Recommended Practices for Landscape Conservation Design

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Executive Summary

This is a practitioner's guide to landscape conservation design (LCD). LCD is a partner-driven approach to achieve a sustainable, resilient landscape that meets the ecological and social needs of current and future generations. It is an iterative, collaborative, and holistic process resulting in spatially explicit products and adaptation strategies that provide information, analytical tools, maps, and strategies to achieve landscape goals collectively held among partners (LCC Network 2016a). As public-private partnerships for collaborating on landscape-scale conservation issues, the Landscape Conservation Cooperatives (LCC) have had years of experience with LCD. Staff from across the LCC Network assembled these recommended practices to provide practical guidance for anyone looking to facilitate or participate in an LCD process (design process).

This guide contains five sections covering major themes in LCD. Each section describes vetted practices one or more LCCs have used in their LCD work, provides resources for further information, and presents a real-world example where the practices have been implemented. The practices are arranged in a logical order but they are not necessarily chronological. Successful LCD requires participants to revisit and refine their work; therefore, embracing iteration is an overarching theme of the process.

Section 1: "Initiating Landscape Conservation Design" recommends sound practices to implement from the outset of an LCD, such as seeking leadership support. This section also identifies actions to take at multiple points in the design process, such as evaluating compatibility with neighboring LCDs.

Section 2: "Convene Stakeholders and Frame the Landscape Conservation Design" focuses on people — how to bring people to the table and how to keep them engaged. This section offers advice for establishing a governance structure, building trust, and setting deadlines, among other topics. In addition, it describes essential steps that can harness the power of multidisciplinary participants, such as identifying stressors, agreeing on indicators, and defining objectives.

Section 3: "Assess Current and Future Desired Conditions" addresses how to use best available knowledge to characterize the current conditions of landscape elements that are important to stakeholders and forecast what may happen to them in the future, and understand what partners see as desirable outcomes. It describes techniques for identifying important drivers of change on the landscape, dealing with uncertainty, and developing plausible characterizations of the future.

Section 4: "Spatial Design" describes how to identify where on the landscape desired functions and opportunities exist — or could exist. It provides guidance on assembling a technical team to carry out these tasks and lists actions the team should take to ensure they generate products that are both useful and widely accepted.

Section 5: "Strategy Design" explains how to arrive at a design that stakeholders can use to decide which actions to take and where and when to take them. It describes products that can help partners implement desired actions such as timelines, a list of funding sources, and a monitoring plan.

INTRODUCTION

Landscape conservation design (LCD) is a means to strengthen conservation delivery by bringing people together to prioritize and coordinate actions on the ground. It puts **stakeholders** at the center of efforts to conserve fish, wildlife, plants, and their habitats. Such an approach empowers stakeholders at all levels of the decision-making process and optimizes operations by aligning **partner** actions to achieve outcomes at appropriate scales. The Landscape Conservation Cooperative (LCC) Network (2016a) defines LCD as:

A partner-driven approach to achieve a sustainable, resilient landscape that meets the ecological and social needs of current and future generations. It is an iterative, collaborative, and holistic process resulting in spatially explicit products and adaptation strategies that provide information, analytical tools, maps, and strategies to achieve landscape goals collectively held among partners.

The LCCs gained valuable experience in LCD and these recommended practices represent current thinking and practical suggestions about how to successfully develop relevant and useful LCDs. They draw from published literature, particularly *Conservation Planning: Informed Decision Making for a Healthier Planet* (Groves and Game 2016), and recommendations identified in *A Review of the Landscape Conservation Cooperatives* (NAS 2016). In addition, they are grounded in the Characteristics of LCC Landscape Conservation Designs (LCC Network 2016b). While they stem from experiences with LCC-supported LCDs, other practitioners can benefit from considering these recommended practices in their own LCD projects.

The practices are intended to respect the unique circumstances of LCD participants, while fostering a more consistent approach to collaborative natural resource management. It should be recognized that the individual organizations and agencies that are partners in the design — and not the partnership itself — have authorities and resources for conservation delivery within their respective jurisdictions, authorities, and missions. Participants may be constrained by legal or organizational mandates (e.g., the National Environmental Policy Act), especially during implementation. In other words, LCDs can only be implemented in the context of the laws and policies participants operate within.

We organize our recommended practices into five sections. The first section considers how to initiate LCD, while the remaining sections follow four of the five LCD attributes described in the **iCASS platform** of Campellone et al. (2018): Convene Stakeholders, Assess Conditions, Spatial Design, and Strategy Design. It is important to note that even though we use numbers to denote each practice, we do so only as a matter of convenience, not to imply a prescriptive linear chronology. Moreover, we recognize — and emphasize — that the LCD process (design process) is iterative, so any given practice may be visited at multiple points throughout the process.

After each practice, we suggest resources for further information. In addition, each section includes a case study that describes specific applications of the practices described in that section. These case studies highlight just a fraction of the LCDs that exist. Many other examples are available on the Landscape Conservation Designs Mapper (LCC Network 2016c).

We provide further context and resources in several appendices, including a discussion of terms with multiple or related meanings (Appendix B), a glossary (Appendix C), a list of literature cited (Appendix D), and full web links to online resources referenced herein (Appendix E).

List of Practices

Please see sections 1 through 5 of this document for explanations, resources, and case studies for the following recommended practices:

Table 1. List of Recommended Practices for Landscape Conservation Design

Practice Number	Practice Title
SECTION 1: Initiating Landscape Conservation Design	
1.1	Recognize the need and plan for iteration both within and among these recommended practices.
1.2	Solicit leadership support.
1.3	Develop a shared vision statement for long-term landscape conservation in the relevant geography.
1.4	Seek compatibility with other planning processes and LCDs in the landscape.
1.5	Assess budgeting and other resource needs and contributions during planning, design, and implementation phases.
1.6	Use a vetted set of principles, such as the adaptive management framework, to structure the decision-making process.
SECTION 2: Convene Stakeholders and Frame the Landscape Conservation Design	
2.1	Identify and convene an inclusive set of stakeholders with a shared interest in the natural and cultural resources within the defined geography.

Practice Number	Practice Title
2.2	Recognize the importance of leadership.
2.3	Agree on the project's context and the design process, focusing on shared fundamental objectives.
2.4	Initiate the formulation of performance metrics specifically tied to the design process and fundamental objectives.
2.5	Build and maintain trust.
2.6	Identify a common language and categorical lexicon.
2.7	Regularly engage stakeholders for the duration of the design process.
2.8	Communicate frequently and effectively.
2.9	Define the project's scope through discussion among the partners.
2.10	Identify primary change agents and risks.
2.11	Identify conservation features, targets, and indicators.
2.12	Identify intermediate objectives.
SECTION 3: Assess Current and Future Desired Conditions	
3.1	Assemble an oversight team to act on behalf of stakeholders.
3.2	Integrate existing landscape conservation efforts.
3.3	Base assessments on fundamental objectives, conservation features, and desired outcomes.
3.4	Conduct a situation analysis using the best information available.
3.5	Identify important sources of uncertainty in a decision context.
3.6	Engage in scenario planning to propose desired future conditions.

Practice Number	Practice Title
SECTION 4: Spatial Design	
4.1	Assemble a technical advisory team.
4.2	Select and understand datasets.
4.3	Assemble datasets.
4.4	Fully vet selected datasets.
4.5	Ensure data management and accessibility.
4.6	Agree on spatial products.
4.7	Incorporate landscape conservation planning and ecological principles into the spatial design.
4.8	Document and archive.
4.9	Ensure accessibility.
SECTION 5: Strategy Design	
5.1	Confirm compatibility with existing plans.
5.2	Integrate spatial design with partner efforts.
5.3	Cross reference and align strategies with adjacent LCDs as appropriate.
5.4	Guide implementation within a partner-defined conservation delivery network.
5.5	Continue the exchange of information and technology.
5.6	Monitor, evaluate, and take action.
5.7	Iterate.

SECTION 1:
Initiating Landscape Conservation Design

The practices below include activities that can be done at the beginning of a design process — or even before — and considerations that are relevant at multiple points during the process.

Practice 1.1: Recognize the need and plan for iteration both within and among these recommended practices.

Partners' thinking often evolves as the design processes proceeds, so we recommend embracing iteration as a core element of LCD. Iteration may take many forms, such as revising design **objectives** months after they were first drafted or going through multiple drafts of spatial designs (see Section 4). Communicating to stakeholders and partners from the outset that iteration is to be expected, and even welcomed, can help manage expectations and avoid frustration.

Resources:

- Williams et al. (2009)
- National Ecological Assessment Team (2006)

Practice 1.2: Solicit leadership support.

Determine the applicability, interest, and roles of your organization's leadership team in supporting LCD as an approach for achieving **conservation goals** on a **landscape**. If the leadership team decides LCD is a potentially useful undertaking, identify potential roles for them, such as: (1) articulating your organization's vision for the future of landscapes within the relevant geography and your organization's associated **landscape conservation** goals and objectives; (2) determining how resources and attention will be allocated to achieve the organization's landscape conservation goals and objectives, which may include members from your organization's leadership team actively engaging in the LCD oversight team (Practice 3.1); and (3) articulating your organization's decision space, such as constraints that may limit your organization's decision-making ability.

Resources:

- LCC Network (2015)
- LCC Network (2014)
- Landscape Conservation Cooperatives and Climate Science Centers (2011)
- National Ecological Assessment Team (2006)

Practice 1.3: Develop a shared vision statement for long-term landscape conservation in the relevant geography.

It is important to include sufficient time for partners to develop a shared vision statement that inspires and motivates stakeholders (Groves and Game 2016). The vision statement should describe what the project area might look like in the future but not delve into specific **desired future conditions** (Practice 2.12).

Resources:

- Groves and Game (2016)

Practice 1.4: Seek compatibility with other planning processes and LCDs on the landscape.

It is important to acknowledge, honor, and make practical use of past and ongoing conservation efforts, whether developed in a traditional planning context or as part of a design process (see Campellone et al. [2018] for a comparison between general planning characteristics and LCD), as these provide a solid foundation for buy-in and recognition of the past and current efforts of stakeholders. Designs that are compatible within and across geographies will contribute to an ecologically connected network of functional landscapes and seascapes, thereby enhancing conservation delivery overall. To this end, existing planning efforts, such as State Wildlife Action Plans, and LCDs, should be considered and integrated, where appropriate, into design processes. Partners should document which products they considered and explain how the LCD complements and builds on those efforts.

Resources:

- Joint Venture conservation planning documents. Available: mbjv.org (June 2017)
- National Fish Habitat Partnerships Fish Habitat Action Plans. Available: http://www.fishhabitat.org/ (June 2017)
- State Wildlife Action Plans. Available: http://teaming.com/sites/default/files/StateWildlifeActionPlansReportwithStateSummaries.pdf (June 2017)
- NAS (2016)
- LCC Network (2016c)

Practice 1.5: Assess budgeting and other resource needs and contributions during planning, design, and implementation phases.

Budgeting should address staffing and capacity needs to develop the design. Costs can vary widely, and depend on several factors, including **risk**, replication, complexity, the level of sophistication, and time spent planning (Groves and Game 2016). As an example, the Great Northern LCC estimated in 2017 that it cost roughly 415,000 USD to develop the Columbia Plateau LCD. About half of that came from the Great Northern LCC and the other half came from matching and in-kind funds. This figure is an underestimate, as it does not account for participants' time and travel costs. As another example, staff from the South Atlantic LCC estimated in 2017 that it would cost 200,000 to 500,000 USD depending on the existing amount of data available to inform the LCD and how many years it takes to develop products. One key factor to consider is data needs. Conservation planning requires that you evaluate existing data sets at multiple scales and, when lacking, invest in their creation and assembly (Practice 4.2). For example, the Appalachian LCC — which encompasses a relatively data-poor region — conducted a data-needs assessment and hosted a science-needs workshop as two of its first steps in their design process.

It is also important to conduct a detailed assessment of the staff and financial resources available to implement the strategies and actions once the LCD is developed, including a realistic fundraising plan to ensure resources are in place for executing desired actions, monitoring, and evaluation (Practice 2.4, 5.6).

Resources:

- Groves and Game (2016)

Practice 1.6: Use a vetted set of principles, such as the adaptive management framework, to structure the decision-making process.

Any design process entails a myriad of decisions. Agreeing upon a decision-making framework and **governance** process can make it easier for participants to agree on who makes decisions, as well as how, when, and why decisions get made, thereby enhancing the efficiency, effectiveness, and **transparency** of the whole process. The adaptive management model is one of several frameworks available for this purpose. It involves, "exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions" (Williams et al. 2009). It is essentially a process of "learning by doing" that follows a cycle of "plan → do → measure → evaluate → adjust."

Resources:

- Campellone et al. (2018)
- CMP (2013)
- Williams et al. (2009)
- Strategic Habitat Conservation Technical Assistance Team (2008)
- National Conservation Training Center Course, ALC3171 Introduction to Structured Decision Making. Available:

https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3171 (July 2017)

- National Conservation Training Center Course, ALC3190 Decision Analysis: Elicitation and Facilitation. Available: https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3190 (July 2017)

Section 1 Example/Case Study: **Connect the Connecticut & Nature's Network**

The North Atlantic LCC's LCD initiatives have evolved in phases, each involving active discussion with our **Steering Committee** and regular consultation with other partners. The first phase, dating back to the formative period of the LCC in 2010, entailed the collection and development of foundational scientific information and tools that could be used for landscape-scale conservation planning. By 2012, our work had advanced to a second phase of demonstrating the tools to partners in three watersheds within the North Atlantic LCC geography. In parallel, with the encouragement of the Steering Committee, LCC staff began working with the Northeast state fish and wildlife agencies (represented on the North Atlantic LCC Steering Committee) to organize and synthesize regional information that could inform updates to State Wildlife Action Plans.

