CERTIFICATION OF MINERAL SOIL PADS IN THE BOREAL REGION – DECISION FRAMEWORK AND SUPPORT TOOLS

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1.0 BACKGROUND

In 2018, the Petroleum Technology Alliance Canada (PTAC) put out a request for proposals entitled *Reclamation Practices on Upland and Peatland Well Sites*. The project was established in response to challenges experienced by practitioners, regulators and industry related to reclamation certification of legacy sites. The specific sites in question are those that were constructed using imported mineral soil pads in peatlands, and upland sites that that have had natural vegetation encroachment. These sites generally present one or more reclamation deficiencies according to the applicable wellsite criteria and cannot receive a reclamation certificate without additional scrutiny and justification under current regulatory criteria and policies. The **goal of the overall project** is to provide recommendations for an acceptable policy framework/decision support tool(s) to assist industry and regulators in making decisions around appropriate management and certification of these sites that ensures that functioning ecosystems are developed and that there is a process that outlines eligibility for reclamation certification. To date the project has been conducted in two stages. This report describes the work in Stage 2 related to sites that were constructed using imported mineral soil pads in peatlands (a separate Stage 2 report has been prepared dealing with upland sites).

When dealing with peatland sites, the question arises of whether to remove mineral soil pads in peatlands. There has been inconsistency in how decisions about these sites are being made (i.e., different levels of reclamation effort have been applied) and in how reclamation criteria are interpreted and applied in terms of defining what are acceptable conditions for certification. Historically, industry and regulators have agreed that in certain site-specific circumstances, sites with mineral pads in peatlands can be certified without the removal of the pad or with partial removal of the pad. There has been a recognition that sites can be deemed to be on a trajectory towards developing a sustainable plant community from an ecological perspective, and to not be causing off-site impacts, without further disturbance/reclamation. A consistent and standard method to define and address these circumstances has been difficult to discern within the current regulatory and policy framework.

Stage 1 of the project identified that there is limited guidance on how decisions are being made to accept or reject requests for a change in land use and that there are *misperceptions* associated with why requests are being made (from the government/regulator perspective) and how the requests are being evaluated (from the industry/practitioners perspective) (Tokay et al. 2019). It was determined that these perceptions must be addressed before meaningful change can occur. Stage 1 also identified the key factors to consider when assessing the ecological implications of a change in land use request (hydrology, cumulative effects and regional considerations, upland function, status of the borrow pit, site location, and land use considerations) and a number of knowledge gaps which should be addressed to confirm the effectiveness of a decision support tool and policy framework. However, consultation with Alberta Environment and Parks (AEP) and Alberta Energy Regulator (AER) regarding the findings from Stage 1 was recommended before developing a policy framework and research project to address the knowledge gaps to ensure resources are allocated appropriately.

Preliminary Decision Support Tools (DST) were presented at a working session in December 2019 to facilitate a discussion involving industry (Oil and Gas and Environmental Consultants) and government (AEP and AER) related to change in land use requests. A summary of the working session and recommendations for changes to the preliminary DSTs is provided in Drozdowski et al. (2020). The purpose of this document is to provide a preliminary decision framework that incorporates revisions to the Decision Support Tools.

2.0 DECISION FRAMEWORK AND SUPPORT TOOLS

This framework will only apply to sites that can be certified based on the Alberta Framework for the Management of Contaminated Sites (GoA 2019) (i.e., sites that do not require remediation). The proposed decision framework consists of four (4) Decision Support Tools (DST) and a rating system to assess recommendations for end land use. The Decision Support Tools are used independently to evaluate the end land use recommendation and consist of the following:

- Adjacent and Regional Impacts Decision Support Tool (Section 2.1)
- Site Specific Decision Support Tool (Section 2.2)
- Access Decision Support Tool (Section 2.3)
- Borrow Decision Support Tool (Section 2.4)

Key terms in each DST are defined and a table is provided that may be used to help determine if the DST leads the user to decide if the pad/access is a candidate for peatland reclamation or upland reclamation.

Each DST has been assigned a value for input into a calculation for an Upland and Peatland rating. Values were assigned to each DST based on consultation with industry, AEP, AER and environmental consultants through Stage 1 and 2 of the project. Higher ratings represent a higher weighted importance than lower ratings (Tokay et al. 2019; Drozdowski et al. 2020):

- Adjacent and Regional Impacts Decision Support Tool = 3
- Site Specific Decision Support Tool = 3
- Access Decision Support Tool = 2
- Borrow Decision Support Tool = 1

A rating for each DST is assigned based on the outcome for each as either a candidate for peatland reclamation or upland reclamation and the weights above. The ratings from each DST with an outcome for a "candidate for peatland reclamation is summed to form a "peatland rating". The ratings from each DST with an outcome for a "candidate for upland reclamation is summed to form an "upland rating" (see example in Table 1). A comparison of peatland and upland ratings is then made using the Process Decision Support tool (Section 3.0). The entire process must be viewed together when weighing whether a site is a candidate for peatland reclamation or upland reclamation (i.e., the answer to each DST does not "pass" or "fail" a site). A depiction of the decision framework for determining an end land use recommendation is provided in Figure 1 and examples are provided in Appendix A.

Table 1. Example calculation of Peatland and Upland ratings

Decision Support Tool*	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
Adjacent and Regional Impacts	3	-
Site Specific Considerations	3	-
Access	-	2
Borrow	-	1
SUM [Peatland Rating]	6	
SUM [Upland Rating]		**3**

*In this example outcomes from DSTs were as follows; Access and Borrow DSTs = Candidates for Upland Reclamation; Local and Regional Impacts and Site Specific Considerations DSTs = Candidates for Peatland Reclamation

