Using Natural Disturbance Patterns to Guide Management of a South-Western Alberta Landscape

Part II: A Natural Pattern Based Planning Process

A Foothills Research Institute, Natural Disturbance Program Project

September 8, 2008

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Using natural disturbance (ND) patterns as the foundation for land management is conceptually attractive (see part I of this report). It offers a biologically defendable foundation for all land management decisions, a starting point for the integration of policies and practices of dozens of different land management agencies, and a direct link to evaluating ecosystem health in a simple, but meaningful way. We also think it offers a way of implementing the draft Land Use Framework (LUF) for Alberta.

Translating this idea into practice is a significant challenge. In fact, there is no single process or method to follow, but rather many different possibilities based on the level of commitment to the approach (Table 1). A small community forest may like the idea of a fully integrated ND process, but may be limited by resources and willing partnerships. Regional exercises will require cooperation among agencies and disciplines at a variety of scales, as well as the commitment of resources, expertise and extensive Aboriginal and public consultation.

Table 1. Natural disturbance pattern elements and their implications.

ND Element	Approach / Level					
	Abcde	**F**ghIjk	**L**mno	**P**qrstu	**V**wxy	**Z**
NRV research	X	X	X	X	X	X
Pattern metrics	X	X	X	X	X	X
Suitable landscape size		X	X	X	X	X
Fully integrate variation			X	X	X	X
Full landscape content			X	X	X	X
Current condition considered			X	X	X	X
Integrating nat'l disturbance				X	X	X
Disturbance tools available				X	X	X
Active adaptive management					X	X
Regulatory streamlining					X	X
The landscape includes water					X	X
Deal with adjacent managers						X
Deal with co-managers						x

We propose here a process for creating a natural disturbance (ND) based plan. This process emphasizes the value of natural patterns and functions of the landscape, and the power of partnerships in creating a plan for a healthy landscape.

Planning Step #1: Evaluate the Commitment to an ND Approach

The first step in an ND planning exercise is to determine the nature and level of commitment to an ND approach. This can be done prior to any actual planning since it specifically defines and summarizes goals, roles, responsibilities, partnerships, tools, data, knowledge, and other intentions. This will set the stage for the planning exercise, but it also serves as the Terms of Reference (TOR) for defining the partnership. In other words, it is a commitment to not just some form of an ND approach, but also to working as a team towards common goals. We want to avoid allowing partners to participate in a process only as long as they get what they want – the commitment has to be specific and timely.

We used the 17 elements detailed in Appendix A to create a Natural Pattern Integration (NPI) game for identifying level and type of commitment to an ND approach. Keep in mind that this is a tool meant only to evaluate the degree to which a landscape is managed based on the concept of a natural pattern foundation – it in no way evaluates the results of a planning exercise, only the intent. The score represents a long-term commitment to managing for healthy landscapes, but it also provides important context for the planning process. For example, the planning team already knows who is involved, what disturbance tools they have at their disposal, how variability will be dealt with, how monitoring will take place and at what cost and by whom, and so on.

The reference point for the scores in this game for all categories is zero – which represents traditional land management. Anything above zero percent represents some level of commitment to an ND approach. Furthermore, a score of 50% is meaningless – there is no *pass* or *fail*.

For context, we ran the scores of various known agencies across Canada through the game to see how they fared. No known land management agency in Canada ten years ago would have scored higher than 10% overall. To date, no known landscape in Canada scores above 50% overall, and almost all of those success stories have occurred in the larger, more progressive national parks.

The score shown in Table 2 is that of the natural-based plan ASRD generated for K-country. The previous score in Table 2 is based on a very quick and rough estimate of the natural pattern efforts of the 2007 Spray Lakes Sawmills (SLS) Developmental Forest Management Plan (DFMP). SLS supported local natural pattern research efforts, defined NRV-based objectives, sought related disturbance concepts from related research, and integrated natural patterns on their own within their harvest areas. Their technical score of 27.4% should be compared against a probable score of less than 5% ten years ago – a laudable improvement.

A technical score of 41.5% for the recent ASRD plan for K-country represents a significant accomplishment under the circumstances. Keep in mind that the timeframe allowed no discussions with any other potential land or agency partners, or the time to fully explore some of the many disturbance options that were tabled. The score increase was largely due to a broader use of natural pattern metrics and tools, and including parts of the non-commercial land in the plan.

The institutional scores were very low in both plans because they were stand-alone products that involved no partnerships.

Table 2. A decision-support tool for evaluating the commitment to an ND-based planning approach, using the ASRD plan for K-country as an example.

NATURAL PATTERN INTEGRATION GAME

How Natural is YOUR Planning Exercise?

TECHNICAL ELEMENTS		**SCORE**	**MAX**
What is the breadth of depth of patterns used? (0=none, 5=many and varied)		6	10
How well do you know the historical disturbance patterns? (0=not at all, 5=intimately)		4	10
What decision-support tools are used? (0=none, 5=many & powerful)		2	10
To what degree is (disturbance pattern) variation included? (0=not at all, 5=intimately)		6	15
How is NRV used in planning? (0=not at all, 5= planning foundation)		6	10
Do plans include disturbance activities for all parts of the landscape? (0=no, 5=yes)		12	15
Is the landscape condition accounted for? (0=not at all, 5=in great detail)		6	10
How many disturbance tools do you have at your disposal? (0=no, 1=yes)			
	- harvesting	5	5
	- prescribed fire	0	10
	- thinning	5	5
	- girdling	0	5
	- flooding	0	10
	- other (list)	0	0
Is active adaptive management being used? (0=no, 5=full on)		4	20
Technical Sub-Total		**56**	**135**

INSTITUTIONAL ELEMENTS		**SCORE**	**MAX**
Is the size of the landscape large enough to be an ecosystem? (0=no, 5=yes)		2	5
Does the landscape include representative ecosystems and zones (5), or not (0)?		4	5
Are the boundaries natural (5) or jurisdictional (0)?		1	5
Are responses to natural disturbance events part of the plan (5) or not (0)?		0	10
What proportion of neighbours are involved and to what degree? (0=none, 5=all)			
(list all here)	- to FMA 2	0	5
	- to provincial park 1	0	5
	- to federal park(s)	0	5
	- to provincial park 2	0	5
	- to reserve 1	0	5
	- other (list all)		
What proportion of other agencies on the land are involved and how? (0=none, 5=all)			
(list all here)	- imbedded quota holders	0	5
	- energy sector (weight based on development potential)	0	5
	- ranchers	0	5
	- Alberta Environment	0	5
	- Alberta Agriculture and Rural Development	0	5
	- DFO	0	5
	- other (list all)		
Does the plan specifically include water? (0=not at all, 5=entirely)		4	10
Intra- agency regulatory collaboration (0=none, 5=complete)		0	10
Inter-agency regulatory collaboration (0=none, 5=complete)		0	10
Institutional Sub-Total		**11**	**110**

	Score	**Previous Score**	**Change**
TECHINCAL SUBTOTAL	**41.5%**	**27.4%**	**14.1%**
INSTITUTIONAL SUBTOTAL	**10.0%**	**6.4%**	**3.6%**
TOTAL NATURAL PATTERN PLANNING SCORE	***20.5%***	***13.4%***	***7.1%***

(*Note: the "Previous Score" above represents that from the '07 Spray Lakes Sawmills' plan***)**