With approval from the Steering Committee, the LCC began to move ahead with LCD in earnest in 2014 by initiating a stakeholder-driven LCD project for the Connecticut River Watershed. This project built upon the collaborative experience and scientific foundation laid in 2010. Development of the Connecticut River Watershed LCD was driven by a core team of partners (Figure 1) who took part in monthly meetings from 2014 through 2015, and reunited in 2016 for the official launch of the final product, known as "Connect the Connecticut."

Figure 1. The Connect the Connecticut planning team. Photo: Bridget MacDonald/USFWS

Figure 2. 2016 planning workshop for Nature's Network. Photo: Steven Fuller/USFWS

At the same time, our work with the states to synthesize regional conservation information continued to progress. In 2013, we agreed to facilitate an effort to identify "Regional Conservation Opportunity Areas" (RCOAs) that could be referenced in State Wildlife Action Plans. By 2015, work on Connect the Connecticut had advanced to the point that experience and tools from that project could be incorporated into the evolving RCOA effort. One of the committees of the Northeast Association of Fish and Wildlife Agencies, the Northeast Fish and Wildlife Diversity Technical Committee, assigned representatives to work on RCOA designations with LCC staff and other partners. Following multiple workshops (Figure 2), an LCD project encompassing the entire Northeast and Mid-Atlantic (U.S.) geography was launched in May 2017 under the new name "Nature's Network" (Figure 3).

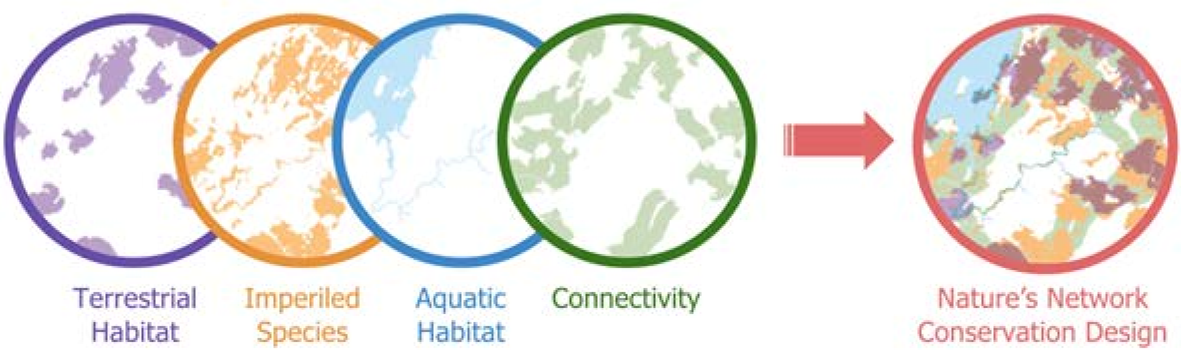

Figure 3. Major, top-level spatial components of the Nature's Network package.

Reflections on the value of select recommended practices:

Practice 1.2: Solicit leadership support.

We found that the Steering Committee played multiple useful roles in the design process:

- Establishing LCD as a priority of the LCC at the outset
- Identifying projects that could create the necessary scientific basis for undertaking LCD
- Providing guidance and momentum to a process that is charting relatively new ground

Although for the most part Steering Committee members themselves have not served on oversight committees for LCD, they have supported participation by their staff on these committees and have helped disseminate this work within their organizations.

Practice 1.4: Seek compatibility with other planning processes and LCDs on the landscape.

Recognizing that it was critical to complement other planning processes, we deliberately worked with state representatives to make sure Nature's Network would be supportive and useful for State Wildlife Action Plan implementation. Our geography is by no means a blank slate for conservation planning; many assessments and prioritizations have already been conducted at a variety of scales, from local to statewide. We therefore incorporated elements or concepts from other conservation assessments into our work wherever possible. At the same time, we emphasized that our LCD products were intended to complement, not replace, existing assessments.

Practice 1.5: Assess budgeting and other resource needs and contributions during planning, design, and implementation phases

We found it to be more feasible to plan for resource and budget needs for individual phases of the evolving design process, rather than conducting an all-encompassing resource assessment at the outset. Each phase involved testing new tools among partners and it was important to demonstrate the feasibility and value of the design process at each step before the Steering Committee and other partners could be expected to commit additional support. Furthermore, it is difficult to fully assess required resources until a design process is underway and the needs and preferences of partners are more fully understood. However, it was critical to ensure that sufficient staff time and resources were available to support the design process from concept to end product, and beyond. In our experience, spreading responsibilities for logistics and team support across multiple individuals with complementary skills and different organizational affiliations was important for momentum and efficacy.

SECTION 2: Convene Stakeholders and Frame the Landscape Conservation Design

In the following section we provide recommendations for recruiting participants and engaging them throughout the design process. We describe key actions that set the stage for LCD, including guidance on defining the strategic, geographic, and temporal boundaries of the design, identifying primary agents of change in the system, deciding what features of the landscape are of interest to stakeholders, and articulating what stakeholders want the LCD to achieve within the context of designing **sustainable landscapes**.

Practice 2.1: Identify and convene an inclusive set of stakeholders with a shared interest in the natural and cultural resources within the defined geography.

A **bridging organization** can play an important role as a cross-cutting convener that brings a diversity of stakeholders together to initiate and participate in the design process. When seeking to identify a cadre of partners — those stakeholders who actively participate — a good starting point is within one's own organization and its leadership team. Beyond that, invite additional stakeholders from across relevant jurisdictions and sectors based on geography (Practice 1.3). Make a concerted effort to engage people from a diversity of sectors (e.g., academic, agriculture, energy, etc.) and jurisdictions (e.g., tribal members, federal/state agencies, local municipalities, non-governmental organizations) that can influence the direction of and contribute to the design. Invitees should represent and have decision authority or capacity to direct resources toward LCD development and implementation. Involving medium to high-level managers and executives can engender organizational support for the initiative. In addition, consider what programs or decisions the LCD will seek to inform (Section 5) and seek those with requisite expertise, such as planners, scientists, managers, leaders, marketing experts, and finance specialists.

Bring representatives to the design table early on to help secure their support for development of an LCD that represents their values, promotes their interests, and meets their needs. Present a clear vision of the benefits stakeholders can expect to derive from participating in the design process. Understand that as the design process proceeds, it is important to recognize and carefully consider who needs to be involved in each particular task. While inclusivity is vitally important to the success of the design, some participants are not interested in participating in all phases. Recognize when particular skill sets, knowledge, or decision-making power needs to be engaged to ensure progress is made, decisions are well-informed, and partner buy-in and contributions are acknowledged. Finally, it is worth noting that since participation may vary over time, it may be necessary to revisit key milestones and decisions (Practice 1.1) and not to rely on any single entity to support the design.

Resources:

- Campellone et al. (2018)
- Krebs (2017)
- Silver (2016)
- Crona and Hubacek (2010)
- Williams et al. (2009)
- Bryson (2003)

Practice 2.2: Recognize the importance of leadership.

Consider appointing a team leader to keep the partners focused on their purpose and **goals**, develop agendas, facilitate meetings, clarify roles and responsibilities, and help communicate among partners and other stakeholders (Practices 2.7 and 2.8). As the design process progresses, those actively participating may shift from managers, administrators, and executives (Practice 2.1) to technical teams (Practice 3.1, 4.1) composed of subject matter experts. As such, it is useful to have a leader who has direct involvement in all phases to ensure smooth transitions between teams. It is important that partners trust this leader to be impartial.

Resources:

- Groves and Game (2016)
- Black et al. (2011)

Practice 2.3: Agree on the project's context and the design process, focusing on shared fundamental objectives.

Agreeing on the project's context and the design process to be used can enhance efficiency, participation, and buy-in on the products developed. The project's context includes the purpose of the design, **fundamental objectives**, decisions to be made, decision-makers, constraints, or sideboards from previous planning efforts, policy, or law (Practice 1.4).

Partners representing the full array of stakeholders should co-develop a governance structure that supports the design process (Practice 1.6). A Memorandum of Understanding or other document can formalize the governance approach. All should agree on the process that will be used to complete and implement the design, including how the group will make decisions. The process should promote participation and transparency, including information sharing (Practice 4.5). The group should collectively identify a realistic timeline for the project.

Fundamental objectives, which "represent statements about the things we value, such as fish, or jobs, or safety, and what we hope will happen to these things, such as increase" (Groves and Game 2016), can be distinguished from **intermediate objectives** (Practice 2.12), which articulate "the desired outcomes that are part of the means of achieving fundamental objectives" (Groves and Game 2016). It is vital that the fundamental objectives be developed in a collaborative process that reflects the shared values of stakeholders. Partners will want to revisit the project's fundamental objectives periodically (Practice 1.1) as new individuals and institutions join the process, assuring that everyone has a voice and can readily see where their mission and roles align with the project.

Resources:

- Oxford University School of Geography and the Environment (2017)
- The Nature Conservancy (2013)

Practice 2.4: Initiate the formulation of performance metrics specifically tied to the design process and fundamental objectives.

An agreed-upon evaluation process can help keep the LCD on track and alert partners to the potential need for course correction or project re-evaluation. Program evaluation is a key element of adaptive management (Practice 1.6) and should be conducted at several stages during an LCD's lifetime, including implementation. Partners should agree on basic measures for **formative evaluation**, which asks the question: *Is the process working?* Formative evaluation measures would be used to refine process considerations, such as who was involved in the design, communication with stakeholders, training of end users, and how they access and implement the tools. Partners should also agree on measures for **summative evaluation**, which asks: *How have outcomes changed due to using an LCD approach?* This is analogous to effectiveness monitoring and evaluation. It is a necessary consideration that addresses **uncertainty** and provides a standard baseline to measure costs and benefits of conservation actions. Where possible, track end-user implementation and determine how the outcomes differed by virtue of having the LCD.

Resources:

- Pacific Northwest Aquatic Monitoring Partnership (2017)
- Sweeney and Pritchard (2010)

Practice 2.5: Build and maintain trust.

Building and maintaining trust is one of the most important, yet most challenging, aspects of collaborative conservation. An LCD is more likely to be embraced, and ultimately implemented, if stakeholders feel that their interests, values, and ideas are considered throughout the design process. It bears repeating that design is an inclusive, stakeholder-driven, participatory process (Campellone et al. 2018). There is no single approach for building trust, but in general, trust grows when partners:

- Respect each individual and organization for its own uniqueness.
- Practice and encourage regularly held face-to-face meetings.

- Make decisions based on a high degree of transparency, use active listening, ensure timely responsiveness to stakeholder concerns, and compromise.
- Use trained facilitators, which can enhance trust and expedite collaborative decision-making.
- Recognize that trust cannot be assumed; it must be earned.
- Encourage continuity in participation as much as possible, as this can increase trust.
- Realize that it can take a long time to build trust, but that trust can easily be broken.

Resources:

- Campellone et al. (2018)
- BiodivERsA (2014)

Practice 2.6: Identify a common language and categorical lexicon.

Stakeholders may arrive with a different understanding of word and phrase meanings, particularly when they come from different disciplines and sectors. Developing a standard lexicon is critical, as confusion over nomenclature can strongly hamper progress.

Resources:

- Appendices B and C of this document
- CMP (2013)
- Salafsky et al. (2007)

Practice 2.7: Regularly engage stakeholders for the duration of the design process.

Stakeholder participation throughout can lead to improved process and products. Regular engagement opportunities keep the information flow and progress fresh for participants, so host events such as online forums, webinars, workshops, or science symposia periodically throughout the relevant geographic area. People should view the LCD as a living and evolving process and set of products. Make the LCD as much about bringing people together around the science as it is about developing the science.

Resources:

- South Atlantic LCC (2017a)
- Eastern Tallgrass Prairie and Big Rivers LCC (2013)

Practice 2.8: Communicate frequently and effectively.

From the outset, develop transparent, accessible mechanisms to communicate with partners as well as broader audiences. Doing so can help maintain a shared understanding of the design process and products, even as membership changes and participation level varies among partners. Formats and placement for communication should be accessible to target audiences, such as a website or web portal. A website or web portal should be easy to use, visually pleasing, and provide access to the diversity of project documents, reference materials, spatial data, and tools that are components of the LCD.

Resources:

- North Atlantic LCC (2017a)
- Pacific Northwest Coast Landscape Conservation Design (2017)

Practice 2.9: Define the project's scope through discussion among the partners.

The scope is the strategic, geographic, and temporal boundaries of the design (Groves and Game 2016). When defining scope, consider the major topics, **conservation features**, and **change agents** that drive decisions on **spatial** and **temporal scales** of the design; these factors can inform future phases of design development. Also, consider how the project will be evaluated in terms of partner engagement, program design, logic, and implementation (i.e., formative and summative evaluation, Practice 2.4). Understand and document resource constraints. Discuss how partners envision using the final design, as this may have implications on the appropriate spatial scale. Finally, be aware that defining scope should be an iterative process (Practice 1.1), so be prepared to reassess the scope as needed.

Resources:

- Commission for Environmental Cooperation (2016)
- EPA (2016)

Practice 2.10: Identify primary change agents and risks.

