Species Detection Survey Protocol

20.0 Vascular Plant

June 2021 – Update









VASCULAR PLANT SURVEY PROTOCOL

2021

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COVER PHOTO CREDITS

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- Glen Lee – *Chrysosplenium iowense*
- Sarah Vinge-Mazer, Saskatchewan Conservation Data Centre – *Psilocarphus brevissimus* var. *brevissimus* and *Navarretia saximontana*
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Table of Amendments			
Version Date	**Page**	**Section**	**Comments**
December 2015			Initial draft
June 2016	3	PREREQUISITES – New Section	Inserted Authority section, moved Personnel to Prerequisites.
June 2016			Format Update.
April 2017	all	all	Included aquatic sampling, defined prairie and boreal sampling dates, clarified terrestrial sampling strategy and minimum sampling intensity, split non-forest vs. forest methods, moved dates from effort to time of year section, added time of day section, added appendices, added definitions in section 20.1.1, added subsections under 20.4 submissions, other wording revisions and clarifications.
February 2019	8	20.1.3	Added update regarding availability of predictive distribution models and SK CDC plants by ecoregion list.
	14	20.3.1	Clarified approximate size cut-off from 1 ha to 1.2 ha to accommodate usual well pad size.
	15	20.3.1.1	Added section to address large study areas where a project footprint hasn't been identified yet.
	-	Personnel Requirements	Removed from document with reference to the Personnel Requirements Roster document
	19	20.4.1	Clarified requirements to submit all observations (including common species) if that data is collected.
June 2021	-	Title	Title changed from Rare Vascular Plant to Vascular Plant to highlight the submission standard of all plant data that is collected, as well as to be consistent with the titles of other guild type survey protocols (e.g., Grassland Bird).
	7	20.1.1	Clarified that aquatic habitats include lotic systems, and terrestrial habitats may include ephemeral lotic systems.
	7-8	20.1.2	Clarified the requirement for data on non-tracked species. See also section 20.4.1.
	14	20.3	Added parameters which are known to exacerbate imperfect detection.

PREREQUISITES

Companion Documents

The Species Detection (SD) Survey Protocols (SDSPs) are a component of the Conservation Standards Program (CSP). The SDSPs are intended to be used in conjunction with other CSP documents, in particular:

- Conservation Standards Terms and Conditions: Species Detection (CSTC-SD)
- Species Detection Application Form (SDAF)
- Species Detection Loadform (SD Loadform)
- Species Detection Personnel Documents (see below)
- Activity Restriction Guidelines (ARG) for Sensitive Species – Contact the regional Ecological Management Specialist (EMS) to discuss ARGs for your project.

Subscribe to the mail-out lists for updates regarding the documents listed above, research permits, Saskatchewan Conservation Data Centre (SKCDC) species lists and ranks, and HABISask.

The importance of reviewing the above documents in advance of conducting SD surveys cannot be overstated. Information contained in these documents is included to help ensure a complete and accurate data submission – please refer to hyperlinks in this document for helpful information. SD Loadforms that need to be returned to the client for corrections may delay regulatory approvals.

Personnel Requirements

Refer to the Personnel Requirements Roster Species Detection Survey Protocols 1-20 for personnel requirements associated with this survey. See the Personnel Instructions and note that Personnel Documents must be updated and re-submitted at the beginning of the (spring) field season, in advance of any SDAFs.

Authority

Pursuant to Section 21 of *The Wildlife Act, 1998*, a Research Permit (RP) is required when conducting Species Detection (SD) surveys for commercial purposes. Regarding *The Wildlife Regulation's* – Section 6.2, the ministry is in the process of developing Qualified Persons (QP) requirements for SD surveys. The Personnel Requirements above, pertain to all SD surveys.

Desktop Screening

Refer to the **CSTC-SD – Section C. 1.**

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20.0 VASCULAR PLANT SURVEY PROTOCOL

20.1 INTRODUCTION

This Species Detection Survey Protocol (SDSP) provides instructions on survey design, techniques and data collection to determine the occupancy (i.e. presence/not detected) of rare vascular plants at a project site (i.e., a rare plant inventory). Surveys that inventory vascular plants are subject to imperfect detection and therefore must be designed to best detect rare plant species potentially affected by disturbance (Nielsen et al. 2017). Projects requiring non-vascular, lichen, or fungi surveys or projects that are designed to monitor previously identified occurrences of rare plants require pre-approval of an alternate methodology using the SDSP Template (see **CSTC-SD C.6.**).

20.1.1 Definitions

This protocol distinguishes between the prairie and boreal regions, between terrestrial and aquatic habitats, and between forest and non-forest sites as follows:

- **Prairie** is defined by the Prairie Ecozone (Cypress Upland, Mixed Grassland, Moist Mixed Grassland and Aspen Parkland Ecoregions) (Figure 20.1).
- **Boreal** is defined by the Boreal Plain, Boreal Shield, and Taiga Shield Ecozones (Figure 20.1).
- **Terrestrial** habitats include those in uplands, the riparian zone, and seasonal wetlands. Seasonal wetlands can be classified as: I) ephemeral ponds, II) temporary ponds, III) seasonal ponds and lakes, and sometimes VI) alkali ponds and lakes and VII) fens and bogs (Stewart and Kantrud 1971), as well as ephemeral lotic systems.
- **Aquatic** habitats can be classified as open water on IV) semi-permanent ponds and lakes, V) permanent ponds and lakes, VI) alkali ponds and lakes and VII) fens and bogs (Stewart and Kantrud 1971) as well as open water in lotic systems.
- **Forest** sites are any sites that can be classified with a forest ecosite in McLaughlan et al. (2010), excluding PR1 (may include some sites within the Prairie Ecozone, (e.g. in the Cypress Hills, Moose Mountain and Aspen Parkland areas)).
- **Non-forest** sites generally refer to grassland sites, but can be defined by any sites that cannot be classified with a forest ecosite in McLaughlan et al. (2010) with the exception of ecosite PR1. Ecosite PR1 is included as a non-forest site.