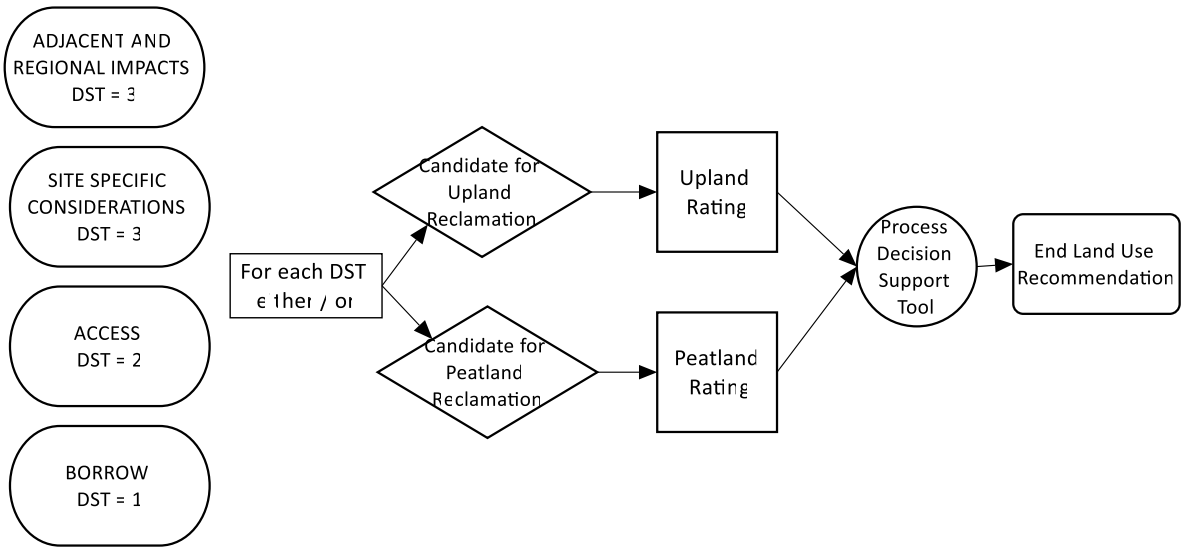

Figure 1. Decision framework for determining end land use recommendation.

2.1 ADJACENT AND REGIONAL IMPACTS DECISION SUPPORT TOOL

The Adjacent and Regional Impacts Decision Support Tool is shown in Figure 2. A glossary for the Adjacent and Regional Impacts Decision Support Tool is provided below for terms within the tool that require explanation and/or context. Use Table 2 to guide decisions in the Decision Support Tool.

Assign and record a rating of 3 in the accompanying Recommendation Calculator to either the "Candidate for Peatland Reclamation" or "Candidate for Upland Reclamation" depending on the outcome for the Adjacent and Regional Impacts Decision Support tool.

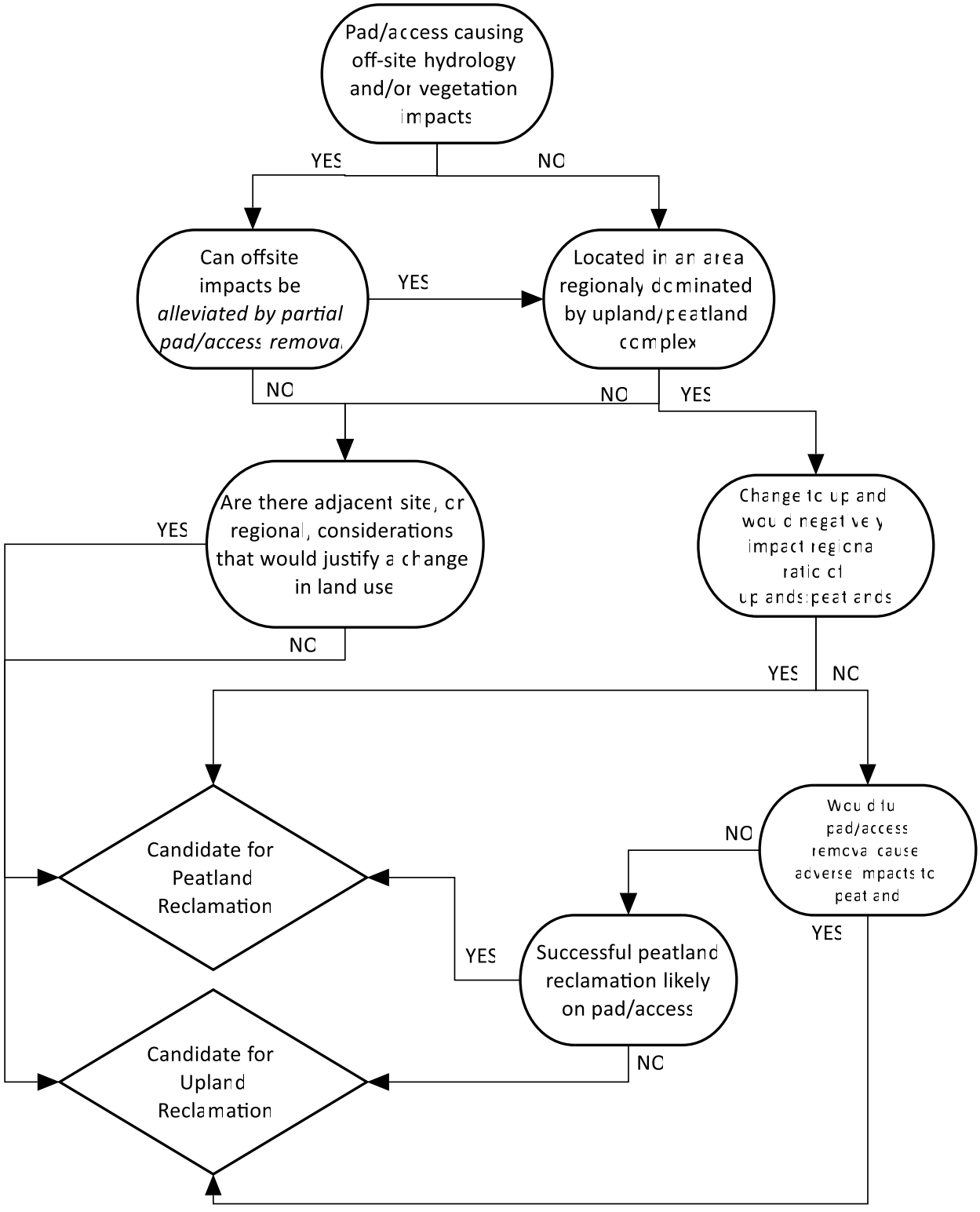

Figure 2. Adjacent and Regional Impacts Decision Support Tool
(refer to the glossary for definitions of key terms).

Glossary

Alleviated – Off-site hydrology and/or vegetation impacts are lessened or eliminated.

Full Pad (Access) Removal: Borrow material and geotextile are removed exposing the peat buried beneath the pad or access road.

Adjacent Area: *The area immediately adjacent to the pad or access road.*

Off-site Hydrology Impact: Flooding or low water levels leading to vegetation impacts.

Off-site Vegetation Impacts: Includes, but is not limited to, mortality, dieback, discolouration, reduced growth, reduced seed production, changes in species composition and assemblages that may result in long term implications for ecological sustainability.

Partial Access Removal: Portions of the access are removed (i.e., swale construction) to allow for free flow of water across the access. Often done at existing culvert sites or other low areas.

Partial Pad Removal: Portions of the pad are removed to allow a part of the pad area to be reclaimed as wetland. Partial removal may involve stripping borrow material from the surface to at or just below the water level or may involve removing the full pad depth on a part of the pad, usually at one edge.

Regional Ratio of Uplands:Peatlands: The ratio of uplands to peatlands within the watershed.[Hydrologic Unit Code (HUC) watershed classification must be clearly defined when assessing a site].