Identify change agents (also known as **drivers** or **stressors**, see Appendix B for discussion on terminology) that may impact current or future conditions on the landscape and prioritize them in terms of extent and intensity. Some agents, such as climate change and human immigration, may expand or intensify through time, so it is important to explicitly agree upon the relevant time frame being considered. Document and characterize uncertainty, risk, and **assumptions**, but avoid excessive focus at this point as it may paralyze discussions. Participants may find it easier to start with articulating undesirable conditions, as there may be less uncertainty and more agreement about what conditions the group would like to avoid. Gaining consensus on dominant change agents among partners can provide information about conservation features that are threatened (Practice 2.11) and desirable future conditions (Practice 3.6).

Resources:

- EPA (2017)
- Salafsky et al. (2007)

Practice 2.11: Identify conservation features, targets, and indicators.

Identify a suite of conservation features (also called **conservation targets**, see Appendix B for discussion on terminology) that collectively represent the desired outcomes of the LCD. In addition to natural and biological features, include ecosystem services and societal benefits that are important to stakeholders. Identify **indicators** that accurately quantify what is happening to conservation features or fundamental objectives. Useful indicators are representative and measurable in a practical sense. They are tied to the later part of the design process as a means to evaluate progress (Practices 2.4 and 5.6). It may be necessary to revisit and refine features and indicators. For example, there may be no confident way to measure an indicator with available data. In that case, stakeholders may reconvene to identify and refine alternate features and indicators as new data becomes available.

As the design process progresses, those actively participating may shift from managers, administrators, and executives (Practice 2.1) to technical teams (Practices 3.1 and 4.1) composed of subject matter experts. Smaller parallel teams will likely be useful to identify the best suite of indicators for particular features as well as the most relevant data sets (Practice 4.2) that provide baseline/current conditions. The same subject matter experts can, in future steps, use existing knowledge, new science, and agreed-upon future **scenarios** (Practice 3.6) to estimate future desirable levels of each indicator providing a temporal goal to direct strategy development and allow estimates to gauge success (Practice 5.6).

Resources:

- Groves and Game (2016)
- CMP (2013)

Practice 2.12: Identify intermediate objectives.

Identify intermediate objectives (also called means objectives or project objectives), drawing from the vision (Practice 1.3) and fundamental objectives (Practice 2.3). It may be wise to draft intermediate objectives with a subset of partners (perhaps the oversight team, as described in Practice 3.1) and subsequently circulate and refine them to the rest of the stakeholders (e.g., via workshops or webinars).

Start with a broad, qualitative objective statement and refine and quantify to the extent that partners are willing to agree on. Engage a wide array of stakeholders as you refine the intermediate objectives. The more that people and organizations feel they've had input on these important elements, the better. It may be important to consider translational tools, such as **conceptual modeling** or **issue framing**, which can help stakeholders understand the intermediate objectives.

Resources:

- National Conservation Training Center Course: CSP2101 Applied Landscape-Scale Conservation Biology. Available: https://training.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-CSP2101 (July 2017)

Section 2 Example/Case Study:
High Divide Collaborative

The Heart of the Rockies Initiative acts as facilitator and convener of the High Divide Collaborative, and is leading a design process that can serve as the framework for conservation planning and delivery in the High Divide landscape.

The High Divide of eastern Idaho and southwestern Montana along the Continental Divide is a landscape of continental significance for wildlife connectivity. The landscape links the Greater Yellowstone Ecosystem to protected core habitats in the Central Idaho Wilderness complex and the Crown of the Continent. Public land represents a significant portion of the High Divide landscape: High Divide counties are 60-90 percent public land.

Even though there are strong economic and cultural ties between those public lands and the region's rural communities and economy, many of the region's residents and community leaders share a general mistrust of outside interests including federal and state government agencies.

This was our context when we initiated the High Divide Collaborative in early 2013 in response to opportunities for enhanced landscape conservation funding through the Land and Water Conservation Fund. Our challenge was to develop a broadly collaborative assessment of conservation priorities, and LCD became our framework.

Reflections on the value of selected recommended practices:

Practice 2.1: Identify and convene an inclusive set of partners with a shared interest in the natural and cultural resources within the defined geography.

The High Divide has a conservative political and social context and working ranchlands are central to the region's rural way of life. It was critical to engage ranchers and other local stakeholders up front in the formation of the High Divide Collaborative (Figure 4).

We invited key thought leaders from the ranching community to speak openly to the entire stakeholder assembly about their perspectives, about what they hoped to gain from the Collaborative, and what their needs were. Number one on their list was trust — trust that their needs would be heard and that the engagement would endure beyond achievement of any immediate goals.

We engaged leaders of watershed groups and conservation districts in a similar manner. The conveners also recognized the need to include local federal and state agency leaders who were viewed as credible community members to put a human face on agency management. This foundation of local stakeholders then allowed greater inclusion of a wide variety of interests including national and regional conservation groups, scientists, and conservation advocates.

Figure 4. Convening stakeholders in the High Divide.
Photo: Joselin Matkins

Practice 2.5: Build and maintain trust.

From the outset the Collaborative has been careful to listen to all stakeholders and to provide planned, recurring opportunities for all perspectives to be heard by the entire group.

Early on, we agreed to basic standards for stakeholder participation in the High Divide Collaborative. Decisions were to be made by consensus — not everyone has to be enthusiastic about a choice, but everyone has a voice and the group is committed to bringing everyone into the decision-making. At the beginning of each of our meetings, we reiterate the value of our foundation of trust in one another, and our need to respect each other's perspectives and be responsive to each other's needs.

Practice 2.7: Regularly engage stakeholders for the duration of the design process.

In addition to monthly conference calls among Coordinating Committee members as well as various *ad hoc* subcommittees, the High Divide Collaborative convenes at annual two-day workshops to engage stakeholders in goal-setting, review the state of science for each resource of interest, and initiate strategy development and **scenario planning**.

The Collaborative also holds annual **conservation celebrations** with field tours to recognize progress made and actions taken within the context of our collaborative goals (Figure 5). Our in-person gatherings occur at multiple locations across our broad project area to ensure that local stakeholders can participate; in addition, this provides opportunities to reference local partnerships and their activities.

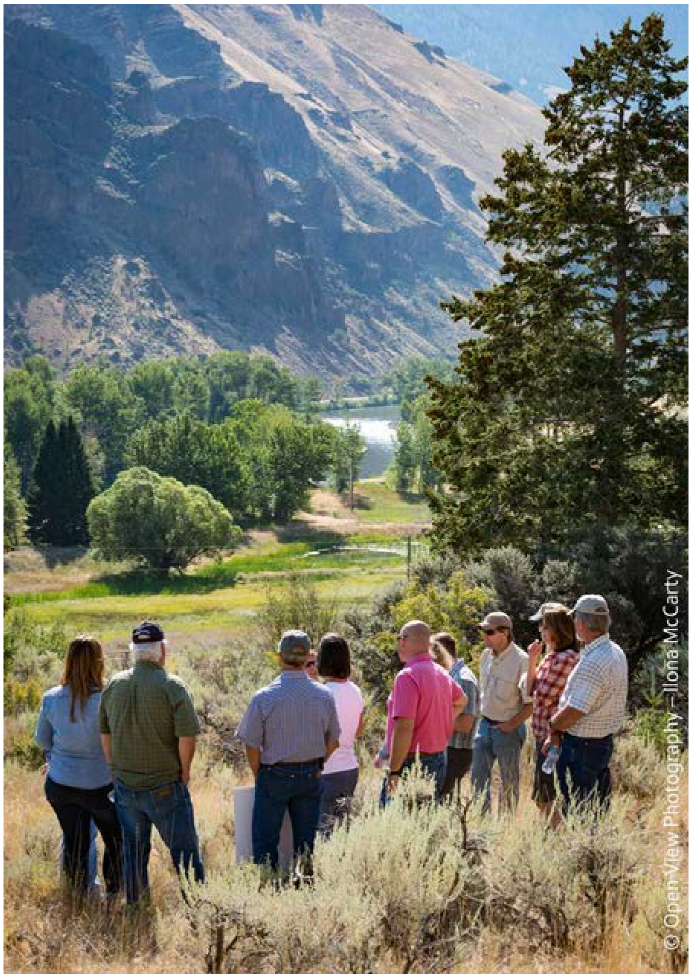

Figure 5. High Divide stakeholders evaluate and discuss options for enhancing riparian connectivity. Photo: Ilona McCarty/Open Valley Photography

Practice 2.9: Define the design scope through discussion among the partners.

A first step in our collaborative process was to clearly identify the geographic boundaries for our area of interest. The simple process of identifying our geography required considerable discussion among stakeholders over several meetings.

Next, we identified our primary conservation goals — the common ground that we could articulate into shared conservation goals as the basis of our shared vision for the future of the High Divide landscape.

Goal-setting is ongoing and dynamic. We revisit our shared goals to confirm stakeholder engagement at each of our meetings, and have refined these goals through direct stakeholder discussion throughout the life of our collaboration. We use these shared goals to develop science to inform the current status of conservation targets and their expected future status. The science informs decision-making, but it does not govern it.

Successes:

- Our deep and ongoing engagement with stakeholders takes time and yields incremental progress as our planning progresses. Our planning process coupled with stakeholder engagement reveals resource conflicts early on. As a result, our design process is adaptive and dynamic as we collectively develop and implement conservation strategies.
- Our clear demonstration of broad and deep support for our shared conservation goals has yielded strong support from our congressional delegations from both states and has resulted in substantial federal investments in our priority conservation initiatives.

Challenges:

- Many local stakeholders need travel assistance to attend meetings as they are not paid to participate in these processes.

- We have been able to sustain broad stakeholder engagement for the Collaborative's four-year lifespan, but we recognize the need to provide added value to retain this engagement. Our LCD must clearly lead to greater opportunity for effective conservation delivery if we are to sustain the Collaborative.
- Convening and facilitating a collaborative effort of this magnitude requires considerable time and resources, and demands a great deal of communication through multiple channels.

Section 3: Assess Current and Future Desired Conditions

This section centers on conditions in the geography — what they are now, what they could be in the future, and what partners desire for the future. It also discusses how to assemble a smaller, targeted team for these tasks and how to collect the best information available to inform decisions.

Practice 3.1: Assemble an oversight team to act on behalf of stakeholders.

As the design moves to a more technical, **quantitative** phase, assemble an oversight (or leadership) team that retains the diverse sector and discipline representation of stakeholders (Practice 2.1) as well as relevant social, economic, and environmental disciplines and local, traditional, and indigenous groups. The leadership team should be comprised of a subset of partners that have the time to invest in finer decision processes and the knowledge and capacity to ensure analyses are conducted in reference to conservation actions (Practice 5.4) and outcome measurements (Practice 5.6).

It is desirable for oversight team members to understand cross-scale, **socio-ecological systems** and interactions; data availability, quality- and objective-vetting processes; software operation and limitations; local resource management histories; and organizational interactions and relationships. Team members should also be adept at communicating complex information and should engage with stakeholders as needed, recognizing that stakeholders and end users may shift as the products develop. The team should perform a **stakeholder analysis** and prepare an associated work plan.

Resources:

- Krebs (2017)

Practice 3.2: Integrate existing landscape conservation efforts.

Building on Practice 1.4, use a multi-disciplinary perspective to examine existing relevant conservation and land use plans, local data on physical and social conditions, and on-the-ground management actions. This will inform projections of **plausible futures** (Practice 3.6) and the feasibility of different strategies by expressing the analysis in terms of actions in which local managers are already engaged.

Partners may wish to review physical or modeled data for many key landscape-scale drivers. To account for multi-sector stressors or opportunities, review other (i.e., non conservation-oriented) relevant planning documents (e.g., transportation, energy development, recreational corridors, urban planning and zoning, agriculture). Consider climate change in addition to other land use stressors. Review plans for their utility in terms of reliability, relevance to management, and interpretability. Because stakeholders will likely vary in their interpretations of these criteria, one or more sessions should convene specifically around vetting the array of available data describing change agents to achieve consensus before adopting data layers and conditions for assessment (Practice 4.4).

Resources:

- Bureau of Land Management rapid ecoregional assessments. Available: https://landscape.blm.gov/geoportal/catalog/REAs/REAs.page (July 2017)
- U.S. Forest Service integrated landscape assessments. Available: http://www.fs.fed.us/pnw/pubs/pnw_gtr896_chapter1.pdf (July 2017)

Practice 3.3: Base assessments on fundamental objectives, conservation features, and desired outcomes.

When assessing current and future conditions, be sure to build from fundamental objectives (Practice 2.3), conservation features (Practice 2.11), and desired outcomes (Practice 2.12). Document conceptual relationships and data manipulations so assessment outcomes can be explained, defended, and replicated. Recognize that assessments may incorporate both spatial and non-spatial information. Consider how surrogate datasets, indices, elicitation of expert opinion, or modeled data can best represent the status of conservation features.

Practice 3.4: Conduct a situation analysis using the best information available.

A **situation analysis** focused on shared values (Practice 2.1), conservation features (Practice 2.11), and change agents (Practice 2.10) sets a baseline for subsequent design. Situation analysis involves the economic, social, ecological, and political trends and opportunities within the socio-ecological system. The analysis should also include an assessment of the political constraints and the capacity of conservation actors. It usually includes a conceptual model and assessment of **threats** to conservation features and may also include some analysis of enabling conditions for conservation and likely barriers to implementation. As part of the analysis, use the best-available information, **traditional ecological knowledge**, and technologies to discuss, model, and describe risks, opportunities, and vulnerabilities of the identified conservation features in a spatial context. Develop conceptual models and plausible scenarios to identify barriers and opportunities for moving systems from their current condition toward the desired future condition.

