2019

Ecological Health Assessments

PROCESS GUIDE

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Introduction

Fundamental to understanding how to manage and steward the natural world, raise awareness, or inspire action is being able to describe how your resources are faring and what needs intervention, and to do so in a credible and compelling way.

One way that natural resource-based agencies, organizations, or partnerships may choose to do this is through an assessment of the state of their resources. While these "ecological health assessments" are often initially developed to create a baseline against which future change can be measured, they can also focus management priorities, educate the public, generate action, and/or increase financial or political support.

The authors of this document were deeply involved in a comprehensive, highly collaborative, cross-jurisdictional ecological health assessment for the protected areas on Mt. Tamalpais in the San Francisco Bay Area (https://www.onetam.org/peak-health). Since then we have been asked for advice by others interested in learning about what we did. Before we embarked upon the assessment for Mt. Tam, we too asked others for help.

The fact is, most people taking on a regional ecological health assessment will not have done something like it before. And, as the saying goes, we don't know what we don't know. In this document, we assemble what we learned through our project for Mt. Tamalpais with advice from interviews with those who have, or currently are, undertaking similar efforts. Combined, this guidance will help shed light on the kinds of things others might want to think about as they embark upon ecological health assessments of their own.

However, the scope and approach of these assessments are often as varied as the landscapes and groups involved. Each will have different specific purposes and goals, and look to solicit different responses from different audiences. Each will consider a distinct suite of biological or cultural systems at a range of scales. And, equally important, each will vary widely in terms of available time, skill sets, and budget.

So, what goes into creating a process guide that is useful for such a wide range of applications?

The process described here is based on what we did for Mt. Tamalpais. This is one approach you can use, but because every effort will be different, we have tried to make the process scalable—describing a more comprehensive and involved method followed by possible alternative approaches. Each reader will need to assess how, or if, to apply this advice to their own project. That said, we have called out key decision points for elements we feel are truly fundamental, no matter what approach you choose to take.

As one interviewee said, "While having a guidebook would have been great, the process of deciding what we wanted and how to get there together was as valuable as the final product that came out of it." Though the scope and breadth of an ecological health assessment can make it a fairly major undertaking, these unique projects also open the door to building relationships, connectivity, and trust through working with your colleagues and peers in a way like no other.

No matter how you choose to approach your own effort, we encourage you to enjoy the journey and all the outcomes—both expected and unanticipated—it will yield.

A Brief Glossary

Certain terms used throughout this document are defined here for clarity.

Expert: For our process, this was defined broadly as a person (e.g., field staff, academic scientist, consultant, etc.) who is especially knowledgeable about a particular aspect of ecological health.

Ecological Health Assessment: A process by which the condition of a suite of natural and/or cultural resources is evaluated. For our assessment we used the following terms:

> **Indicator:** The species, community, or physical process that is measured to determine overall ecological health (e.g., grasslands).
>
> **Metric:** A component of each indicator's health that is assessed or measured (e.g., grassland patch size or grassland species richness).
>
> **Condition:** An indicator's current state, based on the aggregation of its metrics.
>
> **Trend:** The change in condition, as determined by comparing current versus previous measures.
>
> **Confidence:** The amount of certainty with which the condition and trend are assessed.
>
> **Threshold:** The qualitative or quantitative limits for determining when an indicator or metric has crossed from one condition or trend category into another (e.g., "good" to "caution" or "no change" to "declining").

Lessons Learned from Others

Reaching out to groups who had done ecological health assessments before we embarked on our own (see Appendix) yielded a wealth of good advice. While specific guidance, key decision points, and questions to inspire your own thinking are included in each project phase in this document, several overarching recommendations are shared here for your consideration.

- Though the team structure can vary, you need someone to lead this effort. Ideally, this person is highly motivated, organized, and partnership-oriented. You also cannot involve your data manager(s) soon enough. Finally, engaging a single writer/editor to pull all the pieces into a cohesive final product is highly recommended.

- Use existing data. Going after new information often not only ends up being a wormhole, it also takes a lot of time.

- It is absolutely essential to agree upon the assessment's needs and goals before you begin, including the audiences you hope to reach with the results. You will need to refer back to these decisions in order to focus what can be a multifaceted process, dealing with complex natural systems, with no rule book.

- Depending on your goals and audiences, you may want to choose ecological health indicators that will help create relevancy (e.g., threatened and endangered species, charismatic megaflora/megafauna, links to human health) in addition to what you would select from a purely scientific perspective.