Upland/Peatland Complex: consisting of transitional uplands and peatlands.

Table 2. Adjacent and Regional Impacts Decision Support Tool Supporting Information.

Factor	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
To determine if pad/access is causing off-site hydrology and/or vegetation impacts, consider:		
Cause of wetland vegetation impacts	Unsuitable Pad chemistry [1] OR hydrology OR major siltation or erosion [2]	Minor siltation or erosion [2]
Pad influence on water flow	Pad influencing water flow as evidenced by water ponding or vegetation impacts	Minor influences on water flow
Access road influence and orientation on water flow	Access is impeding water flow	Access is not impeding water flow
To determine if offsite impacts can be alleviated by partial pad/access removal, consider:		
Type of wetland targeted for reclamation	This is a knowledge gap, research is either planned or in progress to answer this question	
Surrounding peatland type and characteristics of that peatland (e.g., peat depth and permeability)	This is a knowledge gap, research is either planned or in progress to answer this question	
Water flow direction and velocity	This is a knowledge gap, research is either planned or in progress to answer this question	

Factor	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
Access road length and orientation	This is a knowledge gap, research is either planned or in progress to answer this question	
Pad characteristics (e.g., depth, soil chemistry)	This is a knowledge gap, research is either planned or in progress to answer this question	
To determine if there are adjacent/regional considerations that would influence change in land use, consider:		
Regional caribou plans and direction from appropriate AEP biologists	Change in land use is not aligned with regional caribou plans	If desireable within the regional caribou plan to create more uplands for caribou habitat
To determine the impact of upland/peatland ratio, consider:		
Adjacent area	>50% peatland	>50% upland
Cumulative impact of change in regional wetland:upland ratio	This is a knowledge gap, research is either planned or in progress to answer this question	
To determine if full pad/access removal would cause adverse impacts to peatland, consider:		
Potential siltation or chemical impacts to wetland	No siltation OR chemical impacts likely	Major siltation OR chemical impacts likely
Surrounding peatland type	This is a knowledge gap, research is either planned or in progress to answer this question	
Damage to vegetation on the access road	Refer to Access DST	
Damage to wetland function of the borrow pit	Refer to Borrow DST	
To determine if successful peatland reclamation likely on pad/access, consider:		
Type of wetland targeted for reclamation	This is a knowledge gap, research is either planned or in progress to answer this question	
Surrounding wetland type	This is a knowledge gap, research is either planned or in progress to answer this question	
Extent of peat compression under the pad and potential for rebound	This is a knowledge gap, research is either planned or in progress to answer this question	
Availability of donor materials (Sphagnum mosses vs. fen mosses) for revegetation	Donor materials are readily available and collection does not cause excessive damage to donor areas	Donor materials are not readily available OR collection will cause excessive damage to donor areas
Potential for natural ingress of trees, shrubs, herbs, and mosses from nearby sources	Site is located near seed sources for peatland species, especially early successional species	Seed sources for peatland species, especially early successional species, are not present in the local area

[1] Remediating pad chemistry issues (e.g., salinity, pH) is not likely possible without significant site disturbance.

[2] Minor siltation or erosion issues can be addressed through minimal disturbance reclamation work. Major siltation or erosion issues would likely require significant site disturbance.

2.2 SITE SPECIFIC CONSIDERATIONS DECISION SUPPORT TOOL

The Site Specific Decision Support Tool is shown in Figure 3. A glossary for the Site Specific Considerations Decision Support Tool is provided below for terms within the tool that require explanation and/or context. Table 3 provides further information for consideration of certain site specific factors that may influence a recommendation for upland vs. peatland reclamation.

Assign and record a rating of 3 in the accompanying Recommendation Calculator to either the "Candidate for Peatland Reclamation" or "Candidate for Upland Reclamation" depending on the outcome for the Site Specific Considerations Decision Support tool.

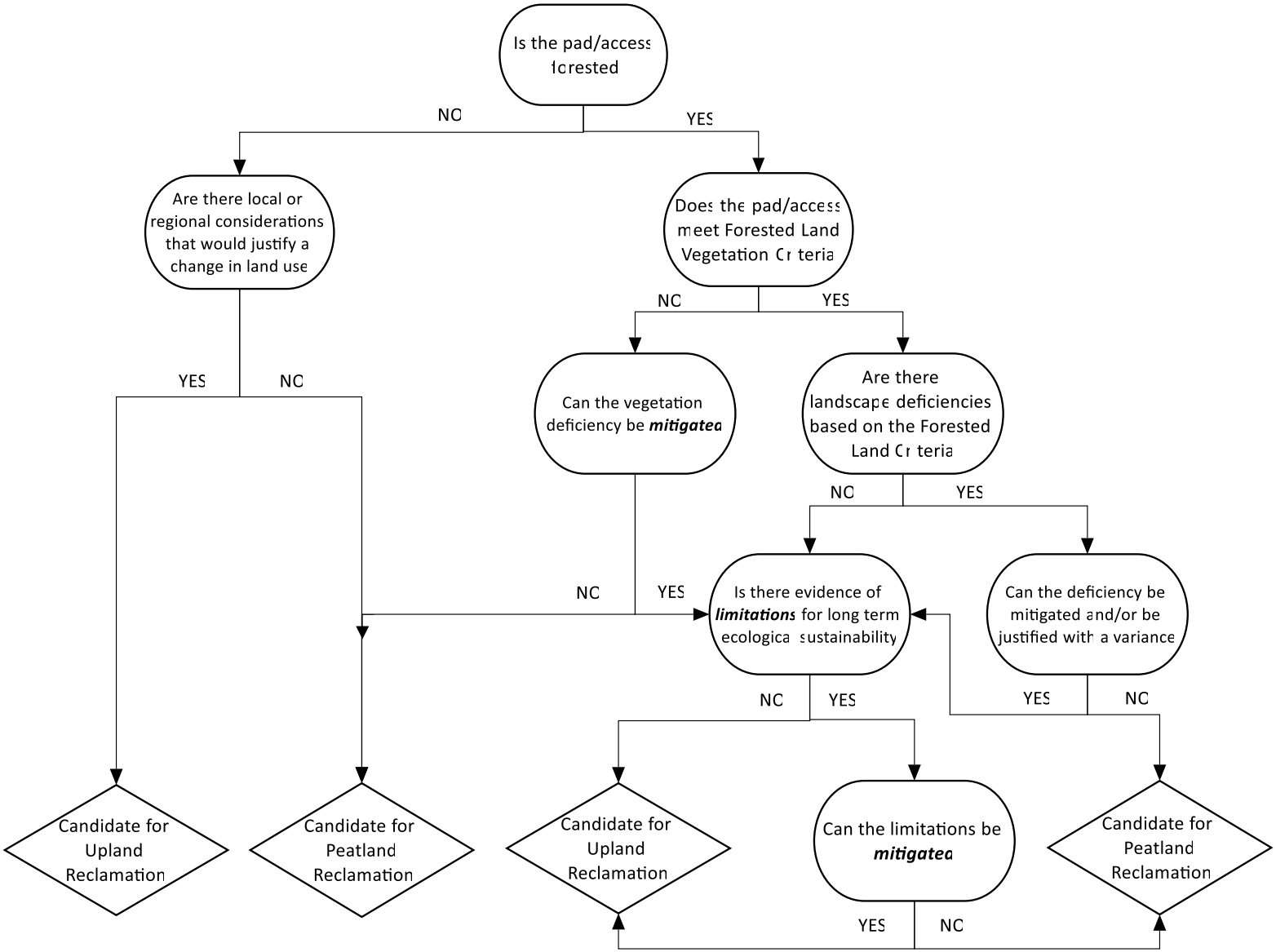

Figure 3. Site Specific Considerations Decision Support Tool
(refer to the glossary for definitions of key terms).