Products may include:

- A **vulnerability assessment** that considers **sensitivity**, **exposure**, and **adaptive capacity** of conservation features to climate and other stressors;

- A depiction of observed change agents;
- Estimates of uncertainty and the sources of uncertainty;
- Reasonable projections of intensity, duration, and extent of change agents into a defined future time period;
- Assessment of partner capacities, constraints and opportunities; and
- Narratives that describe information resources used, relevant ecological context, and justifications of data interpretations.

Resources:

- Groves and Game (2016)
- CMP (2013, see step 1D)
- National Conservation Training Center Course, ALC3184 Climate Change Vulnerability Assessments. Available: https://training.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3184 (July 2017)

Practice 3.5: Identify important sources of uncertainty in a decision context.

Every LCD is sure to encounter uncertainty from at least four sources: (1) understanding how socio-ecological and physical systems function, (2) the accuracy of baseline data, (3) modeled or indexed interpretations of the data, and (4) societal responses to changing conditions. Consider and document sources of uncertainty and assumptions in management-relevant terms. Although sources of uncertainty have not always been explicitly expressed in the past, managers have always been making decisions in an uncertain world. By framing uncertainty and assumptions in management decision contexts, partners can clearly articulate the level of uncertainty and co-develop a structured framework for making decisions (Practice 1.6), directing monitoring (Practice 5.6), and adapting strategies to account for uncertainty. Consider alternative hypotheses and use data/monitoring to test competing models and improve model confidence over time. Use models to frame scenarios for initial discussion and later scenario analysis.

Resources:

- Cross et al. (2012)
- National Conservation Training Center Course: ALC3187 Climate Smart Conservation with Scenario Planning. Available: https://training.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3187 (July 2017)

Practice 3.6: Engage in scenario planning to propose desired future conditions.

Formal scenario planning is a way to address uncertainty in planning for the future (Rowland et al. 2014). Scenarios are not conceived as blueprints, but rather as learning tools for managing uncertainty. As a general rule, they are most useful at broad scales and face increased uncertainty as the forecasted timeline is extended. They cannot make decisions in and of themselves, but can be very useful, transparent tools for informing decisions in an adaptive context. Products may include **influence diagrams** and scenario planning tools to identify factors and potential leverage points affecting the condition of conservation targets.

When developing scenarios, consider a range of potential futures and assess whether the design's current vision and objectives are feasible. Document uncertainty and associated assumptions and identify management intervention points. Stakeholders should discuss the pros and cons of the various scenarios. Ideally, one scenario will emerge as a reference to an achievable and desirable future for the LCD geography, this can inform a concise expression of desired future conditions, which is a necessary element for an effective spatial design (Practice 4.7). Scenario planning should also shed light on which policies and actions could lead to undesirable futures and should therefore be avoided.

Resources:

- Rowland et al. (2014)
- Peterson et al. (2003)

Section 3 Example/Case Study:
State of the South Atlantic

Reflections on the value of selected recommended practices:

Practice 2.11: Identify conservation features, targets and indicators;

Practice 3.3: Base assessments on fundamental objectives, conservation features, and desired outcomes; and

Practice 3.5: Identify important sources of uncertainty in a decision context

The following case study addresses recommended practices 2.11 (identify conservation features, targets and indicators), 3.3 (base assessments on fundamental objectives, conservation features, and desired outcomes), and 3.5 (identify important sources of uncertainty in a decision context). Please note, this case study uses the term "target" to mean the measurable condition desired for an indicator. Please see Appendix B for a discussion about the terms "target" and "indicator."

The South Atlantic LCC convened a **structured decision-making** workshop in 2011 where participants identified this fundamental objective: maximizing the health of natural, cultural, and socioeconomic resources. These resources are different components of the overall ecosystem integrity of the terrestrial, freshwater, and marine environments of the South Atlantic region.

To measure these aspects of ecosystem integrity, we needed to develop indicators. We assembled teams of people with different ecological, organizational, and spatial expertise to choose an initial suite of indicators and to design processes for indicator selection and indicator revision. We built on indicators already in use by other regional conservation plans and lessons learned from other indicator processes. Approximately 200 people from over 50 different organizations were involved in selecting, testing, and providing data for our indicators.

The *State of the South Atlantic*, a report card published by the South Atlantic LCC, emerged out of a need to assess and communicate the condition of the ecosystems of the South Atlantic region based on the South Atlantic LCC's natural and cultural resource indicators (Figure 6).

The South Atlantic LCC originally attempted the report in 2013, soon after selecting our first set of indicators, but encountered several challenges. We tried not only to measure the current condition of every indicator, but to project past and future conditions as well. We discovered that we could not yet adequately model many of the indicators or successfully project indicator condition both forward and backward in time. We also realized that clearly communicating ecosystem condition to a broad audience would require professional design expertise.

Figure 6. Conceptual model of selected features and processes for the beach and dune ecosystem in the State of the South Atlantic.

The South Atlantic LCC updated many of the indicators in 2014 to prepare for the region's first data-driven LCD, the *Conservation Blueprint*. The *Conservation Blueprint* is a living spatial plan identifying priorities for shared conservation action. By 2015, we could model the current condition of all the terrestrial, aquatic, marine, and cross-ecosystem indicators across the entire region. Revisiting the *State of the South Atlantic* with the latest indicators was a logical next step.

Building on lessons learned from our previous attempt, we enlisted the help of the Integration and Application Network (IAN) out of the University of Maryland's Center for Environmental Science, a group with extensive experience creating environmental report cards. This time, we approached the assessment as a snapshot in time and focused on current condition.

Working with a design team provided a great opportunity to showcase the beauty and diversity of the region's landscapes and waterscapes. Because it includes beautiful photos, helpful maps, and easy-to-understand diagrams of key ecological features and processes, the *State of the South Atlantic* is more than a report. It serves as an immersive introduction to the South Atlantic — one that some organizations have even used to orient new employees from other regions. Having a glossy, polished product helps introduce partners to what the South Atlantic LCC does and lends legitimacy to our work.

We chose an A/B/C/D/F report card grading system for several reasons. First, grades are intuitive and easy to interpret. They also implicitly convey a desire to improve — to move from a D to a D+, or a C to a B — without requiring explicit targets. Is the goal for all ecosystems to eventually achieve an A? Is that scientifically defensible, or realistic given human demands on the natural world? We did not attempt to answer those questions. The South Atlantic LCC has set measurable targets for many indicators — specifying what condition we want an indicator to be in, by when — but the list is not yet complete and some targets are likely not achievable. Until we can use targets to inform the *State of the South Atlantic* scoring, report card grades allude to the need to "move the needle" for conservation.

We provided a score for the entire South Atlantic geography, then broke that down by subregions, by ecosystems, and by individual indicators. This summarizes the overall health of the region at a high level, and offers finer resolution for readers interested in exploring a particular area or comparing spatial variation between scores.

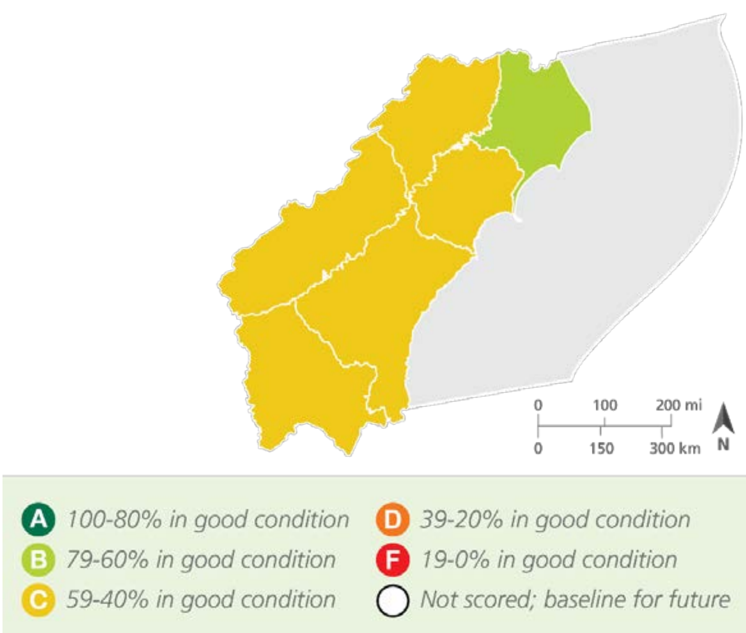

Figure 7: Relative scoring of ecological condition of freshwater marsh ecosystems in the South Atlantic geography.

Translating raw indicator scores into grades required a scoring system. We based the grades on the percent of an analysis unit (like an ecosystem or subregion) in “good” condition, based on the scientific literature (Figure 7). In a few cases, setting a threshold was difficult or impossible.

Some indicators lacked historic data to put their current values into context. For example, maritime forest extent told us how many acres of maritime forest exist today, but we didn’t have enough past data to convert the decline to a specific letter grade. Other indicators were relative measures that identified where the top percentage of the indicator occurred, but did not relate to absolute ecosystem condition. For example, beach birds told us where the highest concentrations of beach birds were — even if all the numbers are skewed much lower than they should be by human activity.

These types of indicators help identify priority areas in the *Conservation Blueprint*, but they don’t work in the *State of the South Atlantic*. If we could not define “good condition” for an indicator, we simply didn’t grade it or include it in the scoring calculations. This allowed us to move forward with the assessment and revisit the thresholds next time.

Of course, we had more confidence in some scores than in others. To communicate uncertainty, we used cell phone bars to represent qualitative confidence in the score for each ecosystem, where better reception signified higher confidence (Figure 8). No ecosystem received higher than three out of five bars, indicating plenty of room for improvement. We published detailed information about the score calculations and good condition thresholds on the website to avoid cluttering the report. The IAN team suggested the assessment function like a layer cake of information, where the report itself serves as the smallest tier at the top, supported by lower layers of more comprehensive documentation available online.

Figure 8. Graphic representation of relative level of certainty about ecological condition used in the State of the South Atlantic to acknowledge and communicate confidence in the analyses.

The South Atlantic LCC deliberately structured all indicators so that high scores always reflect better ecosystem condition. However, in hindsight we realize we overlooked two indicators where the name did not match that positive directionality: “Impervious surface” and “beach alteration.” While we tried to use language like “better” and “worse” to clarify, some readers may still have been confused about whether high impervious surface was ultimately good or bad. We have since corrected the indicator names to “permeable surface” and “unaltered beach” to avoid this issue in the future.

Though this report did not attempt to quantify past or future conditions, we used written narratives to describe risks, opportunities, and successes. The *State of the South Atlantic* helps readers interpret the grades; for example, that urbanization in the Piedmont drives low scores

for the upland hardwood ecosystem, and high grades in the marine environment likely reflect the lack of fishing data included in the calculations.
We sent a late draft of the report to a select team for review, who provided valuable feedback and recommended some changes. Then, we circulated the final printed report to the wider South Atlantic community at our *Conservation Blueprint* workshops in the spring of 2015.

Workshop participants caught an error in one of the subregional maps — a significant oversight that required the report to be reprinted. Even though LCC staff, the IAN team, and the review team had subjected the report to extensive quality control, printing copies in small batches as-needed rather than printing a bulk quantity would have been a better choice to avoid recycling so many of those initial copies.

We plan to publish an updated *State of the South Atlantic* in 2018. In that version, we intend to set good condition thresholds for many of the indicators we could not score. We also hope to use the 2015 edition as a baseline for calculating trends over time. Improved indicator methodologies may require us to back-calculate the 2015 scores with new indicators. Our goal is to eventually incorporate measurable targets for each indicator and models linking conservation actions to indicator outcomes to help the South Atlantic conservation community demonstrate the collective impact of our work.

SECTION 4: Spatial Design

Spatial design provides a holistic approach to identify where on the landscape desired functions and opportunities exist or could exist given change and uncertainty (Groves and Game 2016). It synthesizes data describing multiple aspects of the landscape and typically involves spatial modeling. The following recommended practices provide guidance about how to gather inputs for the spatial design, create the spatial design, and ensure a transparent process.

Practice 4.1: Assemble a technical advisory team.

Although each design is likely to be conducted differently, analyses and modeling are most effective when they employ the best data available, respond to stakeholder needs, and use vetted analytical approaches. To ensure these objectives are met, identify technical specialists that represent the oversight team (Practice 3.1) and stakeholders (Practice 2.1) to form a technical advisory team. Ensure the technical team has a broad knowledge of available data (Practice 4.2). Establish a regular communication schedule giving the technical team opportunity to identify spatial information needs and evaluate source data relevance and quality, analytical approach, product utility and access, and emerging techniques.

Resources:

- Norris et al. (2016)
- Cheruvelil et al. (2014)
- Pooley et al. (2014)

Practice 4.2: Select and understand datasets.

Engage the technical team and partners in understanding and selecting the datasets to be used as inputs into the design. Dataset selection should mirror mappable elements of the identified conservation features (Practice 2.11). Use formative evaluation measures to determine whether the data layers effectively reflect the needs of end users and if new or different layers would be more useful representations (Practice 2.4). Consider issues with data quality, completeness, lineage, vintage, and documentation (i.e., metadata). There is always a need for new data or data that will be complete within months or years; when selecting datasets, weigh the value of waiting for a new dataset versus the need for the LCD to maintain momentum.

The extent to which stakeholders adopt and understand design products depends on how confident they are that the products have a sound basis and were derived using appropriate information and analysis. Members of the technical team and other relevant parties need to be aware of emerging data, research, and models relevant to identified conservation targets, landscape stressors (change agents), management approaches, and the vision and objectives of the design. Carefully evaluate source datasets to ensure transparency and allow efficient integration of new datasets should they become available. Identify and track data gaps so they can be re-assessed in future iterations of the design process. Rapid prototyping and similar iterative approaches can accommodate data gaps, uncertainty, and lack of knowledge.