A breakdown of the logic behind the NPI scores for the ASRD plan for K-country is as follows for technical elements:

- The natural patterns integrated into the SRD plan options include consideration of frequency, size, and severity – three of the more important disturbance pattern elements. However, the plan does not go into a great amount of detail on these patterns and does not deal with duration, shapes, or types. ***Score: 6 out of 10.*** (Previous score: 4)

- There is both local (from two field research projects supported by Spray Lakes and ASRD) and borrowed knowledge (from Foothills Research Institute) research of the natural disturbance regime and associated patterns. Overall, the knowledge base is about average, but needs upgrading if a natural pattern foundation is to be adopted. ***Score: 4 out of 10.*** (Previous score: 4)

- ASRD used long-term scenario planning tools, but better ones were available. They did use recent risk evaluation models for both wildfire and mountain pine beetle (MPB) risk, and the disturbance equivalent water model. ***Score: 2 out of 10.*** (Previous score: 4)

- The plan does not explicitly make it a priority to deal with variability, but it does come into play to some degree in the scenarios. This is an extremely challenging issue to integrate. ***Score: 6 out of 15.*** (Previous score: 3)

- Natural patterns were used as guides in the ASRD plan, but not necessarily as the foundation for planning decisions. ***Score: 6 out of 10.*** (Previous score: 4)

- One of the most forward-looking elements of the SRD plan is its inclusion of all parts of the land base within its planning scenarios. Although wetlands were not specifically mentioned, one would presume they are included. No specific water management elements were included other than the equivalent clearcut area (ECA) estimate. ***Score: 12 out of 15***. (Previous score: 3)

- Although the SRD plan includes elements of landscape condition in the ranking of values (mountain pine beetle and wildfire risk, recreational opportunities, etc), and some of the indicators the plan does not specifically deal with it. ***Score: 6 out of 10***. (Previous score: 6)

- The only disturbance tool used within the ASRD plan is forest harvesting, although that includes thinning in some cases. Prescribed burning is mentioned, but not integrated into the plan. ***Score: 10 out of 35.*** (Previous score: 5)

- Monitoring is mentioned as a useful tool in the document, but not part of the plan per se. ***Score: 4 out of 20*** (Previous score: 4)

The institutional elements of creating a natural-based plan were deliberately not a part of the ASRD planning exercise, so most remain unchanged from the previous SLS plan.

- The size of the landscape in question is average to good, but the area is discontinuous in space. The largest piece of land is only marginally suitable for

disturbance planning. Furthermore, the boundaries are only moderately representation of ecological boundaries. ***Scores: 2 of 5 for landscape size, 4 of 5 for landscape representation, and 1 of 5 for landscape boundaries, zero for all others.*** (Previous scores: same)

- The plan dealt with water, but only as an input through the equivalency disturbance ranking. The NRV of water was not considered. ***Score: 4 out of 10*** (Previous score: 0)

How Might a K-Country Planning Exercise Score Higher?

The ASRD planning exercise was completed in an extremely short period of time. It is not difficult to see how improvements to that effort are possible. For example, we have identified the size, shape, and orientation of the K-country planning area is a limitation because it does not align with the repeating landscape patterns and processes. One obvious way of improving this score is to include neighbours in the planning exercise. For example, if the planning were to include all adjacent provincial parks, Banff national Park, and the Stoney Reserve, the Institutional score would jump from 6.4% to 29.1%. Another of the more obvious improvements that could be made is to introduce a broader range of disturbance tools. If harvesting, thinning, prescribed fire, and girdling were all acceptable tools on all parts of the landscape, the technical score would increase to well over 50%.

Planning Step #2: Evaluate the Existing Landscape Condition and Associated Risks.

Since the focus on an ND approach is landscape health, regardless of the level of commitment (from step #1 above), some cumulative measures of landscape condition are required. There is no way of knowing the likely impact of future disturbance activities – good or bad – without understanding the existing landscape pattern condition. This step also includes an evaluation of any potential risks to the landscape associated with being beyond NRV for any of the metrics.

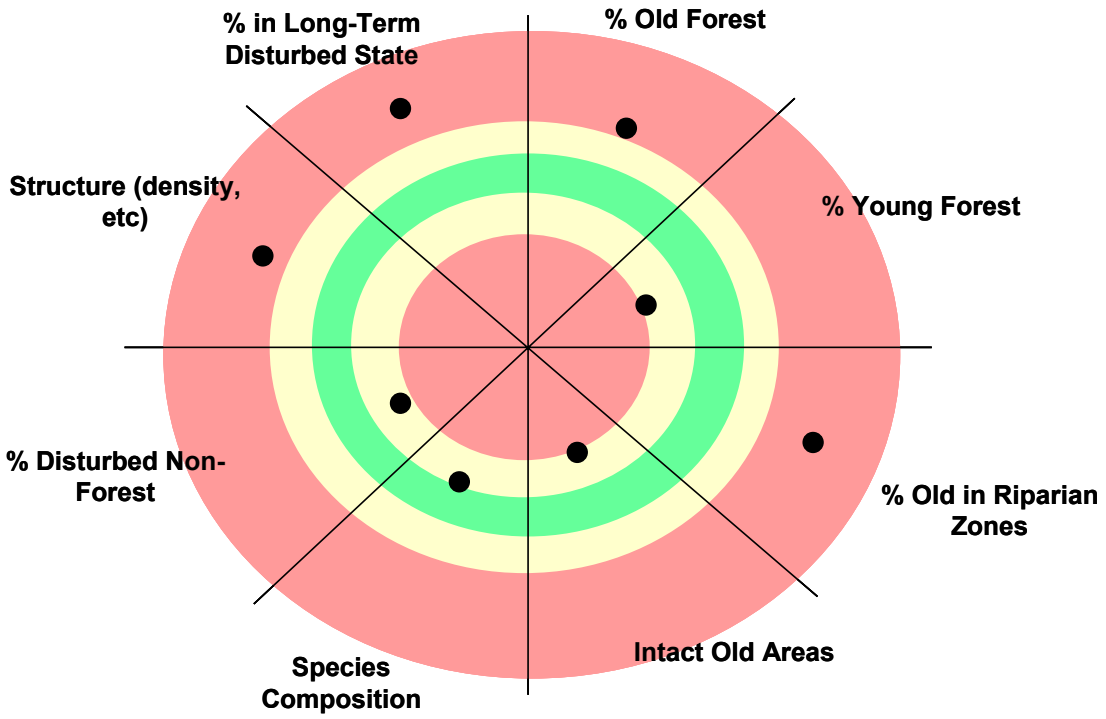
There is no standardized method of assessing landscape condition. In fact, some land management agencies are not required to evaluate landscape condition. However, the indicators should reflect the ultimate goal of evaluating ecosystem health and risk using NRV as a backdrop to identify thresholds. And the presentation should be easy to interpret. The target idea shown in Figure 1 demonstrates how this might work for landscape vegetation condition. It shows a standardized NRV range (shown in green and yellow) for each indicator, plus the existing condition (shown as a black dot). Note that this configuration gives information on whether a given indicator is above or below NRV. The point of this exercise is that it identifies red flags that require attention because they represent risks to ecosystem health, and potentially other social and economic issues. Also note that Figure 1 only shows vegetation condition; other models would be generated for water dynamics, soil processes, and so on. The target shown in Figure 1 is a preliminary estimate of the landscape conditions in the K-country landscape used for the ASRD planning exercise - for demonstration purposes only.