Glossary

Mitigated – landscape, soil, or vegetation work to reduce limitations that will not impact the existing site characteristics that do meet the Forested Land Criteria.

Limitations – soil characteristics that are likely to impede establishment or growth of desired vegetation (e.g., rooting restrictions, compaction, pad material chemistry, presence of shallow geotextile or corduroy).

Forested: Site will meet the Forested Land vegetation criteria and/or is on a trajectory to meet the overall objective of equivalent land capability and ecosystem function.

Modified Reclamation: Any reduction in all or part of the traditional reclamation steps (i.e., recontouring, replacement of subsoil and topsoil, revegetation) required to meet the forested land criteria without applying for a variance to criteria.

Rooting Restrictions: Physical and/or chemical barriers (e.g., soil compaction, geotextile, corduroy) that will result in roots being unable to extend to a depth equivalent to control vegetation.

Table 3. Site Specific Considerations Decision Support Tool Supporting Information.

Factor	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
To determine if pad is forested, consider:		
Vegetation status of pad	Peatland vegetation OR inappropriate or inadequate forested land vegetation OR site dominated by grass species	Site would pass a Detailed Site Assessment using the Forested Criteria with or without a vegetation override
To determine if there are local/regional considerations that would influence change in land use, consider:		
Refer to Local and Regional Impacts DST		
To determine if there are landscape deficiencies based on the Forested Land Criteria, consider:		
Additional benefits of reclamation	Other deficiencies (e.g., coarse woody debris, subsidence, contour, soil chemistry) on the access road or pad would be corrected by full or partial reclamation	There are no other deficiencies on the site (site will pass Forested Land Criteria)
To determine if there are limitations to long term ecological sustainability, consider:		
Type and extent of limitations	Rooting restrictions (i.e., compaction, cordoroy, geotextile, etc.) , topsoil/organic matter availability, nutrient status, soil chemistry	None OR minor limitations
Pad chemistry	Pad salinity or other chemistry issues are causing or may cause impacts to pad vegetation	No major pad chemistry issues

2.3 ACCESS DECISION SUPPORT TOOL

The Access Decision Support Tool is shown in Figure 4. A glossary for the Access Decision Support Tool is provided below for terms within the tool that require explanation and/or context. Table 4 provides further information for consideration of certain factors related to the access that may influence a recommendation for upland vs. peatland reclamation.

Assign and record a rating of 2 in the accompanying Recommendation Calculator to either the "Candidate for Upland Reclamation" or "Candidate for Peatland Reclamation" depending on the outcome for the Access Decision Support tool.

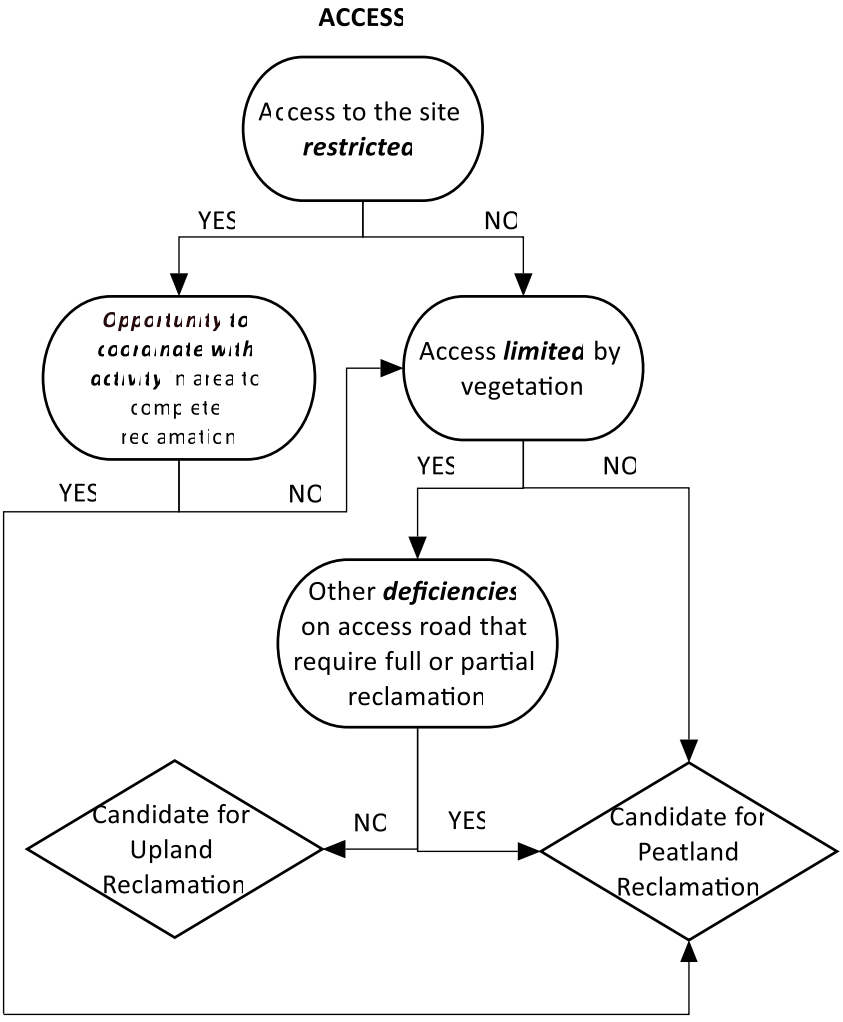

Figure 4. Access Decision Support Tool (refer to the glossary for definitions of key terms).

Glossary

Access – refers to site accessibility and is broader than just the access road; specific considerations for the impacts caused by the access road are included in the "Local and Regional Impacts" and considerations related to the reclamation status of the access road are included in the "Site Specific Considerations" Decision Support Tool

Deficiencies – reclamation deficiencies that prevent the site from passing Forested Land Criteria

Limited Access – road (or parts thereof) is revegetated and would meet Forested Land vegetation criteria on upland portions and Peatland vegetation criteria on peatland portions.