- Using the ecological health assessment process to create publicly meaningful, scientifically based end products that share the findings with target audiences has proven tremendously beneficial in increasing both understanding about resource condition as well as support for their stewardship.

- Although popular communications tools, "report cards" can be problematic, as audiences tend to focus on the letter grade and rather than the larger context. Additionally, without a lot of high-quality data, it is hard to meaningfully distinguish between grades and you may create a false sense of precision.

- It is important to consider and plan for how those responsible for caring for these resources will react if your assessment yields bad news. Will they feel that their efforts are being diminished? Involving them in the development of the health assessment is one way to help manage this.

- The thoughtful and robust discussions and additional expert opinion gained by engaging the broader local scientific community can lead to a better final product and greatly increased credibility. To make the best use of these individuals' time and talents, the initial analysis should be done internally, giving outside experts something to react to and work on with the team.

- Including confidence levels with each metric gives scientists a level of comfort with making statements based on incomplete data, and also makes the quality of the data and amount of professional judgement used clear to others. Further, including confidence levels helps indicate where additional investments could be made.

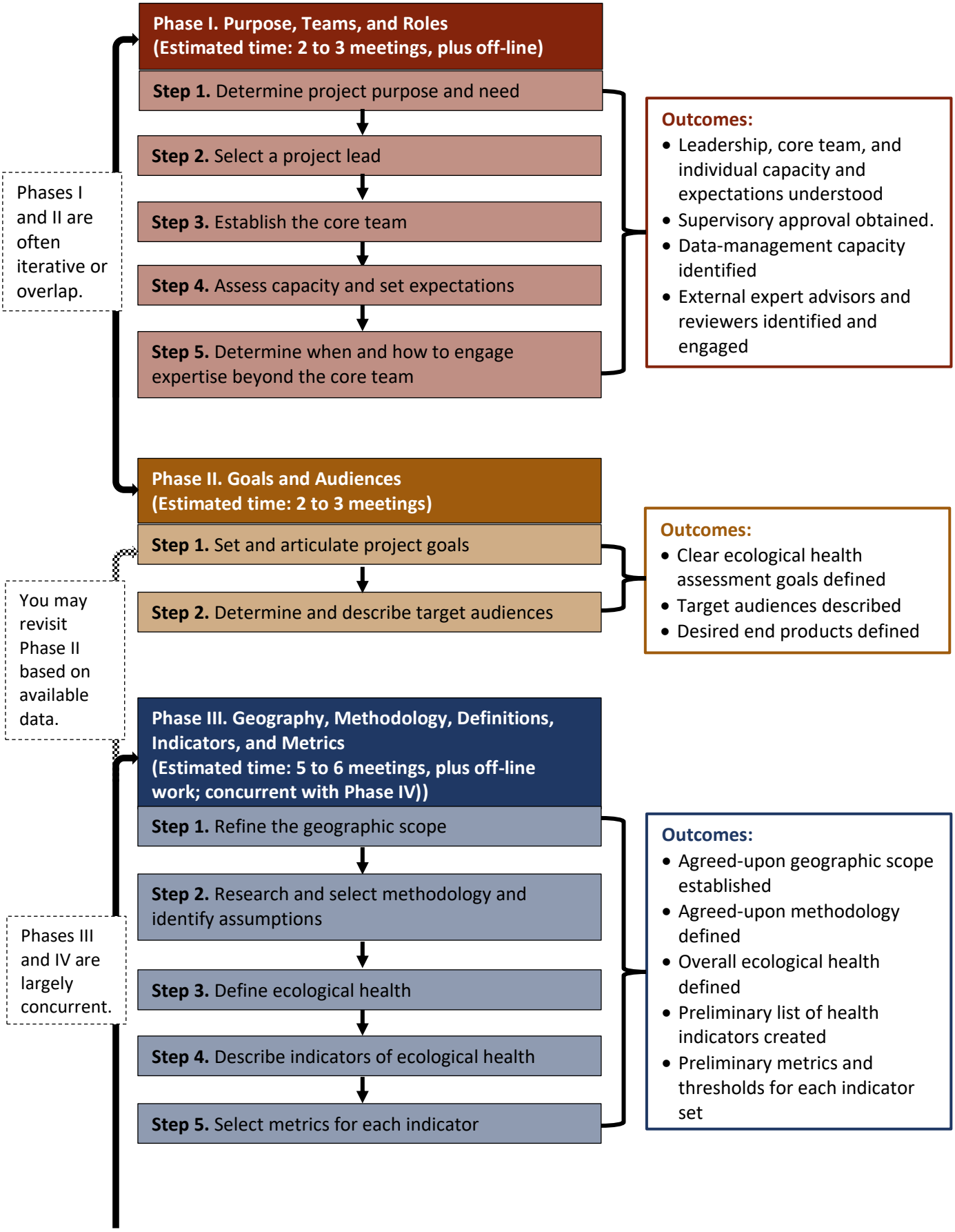
- Lastly, ecological health assessments can be highly resource-intensive projects. Consider available staff capacity and funding early on as you are setting your scope and goals.