Resources:

- Keep in mind, much of the data will likely come from local partners
- United States Geological Survey, ScienceBase. Available: ScienceBase.gov (July 2017)
- Individual LCCs' conservation planning atlases. Available: https://databasin.org/search/#query=Conservation%20Planning%20Atlas (July 2017)
- United States Geological Survey, Geo data portal. Available: https://cida.usgs.gov/gdp/ (July 2017)
- United States Geological Survey, Biodiversity information serving our nation. Available: https://bison.usgs.gov/#home (July 2017)

Practice 4.3: Assemble datasets.

Assemble selected spatial datasets that represent, or are indicators for, each of the conservation features and change agents agreed upon by the partners and rule sets or logical algorithms used to identify locations of interest on the landscape. This is an important step in maintaining the linkages between desired outcomes, the conservation features associated with the outcomes, and a design that can benefit the conservation features. The datasets should include geographic extent, spatial resolution, and units that are relevant to the conservation features, change agents, and intended uses of the design (Practice 2.12). Document and explain limitations and uncertainties clearly (Practice 3.4). Source datasets should be accompanied by metadata explaining their source, derivation, purpose, and limitations.

Resources:

- Great Northern LCC (2017)

Practice 4.4: Fully vet selected datasets.

Engage stakeholders in understanding and selecting the datasets to be used as inputs into the design. Present the decision process and selected data to the oversight team for inspection and approval. Describe important features of spatial and thematic resolution, extent, depth, and estimates of precision and uncertainty. Clearly identify data providers, intellectual property, data sensitivity, and security needs.

Resources:

- Great Northern LCC (2013)

Practice 4.5: Ensure data management and accessibility.

After agreeing on baseline data, it is important that all analyses use that data consistently; inconsistent use during parallel analyses may skew results. Ensure data are appropriately attributed (including identifying authoritative data), versioned, documented, and archived as permanent records of the design. Make data accessible to all stakeholders.

Resources:

- North Atlantic LCC (2017b)
- LCC Network (2016c)

Practice 4.6: Agree on spatial products.

Continued involvement with partners in the design process will improve the quality of final products and enhance the trust building (Practice 2.5) that is essential for an effective process. The technical team should be actively engaged and, as needed, additional stakeholders should be consulted when determining the types of design products that will be developed. Address trade-offs among multiple desired objectives (Practice 3.6), ensure compatibility with partner implementation strategies (Practice 5.1), and review draft products.

Resources:

- Data Basin and associated Conservation Planning Atlases provide tools for commenting on datasets. Available: https://databasin.org (July 2017)

Practice 4.7: Incorporate landscape conservation planning and ecological principles into the spatial design.

The spatial design will be most effective if it is more than the sum of the parts (i.e., the individual locations). Taking into account large-scale socio-ecological systems and connectivity will enhance the long-term viability of the design and its linkages to neighboring geographies. To the degree consistent with LCD objectives, configure the spatial design to reflect landscape-scale processes and the benefits of an interconnected network of landscapes and waterscapes. Such benefits include representation of natural and cultural diversity, **resilience** to current stressors and future change, redundancy, complementarity, and connectivity to allow animals and plants to move and disperse over time.

Resources:

- Marxan software. Available: http://marxan.org (July 2017)
- Zonation software. Available: https://www.helsinki.fi/en/researchgroups/metapopulation-research-centre/software#section-14300 (July 2017)

- National Conservation Training Center Course, CSP7300 GIS Advanced. Available: https://training.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-CSP7300 (July 2017)

Practice 4.8: Document and archive.

Poor documentation has inhibited our collective ability to deliver effective conservation for decades. An LCD should endeavor to avoid that pitfall. Keep careful notes about all aspects of the spatial design, preferably in a working data management plan. Capture all decision points, justifications, and analysis narratives (whether successful or not). Incorporate relevant information in standard-compliant metadata files that accompany each derived data layer.

Resources:

- Federal Geographic Data Committee (FGDC) (2017)
- International Organization for Standardization (ISO) (2017)
- National Climate Change and Wildlife Science Center (2017)

Practice 4.9: Ensure accessibility.

For widespread acceptance of the LCD products, it is important for users to understand what the products are intended to do and to have confidence in how they were developed. Products should be clearly documented and communicated (Practice 2.8) for users, with readily accessible information explaining the significance of mapped locations and how they were derived.

Resources:

- California LCC (2017)
- South Atlantic LCC (2017b)

Section 4 Example/Case Study: **Appalachian Mountains and Western River Basin**

The Appalachian LCC (AppLCC) geography is ecologically complex and encompasses almost 600,000 km^2 across 15 states. Stretching down the spine of Eastern North America, this geography includes seven major river basins. The region provides important benefits for millions of people living in the Eastern United States — from drinking water to spectacular wild lands and associated recreational opportunities. One-third of the nation’s population live in or within one-day’s drive of the Appalachian region.

Reflections on the value of selected recommended practices:

Practice 4.2: Select and understand datasets, and
Practice 4.3: Assemble datasets.

The early days of our LCC partnership were handicapped by poor data. To identify the science information needed to work at such large geographic scales, we conducted a three-day workshop, composed of over 150 researchers and managers. The workshop resulted in a “Science Needs Portfolio” that helped to identify data gaps.

The partners programmed research funds to systematically identify and prioritize information gaps and over the next several years our research program funded several studies across three categories of research: (1) foundational data: “Stream Classification System” and “Classification and Geo-referencing Cave/Karst Resources,” (2) projected expanse of large-scale threats or drivers of change: “Appalachian Energy Forecast Analysis” and “Flow-ecology in the Marcellus Shale Region,” and (3) ecosystem-dynamic information*:* “Ecosystem Services and Environmental Benefits.” Data from these funded studies were then integrated into the spatial design process described below.

Beginning in 2013, a research team based at Clemson University assembled data sets. The team included Drs. Rob Baldwin and Paul Leonard, known experts in applied ecology, and Drs. Yoichiro Kanno and Daniel Hanks, experts in aquatic ecology. They also prepared an annotated review of some of the most commonly used conservation planning tools (software and approaches) to help inform the partners of this new and dynamic field of study. The team cross-walked 21 tools with funded or ongoing projects and assessed the tools according to their function and relevance to our planning: reserve selection, habitat connectivity, species distribution modeling and viability, integrative planning process, threats, and climate change.

Practice 4.1: Assemble a technical advisory team,
Practice 4.4: Fully vet selected datasets, and
Practice 4.6: Agree on spatial products.

Landscape conservation design (Phase I - LCD1)

The overreaching goal of this phase was to develop a first iteration regional conservation design. We followed these steps:

(a) Select the initial list of priority resources. In 2014 the Steering Committee nominated experts to serve on technical teams. They represented subject-area expertise (e.g., freshwater mussels, herpetofauna, birds), or systems-level expertise (focusing on physiographic regions or cultural resources). To facilitate the consultative process, the research team came up with a preliminary “straw man” design using available data and modeling approaches to develop candidate scenarios and conservation targets. The research team then worked with the technical teams on three major modeling revisions over a period of 6 months (Figure 9).

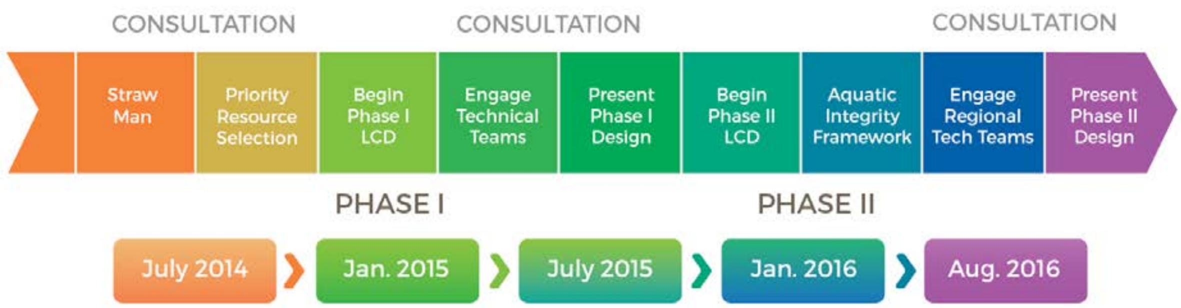

Figure 9. Phases and timeline of the Appalachian landscape conservation spatial design.

(b) Assemble modeling inputs indicative of priority resources. Steering Committee members were key to identifying a list of priority resources or conservation targets represented in the resulting design. While it is impossible to successfully model entire ecosystems with measurable benchmarks, these ecosystems can be monitored and modeled using representative species that are unique to those communities. Many of these were identified as representative of the priority resource (ecosystem).

Twenty resources were selected, spanning coarse, meso, and fine spatial scales to capture landscape pattern and process. Then, selected resources (ecosystem themes) and their corresponding representative species or ecosystem index were selected. Datasets include data gathered during our initial data needs assessment work (2013-2014), which were supplemented by new data (e.g., climate, resilience scores, and energy). Natural landscape condition indices were used for modeling threats.

The Steering Committee also approved the final modeling approach used to generate the design. The research team was instrumental in leading this decision-making process by presenting illustrative modeling results (in advance of the actual study) to illustrate the various options or scenarios.

(c) Generate the spatial design (Figure 9: Phase I - LCD1). Ultimately, the Steering Committee approved a "site (reserve) selection approach" using Marxan, a geospatial model, and "connectivity modeling" using Circuitscape. Marxan identifies the modeled planning units that meet all the objectives for the least possible cost. The technical teams identified habitat fragmentation as the "cost" to minimize.

The connectivity outputs were integrated into Marxan in two primary ways. First, the cost that constrained the minimum set problem was set by inverse of connectivity outputs (i.e., degree of fragmentation). Secondly, connectivity targets were explicitly included for the American black bear (*Ursus americanus*), a large landscape mover (Figure 10A).

The first output is made up of the minimum number and optimal arrangement of planning units (1km^2 hexagons) to achieve targets and goals. An additional output shows how many times a planning unit was selected over 100 repetitions of 500 million iterations each. This output, referred to as "irreplaceability" (Figure 10C), can be thought of as the level of importance to the overall design of each planning unit.

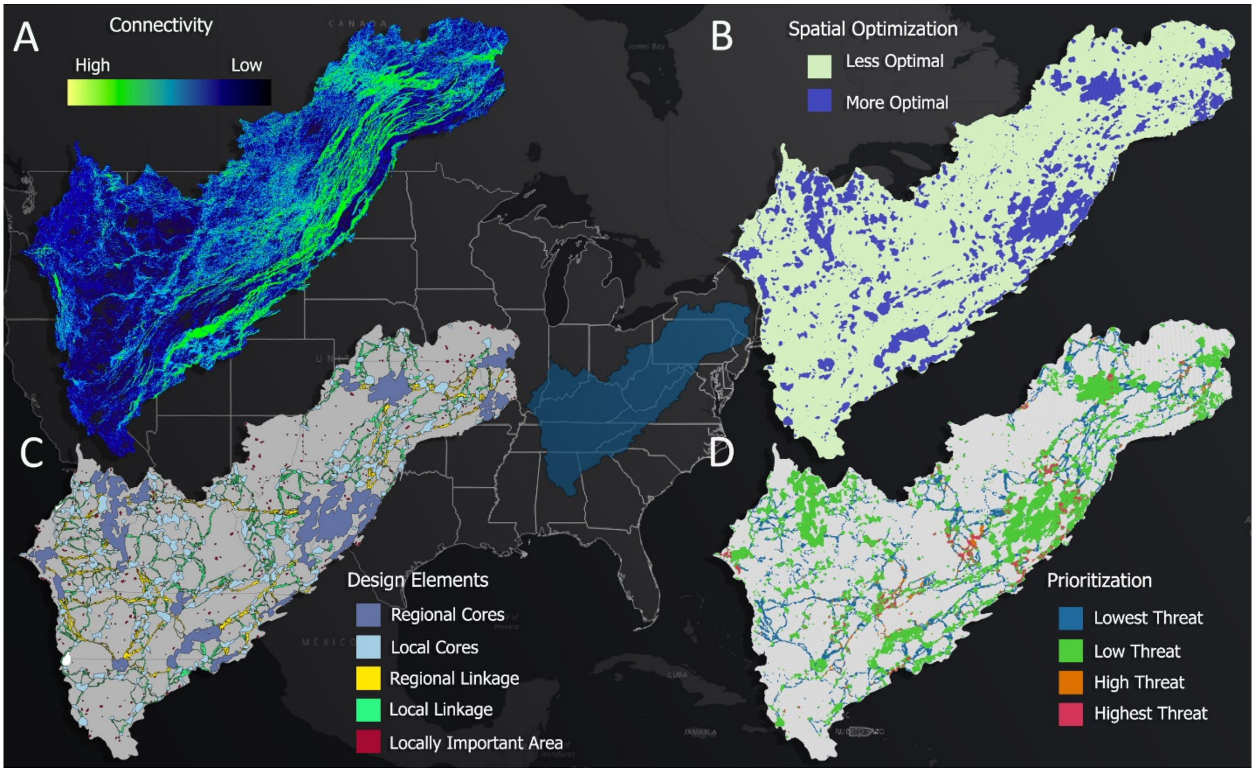

Figure 10. (**A**) Landscape connectivity for the Appalachian LCC represented by a model parameterized for the American black bear (*Ursus americanus*) at 270 m spatial resolution. (**B**) Optimization analysis reflecting results of modeling algorithm showing relative differences to achieve modelling target. (**C**) Irreplaceability, or the weighted importance, over many model runs, of any given area to achieve conservation targets while minimizing costs. (**D**) Spatial prioritization for conservation decisions in areas that are important to the overall conservation plan, based on level of threat of land cover conversion due to energy development and/or housing development while experiencing relatively rapid climate change.