Opportunity to Coordinate Reclamation Work – Operator has other sites to be reclaimed in the area and/or area is designated for the Area-based Closure program.

Restricted Access – site is remote or only available via winter access

Table 4. Access Decision Support Tool Supporting Information.

Factor	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
To determine if access to the site is restricted, consider:		
Site remoteness	Site accessible by all-weather road	Site only accessible in winter
Access road length	Access road is shorter than 1 km OR vegetation does not meet Forested Land or Peatland Criteria	Access road is longer than 1 km AND vegetated (or if there is no access road)
To determine if access is limited by vegetation, consider:		
Access road vegetation	Peatland vegetation OR inappropriate or inadequate forested land vegetation	Peatland vegetation OR appropriate forested land vegetation that meets criteria
Access road environment	Majority of access is padded within a peatland	Majority of access is upland
To determine if there is an opportunity to coordinate with activity in area to complete reclamation, consider:		
Area-based closure	Site is within a designated Area-based Closure program area	Site is not in a designated Area-based Closure program area
Operator portfolio	Operator has other sites in the area that will be reclaimed within three years	Operator has no other sites in the area OR the operator's sites in the area will not be reclaimed for more than 3 years
To determine if there are other deficiencies on the access road that require full or partial reclamation, consider:		
Additional benefits of reclamation	Other deficiencies on the access road that need to be corrected by full or partial reclamation	There are no other deficiencies on the access road or pad (site will pass Forested Land Criteria)

2.4 BORROW DECISION SUPPORT TOOL

The Borrow Decision Support Tool is shown in Figure 5. A glossary for the Borrow Decision Support Tool is provided below for terms within the tool that require explanation and/or context. Table 5 provides further information for consideration of certain factors related to the borrow site that may influence a recommendation for upland vs. peatland reclamation for the pad and access (NOTE: decisions made about reclamation of the pad and access may result in changes to the reclamation criteria used to assess the borrow).

Assign and record a rating of 1 in the accompanying Recommendation Calculator to either the "Candidate for Peatland Reclamation" or "Candidate for Upland Reclamation" depending on the outcome for the Borrow Decision Support tool.

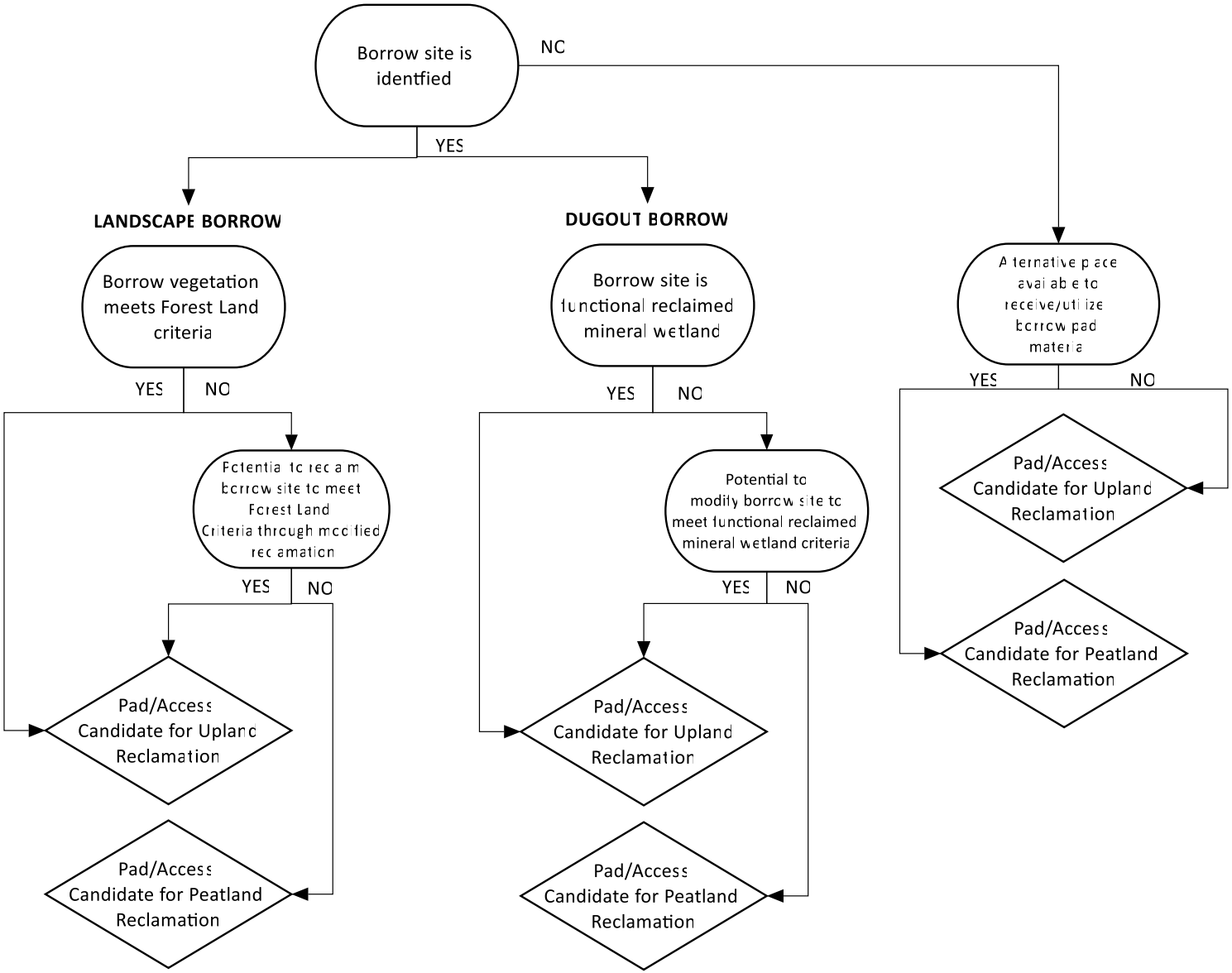

Figure 5. Borrow Decision Support Tool (refer to the glossary for definitions of key terms).

Glossary

Dugout Borrow – an excavation made to supply fill and/or construction material for a well pad or access road which, when reclaimed, is designed to hold water for the majority of the season.

