74.22%	11485
Total		15473.5

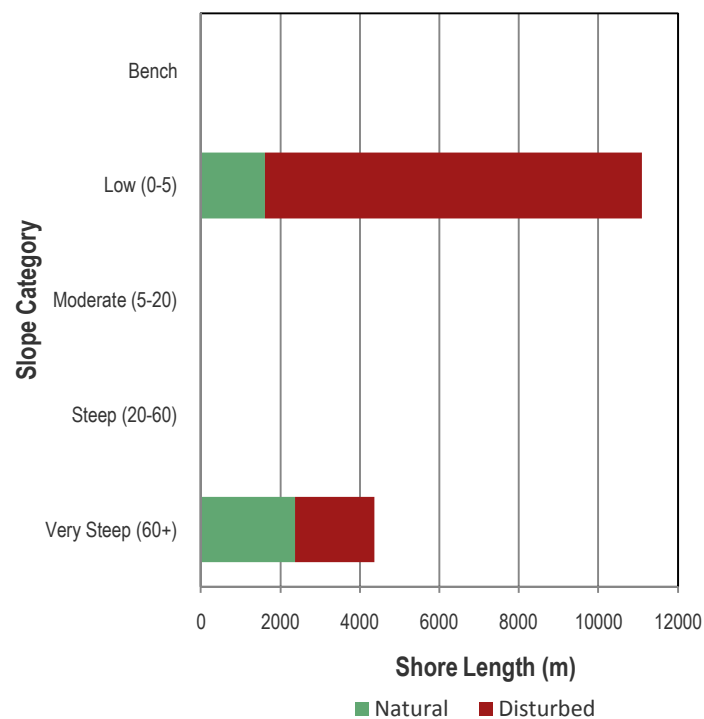


Figure 2: The length of natural and disturbed shorelines in each slope category.

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	28.3	4372	2375	1998	54.3	45.7
Steep (20-60)	0.0	0	0	0	0	0
Moderate (5-20)	0.0	0	0	0	0	0
Low (0-5)	71.7	11101	1614	9487	14.5	85.5
Bench	0.0	0	0	0	0	0
Total	100.0	15473	3988	11485	25.8	74.2

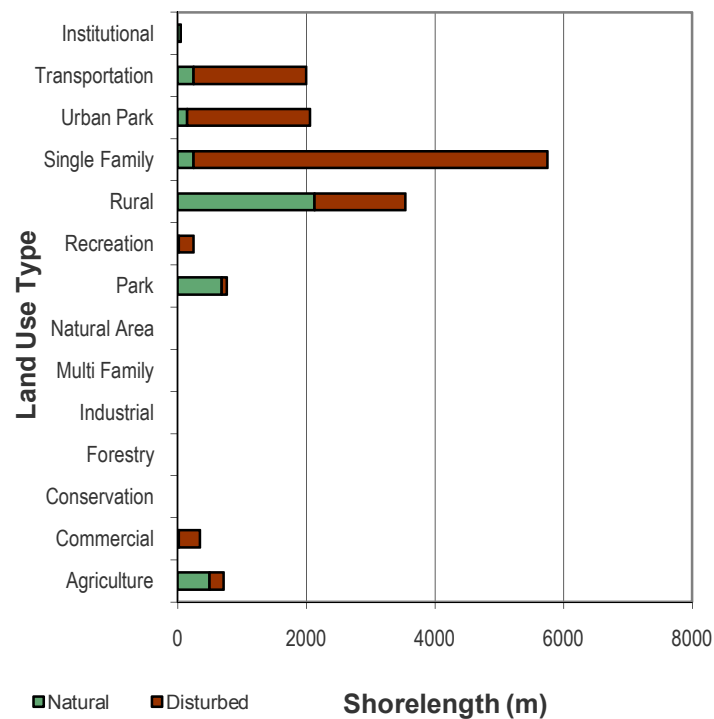


Figure 3: The length of natural and disturbed shoreline in each land use category

Table 3: The total length of natural and disturbed shorelines and their associated land uses around Okanagan Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	4.6%	714	500	214	70.0%	30.0%
Commercial	2.2%	346	15	330	4.5%	95.5%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0	0
Natural Area	0.0%	0	0	0	0.0%	0.0%
Park	4.9%	763	687	76	90.0%	10.0%
Recreation	1.6%	251	15	236	5.8%	94.2%
Rural	22.9%	3543	2126	1417	60.0%	40.0%
Single Family	37.1%	5748	246	5502	4.3%	95.7%
Urban Park	13.3%	2061	151	1910	7.3%	92.7%
Transportation	12.9%	2000	249	1751	12.4%	87.6%
Institutional	0.3%	48	48	0	0.0%	0.0%
Total	100.0%	15473.5				

