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|  | <h1>Landscape Design Checklist</h1> <p><i>Revised RSDS Government Regulator Version</i></p> |
| | <p>May 2005</p> <p>CEMA-RWG Landscape Design Subgroup</p> |

Preamble

The Landscape Design Subgroup – a technical subgroup under Cumulative Environmental Management Association’s (CEMA) Reclamation Working Group (RWG) – created the following landscape design checklist. The checklist is a concise and comprehensive checklist of design objectives for creation (design, construction, reclamation, and maintenance) of landforms and landscapes in the Athabasca oil sands region. It is our intention that this checklist provides the overall framework for design and assessment of all reclaimed landscapes and landforms in the region. Multidisciplinary landscape design teams (specialists in geotechnical engineering, mine planning, surface and groundwater hydrology, geology, soils, vegetation, wildlife and traditional environmental knowledge) will use their skills and professional judgement to satisfy the design items in the checklist with due diligence.

To develop the checklist, subgroup members considered all kinds of oil sands mining landforms as identified in the Virtual Mine and the many issues and desired performances. The checklist was improved through a formal review process through 2003.

By way of definition, *landforms* are typically at the one to ten kilometre scale and include things like overburden dumps, tailings dykes and settling basins, lakes, wetlands, and rivers. *Landscapes* are at the ten to 100 kilometre scale. They include all that one can see from a particular vantage point, are typically thought of as oil sand leases and adjacent areas, typically consist of ten to twenty landforms and are usually designed through the closure planning process. The oil sands *region* is at the 100 kilometre scale and contains all the oil sand leases (and disturbed landscapes) and their cumulative effects. This checklist is primarily aimed at the landform scale but has applicability at all three scales. It is primarily targeted at landforms yet to be constructed.

The attached flowchart describes the basic flow of landscape design and how the checklist can be used. It is important to note that the design of landforms and landscapes is an iterative process that will typically last several decades. The following is an example of how the checklist might be employed for a specific landform:

- A mine planner proposes a new landform, consistent with the overall closure plan for a lease. A volume, schedule, footprint and simplified overall geometry are proposed.
- Using the checklist, a design team ensures the landform is integrated with the overall closure plan and adjusts the design (geometry, material placement, footprint, slope angles, morphology, reclamation material placement and revegetation) to accommodate operational, closure and reclamation goals. Working through the checklist, there is an attempt to satisfy each of the goals, reaching a design that optimizes landscape design goals.

- For up to several decades, the design team guides the landform through all phases of design, construction, regrading, coversoiling, revegetation, decommissioning, reclamation certification and custodial transfer. Throughout, the designs and field practices are adjusted on a go-forward basis. Periodic review by regulatory agencies and stakeholders will help to ensure that there is reasonable compliance with approvals, legislation and assurance of acceptable landscape performance.

The order of checklist design items is neither chronological nor hierarchical. Depending on local circumstances, some items will be more important than others. In some cases, not all goals can be practically or otherwise fully satisfied. Optimization, judgement and compromise, fundamental to any design, are essential in the application of landscape design. If meeting one goal conflicts with meeting others, then the consequences have to be weighed. Most landforms will likely require some kind of human health and ecological risk assessment in design and before reclamation certification – this checklist will help to form the terms of reference for this work. Documentation of decisions, goals and commitments and designs are critical.