20.1.2 Inventory Group

This protocol is designed to assist with surveys for vascular plants that are considered rare in Saskatchewan. Rare plants that must be reported via the SD Loadform include:

1) those listed as S1 to S3 by the Saskatchewan Conservation Data Centre (SKCDC);
2) those included on the SKCDC tracking list[1];
3) those listed under the *Wild Species at Risk Regulations*;
4) those with a designation of endangered, threatened or special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and;
5) those listed under Schedule 1 of the Canadian *Species at Risk Act (SARA)*.

[1] The SKCDC vascular plant and tracking lists, found online at http://www.biodiversity.sk.ca/SppList.htm, should be checked regularly for updates.

Plant observations of non-tracked species made during vascular plant surveys must also be reported on the SD Loadform to the degree that they are recorded. Non-specific location information, if it is not collected for non-tracked species, does not need to be submitted; transect/study area level location is adequate for reporting non-tracked species.

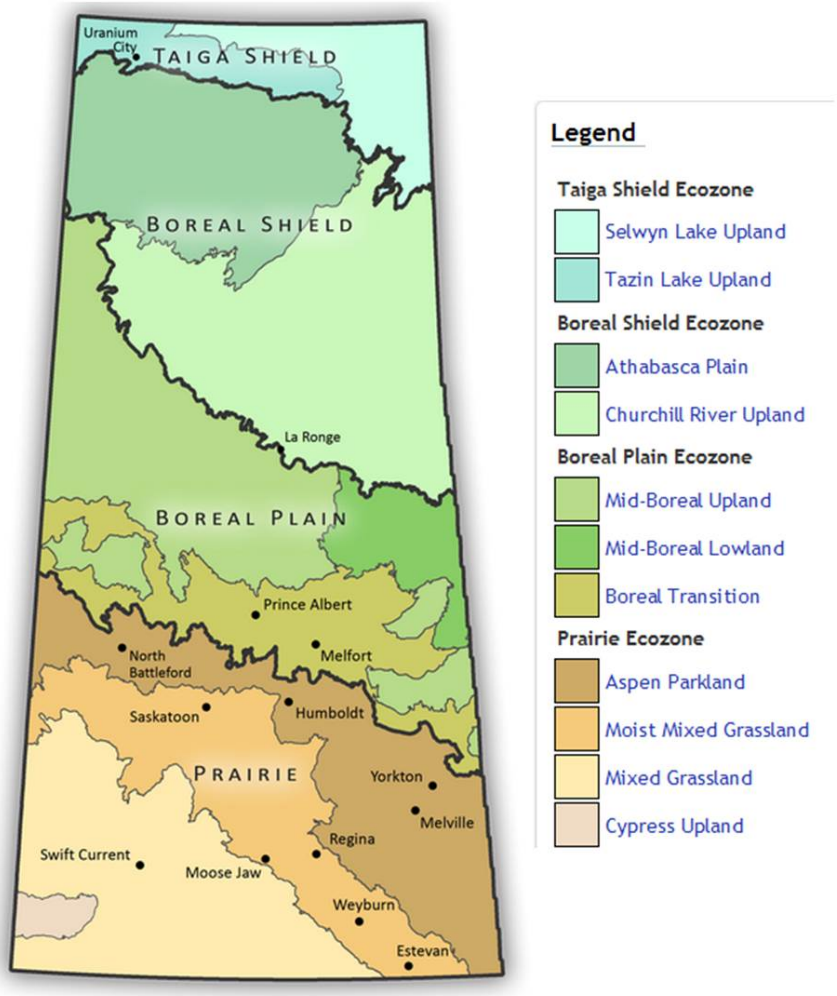

Figure 20.1 Ecozones and Ecoregions of Saskatchewan.

20.1.3 Status and Distribution

The status of plants in Saskatchewan is not static. For the latest information, please refer to the SKCDC species lists.[2] Additional information may be provided in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, and in the Species at Risk Act (SARA) Registry documents.

The confidence in the currently known distribution varies by species. Distributions may be constrained by the locations of previous surveys and therefore may be incomplete. The Ministry of Environment has produced predictive distribution models for select species, available for use

[2] The SKCDC vascular plant and tracking lists, found online at http://www.biodiversity.sk.ca/SppList.htm, should be checked regularly for updates.

on HABISask[3] (under login for authorized users). These may be useful in predicting habitat suitability in areas previously unsurveyed.

Potential species lists for a site should be determined by expected distributions for well-known species as well as the ecosites present (Section 20.3.1.2) and expected species that are known to occur on those types of ecosites. The SKCDC provides a list of tracked plant species by ecoregion that may be helpful in compiling potential species, but should not be considered comprehensive[4]. Searches should not be constrained by the presence or apparent absence of species identified by desktop searches of the SKCDC database on HABISask.

20.1.4 Biology

Plants vary widely in distribution, taxonomy, ecology, and habitat preferences. Identification characteristics and habitat affiliations for listed plant species are available from references including Moss (1983); Kershaw et al. (2001); Flora of Saskatchewan; University of Saskatchewan Virtual Herbarium of Plants at Risk in Saskatchewan; and Flora of North America Association Flora of North America. The Flora of Saskatchewan and Flora of North America are recommended as primary identification resources as they are most compatible with up-to-date SKCDC species lists. Older resources may be better suited for field work and field identification but their use may necessitate cross-checking with a more up-to-date resource.

Plants must be identified to the lowest accepted taxonomic level (e.g. variety or subspecies in some cases) and according to the most recently accepted taxonomic treatment. See the SKCDC website for current taxon and synonymy lists. Field identification of some species may be difficult if not impossible due to the diagnostic features that are indeterminable without microscopic dissection. Specimen collection, where appropriate, will enable further study, or examination by a taxon specialist. See section 20.2.7 for instructions on collecting voucher specimens.