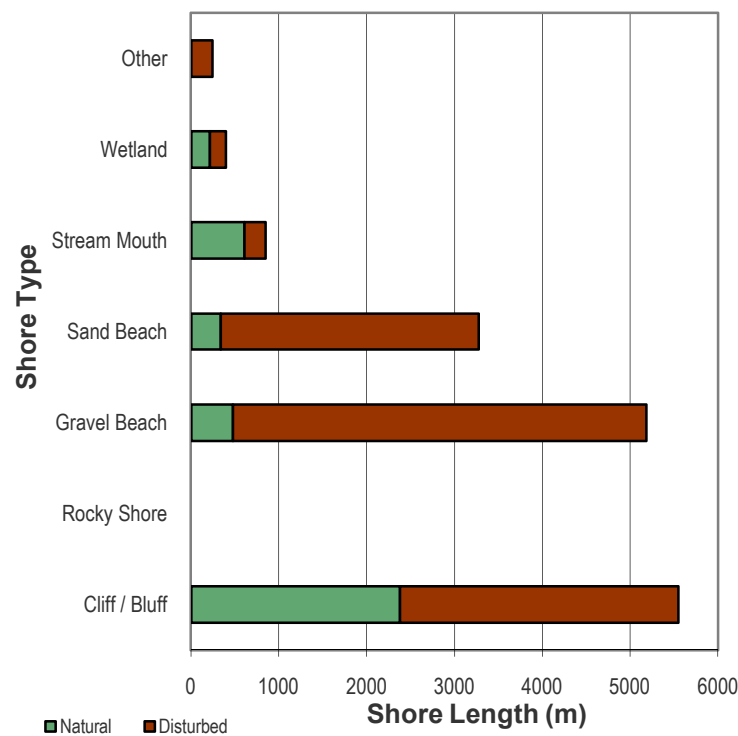


Figure 4: The length of natural and disturbed shoreline in each shore type category

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Okanagan Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	35.8%	5543	2375	3168.3	42.8%	57.2%
Rocky Shore	0.0%	0	0	0.0	0	0
Gravel Beach	33.5%	5180	473	4707.1	9.1%	90.9%
Sand Beach	21.2%	3273	331	2942.5	10.1%	89.9%
Stream Mouth	5.5%	844	599	244.8	71.0%	29.0%
Wetland	2.5%	393	211	182.7	53.6%	46.4%
Other	1.5%	240	0	239.6	0.0%	100.0%
Total	100.00%	15473				

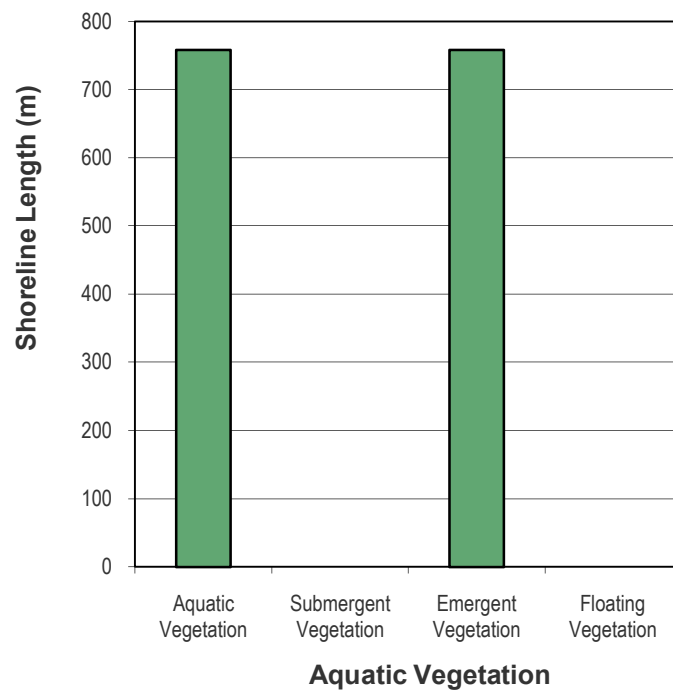


Figure 5: The shore length of each different type of aquatic vegetation.