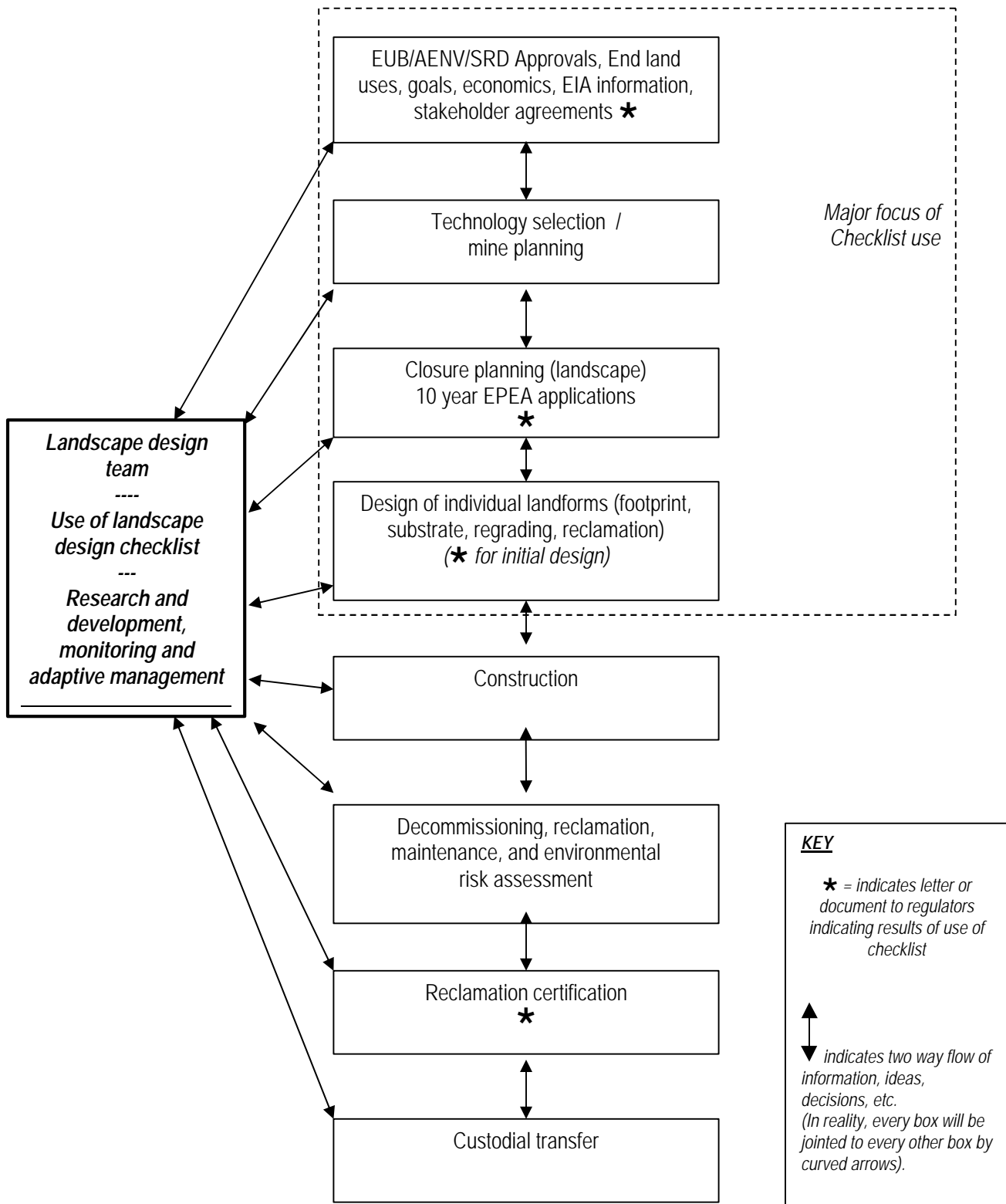
The checklist describes the need for creation of a monitoring and maintenance plan that covers the time from initial construction, through reclamation and decommissioning, to reclamation certification and custodial transfer. As the mining industry worldwide is recognizing the need for long term activities at many or most reclaimed mines, this Subgroup supports appropriate, operator funded closure management plans as part of diligent design.

Supporting the checklist and this new design approach will be several hierarchical levels of information:

- Detailed information will be available to the designers through a series of manuals specific to disciplines or landforms. Some of these authoritative manuals already exist for the oil sands region. A concise Landscape Design Manual that gives the design information on how to meet these objectives will be developed by the Landscape Design Subgroup.
- Designers will eventually have access to most of the models (computer and otherwise) that were used to develop the manuals.
- It is expected that manuals will be reviewed by regulators and accepted for use as best practices in design, recognizing that ultimately the responsibility for design rests with the operators.

Although many of the items in the design checklist may already be incorporated into the design process by some mining operation staff and their consultants, not all items are routinely or optimally followed, and the process is seldom systematic. Aside from the attempt at completeness and formality along with recognition of the need for judgment and optimization, there is little new here. It is anticipated that adoption of this process and formal use of the checklist will become a regulatory requirement for closure planning, design and reclamation in the oil sands region.