Practice 4.7: Incorporate landscape conservation planning and ecological principles into the spatial design.

Landscape conservation design (Phase II - LCD2)

The Appalachians are known for their rich aquatic diversity. We sought to improve the modeling to better characterize the aquatic realm and represent how it is influenced by the terrestrial realm. However, biodiversity objectives and management actions are rarely captured across realms (e.g., freshwater, terrestrial, marine). Generally, these have been treated as separate analyses, despite the increasing awareness that cross-realm considerations are essential to managing landscape-level threats to natural resources.

Identifying appropriate aquatic metrics as data inputs and targets was critical. To do this, we relied on 60 regional experts selected from LCC partner organizations. A series of ten virtual webinar meetings were held over a period of eight months to interact with expert teams that were divided into three regional subgroups (Central, Southern, and Western) to maximize the opportunity for discussion. Twenty-six targets were selected spanning three thematic spatial scales to capture landscape pattern and process.

The modeling approach used “nested planning units” (i.e., catchments inside of larger drainages) to better represent aquatic ecosystems. It adopted a new “integrated modeling approach” to integrate aquatic-based planning units and aquatic connectivity conservation targets prior to the terrestrial optimization modeling. Aquatic planning units for aquatic targets were based on local catchments (i.e., drainage directly into a stream reach) drawn from the National Hydrography Dataset and were populated with predictors (e.g., water quality, connectivity, flow regime) from several sources to create a cumulative layer of existing aquatic condition.

We then performed an optimization analysis based on “cost,” where less cost, or “cheaper,” meant a hexagon was less impacted by human modification and therefore it would be easier to achieve the modeling target (Figure 10B). The landscape connectivity scores were used to modify the boundary relations of hexagons so that highly connected hexagons were more likely to be selected together in optimization. In this way, landscape connectivity can be thought of as loosely coupled with the optimization algorithm, connectivity — thus representing more of the real-world dynamics and inform spatial decision-making and planning.

We mapped five regional core and eight “locally connected cores.” These areas are locally significant and also have high internal local connectivity. There were two major types of linkages identified that are likely providing additional connectivity between regionally connected cores and within locally connected cores.

The first type are region-scale corridors that connect large cores; we call these “Regional linkages.” The second type of major linkage was found bridging Valley and Ridge topography and connecting mountainous regions with the low plateaus in an east–west orientation.

Lastly, the conservation design exercise highlighted smaller, isolated areas are locally significant and were produced in two primary ways: (1) build outs acted as buffers around existing protected areas suggesting that many conservation values around the protected area are not fully protected; and (2) small areas that had unique conservation value regionally but are under no current protection.

Thirty-six of these areas were mapped but there are many that scale to the 1 km^2 hexagon level. Finally, these design elements (i.e., Figure 10C) were prioritized against a cumulative threats index to give practitioners an idea of how quickly an area around a design feature is changing (Figure 10D).

Practice 4.9: Ensure accessibility.

Landscape conservation design (LCD2) – "NatureScape."

To move from optimization outputs to a transparent and user-friendly network design, the team created an open access, online decision-support tool we named "NatureScape." It is actually a suite of tools made up of: (1) a conservation design map reflecting cost-benefit "optimization" modeling output, (2) summary data tables that we customized to examine specific locations or regions to visualize the data underlying the modeling solution or map design, and (3) the aquatic condition score to visualize the aquatic or watershed influence on the design.

Together, the tools helps frame the response to challenging questions our partners faces such as: *How can we invest more strategically, and work more efficiently, to achieve greater conservation benefits for the least cost, given what we know of future trends in land-use, expanding environmental threats, and projected changes in temperature and water availability?*

NatureScape allows partners to identify areas of shared interests and possible collaboration. It presents the 'optimal solution' map to help identify areas of least cost and greatest value to regional conservation objectives, while also providing on-line data visualizations that help identify key conservation targets.

SECTION 5: Strategy Design

A strategy design complements the spatial design (Section 4) and describes a cooperative approach toward achieving desired conditions (Practice 3.6). The strategy helps partners answer the question: *Who does what, and where?* (Campellone et al. 2018) and provides a landscape context for partner alignment when each entity plans, implements, and evaluates their conservation investments and actions. An effective design scales down to inform local conservation actions which, collectively, help to move the relevant geography toward the desired condition. Strategies that flesh out a **theory of change** for achieving desired future conditions and describe benefits of mutually reinforcing activities help partners see where their actions contribute to collective impact (Kania and Kramer 2011). Strategy design products likely include a report, communication tools, graphics, diagrams, timelines, funding and budget planning (Practice 1.5), and a plan for monitoring and evaluation (Practice 2.4). Coordinated implementation by partners should be recognized as voluntary unless or until supported by a formal planning process (e.g., the National Environmental Policy Act).

Practice 5.1: Confirm compatibility with existing plans.

A desired condition can only be achieved if appropriate mechanisms are available and implemented. As such, spatial design products should be clearly related to and compatible with available programs, strategies, and practices, such as those outlined in State Wildlife Action Plans. Available conservation tools (including partner assets, effective regional and local partnerships, and ongoing conservation and monitoring programs) should be integrated throughout the design process (Practice 1.4), especially when they offer good examples of existing actions or policies that help achieve and measure conservation objectives. Conservation strategies and practices prioritized by design partners should have corresponding spatial products.

Resources:

- Bureau of Land Management land use plans. Available: https://eplanning.blm.gov/epl-front-office/eplanning/lup/lup_register.do (July 2017)
- State Wildlife Action Plans. Available: http://teaming.com/sites/default/files/StateWildlifeActionPlansReportwithStateSummaries.pdf (June 2017)
- U.S. Fish and Wildlife Service comprehensive conservation plans. Available: https://www.fws.gov/refuges/planning/ComprehensiveConservationPlans.html (July 2017).
- U.S. Forest Service land management plans. Available: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd593201.pdf (July 2018).

Practice 5.2: Integrate spatial design with partner efforts.

LCD partners typically act at both a planning level (Practice 5.1) and an action level. An LCD strategic design should be cognizant of both. A strategic design that references conservation activities stakeholders and partners are actively performing and conceptually aligns those actions in terms of landscape-scale outcomes will help partners recognize their contributions towards achieving a shared desired condition.

A coarse summation of all management actions occurring in an LCD geography may at first glance seem disjointed. However, once actions are grouped and classified using a standardized schema, clarity on the relative contribution of activities to the desired condition emerges. That information can then be linked to the spatial design, setting the stage for an enhanced, strategic approach to identifying and selecting subsequent conservation activities that build off existing management activities and facilitate progress toward desired future conditions. Use scale, complementarity, and connectivity concepts to integrate partner-specific actions toward landscape outcomes.

Resources:

- CMP (2016b)

Practice 5.3: Cross reference and align strategies with adjacent LCDs as appropriate.

When LCDs are compatible within and across relevant geographies (Practice 1.4) they can collectively contribute to an ecologically connected network of functional landscapes and seascapes. Reviewing adjacent LCDs before and during strategy design development ensures the design achieves landscape-context objectives.

Resources:

- LCC Network (2014, 2015, 2016c)

Practice 5.4: Guide implementation within a partner-defined conservation delivery network.

Ideally, resource managers, decision-makers, and stewards will apply strategies and actions with a full understanding of landscape context and knowing what others are doing and where. Mutually reinforcing activities link partner impacts toward collective impacts. Therefore, focus on leveraging capacities and resources that contribute to partner-defined conservation delivery networks. Promote co-understanding of implementation approaches, challenges, and jurisdictions among actors to improve collaborative conservation delivery. Where feasible, seek program alignment so that partners working in the same local geographies bring their specific expertise in implementation to bear in a sequential, additive way. Seek to share project costs in terms of funds, personnel, equipment, and expertise.

Resources:

- Groves and Game (2016)
- Decker et al. (2014)

Practice 5.5: Continue the exchange of information and technology.

Exchanging information and technology among partners (Practices 2.8 and 4.9) will support ongoing conservation activities, increase awareness of new management options and emerging threats, aid in indicator development and analysis, and facilitate design evaluation. Tailor communication to partner needs and schedules through recorded webinars and web meetings, side meetings coordinated with regularly scheduled conferences, and easy-to-access repositories and tools.

Resources:

- LCC Integrated Data Management Network (2015, see Appendices III and IV)

Practice 5.6: Monitor, evaluate, and take action.

Integrated evaluation mechanisms — a hallmark of adaptive management (Practice 1.6) — are necessary to measure and validate every element of an LCD, including both formative and summative evaluation metrics such as co-production stakeholder engagement, effectiveness, efficiency, costs, and ecological relevance (Practice 2.4). Monitoring and evaluation provide information about how effective partner actions are and, when rolled up, the collective trend relative to desired future conditions. Strategy design should include both a spatially-balanced monitoring plan to measure indicators for each conservation feature and plans for a cost-benefit assessment of implemented actions. Facilitate monitoring and evaluation consistently throughout the design process — from conservation feature identification through strategy implementation — and support monitoring and evaluation of overall strategy design and component actions.

Resources:

- Lindenmayer and Likens (2010)
- National Ecological Assessment Team (2006)

Practice 5.7: Iterate.

From context to evaluation, the design process is intended to be repeatable and iterative. Strategy design should define an evaluation and adjustment cycle to ensure the LCD and component actions are advancing progress toward desired future conditions. Together, partners should develop a timeframe and assessment process to report on management activities, test design utility, and determine methods to evaluate and modify actions. Partners should host workshops and decision processes with specific objectives of updating, and if necessary, modifying spatial and strategic designs and re-committing resources.

Resources:

- Decker et al. (2014)
- Williams et al. (2009)
- Strategic Habitat Conservation Technical Assistance Team (2008)

Section 5 Example/Case Study:
Columbia Plateau/Arid Lands Initiative Strategic Design

The Columbia Plateau-Arid Lands Initiative LCD complemented their spatial design with a strategy design that incorporates many of the practices described in Section 5, including practices 5.1 (Confirm compatibility with existing plans), 5.2 (Integrate spatial design with partner efforts), 5.4 (Guide implementation within a partner-defined conservation delivery network), 5.6 (Monitor, evaluate, and take action), and 5.7 (Iterate).

Although the ALI partnership initially began with a more traditional strategic conservation planning process, the partners soon adopted those key elements of a structured LCD that served to enrich and inform the links between strategy, priority locations, and the collaboration between partner resource management organizations and agencies.

Partners co-developed sets of results chains (Figure 11) based on priority strategies (protection, restoration, development, energy development, agriculture, grazing) that emerged through their conservation planning process.

Results chains are not tied to a specific place, yet they explicitly consider partner organizational mandates, roles, and strengths by describing enabling conditions and resources. Further, the results chains tie individual partner objectives to a common objective, allowing partners and stakeholders to visualize how their contributions lead to collective impact. In this example, a 'proof of concept' phase allows partners an entryway to test how the strategy design aligns with their capacity and capability and evaluate how they can commit resources (e.g., funding) and scale to a fully implemented design.

Protection: Identify and protect priority lands through long-term techniques, such as conservation easements, land acquisition or other voluntary landowner incentives.

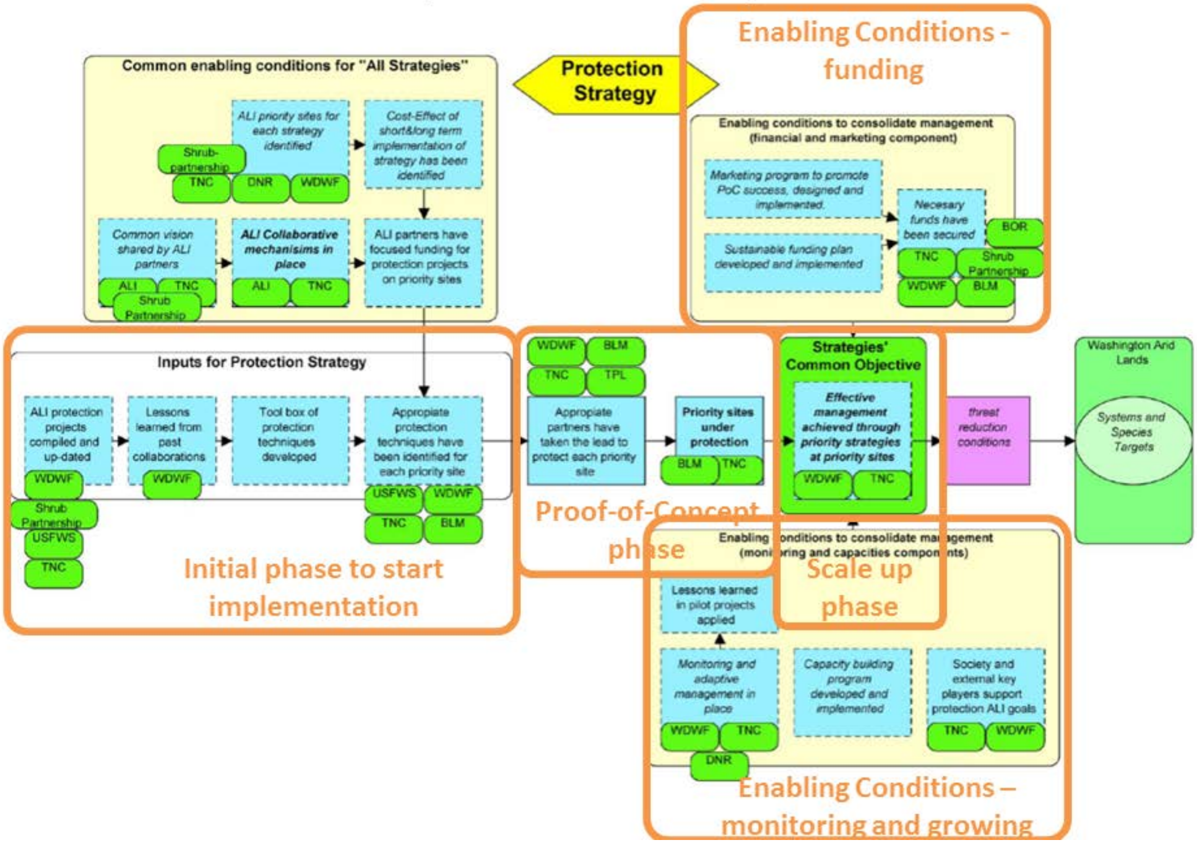

Figure 11. Results chain showing how protection strategies can lead to conservation of priority systems and species on the Columbia Plateau.