Even a very rough summary provides some valuable insights. For example, we noted that the landscape has likely moved beyond NRV for old forest levels (due to fire control). Similarly, the level of old riparian old forest areas is in excess of NRV.

However, because of the impact of linear features and historical fragmented harvesting, the size of intact old forest areas is pushing the lower end of NRV. Another example of a red flag in this case is the amount of recently disturbed non-forest area. That might prompt a planning process to focus efforts on finding ways of creating or allowing disturbances in such areas.

Although this particular tool was not yet developed for the ASRD planning exercise for K-country, the team identified the three most critical landscape condition issues; 1) high risk to wildfire, 2) high risk to mountain pine beetle, and 3) the structural shift in the lower elevation areas away from (historical) low density, open pine forest / meadow complexes to high density pure pine forests. There was no evidence in the report of other red flags identified here such as riparian and non-forested area health, or shifts in species composition, but they were not the most obvious priorities.

Figure 1. Cumulative Measure of Landscape Vegetation Condition Patterns Relative to the Natural Range of Variation of Each Pattern (in Green and Yellow).



Planning Step #3: Understand the Disturbance Patterns

This may at first blush seem an academic exercise, but managers must understand the nature of that which they are managing, and we have already defined our primary management objective as ecosystem health *via* the NRV of disturbance patterns. There is also a need for everyone to become comfortable using the new pattern language that an ND approach introduces. There are at least four parts to step #3.

a) *Identify NRV for the local disturbance patterns.* Everyone involved should be well versed in the best available understanding of the natural patterns. In the best case scenario, this includes a combination of empirical research, but also

some simulation modelling output demonstrating the range and nature of historic landscape conditions. This knowledge forms the backdrop for future discussions, and may also provide some disturbance scenarios for step #4 (see ahead).

b) *Identify past cultural disturbance patterns.* Understanding historical patterns of cultural disturbance relative to NRV helps explain the landscape condition, and identifies why the landscape may be at risk. Figure 2 shows a target diagram similar to that introduced in Figure 1; red represents beyond NRV, and green and yellow are within NRV. The black dots represent the cumulative disturbance patterns of the last 10 years (for example). For example, the decrease in *severity* represents an acknowledgement that low severity surface fires have not been represented over the last few decades, and have been replaced by high-density pure pine stands.

c) *Identify the disturbance pattern priorities*. This exercise combined with step #2 allows the team to generate some initial – *value free* - goals in terms of the general direction of disturbance activities. For example, understanding the relationship between shifts in disturbance frequency and severity, plus the increased risk to wildfire and mountain pine beetle, may lead a planning team to target severity and frequency as priorities for the next disturbance plan (green boxes in Figure 2).

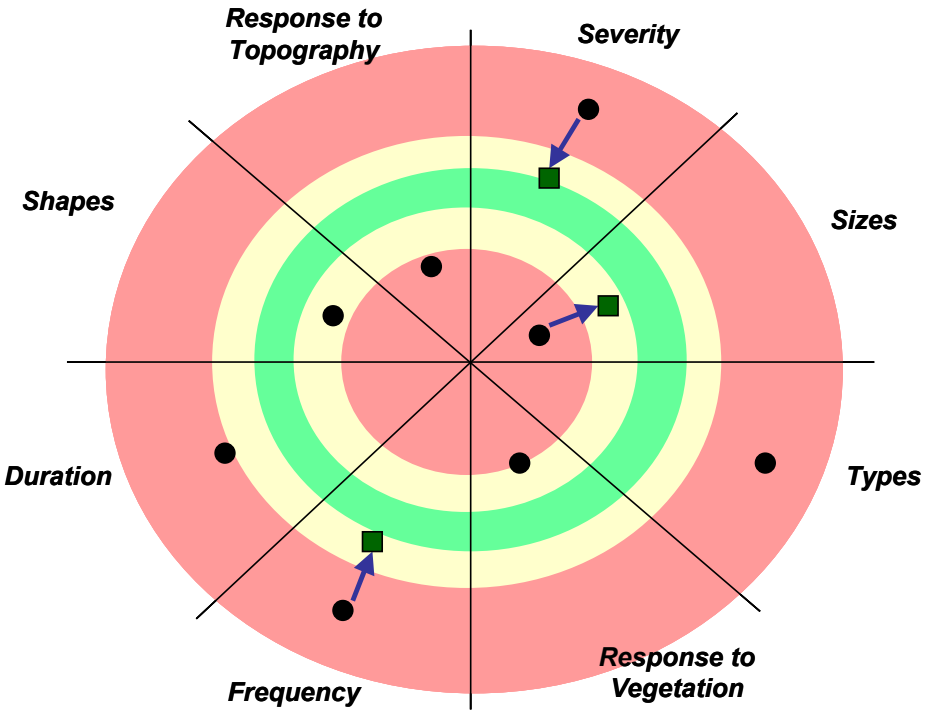
d) *Generate some natural disturbance scenarios*. Based solely on the identified priorities in step 3c, generate some disturbance scenario options. They need not be elaborate or highly detailed at this point. They are mostly for demonstration purposes (and thus generating some sort of map product is critical), although some of these simple scenarios may be used in step #4 ahead. The models to do this are for the most part available.

The interplay between the four parts to step #3 is important. The link between disturbance activities and past and future landscape condition could be the most important piece of information for an ND-based plan. For example, in an extreme case a planning team may design a disturbance plan that is beyond NRV in order to restore a landscape more quickly to a more natural condition.

It is important to note that we have not yet introduced values into the exercise. Furthermore, the identified goals are quite modest (*e.g.," concentrate disturbance activities on low severity disturbance events for the Montane to bring the landscape condition closer to NRV"*). The focus so far is on options for maintaining or improving ecosystem health. And the reason to keep goals general and modest, combined with understanding natural disturbance patterns, is that it should create a range of opportunities, not limit options.

The ASRD planning exercise for K-country took advantage of both local and adjacent disturbance pattern research from the Foothills Research Institute (FRI), and they solicited input from a natural pattern researcher from the FRI as a consultant to the team. The team debated the inclusion of natural disturbance pattern output from a spatial natural disturbance pattern model, but time did not allow for this activity. Although not formalized as in Figure 2, the discussions did focus on dealing with key landscape condition issues such as wildfire and mountain pine beetle risk. The blue arrows roughly represent the intent of the ASRD planning exercise.

Figure 2. Historical Cultural Disturbance Patterns (black dots) and Desired Future Patterns (Green Boxes) Relative to NRV (Green and Yellow Areas in the Target).



Planning Step #4: Design a Filtering Process

Filtering represents the backbone of any land planning process, and includes the identification and ranking of goals and objectives, public input approaches, the regulatory requirements, the range and type of decision-support tools involved, and the mode of identifying the chosen disturbance plan. *This is easily the most challenging step in the planning process, and not because the tools do not exist, but rather because it requires some degree of institutional adjustments. Any sort of universal planning process seeks to replace the perceived independent and omnipotent powers of existing agencies with a shared power and responsibility arrangement. This challenge should not be underestimated.*

Fortunately, there is a tremendous range of filtering processes already in existence, and a growing list of decision-support tools and datasets with which to work. Note also that the development of a terms of reference in step #1, combined with the process outlined in steps 2 and 3 actually include many of the elements of a traditional planning exercise already; identifying roles, responsibilities and resources, gathering and sharing background information and data, identifying risks, developing shared overarching goals, and so on. Overall, we fully anticipate that the planning process will become actually *more* efficient as partnerships increase – not less. Furthermore, the basis for some planning scenarios has already been developed in step #3, and could be adopted in whole or part as part of a more comprehensive scenario development exercise.