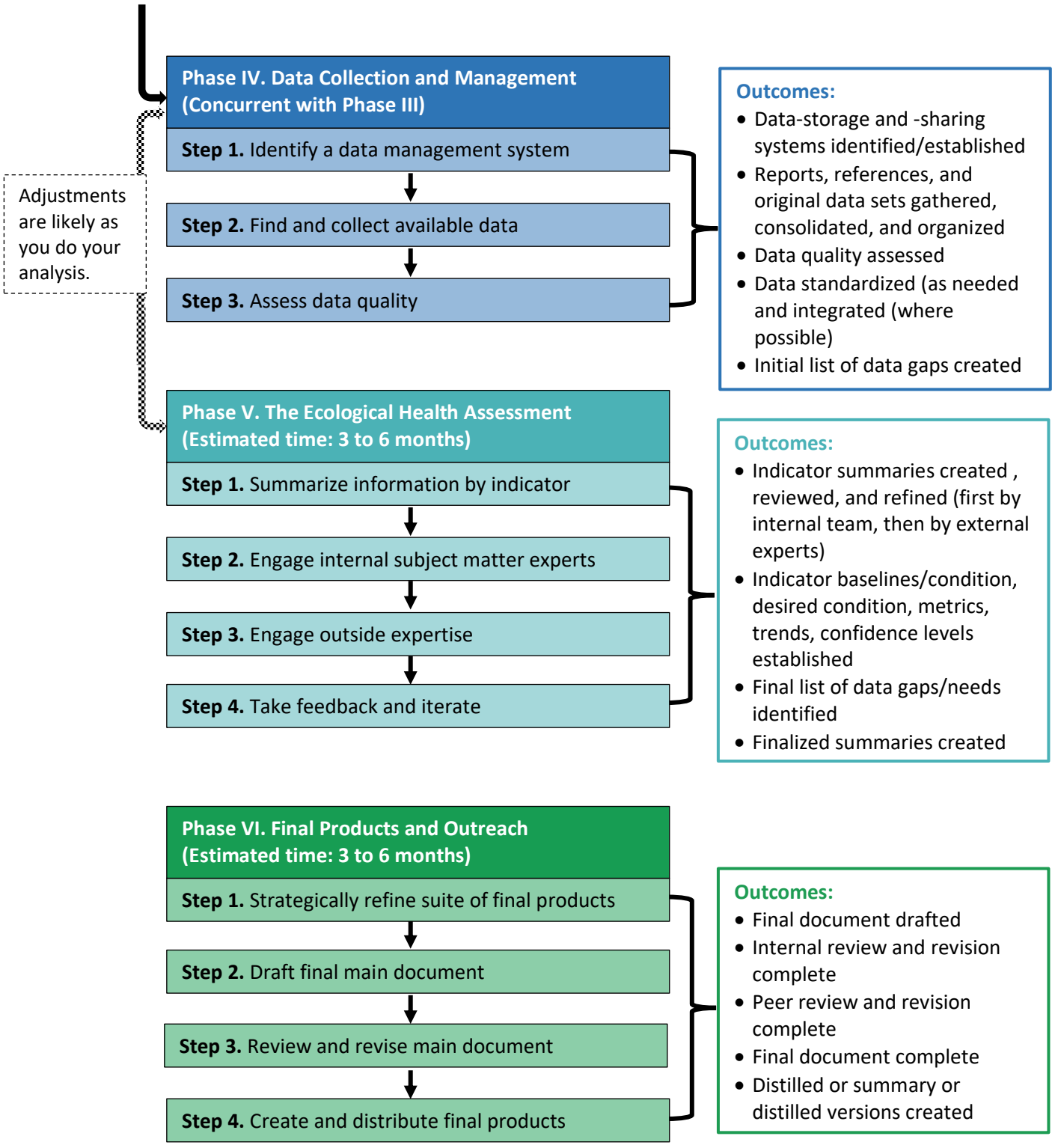
Part I: Ecological Health Assessment Process Overview Flow Chart

The color-coded chart that follows illustrates the basic phases and steps of an ecological health assessment; each is described in greater detail in corresponding sections throughout this document.