The ALI LCD also scales to site-specific considerations and maps strategies to places focused on priority core areas identified by the spatial design, as seen in the ALI Shared Priorities for Conservation at a Landscape Scale Addendum – Mapping Strategies to Places. The ALI also mapped specific strategies to particular places on the landscape by developing a suite of criteria based upon the information in the scorecards. Maps were developed that depict areas that are suited for restoration and protection strategies, as well as evaluating those priorities through the lenses of climate change and fire-risk.

Partners used a scorecard approach (Figure 12), which further integrates spatial and strategy designs and identifies how conservation actions in priority areas contribute to desired conditions for priority conservation features. Scorecards explicitly identify threats and vulnerabilities affecting the core area as well as the land managers and owners (stakeholders) that have authorities and opportunities to direct actions toward shared objectives.

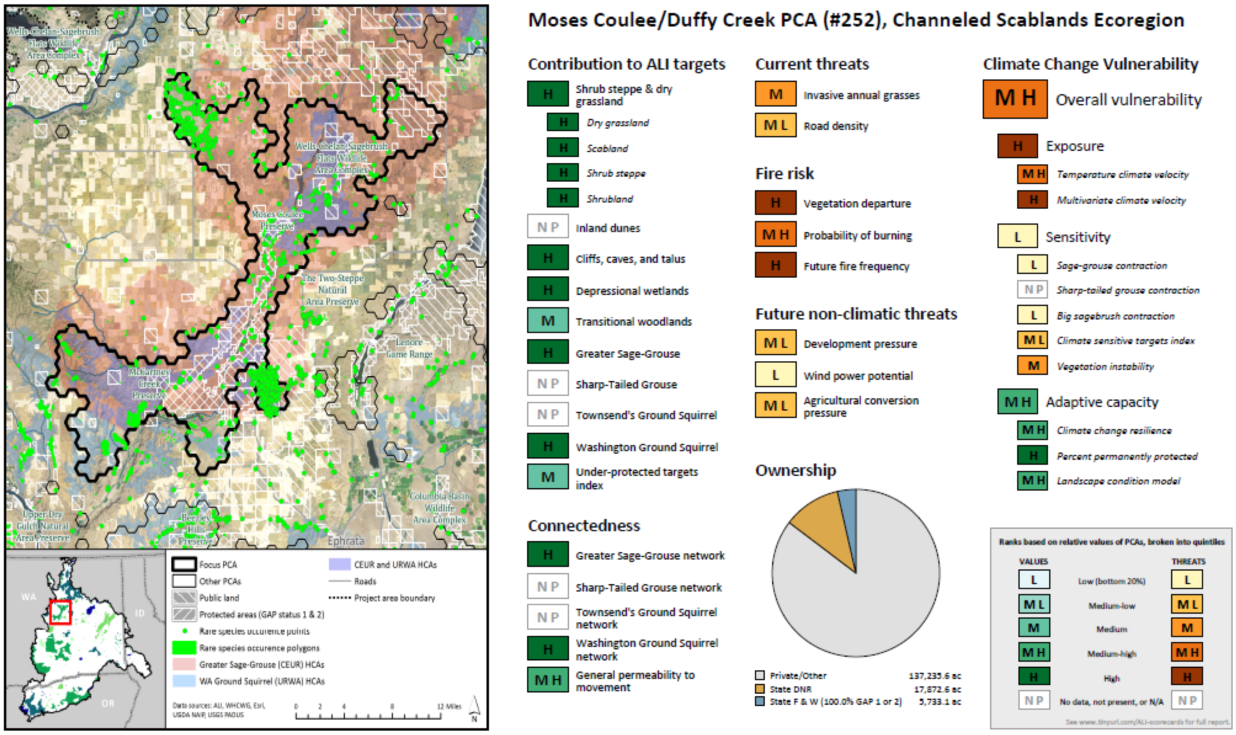

Figure 12. Scorecard for the Moses Coulee/Duffy Creek Priority Core Area relating key elements (targets, threats, vulnerabilities, etc.) evaluated in the Columbia Plateau LCD on a single page. Stakeholders with management responsibility requested this type of synthesis summary.

Scorecards both efficiently inform local managers of site-specific priorities and provide the conduit to scale up toward achieving desired landscape-scale conservation outcomes by highlighting how that priority area ranks — under a range of criteria — relative to all other priority areas in the Columbia Plateau. Not all actions need to be implemented equally across all areas, nor will all partners be involved in all strategic priorities, all phases of implementation, or in all geographies. Partners committing to specific actions in particular places both enable their on-the-ground implementation in those areas, and help identify any gaps that require the ALI to pursue additional partners working in those areas.

The ALI strategy design anticipates shifting the role, structure, and composition of participants to efficiently engage the right people at the right time in the right place, and to effectively coordinate implementation. For example, ALI partners, led by Audubon Washington, are convening specific stakeholders in the Hanford-Yakima Training Center landscape (a subregion on the Plateau, Figure 13) to identify shared values related to reducing wildfire risk, and consequently advancing habitat connectivity goals through the collective action of multiple partners. These discussions are intended to help identify projects that stakeholders recognize as site-specific actions compatible with their economic well-being, while also contributing to the ALI partners' landscape-scale conservation goals.

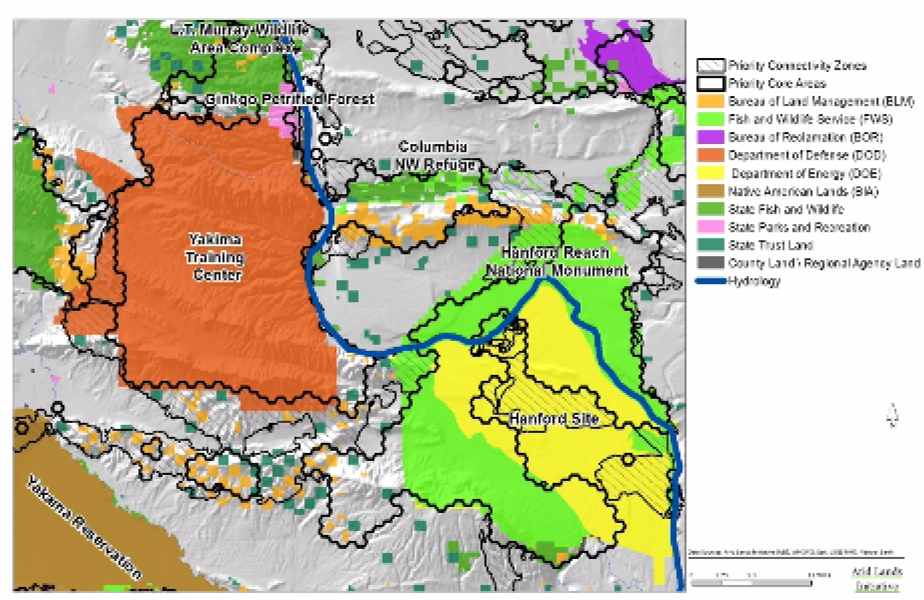

Figure 13. Mapped overlay of Priority Core Areas, Connectivity Zones, and land ownership on the west side of the Columbia Plateau.

Like many conservation projects, this LCD strategy lacks a monitoring plan tied to fundamental objectives and conservation feature indicators. In the strategic planning phase, the ALI partners identified key indicators that would inform their iteration from planning to proof-of-concept implementation, through scaling up. However, partners are currently focused on implementing shared projects or projects that contribute to the ALI's shared goals. Coordinated monitoring across the Columbia Plateau, though critical for showing progress and learning from implemented projects, has not yet risen sufficiently in priority nor obtained funding from partner or external sources to be the focus of implementation. This is not an unusual situation for LCD partners to be in. However, ALI partners fully intend iteration through proof-of-concept testing (Figure 11). Future iterations are expected to incorporate monitoring and evaluation steps to inform and enhance future conservation delivery.

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List of Appendices

Appendix A: Characteristics of LCC Landscape Conservation Designs

Characteristic 1: Collaborative / Multi-sector / Partner-Driven

- Description: The partnership is cross-jurisdictional and multi-sector and operates using collaborative, partner-driven processes.

Characteristic 2: Shared Goals

- Description: Partners collectively develop a shared vision, shared goals, and fundamental objectives for long-term, landscape-scale conservation in the subject geography.

Characteristic 3: Holistic / System Level

- Description: The Design reflects a holistic or systems-level look at the landscape over a specified time frame.

Characteristic 4: Conservation Features

- Description: The partnership identifies conservation features (such as elements of biodiversity, ecosystem processes, human well-being targets, etc.) as the most valued and/or urgent elements around which the Design is constructed. Identifying conservation features allows partners to link goals to specific factors driving change and to propose strategies to monitor these features as measures of progress towards goals.

Characteristic 5: Desired Future Conditions

- Description: The Design includes a spatial and/or narrative expression of the desired future trajectories or conditions of the landscape.

Characteristic 6: Assessment / Situation Analysis

- Description: The Design includes an assessment of current and projected future conditions of the landscape, of the factors driving change (e.g., climate change, land use, etc.), and of the economic, social, and/or ecological trends and opportunities affecting shared goals and desired future conditions within the landscape.

Characteristic 7: Strategies

- Description: The partnership collaboratively provides recommendations on strategies to achieve the vision, goals, and objectives of the Design.

Characteristic 8: Iterative / Adaptive

- Description: The Design products and processes are developed and managed iteratively, incorporate uncertainty, are adaptive to events and responsive to change, and are periodically evaluated and refined.

Appendix B: Terms with Multiple or Related Meanings

Standard terms and their definitions should be agreed upon by stakeholders of a design process (Practice 2.6). This appendix provides information about terms discussed in this guide that have multiple definitions (for these, we provide more than one definition) or terms that are sometimes used interchangeably (i.e., widely considered to be synonyms).

Change Agent, Driver, Stressor, and Threat

Change Agent

Those features or phenomena that have the potential to affect the size, condition, and landscape context of conservation elements. Change agents include broad factors that have region-wide impacts such as wildfire, invasive species, and climate change, as well as localized impacts such as development, infrastructure, and extractive energy development. Change agents can affect conservation elements at the point of occurrence as well as through indirect effects. Change agents are also expected to interact with other agents to have multiplicative or secondary effects (Trammell et al. 2016).

Driver

A generic term for an element of a conceptual model including direct and indirect threats, opportunities, and associated stakeholders (CMP 2013). Some synonyms include: change agent, enabling condition, force, likely barrier, state variable, or threat.

A physical, chemical or biological perturbation to a system that is either: (a) Foreign to that system, or (b) natural to the system but applied at an excessive (or deficient) level (Barrett et al. 1976).

Stress

An impaired aspect of a conservation target (feature) that results directly or indirectly from human activities (e.g., low population size; reduced river flows; increased sedimentation; lowered groundwater table level). Generally equivalent to a degraded key ecological attribute (e.g., habitat loss) (CMP 2013).

Stressor

Any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact (EPA 2017).

Something that causes significant change in the ecological components, patterns and processes in natural systems (Miller et al. 2010).

Threat

A human activity that directly or indirectly degrades one or more targets. Typically tied to one or more stakeholders (CMP 2013).

A process that negatively impacts conservation objectives (Groves and Game 2016).

Direct Threat

Primarily human actions that immediately degrade one or more conservation targets. For example, “logging” or “fishing”. They can also be natural phenomena altered by human activities. Sometimes referred to as a “pressure” or “source of stress” (CMP 2013).

Driver of a Threat

The thing that is causing change (Groves and Game 2016).

Impact of a Threat

Expressed in terms of changes in the attributes of the objectives or features (Groves and Game 2016).

Indirect Threat

A factor identified in an analysis for the project situation that is a driver of direct threats. Often an entry point for conservation actions. For example “logging policies” or “demand for fish”. Sometimes called a root cause or underlying cause (CMP 2013).

Ranking Threats

A natural outcome of assessing a range of threats against some criteria; helpful in understanding the major influences in a system (Groves and Game 2016).

Source of a Threat

See: Driver of a Threat

Threat Abatement

Whether or not a threat is a priority for action depends not only on the nature of the threat but also on the actions available to address the threat (Groves and Game 2016).

Threat Assessment

An understanding of both absolute and relative significance of threats (Groves and Game 2016).

Conservation Feature, Indicator, Key Ecological Attribute, and Target

Conservation Feature

A representation of biodiversity in a conservation plan (Groves and Game 2016).