One obvious possibility is to use the most sophisticated filtering process among the partners as the starting point for discussions. This strategy would be difficult to argue with from a regulatory perspective since it represents the highest common denominator, which means the plan should be universally acceptable. The most developed planning process will also effectively blend a range of goals and objectives, and offer the best method for soliciting public input.

The most challenging filtering issues will be the determination of overall disturbance levels, and prioritizing locations. The NRV of disturbance patterns is of little value on these topics because of the huge range of possibilities. Step #3 is meant to put some bounds on those elements, but it is likely that new tools will be needed. For example, we might consider a modified version of Tradable Disturbance Credits (TDCs). The idea behind TDCs is to determine a desirable average level of disturbance for a given area over time, and then let the market determine who owns the rights to disturbance activities – which in this case would have to be measured in NRV terms. Stakeholders have a variety of strategies that can be pursued under changing market conditions compared to the government being the sole arbitrator through regulation. There is potential for this idea to work within a natural based management model since it is inherently flexible, identifies responsibility, and considers disturbance cumulatively.

The output of step #4 is a disturbance plan that outlines how much, when, and where disturbance activities will occur over the next several years. The plan should also ideally include predictions of the landscape condition and biological responses to the disturbance activities (see step #6 ahead).

As one might expect, the ASRD planning exercise for K-country used the planning standards from ASRD. Since this was just a demonstration exercise, the public input step was skipped. What we lack (in K-country and in Alberta in general) is a spatial decision-support tool that fully integrates land and water-based disturbance patterns and effects. However, the expertise exists to create such a tool, and efforts are underway under the auspices of the FRI.

Planning Step #5: Coordinate Disturbance Activities

One of the advantages of creating a single disturbance plan among many partners is that the resources, expertise, and technology can be pooled. Nor does the agency responsible for a particular disturbance activity have to be the one who might most benefit from that activity. Disturbance actions could be allocated geographically, technically, or even economically. For example, one agency may install all prescribed burns, another to do pre-commercial thinning and tree girdling, two others to share the harvesting using a combination of species mix and access, and perhaps a consortium of three or four other agencies to install any new roads and bridges.

Nor is it necessary for the agency responsible for one aspect of the disturbance activities to be directly associated with the products or benefits of that activity. It may be more efficient and logical for agencies to share these tasks, outputs, and resources as capacity allows. Furthermore, such arrangements can, and should change over time as both need and capacity of the partners' change. In fact, the disturbance tools with which to achieve a disturbance plan may even change over time. Partnerships may even want to convene *disturbance plan implementation teams* to deal with ongoing implementation issues.

Planning Step #6: Identify Feedback Mechanisms

Feedback is a common and logical part of any planning process. The idea is to use experience to gain new insight on the effectiveness of management actions. As applied to land management, this refers to social, economic, and ecological factors. Several forms of feedback in land management exist.

Adaptive management is well discussed in both the literature and policy, and there are two basic versions. Passive adaptive management (PAM) – *the monitoring of key indicators on a continual basis* – is by far the most common, although by no means universally required. Although many land management agencies have little or no legal requirement to monitor in Alberta, most do in some form to ensure they are meeting their primary objectives (*i.e.*, overnight stays or trail use in parks, gas production for energy companies, etc).

A smaller number of agencies are required to report on a wide range of indicators. National Parks and forest management companies collect information on many ecological, social, and economic indicators. One of the criticisms of this requirement is that many of the ecological measurements represent cumulative responses, while the responsibilities and disturbance activities are often not. The Alberta Biodiversity Monitoring Institute (ABMI) is the only known provincial cumulative biological monitoring program. It is well suited to track the overall performance of an ND approach, especially in terms of overall landscape patterns and actual species diversity. It could also address whether or not cumulative management actions reach desired targets at large spatial scales. ABMI does not track the effects of specific local management activities and further monitoring would be required at this level when new approaches are proposed.

The pinnacle of feedback systems is active adaptive management (AAM) - *the comparison of predicted and measured responses to management activities.* This includes all responses; ecological, economic, and social. Thus, true AAM extends to both research and management. Active adaptive management systems are rare.

It is not surprising that cumulative and adaptive feedback systems are rare since traditional planning systems discourage it. Consider a generalized model of a traditional land management system in Figure 3 (adapted from Figure 4 in part I of this report). Since individual values are the primary drivers of isolated, uncoordinated management actions, the only logical need for feedback is to the original values (represented by the green dashed lines in Figure 3). Not only is there no incentive to monitor cumulative (landscape condition and biological) responses, it is extremely challenging to make it meaningful without an associated cumulative disturbance plan.

In contrast, an ND model of land management dovetails perfectly with an AAM feedback system. In fact, the gathering of many plans into one disturbance plan allows predictions to be made at virtually every stage (see the green dashed lines in Figure 4). The value of the link between patterns and conditions as a planning tool (as outlined in steps #2 and #3) has already been demonstrated. And there is still a direct link to feedback on the social and economic values, but now it flows logically through the functions of the ecological system dynamics that they are a part of.

The ASRD plan for K-country did not specifically deal with monitoring, although ASRD has one of the most rigorous passive adaptive management requirements in Alberta.

Figure 3. Feedback (Green Dashed Arrows) Within a Traditional Forest Land Management System.