As noted in the introduction, the process we present here reflects the rather more comprehensive and detailed approach we used for the ecological health assessment for Mt. Tamalpais. We suggest that readers consider the information and advice in this document, but then scale your own effort to match your needs and available resources.

It is also worth noting that estimated times given for each phase are very rough guideposts. What is actually required will vary depending on things like the scope and scale of the project, level of project management and support, team size and working relationships, engagement of other subject matter experts, and the suite of desired final products.


Phase I. Purpose, Teams, and Roles
(Estimated time: 2 to 3 meetings, plus off-line)
Step 1. Determine project purpose and need
Step 2. Select a project lead
Step 3. Establish the core team
Step 4. Assess capacity and set expectations
Step 5. Determine when and how to engage expertise beyond the core team
Outcomes:
• Leadership, core team, and individual capacity and expectations understood
• Supervisory approval obtained.
• Data-management capacity identified
• External expert advisors and reviewers identified and engaged
Phases I and II are often iterative or overlap.
Phase II. Goals and Audiences
(Estimated time: 2 to 3 meetings)
Step 1. Set and articulate project goals
Step 2. Determine and describe target audiences
Outcomes:
• Clear ecological health assessment goals defined
• Target audiences described
• Desired end products defined
You may revisit Phase II based on available data.
Phase III. Geography, Methodology, Definitions, Indicators, and Metrics
(Estimated time: 5 to 6 meetings, plus off-line work; concurrent with Phase IV))
Step 1. Refine the geographic scope
Step 2. Research and select methodology and identify assumptions
Step 3. Define ecological health
Step 4. Describe indicators of ecological health
Step 5. Select metrics for each indicator
Outcomes:
• Agreed-upon geographic scope established
• Agreed-upon methodology defined
• Overall ecological health defined
• Preliminary list of health indicators created
• Preliminary metrics and thresholds for each indicator set
Phases III and IV are largely concurrent.


Phase IV. Data Collection and Management (Concurrent with Phase III)
Step 1. Identify a data management system
Step 2. Find and collect available data
Step 3. Assess data quality
Adjustments are likely as you do your analysis.
Outcomes:
Data-storage and -sharing systems identified/established
Reports, references, and original data sets gathered, consolidated, and organized
Data quality assessed
Data standardized (as needed and integrated (where possible)
Initial list of data gaps created
Phase V. The Ecological Health Assessment (Estimated time: 3 to 6 months)
Step 1. Summarize information by indicator
Step 2. Engage internal subject matter experts
Step 3. Engage outside expertise
Step 4. Take feedback and iterate
Outcomes:
Indicator summaries created , reviewed, and refined (first by internal team, then by external experts)
Indicator baselines/condition, desired condition, metrics, trends, confidence levels established
Final list of data gaps/needs identified
Finalized summaries created
Phase VI. Final Products and Outreach (Estimated time: 3 to 6 months)
Step 1. Strategically refine suite of final products
Step 2. Draft final main document
Step 3. Review and revise main document
Step 4. Create and distribute final products
Outcomes:
Final document drafted
Internal review and revision complete
Peer review and revision complete
Final document complete
Distilled or summary or distilled versions created

Part 2: Ecological Health Assessment Process Details

Expanding upon the previously presented color-coded chart, each phase and its steps are described in more detail in the following pages. We also offer advice and key questions and considerations for your reference as you work through your own process. Aspects that are considered essential or key decision points likely common to many different kinds of ecological health assessment efforts are in highlighted in a ***bold, italic font*** that is ***color matched*** to each phase.

While these phases and steps are presented in a linear fashion so they can be described in sequence, the process is likely to be more iterative. Or, with new information, you may find that you need to go back to an earlier step and make revisions. While we have noted which parts of the process are more likely to be non-linear, each project is different, and the details of your experience may vary.