How the Landscape Design Checklist may be used





Landscape Design Checklist

The landscape designer (or evaluator) shall address the following design issues so that landscape performance will sustain proposed end land uses and equivalent capability.

| Design items | Action | Examples of available guidance/ comments |
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| Planning | | |
| 1. Regulations, agreements, and corporate objectives | 1.1 Prepare a list of all specific applicable regulations and agreements that are being considered in design. 1.2 Prepare a list of all specific corporate objectives 1.3 Design landscape to clearly meet these objectives | Proposed Landscape Design Manual (Goals and regulations chapter) AENV, EUB and SRD Approvals Guidelines and Standards (ELU, IRP) Corporate closure plan |
| 2. Technology selection | 2.1 Select technologies that produce materials that can be reclaimed to desired end land use. 2.2 All competing technologies must be evaluated using formal screening processes that consider life-cycle economics and environmental impacts. | Proposed Landscape Design Manual (Mine and closure planning chapter) |
| 3. Footprint – size/location | 3.1 Design footprint considering all relevant issues. 3.2 Resolve and document lease boundary issues with adjacent users. 3.3 Resolve and document issues about mining up to or through rivers, lakes, wetland, and other natural features. 3.4 Integrate footprint with closure landscape commitments and plans. | Proposed Landscape Design Manual (Mine and closure planning chapter) <i>Footprint considerations include items such as resource recovery, economics, social values, natural appearance, environmental impacts, historic sites, adjacent land uses and infrastructure</i> |
| 4. Mass balances | 4.1 Design to accommodate material balances. 4.2 Plans and schedules shall meet operational and long-term goals and include the transition (and retrofitting) from an operational landform to a reclamation landform. | Proposed Landscape Design Manual (Mine and closure planning chapter) <i>Material balances would include overburden, granular resources, tailings, water, and reclamation coversoils</i> |
| 5. Preservation of byproduct resources | 5.1 Store any byproduct that is considered a potential future resource, in such a way that it can be recovered in a manner acceptable to the EUB, AENV, SRD, and post-recovery landscape has the capability to meet environmental and end land use goals. 5.2 Design and manage byproduct landforms to reduce potential for combustion triggered by internal (spontaneous combustion) or external sources (lightning, wildfire). | Proposed Landscape Design Manual (Mine and closure planning chapter) |



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| 6. Design for operations | 6.1 Choose suites of technologies that support the ongoing operation (e.g. acceptable recycle water quality). 6.2 Design and schedule reclamation and closure activities to allow continuing oil sands operations. 6.3 Avoid compromising operational safety to satisfy closure goals. 6.4 Design to promote timely and progressive reclamation. | Proposed Landscape Design Manual (Mine and closure planning chapter) |
| 7. Design for closure | 7.1 Design landforms to be consistent with approved closure plan including surrounding lands 7.2 Plan all phases of construction and reclamation to achieve closure landform. 7.3 Plan and schedule decommissioning of facilities, inventories of process affected water, byproducts and wastes. 7.4 Integrate any long-term infrastructure with reclamation plans and landscape designs. 7.5 Design infrastructure with a consideration of its future decommissioning and reclamation. | Proposed Landscape Design Manual (Mine and closure planning chapter) Legislation Guidelines (IRP, ELU, etc) Approvals EUB/AENV/SRD |
| 8. Closure Management, (Pre-certification) | 8.1 Design to avoid or minimize the need for post operational maintenance, design for stable, self-sustaining landforms and to prevent re-disturbance of previously reclaimed lands. 8.2 Identify areas requiring or at risk of needing post-operational monitoring and mitigation. 8.3 Develop a monitoring and mitigation program for the period during and after construction and reclamation and until the landform is considered stable and suitable for reclamation certification. 8.4 Give explicit consideration to monitoring and mitigation requirements, where there may be a potential for extreme events and impacts of targeted end land use. 8.5 Develop conceptual plan for potential mitigation activities. | Proposed Landscape Design Manual (Environmental risk management chapter) |
| 9 Post Certification | 9.1 Design recognizing that no post certification maintenance is envisioned under the EPEA Act and Public Lands Act. | Proposed Landscape Design Manual (Environmental risk management chapter) |
| Desired Characteristics / Goals | | |
| 10. End Land Use | 10.1 Design with human and wildlife health and safety as the highest priority. 10.2 Design landscape to meet goals for targetted land uses including access and meeting equivalent capability targets on the whole lease. | Integrated Resource Plan Proposed Landscape Design Manual (Mine and closure planning chapter) |