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Okanagan Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	4.9%	758
Submergent Vegetation	0.0%	0
Emergent Vegetation	4.9%	758
Floating Vegetation	0.0%	0

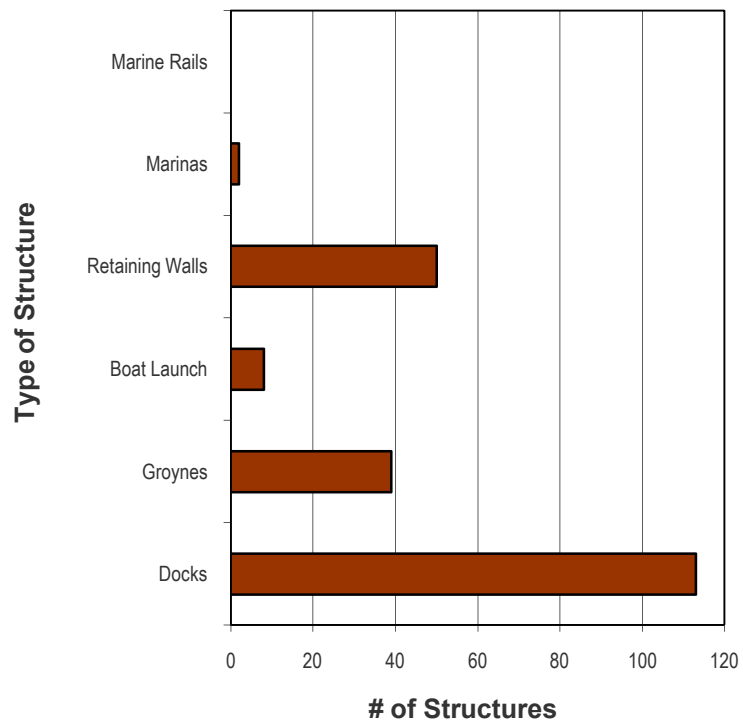
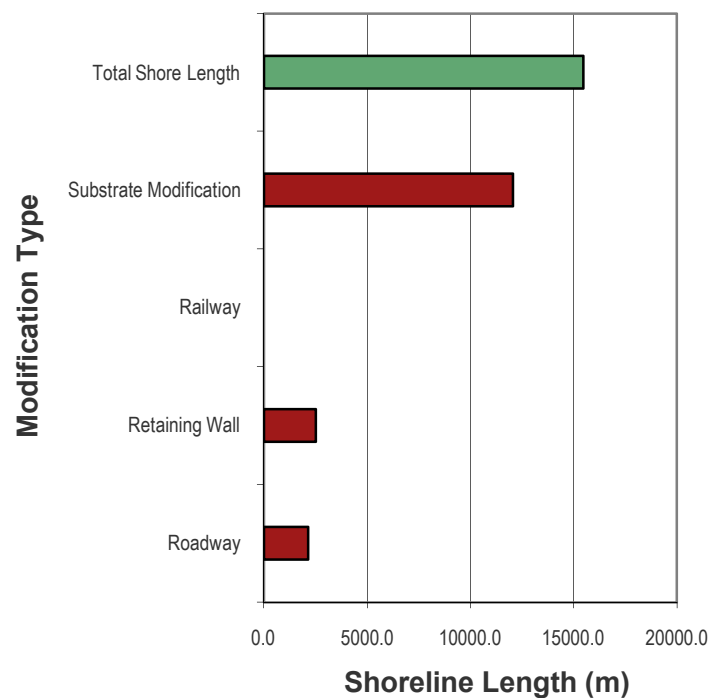


Figure 6: The number of different shore modifications observed.

Table 6: The total number and density (# per km) of different shoreline modifications occurring around Okanagan Lake

Type	Total #	# Per km
Docks	113	7.30
Groynes	39	2.52
Boat Launch	8	0.52
Retaining Walls	50	3.23
Marinas	2	0.13
Marine Rails	0	0.00



. **Figure 7:** The shore length of different shore modifiers were observed.