Phase I. Purpose, Teams, and Roles

Ecological health assessments come in many shapes and sizes. However, all of them require collecting and synthesizing an array of (likely disparate) information in order to try to understand and say something about complex natural systems and processes. Most will serve multiple goals and audiences. Most will involve some mix of agencies, organizations, departments, and other stakeholders. None are typically anyone's full-time job and so are being carried out in addition to the regular workloads of the people involved.

It is absolutely essential to have a strong, well-organized project lead and a relatively small, highly engaged core team of people with relevant expertise to drive your effort. It is also essential that you understand your data management capacity and approach, as the data and other information you are working with are the very foundation of the project. If you do not have these fundamental pieces, you may want to reconsider doing an ecological health assessment at this time.

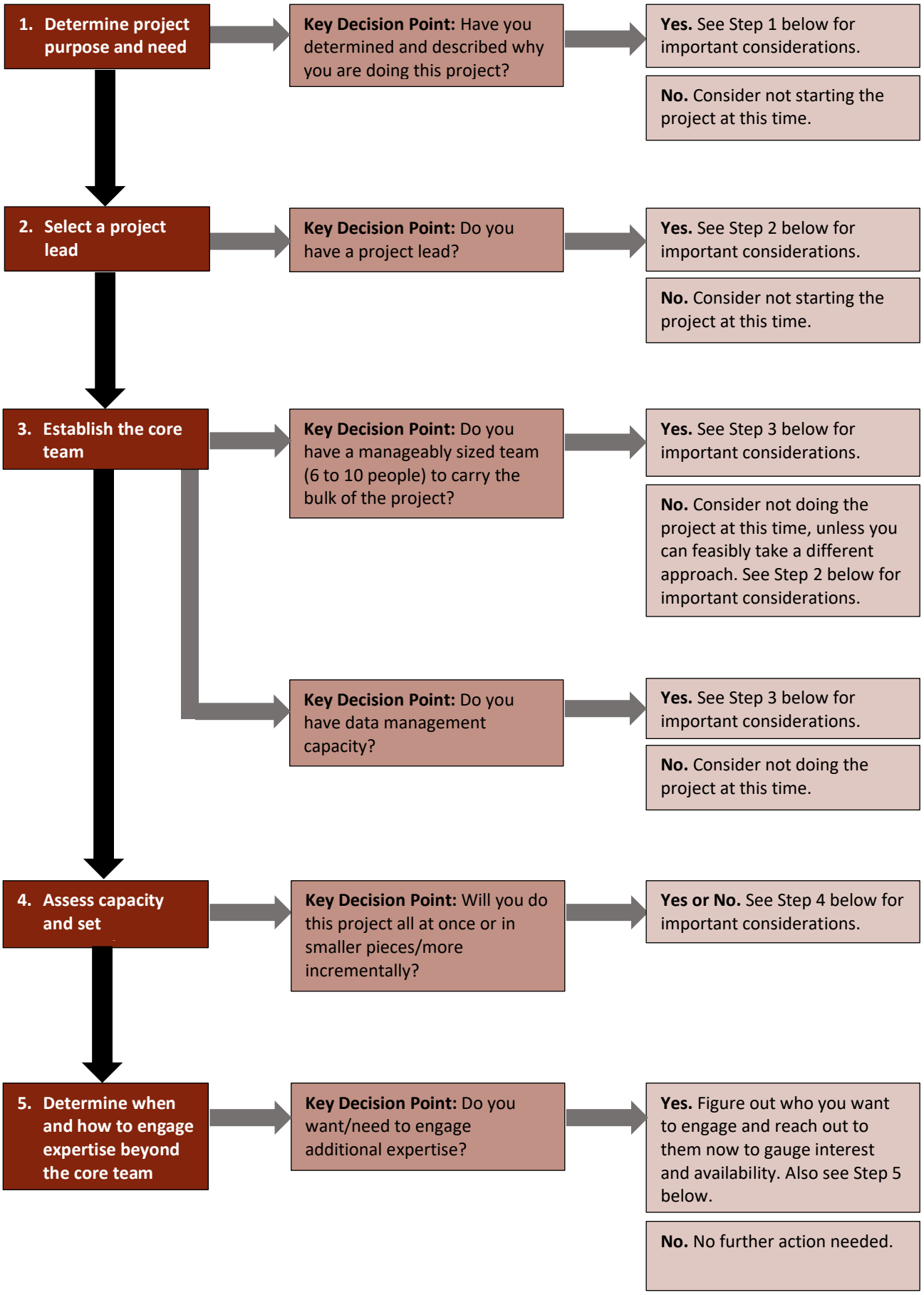
You will also want to decide your overall purpose, need, and approach in this phase, including scope. ***Are you going to do this project in one big push, or more incrementally over a longer period of time? Based on your project's goals and breadth, do you need to engage a larger group of scientists or managers?***

A note on process. . .