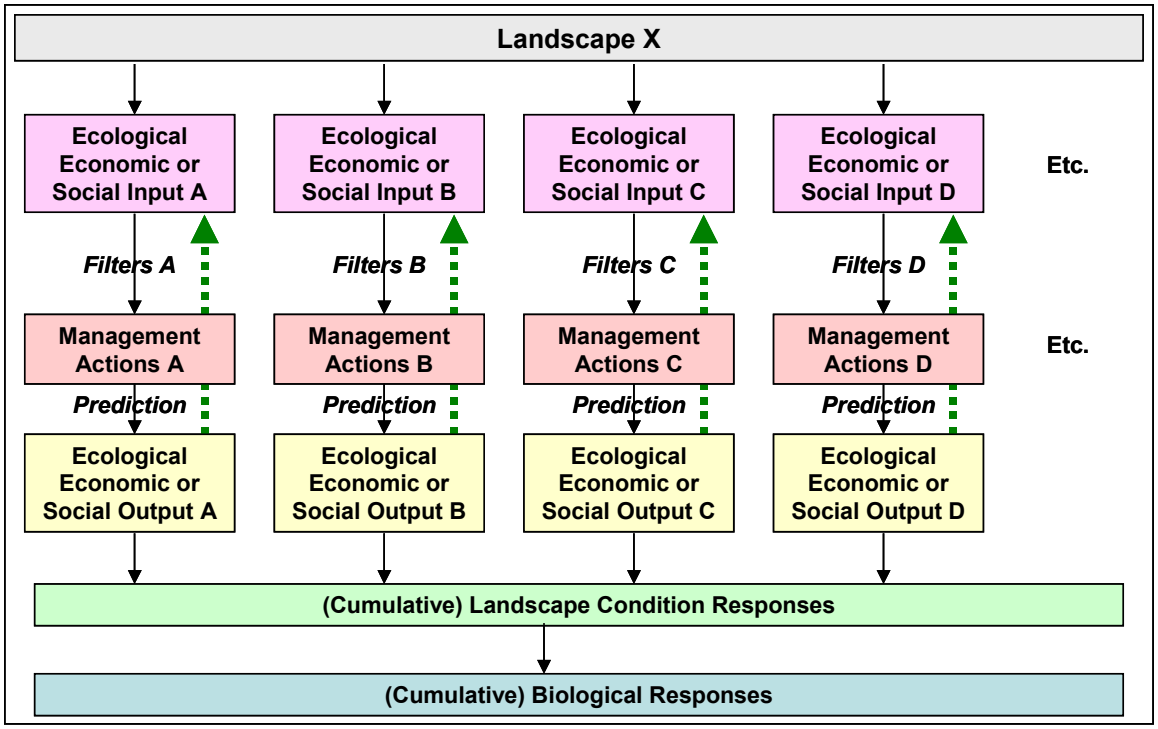
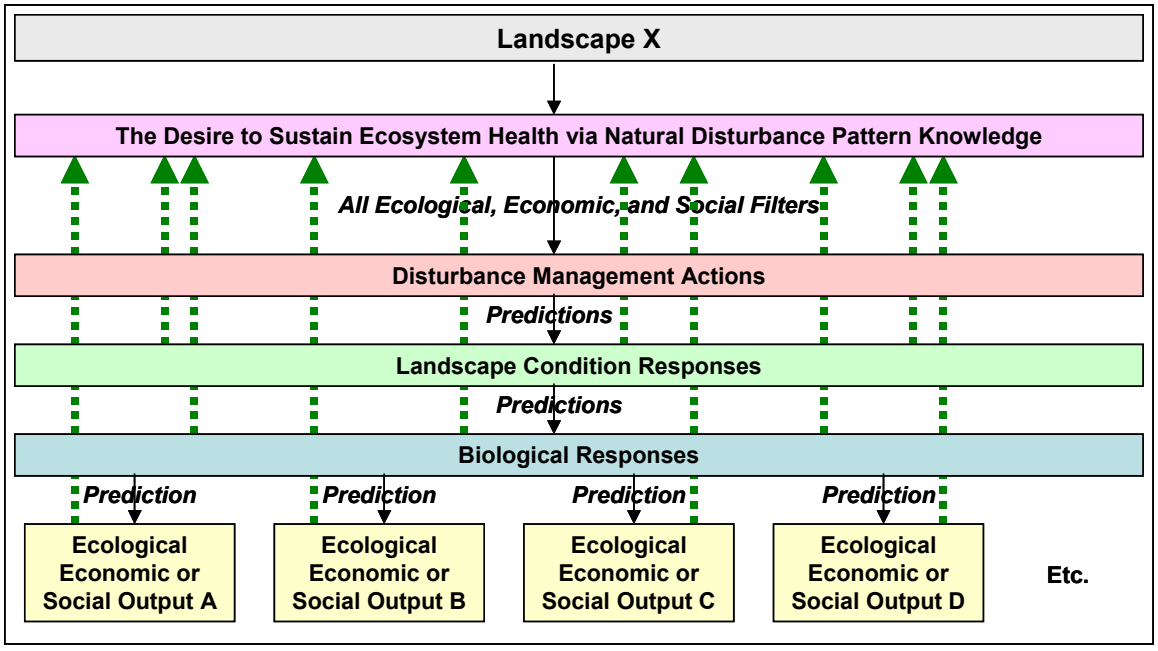


Figure 4. Feedback (Green Dashed Arrows) Within an ND-Based Forest Land Management Approach.



Why the Six-Step Planning Process?

Our experience with planning systems dates back many centuries, and land management planning in Canada is many decades old. The reason we are suggesting the need for a new planning model now is that we are making a fundamental shift in thinking in terms of what it is we think we are managing and why; *goods and services to meet the needs of individual values,* versus *ecological health to meet the needs of all values over the long term.*

However, we are not necessarily suggesting a new concept. Many of the ideas discussed here are consistent with the Draft Land Use Framework (LUF) for Alberta. For example:

- This process outlined here is potentially a manifestation of the LUF vision to "…*respect and care for the land as the foundation…".* There is no greater level of respect for the land than using knowledge of Mother Nature to help manage it under the auspices of sustaining ecological health as the priority.
- One of the three desired outcomes of the LUF is "*Healthy ecosystems and environment*". This planning process not only focuses on ecosystem health, it provides mechanisms with which to explicitly measure and monitor it.
- An ND approach offers a universal, biologically defendable foundation for identifying and evaluating the risks of thresholds and carrying capacity.
- The LUF stresses the desire to "*…integrate provincial policies at the regional level..".* We specifically identified institutional issues, tools, and a universal biological foundation for management all in an attempt to facilitate integration. The potential to streamline policies and practices within the government alone suggests that the ND model is well worth exploring.
- The LUF recognizes the need for integration of management activities and the importance of cumulative impacts. A *disturbance plan* is the ultimate manifestation of the integration of management activities. Furthermore, we explicitly rank efforts to integrate activities to evaluate cumulative management efforts. Lastly, we are confident that there are potentially tremendous economic efficiencies to be gained by coordinating disturbance activities.
- An ND approach can be applied to any landscape, at any time. The concept works equally well for grasslands, wetlands, or forests. Even highly culturally modified landscapes can benefit from going through an ND-based planning process. The fact that it discourages a "one-size fits all solution is also consistent with the LUF.

In summary, an ND approach could quite easily be used to deliver on the vision of the LUF for individual landscapes, entire regions, or the whole province.

How Might it Work?

Below are four brief examples of how the six-step process described here might play out. Although the issues in each example are real, the landscapes and partners in each are entirely fictional.

ND PLANING SCENARIO 1 – Hilly Park

Scenario: The landscape is a 30,000 ha southern foothills / grassland provincial park, managed by Alberta Tourism Parks and Recreation (TPR). The park priority is to maintain existing landscape conditions for recreational experiences. Parks has no requirements to integrate natural patterns, no standardized planning process, and in this case has no desire to include adjacent neighbours.

Step 1: Evaluate the Commitment to an ND Approach:
The park has not been proactive in support of natural disturbance research, but are the beneficiaries of adjacent research efforts. They have no mandate to use natural patterns as either planning guides or indicators of success. In the past few years this park has accepted prescribed fire as a disturbance tool, but only to deal with high risk areas. This park is far too small to be biologically meaningful on its own. *NPI Scores: Technical = 10.9%, Institutional = 2.7%, Cumulative = 5.5%*

Step 2: Evaluate the Existing Landscape Conditions and Associated Risk.
Fire control and the lack of disturbance activity has allowed significant invasion of trees into open meadow grasslands, and the density of forested areas to increase. The wildfire risk is therefore high to extreme. Landscape condition score**:** *Six of eight indicators are beyond NRV.*

Step 3: Understand the Disturbance Patterns.
The frequency and size of the disturbance activities of the last 30 years is far below natural, historic levels. Identified restoring open tree – meadow complexes as a priority. Natural disturbance pattern score: *Six of eight indicators are beyond NRV.*

Step 4: Design a Filtering Process.
TPR has no minimum requirements for planning, but Hilly held four open houses collaboratively with ASRD fire experts, and will write brief prescribed burn management plans for some small areas over the next five years.