Desirable Species – The presence of species that contribute to the native plant community trajectory type. Desirable species for **wet transitional zones** are hydrophytic or upland species native to the natural subregion. For **reclaimed mineral wetlands**, they are native hydrophytic species associated with wetland plant communities and have been provided in *Directive for Reclamation Certificate Site Assessments for Pits and Quarries (draft).*

Functional Reclaimed Mineral Wetland –A mineral wetland area created after the operation of pits, quarries, borrow activities, or similar activities that meets the design requirements set out in *Design Requirements for Mineral Wetlands for Reclamation (draft). Wetland function can be evaluated for areas that meet the design requirements based on the metrics described in the Alberta Wetland Rapid Evaluation Tool (ABWRET) (GoA, 2016). A reclaimed mineral wetland may not meet the ABWRET criteria and still be considered functional, if evaluated based on ecological metrics.*

Landscape Borrow – an excavation made to supply fill and/or construction material for a well pad or access road which, when reclaimed, does not hold water for the majority of the season.

Mineral Wetlands – A wetland characterized by mineral soils and/or organic layers that has either no accumulation of peat or a peat layer of less than 40 cm deep. The depth of water of a mineral wetland is less than 2 m. Water sources include surface runoff and/or groundwater.

Revegetated – Site will meet the vegetation criteria within the applicable criteria document and/or is on a trajectory to meet the overall objective of equivalent land capability and ecosystem function.

Wetland Attributes – It includes marsh, shallow open water, and swamp classes as attributes of a reclaimed mineral wetland. For marshes and shallow open water classes, it is further broken down into zones (shallow open water, emergent, wet meadow zones).

Wet transitional zones – An area not intended to be a functioning mineral wetland, where slopes are steeper than recommended for wetlands. Wet transitional zones may contain hydrophytic and/or upland vegetation. Wet transitional zones are reclaimed to native hydrophytic and/or native upland vegetation based on site conditions. Lotic systems (riparian) may also be included in this category.

Table 5. Borrow Decision Support Tool Supporting Information.

Factor	Candidate for Peatland Reclamation	Candidate for Upland Reclamation
To determine if there is an alternative place available to receive/utilize pad material, consider:		
Borrow site availability – full or partial pad removal	Borrow is available to receive all the borrow material.	Borrow is reclaimed OR site cannot be located.
Alternative site	Pad material could be reused OR disposed of in a nearby area	No potential for reuse OR nearby site for disposal
For landscape borrows, consider:		
Landscape Borrow Vegetation	Landscape borrow site is not vegetated OR has vegetation that will not meet the Forested Land vegetation criteria	Borrow site vegetated and will meet the Forested Land vegetation criteria
For dugout borrows, consider:		
Dugout Borrow Status	No evidence that site is filling to designed water level OR site is not vegetated	Full to designed water level and vegetated
Reclaimed mineral wetland function	Limited to no wetland attributes or desirable species in wet transition zone	ABWRET value considered High (A) OR Moderate (B) OR ABWRET value considered Moderately Low (C) with well developed desirable vegetation OR meets criteria for a functional mineral reclaimed wetland with appropriate wetland attributes and desirable vegetation

3.0 PROCESS DECISION SUPPORT TOOL

The following steps are taken to determine the final recommendation about whether to proceed with reclamation as an upland (change in land use) or peatland (Table 6). A Process Decision Support Tool is provided in Figure 6 and examples showing how the four DSTs and the Process DST work are provided in Appendix A.

Table 6. Steps for determining end land use recommendation.

Step 1	• For each of the four Decision Support Tools, determine whether the site is a Candidate for Peatland Reclamation or a Candidate for Upland Reclamation.
Step 2	• Assign the appropriate rating for each DST to either the Candidate for Peatland Reclamation or a Candidate for Upland Reclamation category based on the following: o Local and Regional Impacts = 3 o Site-specific Considerations = 3 o Access = 2 o Borrow = 1
Step 3	• Using the accompanying Quantification Tool enter the rating from each of the four DST to determine the: o ***Peatland Rating*** by summing the ratings for each DST that identified the site as a Candidate for Peatland Reclamation; o ***Upland Rating*** by summing the ratings for each DST that identified the site as a Candidate for Upland Reclamation.
Step 4	• Calculate the difference between the ***Peatland Rating*** and ***Upland Rating*** o Where the difference in the ratings is at least 3 the final recommendation is the option with the highest rating. o Where the difference in the ratings is less than 3 the ratings should be modified based on answers to the questions in Table 7. Once the modifications are made, the final recommendation is the option with the highest rating.