Phases I and II can happen in the order described here, but it's likely they will take place in an iterative fashion. For example, you may begin with a clear purpose and audience in mind, in which case you'll want to assemble a team designed to help you deliver what you need. Or, you may start with a team of people who know they want to do something like an ecological health assessment but need to collaboratively define what that means and who it is for. Furthermore, your purpose and goals may evolve as you begin to work through the project, in which case, you will need to adjust your team accordingly.

Because Phases I and II are essential to your project's success, they should be given adequate time and attention regardless of the order in which you do them.

Phase I. Flow Chart of Steps and Key Decision Points



Phase I. Purpose, Teams, and Roles

Step 1. Determine project purpose and need

Best Practices and Key Considerations	Questions
First, you must identify this project's value, purpose, and need. ⇒ You will fully define and refine your goals and audiences in Phase II, but you want to be as clear as possible about why you are doing this project right from the start as it affects how you will set everything else up. For example, there is no need to establish a formal team in Step 3 below if you determine that you don't need one for your purposes. This either formal or informal evaluation should be done by a small team of people who are highly invested in its outcomes.	1. Why are you doing an ecological health assessment? What do you hope to achieve? For whom? 2. How many different agencies, organizations, or other entities need/want to be involved? 3. How may this affect the assessment's geographic or taxonomic scopes? 4. Are there other ways to get the information or end products you need or want other than doing an ecological health assessment? 5. Is the assessment intended to guide management decisions, provide public information, develop a baseline, etc.? Is it a one-time thing, or do you think you will you want to iterate and update over time?

Your Notes

Step 2. Select a project lead

Best Practices and Key Considerations	Questions
You cannot run a project like this by committee—you need a leader. ⇒ The team leader is the project's champion. They maintain the chain of responsibility and communication processes, set the agendas, coordinate individual efforts, and ensure that systematic progress is being made at and between meetings. At the same time, they need to be able to calibrate the project's pace and demands to keep the team from becoming overwhelmed. However, they do not need to have supervisory authority over the other team members; a group of peers with an agreed-upon leader can work quite well.	1. Do you have someone who can lead this project? 2. Is the organization they represent invested in ecological health (i.e., is the project congruent with their missions or goals)? 3. Can they commit the necessary time? 4. Are they well-respected? 5. Are they highly organized and have project management experience? 6. Are they partnership-oriented (if working in collaboration with other groups)? 7. Are they empowered to make decisions? 8. Will they be able to keep the larger project goals at the forefront and align collective input above their own interests and opinions? 9. Do they have the right perspectives, skill sets, and/or connections to others (e.g., scientists, decisionmakers, regulators, communicators, fundraisers, etc.) for what you are trying to accomplish? (Also see goals discussion in Phase II.)
The team leader should have excellent organizational and meeting skills, be empowered and comfortable making decisions, and be willing to devote the substantial amount of time required to take on this important and demanding task. ⇒ The best lead for your project may vary depending upon its purpose (see Phase II). For example, an academic scientist and a land manager will likely create very different products. No matter their background, it is helpful to have someone who is connected with or understands other important project stakeholders or audiences. Having someone who can get necessary resources (e.g., the right experts in the room, meeting space, materials, etc.) is also hugely helpful. The person in this role will also need to dedicate roughly between .25 and .5 FTE depending on assessment complexity, project phase, and team size.	