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Okanagan Lake

Category	% of Shoreline	Shorelength (m)
Roadway	14%	2159.7
Retaining Wall	16%	2518.4
Railway	0%	0.0
Substrate Modification	78%	12047.4
Total Shore Length		15473.5

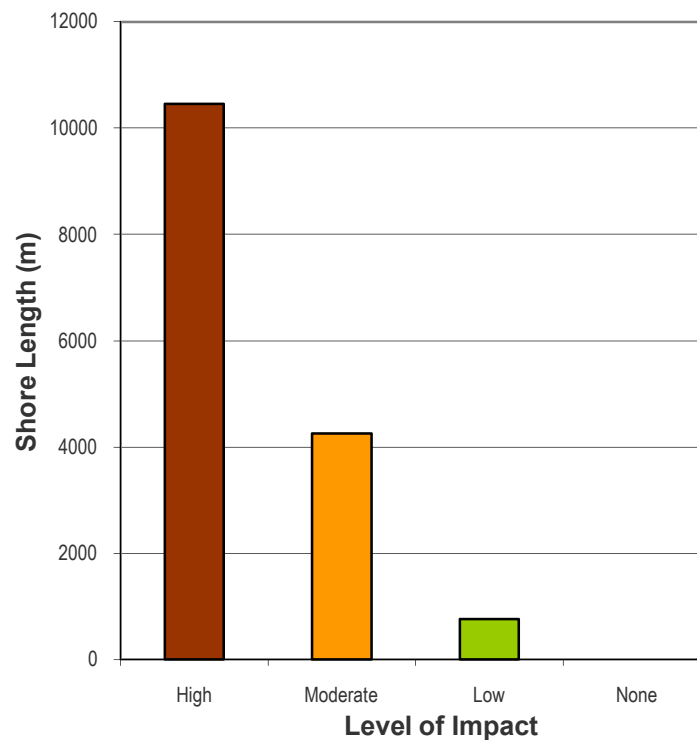


Figure 8: The shore length of different levels of impact on Okanagan Lake..

Table 8: The Level of Impact around Okanagan Lake (High > 40%, Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length
High	67.56%	10453
Moderate	27.51%	4257
Low	4.93%	763
None	0.00%	0
Shore Length		15473.5

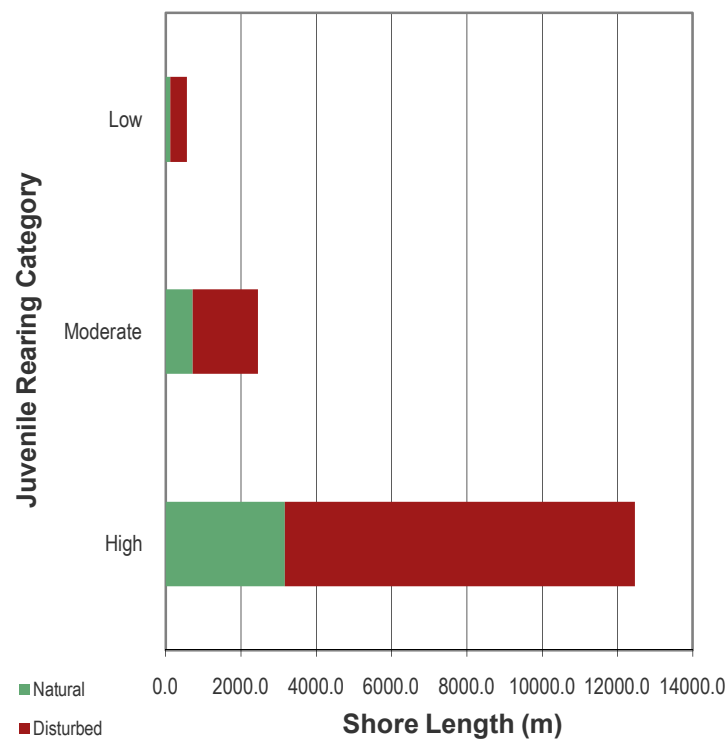


Figure 9: The natural and disturbed shore length of areas classified as having and High, Moderate, or Low Juvenile Rearing ranking.

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on Okanagan Lake.