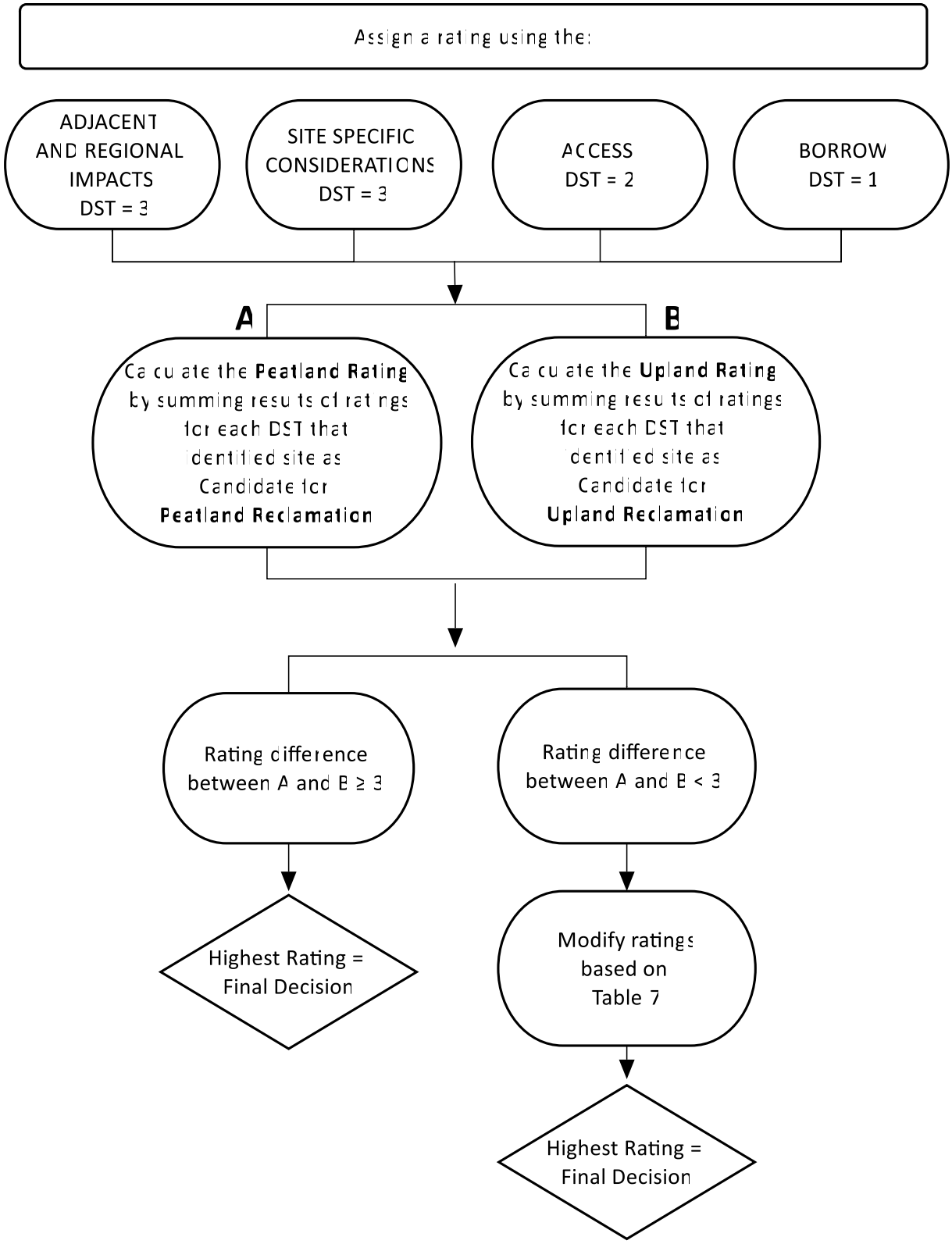

Figure 6. Process Decision Support Tool.

Table 7. Additional factors to consider in developing the final site rating.

Factor	Modification to Peatland Rating	Modification to Upland Rating
The Wetland Policy applies to the site (i.e., constructed post-2016)	+1	0
Borrow pit is available to receive pad/access borrow material	+1	0
Impacts to local hydrology are evident	+1	0
Site is in an upland/peatland complex area with >75% peatland	+1	0
Pad and access are not forested with desirable vegetation	+1	0
Site access is restricted	0	+1
Borrow site is a functional reclaimed mineral wetland	0	+1
Partial reclamation to peatland is possible so the rest can remain as upland	0	+1
Cost of full or partial reclamation of the access/pad to peatland exceeds $250K	0	+1

4.0 REFERENCES

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APPENDIX A - EXAMPLES

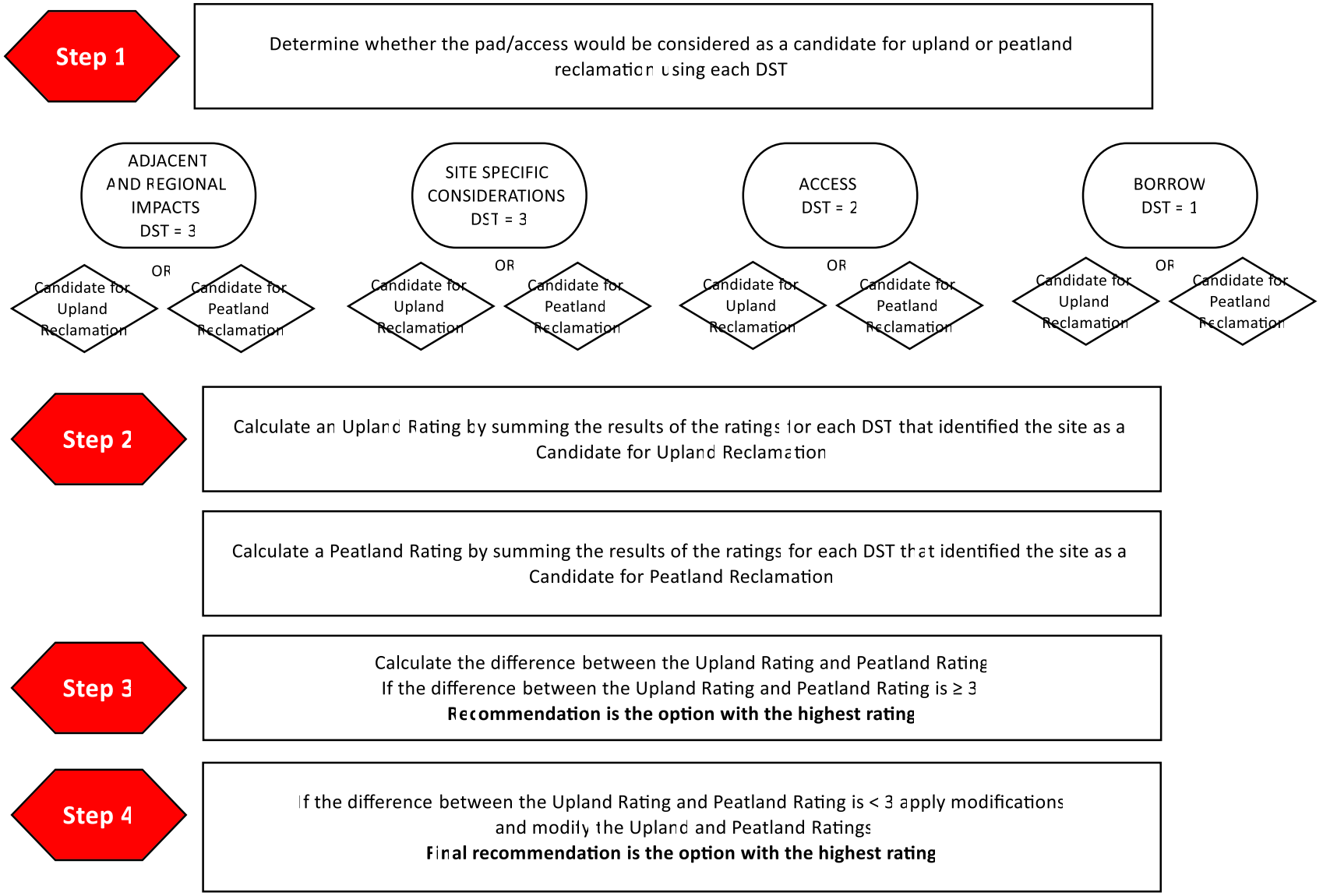
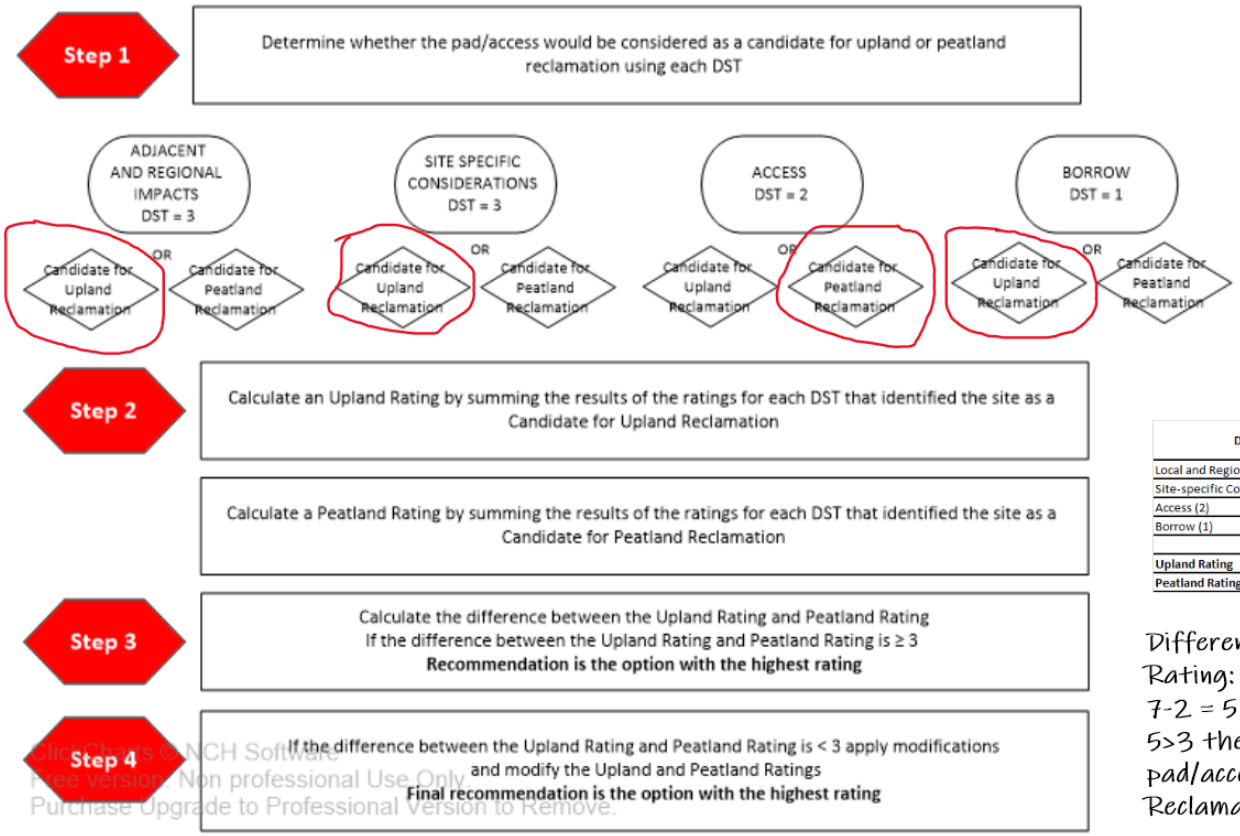