Step 5: Coordinate Disturbance Activities.
No internal capacity exists to do prescribed burns. The plan is submitted annual to ASRD to carry out the burns.

Step 6. Feedback Mechanisms.
No monitoring is planned.

Likely Outcomes: The public response to prescribed burning was negative, which resulted in scaling back burning activities significantly. The disturbance activities that will take place are inappropriately matched to the historical disturbance regime. This landscape will experience increased risk of natural disturbance activity in the near future, and the risk of the entire park burning in the next 20 years is moderate to high.

ND PLANING SCENARIO 2 – Tuffy Forest Management

Scenario: The landscape is 200,000 ha northern boreal plains area assigned to Tuffy Inc. Forest management companies are all subject to the basic minimum requirements in the planning manual of ASRD that include several references to natural pattern metrics. This company has chosen to implement the minimum regulatory requirements.

Step 1: Evaluate the Commitment to an ND Approach:
The company has not been proactive in support of natural disturbance research, but are the beneficiaries of a substantial amount of related efforts. The company must meet basic, minimum natural pattern requirements for a few key metrics. Timber harvesting is the only disturbance tool available. The area is of sufficient size and shape to be only moderately meaningful biologically. *NPI Scores: Technical = 28.9%, Institutional = 6.4%, Cumulative = 13.9%*

Step 2: Evaluate the Existing Landscape Conditions and Associated Risk.
Linear features and fragmented harvesting have created significant amounts of forest edge and reduced the size of critical intact habitat. Landscape condition score**:** *Three of eight indicators are beyond NRV.*

Step 3: Understand the Disturbance Patterns.
The last 20 years included fragmented harvesting and a steady increase in the density of roads and seismic lines. The company has prioritized installing larger disturbance events and trying to restrict new linear development. Natural disturbance pattern score: *Four of eight indicators are beyond NRV.*

Step 4: Design a Filtering Process.
Following the SRD planning manual means that this plan meets fairly comprehensive requirements for land management in Alberta.

Step 5: Coordinate Disturbance Activities.
Only harvesting is at their disposal as a tool.

Step 6. Feedback Mechanisms.
A host of passive indicators as specified in the ASRD planning manual.

Likely Outcomes: Forest management is the only land activity in Alberta that is based on the concept of sustainable disturbance rates. The ASRD requirement beyond that to include some natural patterns as management inputs are far beyond other provincial requirements. However, this landscape is in danger of local extinctions due to unchecked cumulative effects of linear features and other disturbance activities that will continue to fragment the remaining habitat.

ND PLANING SCENARIO 3 – Bailey Park Land Co-op

Scenario: The landscape covers six million ha of the northern foothills. The primary agency in question is a National Park, in collaboration with two neighbouring forest management areas. The primary mandate of National Parks is to sustain natural processes and functions as well as provide nature experiences. The park has supported NRV focused research for many years, and understands the need to integrate variability. Everyone agrees to use harvesting, thinning and prescribed burning as tools in all parts of the forest, and NRV as one of the primary decision filters.

Step 1: Evaluate the Commitment to an ND Approach:
Technically, the use of prescribed burning is a considerable benefit, as is the desire to disturb all forested areas (however, no agreement was reached on dealing with non-forested areas or water). The institutional score reflects the collaborative efforts of several land management agencies, plus the impact of the outstanding landscape size, content, and boundary characteristics. Variability was not accounted for. *NPI Scores: Technical = 61.8%, Institutional = 26.4%, Cumulative = 38.2%*

Step 2: Evaluate the Existing Landscape Conditions and Associated Risk.
Remote location, recent natural wildfire events, combined with being in an area of little or no energy sector interest has sustained a relatively healthy landscape, although the age of non-commercial forest and non-forest areas will soon be an issue. Landscape condition score**:** *Two of eight indicators are beyond NRV.*

Step 3: Understand the Disturbance Patterns.
10 years of fragmented harvesting in the company areas is the most notable deviation from NRV. Agreed to focus on creating a range of disturbance sizes on all parts of the landscape. Natural disturbance pattern score: *Two of eight indicators are beyond NRV.*

Step 4: Design a Filtering Process.
Agreed to follow a modified version of the ASRD planning process as the basis for scenario development, combined with Parks Canada process of public input.

Step 5: Coordinate Disturbance Activities.
Parks will coordinate all prescribed burns, and the two companies will divide the mechanical disturbance activities according to location and equipment availability.

Step 6. Feedback Mechanisms.
Indicators as specified in the ASRD planning manual.

Likely Outcomes: The integration of objectives, resources and disturbance tools, data and research for so many neighbours, and the agreement to use natural patterns as primary filters, is far more likely to maintain a huge portion of the region in a natural, healthy condition – including water values which are ideally managed across very large areas. It also helps that this landscape has no critical existing conditions the require attention.

ND PLANING SCENARIO 4 – Pottersville Community Forest

Scenario: The landscape is 1 million ha of the north-eastern boreal under the auspices of a community forest that includes the DFO, Alberta Environment, Alberta Energy, the local ranchers association, Alberta Agriculture and Rural Development and five locally active energy sector companies. ASRD has agreed to adopt a "one window" approach to input and approvals. Everyone agrees to use NRV as the foundation for management actions. Little is known about the local disturbance regime, and only a few pattern metrics are considered. Mechanical only.

Step 1: Evaluate the Commitment to an ND Approach:
Technically, the agreement to use landscape condition somewhat offsets the negative scores for lack of local NRV knowledge, not using variation, and only using harvesting. The institutional score is favourable because of the inclusion of many co-land managers, plus the commitment from ASRD to participate with one voice. The landscape size, and content are also very favourable to disturbance-based planning.
NPI Scores: Technical = 24.5%, Institutional = 65.5%, Cumulative = 51.8%

Step 2: Evaluate the Existing Landscape Conditions and Associated Risk.
The cumulative effects of many overlapping management activities over the last four decades have created a landscape well beyond its natural bounds in many respects. This landscape is at high risk in terms of water, habitat, and soil. The team response was to identify some very large, well-placed, disturbances in key watersheds.
Landscape condition score**:** *Seven of eight indicators are beyond NRV.*

Step 3: Understand the Disturbance Patterns.
A huge range of cultural disturbance activities has been well beyond the NRV of disturbance patterns. The team made it a priority to mitigate the disturbance patterns of the most heavily affected areas and impose a moratorium on new linear features.
Natural disturbance pattern score: *One of eight indicators are beyond NRV.*

Step 4: Design a Filtering Process.
The team hired a management consultant to facilitate the design of an appropriate filtering process that everyone could work within.

Step 5: Coordinate Disturbance Activities.
The plan included detailed pattern specifications that were tendered out to the growing list of consultants specializing in designing and installing disturbance plans.

Step 6. Feedback Mechanisms.
None beyond the minimum ASRD requirements.

Likely Outcomes: The integration of objectives, resources, disturbance tools, data and research for so many collaborators, and the agreement to use natural patterns as primary filters, is likely to improve landscape health, but it will take many years to reduce the risks significantly.