20.2 SURVEY STANDARDS

The survey standards provide instructions on the areal extent of surveys to be conducted, survey parameters deemed necessary to detect target species and associated habitat features, as well as minimum equipment needs. Adhering to these standards ensures data collected is defendable and provides the level of accuracy necessary to identify presence/absence of the target species and supports critical aspects of project development, such as project siting and mitigation planning. Refer to these survey standards when completing the Survey Standards Data Worksheet in the SD Loadform to ensure any deviations are properly recorded.

20.2.1 Survey Area Extent

Surveys must be conducted in any and all areas that provide suitable habitat (as defined in CSTC-SD – C.1.d.) for the target species in addition to any areas with HABISask species or habitat occurrences, or predicted habitat (e.g. as determined by the predictive distribution models on HABISask). Surveys must be conducted in any and all habitat types capable of supporting rare plants, including wetlands. Aquatic habitats (Section 20.1.1) may also need to be surveyed

[3] HABISask is the Government of Saskatchewan's Hunting, Angling and Biodiversity Information of Saskatchewan web-based application and can be found online at https://gisappl.saskatchewan.ca/Html5Ext/?viewer=habisask

[4] The SKCDC Tracked Vascular Plant Species by Ecoregion can be found online at http://www.biodiversity.sk.ca/SppList.htm and is updated regularly.

(Section 20.3.2). For guild-type surveys (e.g. Grassland Birds, Vascular Plants), the proposed project area plus the greatest ARG setback for a given species in the guild with the potential to occur in the survey area, must be assessed (e.g. if there is the potential for a Species At Risk to occur, then a 300 metre setback may need to be assessed based on the project disturbance level and habitat present).

Remnant habitat areas that are within the survey area must also be surveyed regardless of the dominant surrounding land use type. Some rare species, such as Water Hyssop (*Bacopa rotundifolia*) and Dwarf Woollyheads (*Psilocarphus brevissimus* var. *brevissimus)* can be found in ephemeral wetland habitats within cropland or cultivated fields. These plants, and other rare species, often have few other occurrences in Saskatchewan. This underscores the importance of small remnant sites to biodiversity conservation.

20.2.2 Time of Year

Different plant species may be in a variety of developmental stages at any given time during the growing season, affecting their detection and identification. Rare plant inventories must be timed to maximize the probability of detection of as many species as possible per visit. Plants in flower and fruit are more detectable and also easier to identify; therefore, these phenological stages should guide survey timing. Some plants (e.g. annuals) germinate or appear above ground (e.g., *Botrychium*) only when specific environmental conditions are suitable and this must also be taken into consideration.

At least two, but preferably three, surveys must be completed at *each* sample site (e.g., transect) within the survey area extent (Section 20.2.1) during the growing season. More than two visits may be required for dry grasslands and early or late-blooming species (ANPC 2012). When justified, additional surveys may be required for certain species such as the willows (*Salix* sp.). A single, late season survey is sufficient for any required aquatic plant surveys.

The following sections provide a schedule of specific calendar dates for conducting surveys. Refer to Section 20.1.1 regarding definitions for “prairie”, “boreal”, “terrestrial” and “aquatic” for the purposes of this protocol.

20.2.2.1 Prairie Terrestrial

- The survey periods for the preferred three surveys are:
  May 15 to June 20
  June 21 to July 31
  August 1 to September 15
- Surveys must be separated by at least 4 weeks (28 days)

- If only two surveys are to be conducted, the survey periods are:
  May 15 to July 1
  July 2 to September 15
- Surveys must be separated by at least seven weeks (49 days)

20.2.2.2 Prairie Aquatic

- A single survey should be conducted between:
  July 15 to August 31

20.2.2.3 Boreal Terrestrial

- The survey periods for the preferred three surveys are:
  June 1 to June 30
  July 1 to July 31
  August 1 to August 31
- Surveys must be separated by at least four weeks (28 days).

- If only two surveys are to be conducted, the survey periods are:
  June 1 to July 15
  July 16 to August 31
- Surveys must be separated by at least six weeks (42 days).

- In the Taiga Shield Ecozone the survey periods may be adjusted to:
  June 15 to July 15
  July 16 to August 15
- Surveys must be separated by at least four weeks (28 days).

20.2.2.4 Boreal Aquatic

- A single survey should be conducted between:
  August 1 to August 31

These survey windows (see 20.2.2 subsections) should be further refined to target the most vulnerable species that have the potential to occur at the site – at least one visit should be timed to overlap with a peak detection time for these species. Federally-listed plant Species at Risk – or those with a status recommended by COSEWIC – are considered the most vulnerable of species, followed by S1, S2, and finally S3 species (see Section 20.1.2). Table 20.1 provides examples of flowering and fruiting periods for select Species At Risk, indicating when they are most detectable. Information on flowering and fruiting periods for other rare species can be obtained by studying specimens from the W.P. Fraser Herbarium (University of Saskatchewan).

20.2.3 Time of Day

Light availability can affect the detection of plants; therefore, surveys must be performed during daylight hours. Avoid surveying within an hour of sunrise or sunset as shadows may obscure some species.

Table 20.1. Flowering and fruiting times for vascular plant Species at Risk in Saskatchewan (modified from Henderson 2009, C. Neufeld pers. comm.).

Species	Seasonal Timing	
	Flowering	Fruiting
Slender Mouse-ear cress (*Transberingia bursifolia* ssp. *virgata*)	Late May-June	Late May-early July
Soapweed (Yucca) (*Yucca glauca*)	June-July	Year-round
Western Spiderwort (*Tradescantia occidentalis* var. *occidentalis*)	Late Jun-July	July
Smooth Goosefoot (*Chenopodium subglabrum*)	Late June-July	Aug.-Sept.
Buffalograss (*Bouteloua dactyloides*)	Late June-July	July-Sept.
Small-flowered Sand-verbena (*Tripterocalyx micranthus*)	June-Aug.	July-Aug.
Hairy Prairie-clover (*Dalea villosa* var. *villosa*)	July-Aug.	Aug.-Sept.
Tiny Cryptantha (*Cryptantha minima*)	June-July	July-Sept.
Dwarf Woolly-heads (*Psilocarphus brevissimus* var. *brevissimus*)	June-July	July-Aug.