Indicator

In conservation, something that is reported on as evidence of how well the plan objectives are being achieved (Groves and Game 2016). Note: This is our preferred definition.

A measurable entity related to a specific information need such as the status of a target/factor, change in a threat, or progress toward an objective. A good indicator meets the criteria of being measurable, precise, consistent and sensitive (CMP 2013).

Key Ecological Attribute

Aspects of a target's biology or ecology that if present, define a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time.

Target

Quantitative statements of the outcomes planners want to achieve for each objective (Groves and Game 2016).

Conservation Target

An element of biodiversity at a project site, which can be a species, habitat, or ecological system that a project has chosen to focus on. All targets at a site should collectively represent the biodiversity of concern at the site (CMP 2013) Note: This is our preferred definition.

The biological, ecological, cultural, and/or physical entities or processes that a project is trying to conserve (modified from Salafsky et al. 2008).

Human Wellbeing Target

An aspect of human wellbeing that the project chooses to focus on (CMP 2016a).

Appendix C: Glossary

Standard terms and their definitions should be agreed upon by stakeholders of a design process (Practice 2.6). The following are standard definitions identified by vetted conservation planning frameworks.

Adaptive Capacity

The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (Glick et al. 2011, IPCC 2001).

Assumption

A project's core assumptions are the logical sequences linking project strategies to one or more targets as reflected in a results chain diagram. Other assumptions are related to factors that can positively or negatively affect project performance (CMP 2013).

Bridging Organization

Institutions that use specific mechanisms such as working groups to link and facilitate interactions among individual actors in a management setting (Kowalski and Jenkins 2015).

Change Agent

See: Appendix B.

Conceptual Model

A descriptive model of a system based on qualitative assumptions about its elements, their interrelationships, and system boundaries (Groves and Game 2016).

Conservation Design

Applying models to spatial data that culminates in the designation of priority management areas and coarse estimates of the amount of habitat that will be needed to attain a suite of population objectives (USFWS 2008). Conservation design involves combining geospatial data with biological information and models to create tools such as maps that evaluate the potential of every acre of habitat to support a species' population (LCC Network 2014).

Conservation Feature

See: Appendix B.

Conservation Goal

A description of shared broad-scale desired and/or negative states or conditions of a landscape that span political, jurisdictional, and ecological boundaries (LCC Network 2014).

Conservation Target

See: Appendix B.

Design Partner

See: Partner.

Desired Future Condition

An expression of resource goals that have been set for a unit of land. It is written as a narrative description of the landscape as it will appear when the goals have been achieved. The condition also includes a description of physical and biological processes, the environmental setting, and the human experience (USDA Forest Service 2008).

Direct Threat

See: Appendix B.

Driver

See: Appendix B.

Driver of Threat

See: Appendix B.

Exposure

The nature and degree to which a system is exposed to significant climate variations (Glick et al. 2011, IPCC 2001).

Formative Evaluation

Any evaluation that takes place before or during a project's implementation with the aim of improving the project's design and performance (i.e., how the products or tools were developed) (Sweeney and Pritchard 2010).

Fundamental Objective

The goals that we ultimately want our actions to achieve; a statement(s) about the things we value (Groves and Game 2016).

Goal

A formal statement detailing a desired impact of a project, such as the desired future status of a target (CMP 2013).

Governance

Sustaining coordination and coherence among a wide variety of stakeholders with different purposes and objectives (Pierre 2000; as cited by Campellone et al. 2018).

Human Well Being

Involves three components: people's needs are being met, they can act to pursue goals, and they have obtained a satisfactory quality of life (Groves and Game 2016).

Human Well Being Target

See: Appendix B.

iCASS Platform

A heuristic for landscape conservation design. An innovative systems framework consisting of five attributes and nine principles. The *iCASS* acronym stands for: i = innovation; iC = inclusiveness: convene stakeholders; iA = interdisciplinary assessment of current and plausible future conditions; iS^1 = interactive spatial design; and iS^2 = informative strategy design (Campellone et al. 2018).

Impact of a Threat

See: Appendix B

Indicator

See: Appendix B.

Indirect Threat

See: Appendix B.

Influence Diagram

A simple graphical representation of a decision situation. Different shapes represent decision elements, such as ovals for chance events and diamonds for consequences. The shapes are then linked by arrows in a specific way to show relationships among the elements (Clemen and Reilly 2013).

Intermediate Objective

The desired outcomes that are part of the means of achieving fundamental objectives. Also called *means objectives* or *project objectives* (Groves and Game 2016).

Issue Framing

A process that can help community members evaluate the benefits and drawbacks of a potential course of action. It has at least four interconnected components, including analyzing the issue, exploring the values that individuals and groups have, creating a vision for the community, and developing a strategy to move forward and get results (Rice et al. 2012).

Key Ecological Attribute

See: Appendix B.

Landscape

A bounded area of indeterminate size that humans have an affinity for or connection to, and within which they assess appearance, quality, and function of the landscape based on social norms and interests (Termorshuizen and Opdam 2009).

Landscape Conservation

A nationwide adaptation strategy, implemented at regional-scales that uses participatory, deliberative, and innovative processes to identify stakeholder interests and combine them with the best available science to iteratively explore and learn from transparent decision-making and implementation of social-ecological strategies (IPCC 2007).

Landscape Conservation Design (LCD)

A partner-driven approach to achieve a sustainable, resilient landscape that meets the ecological and social needs of current and future generations. It is an iterative, collaborative, and holistic process resulting in spatially explicit products and adaptation strategies that provide information, analytical tools, maps, and strategies to achieve landscape goals collectively held among partners (LCC Network 2016a).

Means Objective

See: Intermediate objective.

Objective

A specific description of a measurable outcome pursued in support of a goal. All objectives should ideally be SMART (specific, measurable, attainable, realistic, and time-bound) (Doran 1981).

Partner (Design Partner)

A subset of stakeholders who are significantly engaged throughout the design process, understanding that any given individual or organization’s participation will likely vary over time, depending on availability, expertise, and interest.

Plausible Futures

Alternative characterizations of the future, under different assumptions, not intended to be associated with probabilities (Rowland et al. 2014).

Project Objective

See: Intermediate objective.

Quantitative

An amount that can be measured and expressed numerically (Groves and Game 2016).

Ranking Threat

See: Appendix B.

Resilience

The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker et al. 2004).

Risk

An uncertainty that might negatively affect the ability to achieve a project's objectives. Risks are those uncertainties considered most likely to influence the successful implementation of strategies (Groves and Game 2016).

Scenario

Depicts plausible futures of a system under different conditions. A hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points (Kahn and Wiener 1967). Evaluation of decisions under multiple scenarios provides insight into how robust decisions are under different assumptions about the future state of the system (LCC Network 2014).

Scenario Planning

The process of developing a set of plausible futures (or scenarios) that describe how some of the main uncertainties -- demographic trends, policies, markets, budgets, degree of climate change, stakeholder support -- might behave, and then exploring how potential options would be expected to perform under these scenarios (Groves and Game 2016).

Sensitivity

The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli (Glick et al. 2011, USCCSP 2008).

Situation Analysis

The process of identifying and articulating how socioeconomic, political, institutional, and ecological factors drive change in the system of interest (Groves and Game 2016).

Socio-Ecological System

An ecosystem and the set of social and institutional actors that interact regularly with it (Groves and Game 2016).

Source of a Threat

See: Appendix B.

Spatial Scale

The geographic extent or scope of the design.

Stakeholder

An individual, group, or organization that is interested in some aspect of a conservation plan or project and may be affected by, or will potentially affect, project activities (Groves and Game 2016). All human agents and agencies, regardless of expertise, title, or role in the design process (Campellone et al. 2018).

Stakeholder Analysis

The process of identifying the individuals or groups that are likely to affect or be affected by a proposed strategy or action, and classifying them in some manner regarding their impact on the project or project's impact on them (Groves and Game 2016).

Steering Committee

The governing body representing the formal partners in a Landscape Conservation Cooperative that directs staff activities and functions as leadership liaisons to the broader conservation community.

Stress

See: Appendix B.

Stressor

See: Appendix B.

Structured Decision-Making

An organized approach to developing and evaluating creative alternatives and making defensible choices (Groves and Game 2016). An approach to decomposing and analyzing decisions to identify solutions that achieve the desired objectives, in a manner that is explicit and transparent. Based in decision theory and risk analysis, structured decision-making is a concept that encompasses a very broad set of methods, not a prescription for a rigid approach for problem solving (Runge et al. 2012).

Summative Evaluation

Evaluates the impact of an intervention on a target group; identifies what the landscape conservation design achieved that differed from conservation actions or outcomes in the absence of a landscape conservation design approach. Occurs most often at the end of a project or during implementation (Sweeney and Pritchard 2010).

Sustainable Landscape

A biological system that remains diverse, healthy, and productive over time (Wathen et al. 2013).

Target

See: Appendix B.

Temporal Scale

The period of time considered during development of the design.

Theory of Change

An articulation of how an action is anticipated to achieve an objective, including a set of causal linkages and the assumptions underlying them (Groves and Game 2016).

Threat

See: Appendix B.

Threat Abatement

See: Appendix B.

Threat Assessment

See: Appendix B.

Traditional Ecological Knowledge

A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living things (including humans) with one another and with their environment (Berkes 1999).

Transparency

The perceived quality of intentionally shared information. In a highly transparent process, participants feel they are given complete, accurate information in a timely manner and in a way they can understand (Schnakenberg and Tomlinson 2014).

Transparent

See: Transparency.

Uncertainty

A situation characterized by imperfect and/or unknown information (Groves and Game 2016).

Vulnerability Assessments

A process undertaken to determine the relative susceptibility of ecological or human communities to adverse effects from climate change. Generally includes three components: sensitivity, exposure, and adaptive capacity (Groves and Game 2016).

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Appendix E: Full Web Links

Introduction

Hyperlinked Text	Full Web Link
Characteristics of LCC Landscape Conservation Designs	https://lccnetwork.org/resource/lcc-network-landscape-conservation-design-characteristics
Landscape Conservation Design Story Mapper	http://fws.maps.arcgis.com/apps/MapJournal/index.html?appid=b1b48755d62141d78034d13d2734e088

Section 1

Hyperlinked Text	Full Web Link
Joint Venture conservation planning documents	http://mbjv.org/
National Fish Habitat Partnerships Fish Habitat Action Plans	http://www.fishhabitat.org/
State Wildlife Action Plans	http://teaming.com/sites/default/files/StateWildlifeActionPlansReportwithStateSummaries.pdf
National Conservation Training Center Course: ALC3171 Introduction to Structured Decision Making	https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3171
National Conservation Training Center Course: ALC3190 Decision Analysis: Elicitation and Facilitation	https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3190
Connect the Connecticut	http://connecttheconnecticut.org/
Nature’s Network	http://naturesnetwork.org/

Section 2

Hyperlinked Text	Full Web Link
National Conservation Training Center Course: CSP2101 Applied Landscape-Scale Conservation Biology	https://training.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-CSP2101
High Divide Collaborative	http://www.highdivide.org/

Section 3

Hyperlinked Text	Full Web Link
Bureau of Land Management Rapid Ecoregional Assessments	https://landscape.blm.gov/geoportal/catalog/REAs/REAs.page
U.S. Forest Service Integrated Landscape Assessments	http://www.fs.fed.us/pnw/pubs/pnw_gtr896_chapter1.pdf
National Conservation Training Center Course: ALC3184 Climate Change Vulnerability Assessments	https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3184
National Conservation Training Center Course: ALC3187 Climate Smart Conservation with Scenario Planning	https://nctc.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-ALC3187
State of the South Atlantic	http://www.southatlanticlcc.org/state-of-the-south-atlantic/
Southeast Conservation Adaptation Strategy Conservation Blueprint	http://secassoutheast.org/blueprint.html

Section 4

Hyperlinked Text	Full Web Link
United States Geological Survey ScienceBase	https://www.sciencebase.gov/
Conservation Planning Atlases	https://databasin.org/search/#query=Conservation%20Planning%20Atlas
United States Geological Survey Geo Data Portal	https://cida.usgs.gov/gdp/
Biodiversity Information Serving Our Nation (BISON)	https://bison.usgs.gov/#home
Marxan software	http://marxan.org/
Zonation software	https://www.helsinki.fi/en/researchgroups/metapopulation-research-centre/software#section-14300
National Conservation Training Center Course: CSP7300 GIS Advanced	https://nctc.fws.gov/NCTCWeb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-CSP7300
Circuitscape software	http://www.circuitscape.org

Section 5

Hyperlinked Text	Full Web Link
Bureau of Land Management land use plans	https://eplanning.blm.gov/epl-front-office/eplanning/lup/lup_register.do
State Wildlife Action Plans	http://teaming.com/sites/default/files/StateWildlifeActionPlansReportwithStateSummaries.pdf
National Wildlife Refuge System Comprehensive Conservation Plans	https://www.fws.gov/refuges/planning/ComprehensiveConservationPlans.html
U.S. Forest Service land management plans	https://www.fs.fed.us/emc/nfma/index.htm

Hyperlinked Text	Full Web Link
Columbia Plateau LCD Strategy Design	https://www.sciencebase.gov/catalog/item/54ee1862e4b02d776a684a11
ALI Shared Priorities for Conservation at a Landscape Scale Addendum – Mapping Strategies to Places	https://www.sciencebase.gov/catalog/file/get/57f5686fe4b0bc0bec051c29?f=__disk__43%2F0f%2F4b%2F430f4b8f7199b6157a55f84dbe02615e906d6ef8