Lessons Learned from the Scenarios

Even as an academic exercise using a first draft of some evaluation tools, we can gain some valuable insights. For example, scenarios 1 and 2 represent isolated agency-specific management efforts involving no collaboration. Thus, the total NPI game scores of 5.5% and 13.9% very broadly represent the relative bare minimum capacity of existing Alberta Tourism Parks and Recreation, and Albertat Sustainable Resource Development respectively, to create an ND-based landscape plan - *in isolation*. This is not meant as a deliberate critique of specific government agencies, but rather a demonstration of how scenarios can be used to evaluate the implications of various policies.

It is also interesting to note that the relationship between the commitment to an ND approach, and the potential future health of a landscape, is direct. The NPI game presented here is only a first approximation of a decision-support tool to evaluate committment, but the scores are roughly linearly assocated with the potential to improve ecosystem health.

The contrast between scenarios 3 and 4 area also instructive. Scenario 3 represents a tremendous individual effort by an agency to a) employ the highest possible use of a natural pattern strategy philosophcally, b) support NRV research financially, and c) take the concept of landscape health very seriously. Unfortunately, this was all done in isolation of neighbours and potential collaborators. In contrast, Scenario 4 represents an admirable effort to gather land management neighbours and collaborators together into a joint planning exercise, but suffers from a lack of technical elements. The reason the overall score for scenario 4 is higher than scenario 3 (51.8% versus 38.2%) is that institutional elements are far more important to secure over the long term, and technical details are far easier to acquire over the short term. In this case, the landscape in Scenario 4 is far more likely to become a healthy landscape over time. For reference, a regionally coordinated disturbance plan would likely result in a 80-90% NPI score.

Scenario developments such as this also allow one to imagine the form of new planning tools and mechanisms; blending filtering processes from two or more agencies, sharing disturbance expertise and capacity across jurisdictional borders, disturbance plan implementation teams, or even contracting out the implementatin of disturbance plans to thrid parties.

These examples also provide some context for the ASRD planning exercise for K-country. The techical score of 41.5% with limited time and resources is notable on a relative scale, and suggests a single-minded committment to creating an ND-based plan. The institional score of 10% is low, and largely reflects the isolated nature of the planning exercise. To be fair, as an abbreviated demonstration of a proof of concept, there was never any intention of involving others.

What is Next for the FRI Team?

We have now delivered a short discussion paper on the rationale for adopting an ND approach, as well as this series of two reports that outlines a plan-for-a-plan towards developing an ND-based land management plan. However, we feel our work is far from complete. We propose the following six objectives. Note that objectives 1-5 ideally all feed into objective #6.

The innovative nature of the process described here is such that some alternative proof-of-concept (*i.e*. mostly qualitative) plans integrating various assumptions about technical and institutional elements for K-country would be a valuable investment as a means of exploring the likely impact of various policy options institutionally.

> *Objective #1*: Generate two more qualitative planning scenarios for K-country in the 50-90% NPI range with very basic spatial and non-spatial output comparable to that created from the ASRD exercise. Deadline: December 1, 2008.

Technically, we already possess many, but not all of the tools to develop an ND based plan. The most obvious gap is knowledge and models that link terrestrial and aquatic dynamics. Typically, we tend to focus on either terrestrial or aquatic components - not both. Such a model must include the capacity to identify NRV for each component as well. A proposal has already been submitted on behalf of over 10 scientists under the auspices of the FRI to the Water Research Institute to address the required research gaps, and develop a decision-support tool.

> *Objective #2*: Encourage / support the research and development necessary to develop a simulation-based NRV decision-support tool that links disturbance activity to water and land responses. Deadline: Ongoing.

Assuming the K-country will be a demonstration site of an ND based plan, there is an immediate need to upgrade our understanding of natural disturbance patterns.

> *Objective #3*: Encourage / support local research on historical disturbance patterns on the K-country landscape. Deadline: Initiate by January 1, 2009

Of the six-step process outlined in this document, the technical weak link is step #6; feedback. As discussed above, the majority of monitoring programs today are either disconnected from management activities, or linked to the supply only one or a few values. If and when we get to the point of applying these six steps, we need to at least have an outline of what a shared, active adaptive management system might look like.

> *Objective #4*: Develop an active adaptive management framework that is consistent with an ND approach. A *framework* in this case is just a "how to" model, not a blueprint. Deadline: December 1, 2008.

The shift in thinking that an ND approach requires should not be underestimated. We have been operating under the current (value or silo based) management model for many decades. Based on our collective experience, the response from land management professionals varies from polite indulgence, to apprehension, to outright resentment. Acceptance and unqualified willingness to support the concept, let alone participate, should not be assumed.

This reticence could be a tremendous opportunity, of which we should be taking full advantage. At the very least, we have their attention. These professionals represent the first line of feedback to both the concept and the process. Conceptually, there should be a dedicated, focused communication effort to explain exactly what an ND approach means. There is nothing more threatening than a new idea that is not fully articulated and openly and mutually explored.

> *Objective #5*: Initiate a comprehensive communications and education effort focusing on discussing the merits, challenges, and opportunities of ND approaches. The FRI has already developed a three-day professional short course on this topic, but the effort needs to also include a series of presentations, papers, briefing notes, and workshops as well. Deadline: Ongoing.

In the end, the best proof-of-concept of a new idea is a demonstration. There are now two possible landscapes on which to test an ND approach; K-country (or rather, the greater K-country area that includes many different land agencies) and the FRI landbase (consisting of Hinton Wood Products, Jasper National Park, Willmore Wilderness Area, Switzer Provincial Park, and other provincial land).

> *Objective #6*: Facilitate the development of an ND-based planning process for K-country and/or the FRI land base. Deadline: Initiated by January 1, 2009.

Appendix A

The elements of a natural-based planning exercise

There are two types of elements required to create a natural-based land plan; technical and institutional.

A) Technical Elements

The technical elements of a natural pattern based planning exercise are largely scientific in nature. The only inputs required are scientific and modelling expertise, research, a combination of existing and new planning tools, and an integrated approach to gathering new knowledge. Any single agency could develop and implement technical elements in isolation on any landscape. The technical elements of a natural pattern approach are well within our grasp – they either already exist, or they can be had with the appropriate resources.

i) The number and nature of the disturbance pattern metrics

There are dozens of possible disturbance pattern metrics, and each offers unique insights. However, to start, it is important to include metrics that represent all aspects of a disturbance regime; 1) type, 2) frequency, 3) size, 4) shape, 5) severity, and 6) duration. The decision of which aspect to focus on if time and resources are available depends on the priorities and objectives. In general, severity is a pattern worth further exploration since it dictates the sizes, shapes, types, and mortality levels of undisturbed residuals. Note that the number and nature of disturbance pattern metrics is in part dictated by the available knowledge of the local disturbance regime (see element ***ii*** below). Adopting a complex set of pattern indicators unsupported by research is confusing at best, and potentially negligent.

ii) Quantity and quality of the NRV research

Research strongly suggests that historical disturbance patterns are landscape specific. Thus it is always better to have broad-based local disturbance pattern research either in hand, or in progress. However, in the absence of local research, it is still possible to borrow some generalities from other regions to help achieve some level of natural pattern integration (see element ***i*** above). It is important that the metrics reflect the sophistication of the existing research and tools.

iii) What decision-support tools will you use?