20.2.4 Search Effort

Total effort at a site will be determined by a number of factors including the project size and habitat types present. A minimum sampling effort is required (Section 20.3.1.3).

At least two survey visits are required (see Section 20.2.4) at each sampling site (e.g. transect), except for aquatic plant surveys.

Surveyor search speed, number of surveyors, number of visits, and transect dimensions are used to calculate survey effort for terrestrial surveys. Transect width, length and search speed are determined by a number of factors (Sections 20.3.1.4 and 20.3.1.6). Search effort is not calculated for aquatic surveys.

Teams of two qualified (see Personnel Requirements Roster - Species Detection Survey Protocols 1-20) people conducting a survey together are required to achieve better visual coverage of the site and species detection (Henderson 2009, Zhang et al. 2014). To maintain alertness and decrease visual search fatigue and recording errors, actual sampling time should not exceed eight hours per day (McLaughlan pers. comm.; Henderson 2009).

Other surveys (e.g. for animal species) must not be conducted at the same time as the vascular plant survey. Surveyors must devote their focus solely to the vascular plant survey to ensure surveyor errors are minimized and species detection is maximized.

When search efforts do not detect any target species, it is important to document and report on these results (Henderson 2009). This data can be used by the Ministry of Environment to refine and inform habitat (ecosite) correlations with rare species. This information is to be recorded on the Survey Data worksheet within the SD Loadform and includes transect start and ends points (or sample points for aquatic surveys), start and end times, transect length and width, and number of surveyors.

20.2.5 Environmental Conditions

Climatic conditions can strongly influence both the presence and the detection of many of Saskatchewan's rare plants. Weather conditions can also affect plant phenology and morphology. Rare plant detection probability is related to these factors (Chen et al. 2009). If poor conditions exist, surveys should be conducted over a number of growing seasons and moisture conditions (ANPC 2012).

Personnel must review regional weather conditions during the planned survey period. Weather conditions can reduce the efficacy of plant surveys. Surveys must be conducted when winds do not exceed a moderate breeze (i.e. Beaufort scale 4 [20-29 km/h]), in no more than a light rainfall or dusting of snow, and under clear to overcast skies with no fog or smoke conditions.

20.2.6 Equipment List

- ENV research permit and associated documentation (see CSTC-SD – **Section A.**)
- Other appropriate permits and permissions (see CSTC-SD – **Section A.**)
- SD Loadform
- GPS unit
- Survey flags
- Survey poles
- Camera (with appropriate macro capabilities)
- Ruler
- Hand lens
- Plant press
- Regionally appropriate flora
- Lists of provincial and federal species of interest and potential rare species for the area
- Field note book, pencils/pens or other data collection device
- Collecting tools (e.g. gloves, clippers, shovel)

In addition to the above, aquatic surveys will require:

- Appropriate watercraft and safety equipment
- Double-sided sampling rake (see Hauxwell et al. 2010)
- Weighted sampling rake attached to a rope (see Hauxwell et al. 2010)
- Sealable storage bags for voucher specimens
- Waterproof voucher sample labels
- Cooler with ice for storing specimens
- Depth finder
- Bin for sample processing
- A map and/or bathymetric map of the waterbody will be helpful

20.2.7 Collection of Voucher Specimens

Research Permit conditions require that surveys and corresponding data collection, using the SD Loadform, be conducted according to standardized protocols. Collecting rare plants is discouraged for conservation reasons but may be appropriate in some circumstances. Collecting rare plants is to be limited to those plants that require dissection for correct identification and for which collecting will result in the loss of less than four per cent of the individuals in the local population (ANCP 2012, Lancaster 2000).

Due to the frequent misidentification of aquatic species, as well as the nature of the aquatic survey procedure (Section 20.3.2), voucher specimens are recommended for these species (Hellquist 1993). It is strongly advised that a full specimen be taken of any previously unrecorded plant taxon found in Saskatchewan as long as doing so will not be detrimental to the local population. Saskatchewan's Rare Plant Translocation Policy has not permitted translocation since 2016; therefore, if plants will be destroyed during project activities, collecting a specimen is recommended.

Photographs of diagnostic features may preclude the need to collect plants or plant parts for identification. Take several close-up photos showing a ruler (for scale) and characteristic plant parts as outlined in the description of the species in the appropriate flora. If collection is required or recommended, photograph the plants with a ruler *in situ* and if possible, take only the key diagnostic parts needed for identification. The W.P. Fraser Herbarium recommends collecting and preparing plants as per the procedures described in Collecting and Preparing Plant Specimens for Identification (Storrie 2009; H. Cota-Sanchez, pers. comm.). Similarly, the recommended procedures for the preparation of aquatic voucher specimens is detailed in Hauxwell et al. 2010. Submissions of specimens must follow Section 20.4.2.

20.3 SURVEY METHODS

This section discusses the procedures for designing and conducting surveys to detect (e.g. presence/not detected data) rare plant species at a site of interest. The objective is to provide a standardized methodology that reduces bias and can best detect all possible rare plant species that are present (e.g. a rare plant inventory).

Past surveys have used meandering and vegetation plots/quadrats to survey for rare plants; *these are not acceptable survey methods*. A targeted single species search is not sufficient to detect all possible rare plants but may be conducted as an additional survey in certain circumstances. It should be noted that the presence or apparent absence of species as determined from a desktop search of SKCDC data on HABISask does not preclude the need to conduct a full rare plant inventory. If, however, a desktop search identifies existing rare plant occurrences within the project footprint or setback distances, those sites should be visited to confirm the presence of the species (in addition to the sampling protocol described below).