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| 11. Soils | 11.1 Design and construct landform morphology and substrate to support replaced soil quality and to protect soils from loss and degradation. 11.2 Design reclamation material layers to achieve target soil capability. | Land Capability Classification System Manual, proposed Landscape Design Manual (Soils chapter) |
| 12. Vegetation | 12.1 Design topographic features, soils and substrate to support vegetation to achieve end land uses. 12.2 Create a vegetation plan that meets intended land uses on a lease- wide basis. 12.3 Create a vegetation plan that meets intended land uses for landform. 12. Design vegetation plan to aid landform stability (erosion, water table, moisture). | The Veg Manual, proposed Landscape Design Manual (Vegetation chapter) |
| 13. Wildlife | 13.1 Incorporate wildlife habitat and movement into design of landform and landscape scales . 13.2 Provide spatial attributes appropriate for wildlife and aquatic habitat goals. | The Veg Manual, Landscape Design Manual (Wildlife habitat chapter) Guidelines (IRP) SEE Design guide for details |
| 14. Aquatics | 14.1 Design drainage patterns, watercourses and waterbodies to be an appropriate combination of biological zones. 14.2 Avoid pond / lake evapoconcentration that leads to unproductive water bodies. 14.3 Indicate any water treatment wetlands that may be exempt from some aquatic ecology and influent water quality considerations. | The Wetland Manual, Landscape Design Manual (wetlands, lakes, and aquatics chapter), Alberta Water Quality Guidelines See Design Guide for details |
| 15 Geotechnical slope stability | 15.1 Design to protect slopes from instability. 15.2 Design to protect downstream areas from effects of catastrophic release of mobile materials. 15.3 Design to allow only acceptable consequences of potential flowslides. | Proposed Landscape Design Manual (Geotechnique chapter) <i>It will include failure mechanisms such as liquefaction, piping, material mobility, earthquakes, overtopping, rising water table, slope instability, retrogressive erosion or slumping, toe erosion</i> |



Landscape Design Checklist

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| Design items | Action | Examples of available guidance/ comments |
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| 16 Trafficability / bearing capacity | 16.1 Plan construction techniques to enhance trafficability for reclamation. 16.2 Design trafficability and bearing capacity to be compatible with end land use. | Proposed Landscape Design Manual (Geotechnique chapter) |
| 17. Natural appearance | 17.1 Design topography to resemble natural landforms in the region. | Proposed Landscape Design Manual (Mine and closure planning chapter) |
| 18 Seepage and groundwater (quality and quantity) | 18.1 Design to protect groundwater from impacts that affect offsite and/or on-site end land use. 18.2 Evaluate reclamation water balance at all critical scales. 18.3 Avoid reliance on seepage controls that require long-term maintenance. 18.4 Evaluate landscape performance (geotechnical, soils, etc) for long-term seepage conditions. | Proposed Landscape Design Manual (Seepage and groundwater chapter) |
| 19 Surface water hydrology (quantity and quality) | 19.1 Design an integrated landform, landscape and regional drainage system. 19.2 Design watercourses and waterbodies to have physical capacity to accommodate all ranges of hydrologic processes at acceptable rates of erosion. 19.3 Integrate operational and closure water balances to reduce inventory of process affected water at closure. | Proposed Landscape Design Manual (Surface water hydrology chapter) |
| Processes | | |
| 20 Natural hazards and disturbing forces | 20.1 Design landscapes to be acceptably stable under target end land uses. 20.2 Design landscapes to be acceptably stable under a variety of natural hazards and extreme events including fire, floods, drought, extreme precipitation, blight and disease, wind, earthquakes, animal effects. | Proposed Landscape Design Manual (Environmental risk management chapter) |
| 21 Erosion, transport, and sedimentation | 21.1 Design operational wind and water erosion control measures where needed. 21.2 Design to accommodate all forms of erosion of (or depositing onto) landforms including lakes and major drainages at acceptable rates. | Proposed Landscape Design Manual LCCS manual |
| 22 Settlement of fills | 22.1 Design long-term properties and topography to accommodate settlement and control any undesirable ponding. 22.2 Design surface water drainage system to accommodate settlement, including long-term saturation settlements and settlement of soft tailings. | Proposed Landscape Design Manual (Geotechnique chapter) |

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| | <p>APPENDIX A DEFINITIONS</p> |
| <p>Post Operational</p> | <p>The period after mining operations are final, and prior to reclamation certification</p> |
| <p>Avoid</p> | <p>To keep from happening: prevent or to refrain from. (Webster's II, New Riverside Dictionary, 1984)</p> |
| <p>Minimize</p> | <p>Reduce to the smallest possible amount or degree; (Adapted from: The Concise Oxford Dictionary of Current English, 7th Edition, 1982. Oxford University Press, NY.)</p> |