Juvenile Rearing Category	# of Segments	Shore Length (m or %)				Total
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	
High	12	3161.1	25.4%	9301.0	74.6%	12462.4
Moderate	4	713.5	29.2%	1729.2	70.8%	2442.9
Low	1	113.7	20.0%	455.0	80.0%	568.9
						15474.2

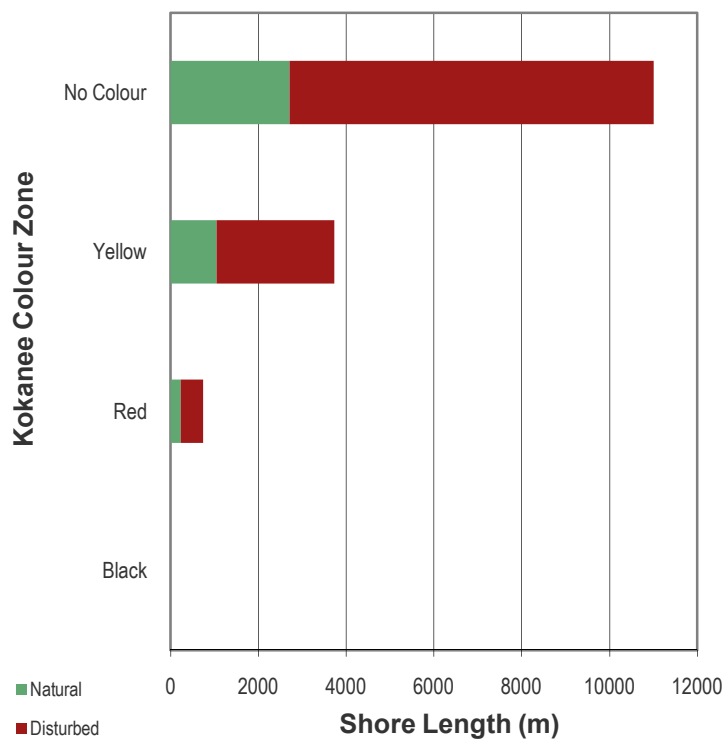


Figure 10: The length of natural and disturbed shoreline in the different shore spawning kokanee zones.

Table 10: The length of natural and disturbed shorelines within the different Okanagan Large Lakes Protocol Kokanee Shore Spawning areas.

Black		Red		Yellow		No Colour	
Natural	Disturbed	Natural	Disturbed	Natural	Disturbed	Natural	Disturbed
0	0	31.6%	68.4%	28.0%	72.0%	24.6%	75.4%
0	0	236	510	1046	2684	2706	8291

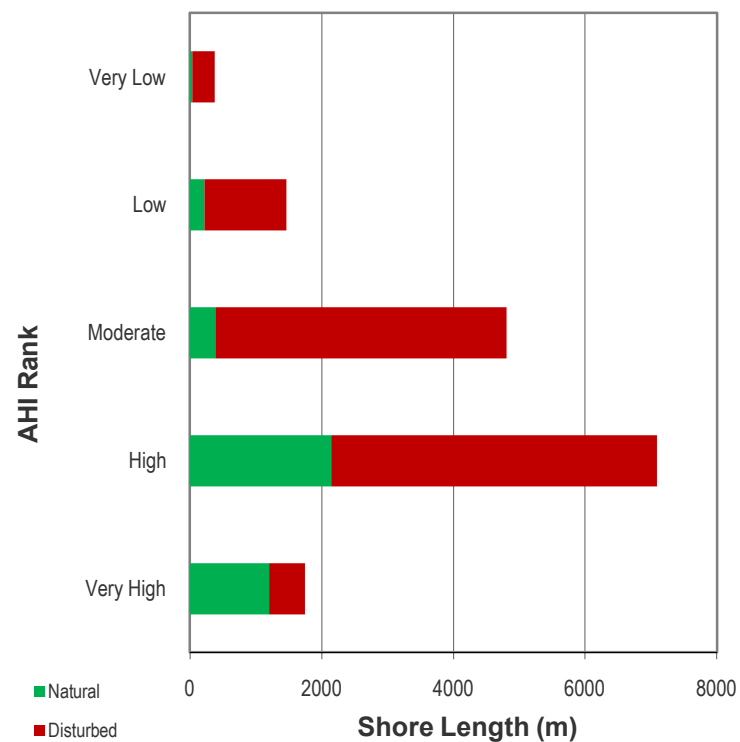


Figure 11: The length of natural and disturbed shoreline in the different AHI rankings.

Table 13: The shoreline that is natural and disturbed (m and %) within each of the different AHI rankings.

AHI Rank	Natural		Disturbed	
	m	%	m	%
Very High	1202.145728	69.0%	539.031143	31.0%
High	2140.305178	30.2%	4949.471009	69.8%
Moderate	389.156445	8.1%	4416.862167	91.9%
Low	219.2249476	15.0%	1242.274703	85.0%
Very Low	37.4995101	10.0%	337.4955909	90.0%