Failure to detect any particular rare plant species during surveys is considered "not detected" rather than definitive evidence that the species is absent from the area (Henderson 2009). Imperfect detection is exacerbated when surveys are time-constrained, sites have increased vegetation structural complexity (Dennett & Nielsen 2019) and increased species richness (Denny et al. 2017), and for species that are cryptic, not abundant, and diffusely distributed (Dennett & Nielsen 2019, McCarthy et al. 2013). Thus, care must be taken to structure survey parameters appropriately to reduce errors in detection.

Some survey procedure details need to be reported on the 'SurveyStandardsData' worksheet of the SD Loadform (see section 20.4.1 for some helpful notes). Deviations from approved sampling techniques must be described in the 'SurveySummary' Worksheet and detailed within the SD Loadform. Include any additional comments in the 'Comments' field in the 'Metadata' tab of the SD Loadform, not in the cover email used to submit it.

20.3.1 Terrestrial Procedures

Section 20.1.1 defines terrestrial versus aquatic habitats for the purpose of this protocol. For projects where aquatic surveys are not required, terrestrial surveys should still be performed for riparian areas, emergent vegetation and ephemeral wetlands.

In order to determine the appropriate terrestrial survey design for the project, the following must be considered, for which requirements are given below (see also Appendix C):

1) Is the project/disturbance footprint small or large?
2) Does the project occur in a forest or non-forest site (Section 20.1.1)?
3) In non-forest sites, how long will transects be?
4) Based on the potential rare species for the area and the habitat to search, how wide will transects be and what will be the maximum search speed?
5) Based on the landscape orientation, what will be the standard transect orientation?

Ideally, the entire project/disturbance footprint - including the area within appropriate setback distances - should be systematically searched using parallel transects (e.g. a census search). Systematic census searches must be completed for smaller projects (e.g. well leases of approximately 1.2 ha or rights-of-way <30 m wide and up to 300 m long, may include well pads, borrow pits, certain pipelines or utility corridors; Henderson 2009). Note that other jurisdictions recommend census searches for projects up to five ha (Department of Conservation and Natural Resources 2011). For larger project areas (e.g. strip mining, peat harvesting, processing facilities, long rights-of-way) and set-back distances (e.g. 300 m for federal plant Species At Risk), this may not always be possible, therefore, a sampling design will be accepted (Henderson 2009, see sections below).

Rare plant inventories for larger areas require a sampling strategy that samples all habitats with the potential to support rare plants in order to detect as many rare species as possible. The limitations of sampling should be noted: it only provides presence data for a species at a given site and does not detail where a species occurs throughout a site (therefore is problematic in being used to inform mitigation), nor is it suitable for determining abundance or monitoring changes. If a plant Species At Risk is found, further inventory work may be needed to determine the extent of the local population and how it may be affected by project activities. Proponents should contact the appropriate Ministry of Environment staff person (often the Ecological Management Specialist), if such is the case, to find out what is required.

20.3.1.1 Projects Without a Defined Footprint at Time of Survey

If a project footprint has not yet been defined within a larger study area, a habitat stratification approach (below) should be used in order to assess the potential impact of the project on the study area. *Once the footprint is defined, further surveys are required* within the footprint (and setback area) if previous surveys did not adequately cover the footprint to minimums described below (Section 20.3.1.3). These footprint surveys are necessary to determine the impacts and outline mitigation for any rare plants found within the footprint. The defined footprint can either be census-searched if it is small enough (see above) or appropriately sampled using the technique below.

20.3.1.2 Habitat Stratification for Large Projects

Pre-survey planning must be employed to determine habitat types at the project site. Habitats are stratified using site imagery (e.g. aerial photos or satellite images). Non-forest (Section 20.1.1) surveys may make use of the Range Ecosite Map (Thorpe 2014). The Range Ecosite Map is best used at 1:100,000 or smaller scale. For smaller areas (i.e. at larger scales), this map can be used as a first step, but further refinement based on field visits and imagery is likely necessary (Thorpe 2014). Use the Forest Ecosite Classification (McLaughlan et al. 2010) for forest surveys.

Additional habitats, plant communities or unusual features that need to be sampled may also be identified using aerial/satellite images. Local topography and moisture regimes may further refine stratification units. Riparian areas, including habitats with emergent vegetation, should be included as habitat types to survey. Where aquatic habitat (Section 20.1.1) is present on the project site, an aquatic rare plant survey may be needed (Section 20.3.2). Surveyors may increase sampling intensity in rare habitats or those likely to house rare species (Fancy 2000, Henderson 2009). Rare habitats or small features can reasonably be census-searched using parallel transects.

20.3.1.3 Minimum Transect Requirements and Placement

Transects are the required sampling unit. Transects are required instead of plots or meanders because they are repeatable, reduce bias, allow calculation of search effort, reduce errors, and are more likely to detect rare plants (Henderson 2009, Dennett et al. 2018). Supplemental quadrats may be placed along transects to increase search effort for cryptic species but will not contribute to the calculation for total sample area or be used at the expense of transects.

For small projects, transects are placed parallel to one project boundary and each other, with start and end points on the other project boundary. For large projects, once habitats have been stratified and delineated, generate random transect start points within each habitat type.

As much as possible, transect start points need to be randomly determined before field visits in order to reduce bias (Mackenzie and Royle 2005). In-field modifications may be required if rare habitat types, or habitat types not identified in pre-survey planning are encountered, as they will also need to be surveyed. It is acceptable to census-search small, irregular habitat types encountered in the field. If ad hoc transects are generated, they should still be placed as randomly as possible and follow project standards for dimensions and orientation. Straight-line belt transects are the preferred sample unit but a triangular configuration of belt-transect may be appropriate in some cases (Henderson 2009).

Enough points must be generated to meet the minimum sampling intensity required and will be partially determined by transect dimensions (Section 20.3.1.5). The number of transects required for the minimum search effort depends on whether the project is on a forest or non-forest site, the project size, and the transect dimensions (e.g. the area covered by the transect). In non-forest sites, a minimum sampling threshold of 3-5 per cent of the area of each suitable habitat strata is required (Henderson 2009).