A variety of existing decision-support tools can be brought to bear that will vastly improve the ability of the plan. Access to complete, up to date spatial data is critical, and any other data on specific issues can only help. Other tools include fully spatial scenario planning models, models for evaluating NRV and landscape condition (see Figures 2 and 3), and process models that link disturbance patterns to landscape condition (including land, vegetation, soil, and water) to biological responses.

iv) Integrating variability

Natural processes like disturbance are not deterministic, but nor are they fully random. For all patterns, there exist a range of possibilities. Capturing this variation, or NRV, is a critical part of managing for natural patterns. How are you going to introduce / embrace / encourage variability, and discourage the use of hard targets such as averages and minimums?

v) How are natural patterns used in planning?
Natural patterns can be integrated into planning in a number of different ways. For example, you can use pattern metrics as post-planning NRV checks, you can include them in with the other list of values to try and balance as a group, or you can use them as the common starting point for planning decisions. Using natural patterns as the common starting point for planning decisions is the highest and best use.

vi) Is the whole landscape being actively managed?
There may be parts of the landscape where conflicting policies may be actively preventing disturbance for some reason (riparian zones, bogs, non-merchantable forest, meadows, lakes, streams, wetlands, etc). A more complete plan for disturbance activities is more likely to sustain a healthy landscape and a suite of social and economic values.

vii) Consideration of landscape condition
There are two levels of integration of natural patterns; disturbance patterns and landscape condition responses (see Figures 1 and 2 in part one of this report). The landscape condition provides important context for decisions. A landscape heavily influenced by cultural activity for many years may already be well beyond NRV and require some sort of disturbance pattern restoration plan. For example, one may design a disturbance plan that is deliberately beyond NRV in order to restore a landscape to a more natural pattern condition.

viii) What disturbance tools are available?
The more disturbance options there are available, the greater the chances of success. The list includes prescribed burning, flooding, harvesting, thinning, girdling, road building, etc. Tools that occur naturally (such as flooding, and prescribed fire) are far superior in quality to surrogates (such as harvesting and thinning).

ix) Adaptive feedback mechanism
The ultimate leap of faith involved in an ND strategy is that Mother Nature knows best – that biodiversity - and the associated goods and services - will just happen if we stick close to creating natural disturbance patterns. This premise demands that knowledge gaps about the many NRV-related elements (which include disturbance patterns, landscape condition, and biological responses), as well as the likely social, and economic consequences of disturbance plan choices must be dealt with in an efficient and timely manner. The ideal feedback mechanism is an adaptive management policy that requires a) making predictions, b) measuring outcomes / responses, c) comparing predictions to responses, and d) formulating new questions, knowledge, tools, and predictions for next time.

B) Institutional Elements

Institutional elements are those that require collaboration with other agencies to varying degrees. Achieving some level of success with the institutional elements requires an entirely different type of commitment that involves policy changes, regulatory streamlining, education, communication, and perhaps even redefining agency functions.

i) Landscape size
Landscape size should be based on the repeating pattern derived from the underlying natural disturbance process, so that disturbance activities can be managed in a more meaningful way over space and time. Larger landscapes are always more desirable, and particularly so as relates to the aquatic components of a landscape. As landscape size decreases, options become limited, and the risk of fragmentation increases, and management activities become less meaningful from a cumulative effects perspective. In foothills and boreal landscapes, areas at least 500,000 ha are preferred, although the ideal minimum size is several millions of hectares.

ii) Landscape content
A landscape should be representative of the full range of ecosystem types of the surrounding area. This is particularly important in areas where dramatic changes in stand conditions occur over short distances. In the Alberta foothills, for example, it is critical to include parts of the montane, lower foothills, upper foothills and subalpine natural subregions since the historical disturbance patterns of each are intimately connected.

iii) Landscape boundaries
There are two parts to the issue of boundaries: 1) boundary location, and 2) the resulting shape of the landscape. Boundaries that are based on natural features and breaks are more likely to represent a biologically relevant area than are jurisdictional boundaries. Similarly, simply shaped landscapes are more likely to be biologically meaningful than are landscapes that are convoluted.

iv) Integrating natural disturbance activity
It is impossible to plan precisely for natural disturbance events since the location and extent of such events cannot be predicted. However, we do know that natural disturbance activity will continue in some form. One of the shifts required to adopt a fully integrated natural pattern strategy is to acknowledge those risks towards generating a plan for how to deal with them when they happen. This involves a willingness to adapt planned activities to harmonize with natural events as they occur, potentially including mitigation or restoration responses.

v) Planning with neighbours
Disturbance planning that involves neighbouring areas under the jurisdiction of other agencies increases the size of the landscape, and reduces the total number of management plans for a given area. In particular, the relationship between the capacity to deal effectively with water management issues and landscape size is direct and significant. A long list of land partnerships also potentially provides a greater range of tools, systems, and expertise. There are degrees of cooperation among neighbours from sharing short and long-term plans as they occur, to sharing initial stages of planning, to fully collaborative planning activities.

vi) Planning with co-land managers
Disturbance planning that involves all agencies operating on a given land base is necessary to address cumulative effects – none more important than the link between terrestrial and aquatic components. There are many different land management agencies that have partial rights and responsibilities on the same piece of land. Alberta Environment is responsible for water; the Federal Department of Fisheries and Oceans

is responsible for fish habitat; Alberta Tourism Parks and Recreation is responsible for provincial parks; Parks Canada is responsible for national parks; Alberta Energy is responsible for the rights and access to oil and gas; Alberta Sustainable Resource Development is responsible for the access to timber; and grazing rights fall under the purview of Alberta Agriculture and Rural Development. The greater the participation level of each land management agencies, the more "natural" the pattern outcome is likely to be. Involvement can take many forms, from sharing ideas, data, and knowledge, to offering advice and input, to full collaboration on the final product.

vii) Does the landscape include water?
Water is important enough to warrant its own category because it is trans-landscape in nature, and involves many different agencies. The capacity of single agencies to deal effectively with water issues (see Technical element ***vi*** above) is limited. Having DFO and/or Alberta Energy involved does not necessarily mean that water issues are being *fully* represented. There must be a fundamental shift in perspective in terms of what it is we think we are managing, and that perspective must include water at multiple scales and in an integrated aquatic ecosystems approach. In other words, the plan should specifically define water values and needs, management strategies, and best practices, as well as plan impacts and outcomes.

viii) Regulatory streamlining
It is not possible to fully integrate any sort of land management strategy that adopts a common foundation (such as an ND strategy) without full support from the regulatory agencies involved in land management. There are two relevant levels of support.

a) Inter-agency streamlining means that all departments and branches within a single agency speak with one voice on strategic perspectives, offer a universal "one window" approach to the regulatory procedures involved, and share common databases.
b) Intra-agency streamlining refers to the agreement between the many agencies to the basic principles or philosophy of landscape management. Procedures may differ, but they are connected and integrated and share data as much as possible.

In an ideal world, a planning exercise would involve all 17 of the planning elements listed above. In reality, the capacity to improve on one or more of these elements qualifies as a version of a natural-pattern approach. The level of commitment to an ND approach is ideally directly related to the degree of commitment to each of the 17 elements, as per the NPI game in Table 2.