Figure A-1. Step by Step Depiction of the Decision Framework.



Decision Support Tool	Candidate for Upland Reclamation	Candidate for Peatland Reclamation
Local and Regional Impacts (3)	3	
Site-specific Considerations (3)	3	
Access (2)		2
Borrow (1)	1	
Upland Rating	7	
Peatland Rating		2

Difference between Upland and Peatland Rating:
7-2 = 5
5>3 therefore recommendation that the pad/access is a candidate for Upland Reclamation

Figure A-2. Example 1 applying the Decision Framework.

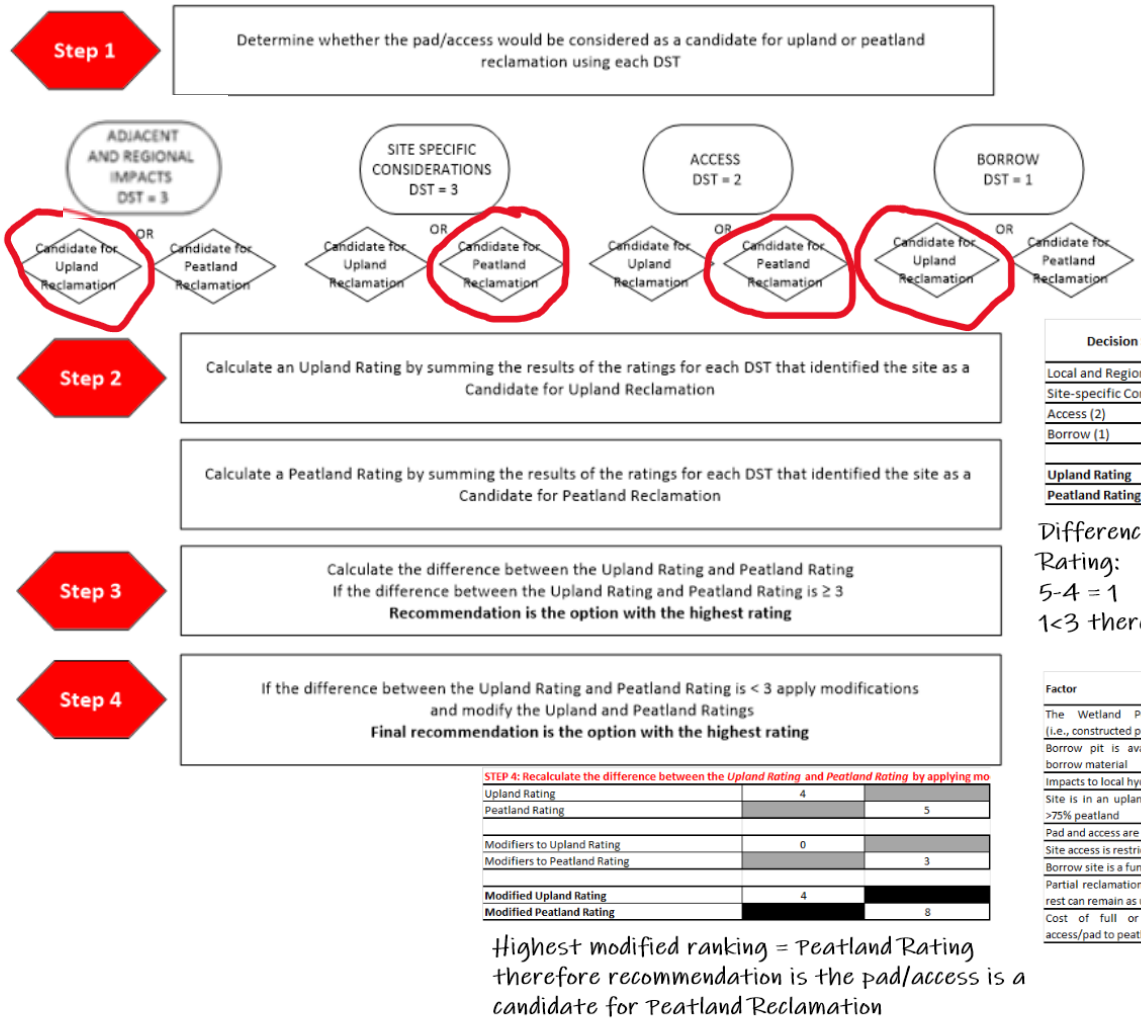


Figure A-3. Example 2 applying the Decision Framework.