In forest sites, use the following formula to calculate the number of transects to be completed per habitat strata:

$$y=(0.8x/z)+(40/z)$$

where:

- "y" is the number of 100 m transects;
- "z" is the total transect width (e.g. for a two-person team) in meters (see Section 20.3.1.4 for determining transect width)
- "x" is the area of each habitat strata in hectares (M. McLaughlan, pers. comm.).

A minimum of one transect must be completed for each stratum. Generated transects must be a minimum of 10 m apart to avoid overlap (unless they are being used in a census-search situation). An example calculation for a forest site is provided in Appendix B.

20.3.1.4 Transect Dimensions

Transect dimensions may vary based on best-fit for a particular project. Transect length for small sites where census-searching is required will depend on the project boundary. For large projects, in non-forest sites, straight-line belt transects >500 m^2 are required. Depending on the project, transect width will range from 0.5-2.5 m (per surveyor, e.g. 0.25-1.25 m on either side of the surveyor) and therefore transect length may range from 200-1000 m (Henderson 2009). In forest sites, transect width may range from 2-4 m (per surveyor, e.g. 1-2 m on either side of the surveyor, Zhang et al. 2014) and transect length will always be 100 m (M. McLaughlan, pers. comm.). While transect dimensions may vary between projects, they must be standardized per individual project.

The best transect width for the project is determined by the most cryptic potential target species and the degree of obscuring vegetation. Potential cryptic species in tall or thick vegetation necessitate using a narrower transect width. If cryptic species are unlikely and vegetation is short or sparse, transect widths may be wider, but must be no wider than the ranges given above. Personnel may wish to consult Henderson (2009) for examples. For non-forest sites, once the transect width is determined, the minimum transect length can be calculated so that the minimum belt-transect area is 500 m^2. As long as transect length is between 200-1000 m and transect area is >500 m^2, surveyors may choose a standard transect length that best fits the site.

When very irregular landscape features are encountered, if surveyors are using transects instead of census-searching, and if minimal sampling coverage will be difficult to achieve using the site standard for transect orientation and length, then orientation may be modified (see Section 20.3.1.5) or transects broken into parallel segments across the feature to ensure minimal sampling coverage.

20.3.1.5 Transect Orientation

Transect orientation for census-searching will be parallel to one of the project boundaries. In large sites, it will depend on landscape orientation. It is preferable to orient all transects in the same direction at a site (Henderson 2009). Transects may cross habitat types and this should be accounted for in the percentage-of-area-sampled calculation. Transect orientation for linear-feature or irregular habitat types and those with gradients (e.g. slope, moisture) may deviate from the site standard (see Henderson 2009 for information on appropriate transect orientation in these cases).

20.3.1.6 Transect Search Speed

Maximum transect search speed is also dictated by the potential for cryptic species, the degree of obscuring vegetation as well as the degree of species richness for habitat strata. In non-forest sites, search speeds may vary between 0.5-4 km/h (Henderson 2009). In forest sites, search speeds may vary between 0.5-1.3 km/h (extrapolated from Zhang et al. 2014). Potential cryptic species in tall or thick vegetation with higher expected species richness necessitate a slower search speed. If cryptic species are unlikely, vegetation is short or sparse, and expected species richness is lower, search speeds may increase to the maximum range value. Search speed may vary between transects and even within a transect.

20.3.1.7 Transect Set-Up and Searching

Henderson 2009 details an appropriate transect set-up and searching protocol using a team of two surveyors. Transects are searched by walking a straight line while surveyors scan the width for species of interest. Meandering over the width of a very wide transect is not acceptable.

20.3.1.8 Spatial Data Collection

The SKCDC has prepared Guidelines for Collecting Spatial Data During Vascular Plant Surveys (2016) which are helpful for data collection.

20.3.2 Aquatic Procedures

In aquatic habitats (defined in Section 20.1.1), a rare aquatic plant survey must be performed to determine the presence of rare aquatic plant species if the following applies (Government of Saskatchewan 2015):

1) the project will cause surface disturbance within 45 m of a watercourse, water body or wetland with permanent open water;
2) the project will cause surface disturbance on a slope leading directly to a watercourse, water body or wetland with permanent open water even if that disturbance will occur at a distance greater than 45 m; or
3) the project will cross a watercourse, waterbody or wetland with permanent open water (other than by directional drilling).

The aquatic survey is designed to inventory submerged, floating-leaved and emergent vegetation. The terrestrial protocol will be used to survey riparian areas and shorelines. Aquatic surveys are subject to their own minimum sampling protocol (see below) – any aquatic habitats that may be affected need to be surveyed (e.g. not sampling at a 3-5 per cent rate as in prairie terrestrial habitats).

A point-intercept survey method is a relatively rapid and cost-effective way of conducting an aquatic plant inventory (Madsen 1999). Sampling points are randomly generated in a systematic design throughout the waterbody before field work, enabling the surveyor to find a higher number of species (Madsen and Wersal 2012). Higher sampling intensities are more likely to detect rare species. The size of the littoral zone[5] is the most important factor when setting sampling intensity; therefore, water bodies with larger littoral zones should be sampled more intensely. The grid resolution should be such that survey points are no more than 70m apart and

[5] The littoral zone is defined as the area in which plants grow (Hauxwell et al 2010). The depth to which plants (macrophytes) can grow is affected by light penetration.

no closer than 25 m (Mikulyuk et al. 2010). Only those points within the littoral zone need to be sampled (Hauxwell et al. 2010, outlines a procedure for determining maximum depth of plant colonization in large, deep water bodies). While first adhering to the 25-70 m range for grid resolution, a minimum of four survey points should be surveyed per hectare of littoral zone. Ensure enough points are surveyed to capture the variability within the littoral zone (e.g., depth or substrate changes).

Aquatic surveys are generally conducted from an appropriate watercraft. In water 4.5 m deep or less, use a pole rake sampler by lowering it to the bottom, twisting it around twice and then pulling straight up. Where the depth is greater than 4.5 m, drop the rope sampler straight into the water beside the boat (same side each time), drag along the bottom for approximately 0.3m, then pull to the surface (Hauxwell et al. 2010). Plant material may then be removed from the rake, sorted, identified, and prepared for voucher collection. Floating or emergent rare plant species encountered between, or on survey points, should also be recorded.

In shallower wetlands, surveyors may choose to wear waders and walk to sampling points rather than use a watercraft. Visual surveys of submerged species are not sufficient; samples using the rakes must still be taken (Hauxwell et al 2010).

Equipment including watercraft, waders, footwear, rakes and bins must be decontaminated between water bodies to prevent spreading invasive species and pathogens (see Appendix 4 in Randall et al. 2018).

20.4 SUBMISSIONS

To ensure the highest quality information is provided and to avoid having submissions returned, please refer to instructions in the CSTC-SD and the SD Loadform in advance of conducting surveys and submitting the SD Loadform. Information on Common Mistakes and Tips is also mailed out annually in advance of the November 10 permit expiry/submissions deadline. A SD Loadform with the survey data must be submitted even if no rare plants were observed and recorded. Contact SKCDC Botanist: sarah.vingemazer@gov.sk.ca with any questions regarding the SD Loadform.

20.4.1 Species Detection (SD) Loadform Notes

Systematic (census) transect searches of entire project areas do not need to have each transect entered on the SD Loadform; simply indicate the area that was searched systematically and provide the dimensions. Where sample units (e.g., randomized transects) are used, each should be indicated on a separate line in the Survey Standards Data tab with start and end points and times included. Transect dimensions must be included as well. Sample units should each have a unique name which should be referenced in the SD Loadform with each subsequent survey visit.

Environmental (weather) conditions must be indicated in the appropriate fields of the SD Loadform for plant surveys (Section 20.2.1).

Monitoring work where observers revisit known sites from past years' observations should each be recorded on a separate line as a sample site. Observers must indicate whether the target species was observed.

Where common (not tracked) species have been recorded with locations, these observations must be submitted along with rare plant information (as per see **CSTC-SD D.6.**).

20.4.2 Specimen Submissions

Collected plant specimens must be promptly submitted to the W.P. Fraser Herbarium, at the University of Saskatchewan, and must follow herbarium submission guidelines, including proper preservation and labels. Contact the herbarium (sask.herbarium@usask.ca) in advance of any submissions. Information on voucher specimens submitted to the W.P. Fraser Herbarium must be included on the ministry SD Loadform. The identification of voucher specimens that have been confirmed by the Herbarium must also be submitted to SD.researchpermit@gov.sk.ca.

20.4.3 Invasive Species

*i*MapInvasives is the provincial system for submitting the occurrence of invasive plant or animal species. Any observations of prohibited, noxious or nuisance weeds (including, but not limited to, those designated in *The Noxious Weeds Designation Regulations* 2010), along with observations of any other invasive species, should be submitted using this website. An account is not required to submit observations. Please direct any inquiries to invasives.imap@gov.sk.ca.

20.5 ADDITIONAL RESOURCES

Alberta detailed status reports for plant species at risk
Alberta Native Plant Council publications
Annotated Catalogue of Saskatchewan Vascular Plants
Collecting and Preparing Plant Specimens for Identification
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
Conservation Standards Terms and Conditions: Species Detection
The Encyclopedia of Saskatchewan
Flora of North America
Flora of Saskatchewan Association
Guidelines for Collecting Spatial Data During Vascular Plant Surveys
Guidelines for Rare Vascular Plant Surveys in Alberta
HABISask Application
Native Plant Society of Saskatchewan
Nature Serve Explorer
The Noxious Weeds Designation Regulations
Occupancy Survey Guidelines for Prairie Plant Species At Risk
Publications Saskatchewan – Wildlife Research Permitting
Species at Risk Act (SARA) Registry
Saskatchewan Activity Restriction Guidelines for Sensitive Species
Saskatchewan Activity Restriction Guidelines for Sensitive Species Background Information
Saskatchewan Conservation Data Centre (SKCDC)
Saskatchewan Ministry of Environment Wildlife Research Permitting webpage
Set-Back & Occupancy Survey Guidelines Prairie Plant Species at Risk
Stewart and Kantrud 1971 Wetland Classification System
The Wildlife Act
The Wildlife Regulations
W.P. Fraser Herbarium (SASK Herbarium)

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20.7 PERSONAL COMMUNICATION

Hugo Cota-Sanchez, Professor and Herbarium Curator, Department of Biology, University of Saskatchewan, 2017.
Ryan Fisher, Landscape Conservation Specialist, Fish, Wildlife and Lands Branch, Ministry of Environment, 2017.
Michael McLaughlan, Forest Ecologist, Forest Service Branch, Ministry of Environment, 2017.
Candace Neufeld, Grassland Ecologist, Environment and Climate Change Canada, 2017.

APPENDICES

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Appendix A - Vascular Plant Survey Quick Reference

- Rare plant inventories are conducted to detect any probable rare plant species, no matter the results of a review on HABISask or assumptions of surveyors about rare plant potential.
- Surveyors must not conduct other wildlife surveys at the same time as vascular plant surveys
- Additional permits may be required (see **CSTC-SD A.4.**).
- Within the project area, all potential habitats must be surveyed no matter their size or the dominant surrounding land use (e.g. crop). This includes wetlands. Setback distances (30-300 m) must be surveyed as well (Section 20.2.1).
- Aquatic surveys may be required to detect submerged plant species (Section 20.3.2).
- Personnel conducting surveys must meet the minimum qualifications (Personnel Qualifications). Teams of two people must conduct the survey (Section 20.2.1).
- A minimum of two survey visits are required at each sample site; three visits are preferred. There is a minimum amount of time that must pass between survey visits (Section 20.2.2).
- Acceptable survey windows differ depending whether a project site is located in the Prairie or Boreal and Taiga regions (Section 20.2.2).
- Transects (straight, belt-line) are the required sampling unit. Supplemental quadrats may be used to increase search effort for cryptic species (Section 20.3.1.3).
- Small project footprints (~1.2 ha or rights of way <30 m up to 300 m long) will be systematically census-searched using parallel straight-line belt transects (Section 20.3.1).
- For large project footprints (>1.2 ha or rights of way >30 m), pre-planning will stratify habitats within the site and each habitat strata will have a minimum area sampled (Section 20.3.1.2). The calculation for the minimum number of transects varies between forest and non-forest sites. Transect placement must be random within each habitat strata (Section 20.3.1.3).
- For projects in a large study area where no footprint has been defined at the time of surveys, further surveys will be needed once the footprint has been defined (Section 20.3.1.1).
- Transect width and search speed are determined by the most cryptic potential species and degree of obscuring vegetation. Transect width (for a two-person survey team) will usually be between 1-5 m and always <8 m (Sections 20.3.1.4 and 20.3.1.6).
- Transects length and orientation will adhere to a project standard. Length in non-forest sites can be chosen between 200-1000 m (calculated partly based on transect width). Length in forest sites is always 100 m. Transect orientation is determined by the landscape orientation at the site (Sections 20.3.1.4, 20.3.1.5).
- Survey effort can be increased in habitat types more likely to support rare species.
- Survey data must be recorded in the SD Loadform in addition to observation data. This includes dates for each survey visit, the start and end point and time for each transect (unless a census search is carried out), transect dimensions and weather conditions (Section 20.4).
- Use the most current taxonomy (often the Flora of North America) for submitting observations (Section 20.1.4).
- Voucher specimens may be recommended in certain situations. Other permits may be required for collection (Section 20.2.7).
- Projects requiring non-vascular, lichen or fungi surveys or projects that are designed to monitor previously identified occurrences of rare plants require the submission of an alternate methodology for approval (Section 20.1 and **CSTC-SD C.6.**)

Appendix B - Example Calculation for Required Number of Transects per Terrestrial Habitat Strata in a Forest Site

The following calculations were completed for an example site of 950 ha in the boreal forest, using transect dimensions of 4 x 100 m (e.g. two people per transect surveying 2 m each, that is, 1 m on each side per surveyor), and the formula

$$y=(0.8x/z)+(40/z)$$

where

"y" is the number of 100 m transects;
"z" is the total transect width (e.g., for a two-person team) in meters;
"x" is the area of each habitat strata in hectares.

Upland Ecosites	Area (ha)	Per cent of total area	# of required transects	Approx. time to complete (hours)*	% sample
BP5	70	7.4%	24	3.84	1.4
BP6	110	11.6%	32	5.12	1.2
BP7	21	2.2%	14	2.24	2.7
BP9	1	0.1%	10	1.6	40.0
BP10	3	0.3%	11	1.8	14.7
BP14	79	8.3%	26	4.16	1.3
BP15	14	1.5%	13	2.08	3.7
BP16	80	8.4%	26	4.16	1.3
Total Upland Ecosites	378	39.8%	156	25	1.7

Wetland Ecosites					
BP18	20	2.1%	14	2.24	2.8
BP19	300	31.6%	70	11.2	0.9
BP20	1	0.1%	10	1.6	40.0
BP23	45	4.7%	19	3.04	1.7
BP24	7	0.7%	11	1.76	6.3
BP25	110	11.6%	32	5.12	1.2
BP26	52	5.5%	20	3.2	1.5
BP28	2	0.2%	10	1.6	20.0
Total Wetland Ecosites	537	56.5%	186	30	1.4

Total Open Water	27	2.7%
Total Existing disturbance	8	0.8%

Total	**950**	**100.0%**	**342**	**55**	**1.4**

*Estimated survey times are based on 60 min/625 m (Zhang et al. 2014). Total time does not include travel time between transects. Because surveys should be carried out by a team of two people, total person-hours would be the total hours multiplied by two.

Appendix C - Vascular Plant Terrestrial Survey Design Summary

Survey Windows (Section 20.2.2)	
Prairie Ecozone (Section 20.2.2.1)	**Boreal Plain, Boreal Shield or Taiga Ecozone** (Section 20.2.2.3)
• The survey periods for the preferred **three** surveys are: May 15 - June 20 June 21 - July 31 August 1 - September 15 • Surveys must be separated by at least four weeks (28 days) • If only **two** surveys are to be conducted, the survey periods are: May 15 - July 1 July 2 - September 15 • Surveys must be separated by at least seven weeks (49 days)	• The survey periods for the preferred **three** surveys are: June 1 - June 30 July 1 - July 31 August 1 - August 31 • Surveys must be separated by at least four weeks (28 days). • If only **two** surveys are to be conducted, the survey periods are: June 1 - July 15 July 16 - August 31 • Surveys must be separated by at least six weeks (42 days). • In the **Taiga** Shield Ecozone, the survey periods may be adjusted to: June 15 - July 15 July 16 - August 15 • Surveys must be separated by at least four weeks (28 days)

Survey Design (Section 20.3.1)				
Project Size	**Small (<1 ha or R-O-W <30 m)**		**Large (>1 ha or R-O-W >30 m)**	
Survey Method (Section 20.3.1)	Systematic census-search using parallel transects		Habitat stratification and minimum sampling intensity using transects	
Non-forest or Forest site type	**Non-forest site**	**Forest site**	**Non-forest site**	**Forest site**
Minimum Sampling Intensity Calculations (Section 20.3.1.2)			3-5 per cent of the area of each habitat strata	Total number of 100 m transects per habitat strata determined by the formula y=(0.8x/z)+(40/z)
Transect Width (per two-person team, Section 20.3.1.4)	1-5 m	4-8 m	1-5 m	4-8 m
Transect Length (Section 20.3.1.4)	Length of project footprint		200-1000 m	100 m
Transect Orientation (Section 20.3.1.5)	Parallel to project boundary		Site specific depending on landscape orientation	
Transect Search Speed (Section 20.3.1.6)	0.5-4 km/h	0.5-1.3 km/h	0.5-4 km/h	0.5-1.3 km/h