Your Notes

Step 3. Establish the core team

Best Practices and Key Considerations	Questions
Determine how you will set up your team structure (e.g., will a small core team drive the process, or several smaller teams?). ⇒ In general, a small core team of around 6 to 10 people is the most effective and efficient.* Larger teams can take longer to reach agreement and get things done. It can also be challenging to find a large number of people who are able to commit the level of time and effort required. The core team does not necessarily have to do all of the background work or analyses (see Step 5 below), but they help drive the overall process and can "own" various aspects of the project. *An alternative to having a single small team driving the process is to have a few small, topic-focused teams. Many of the best practices and considerations described here still apply, though perhaps on a different scale. These teams (or team representatives) will need to get together periodically to check in on progress and ensure coordination. The project lead may also have to invest more time making sure everyone is on track, and that what is coming out of each group is consistent.	1. What is the minimum number of people you need to get the right range of subject matter expertise and professional perspectives? 2. Is this a manageably small team? 3. Do you want to add members based on connections or capacities that will help get things done? 4. Do you need people on your team who can help build or improve relationships among adjacent land managers and/or among partners with different perspectives, or to build relationships that will facilitate future management or project work? 5. Do the organizations that are involved or invested in this ecological health assessment trust that their interests will be represented if they are not on the core team? 6. If not, can you ensure their comfort by putting a process in place to regularly update them? 7. Have the people on your core team worked together before? 8. What are their relationships like? 9. If they have not worked together before, can you do some relationship-building ahead of time? 10. Are team members trusted within the field? Are they known for getting things done?
Your team might need to be bigger for various reasons (e.g., your assessment includes things like human dimensions in addition to ecological health). ⇒ If the team is large, you may need more structured meetings, agreements, reporting, communications, and decision-making to keep the various facets of the project together and moving forward. In this case, your project lead will need to be especially well-versed in facilitation, project management, etc.	
Put processes in place to ensure that those who cannot participate are kept informed. ⇒ Not everyone needs to be at the table. The most important thing is to have those with the right range of expertise and the time and enthusiasm to do the work. Even if multiple agencies or organizations are involved in your particular geography, that does not necessarily mean they all need to be represented on the core team. Create a process to periodically bring information back to the larger network as updates, to get feedback or direction, or to help ensure buy-in.	

A group of people who have worked together before may have a greater level of trust and be able to manage discussions and agreements more easily.

⇒ Consider a retreat or other relationship-building activity(ies) if your team members do not know each other very well. Create space in your process for people to have conversations. Buy lunch and take a break from the meeting agenda to allow team members build relationships.

Core team members must be empowered to make decisions.

⇒ Consulting with other experts on specific questions is fine. Keeping supervisors apprised of progress and outcomes is fine. But if core team members have to request input on every decision, it will decrease morale and greatly increase the amount of time the project takes.

The perspectives and backgrounds of your team members will affect the final product(s).

⇒ A purely scientist-driven approach will yield a certain kind of ecological health assessment. Land managers will likely create something different. At an even finer scale, representatives from working lands, public utilities, or parks will all view ecological health through different lenses. Including multiple perspectives can create a balance between the academic and the pragmatic aspects of assessing ecological health, but who you have on your team is likely to affect your outcomes.

Who is on your core team can also affect how you measure ecological health.

⇒ Team members tend to focus on the processes, ecosystems, or taxonomic groups they know best. Engaging experts outside of your core team can help broaden the range of health indicators you consider (see Step 5 below); however, since the core team spends the most time on the project, it is hard to completely avoid biases that may come with their personal passions and expertise.

Determine your data management approach and staffing.

⇒ Data collection and management can be among every project's most time-intensive activities (see Phase IV). Furthermore, your data—and what you can or cannot do with it—will largely drive the scope of your project and its outcomes. Assign a trusted person to be your data lead and have them on the core team from the beginning. If you do not have the staff capacity to have a dedicated data manager, you may consider having

11. Are your core team members empowered by their supervisors, agencies, or organizations to make decisions?

12. Will the perspectives of your core team members affect how they think about ecological health and the final product that comes out of this process? Are they in line with your goals for this project?

13. ***Essential:*** Do you have someone (staff or consultant) who can handle your data collection and management? What are their skill sets, capacities, and availabilities?

focused working groups or subcommittees that are responsible for collecting and analyzing their own data. ***It is absolutely vital that you consider your data management capacity early in the process.***	
Your Notes	

Step 4. Assess capacity and set expectations

Best Practices and Key Considerations	Questions
Determine if you are going to do this project in one big push or incrementally over a longer period of time. ⇒ There are pros and cons to each approach. Doing it all at once requires a more intense time commitment, but the project is done faster. An incremental approach requires less time in the short-term, but makes the project last longer.	1. How frequently will you need to meet, and for how long? 2. What are the expectations for work outside of regular meetings? 3. Will you need/want agreements, group charters, or other formal ways to codify roles and expectations, or is a more informal approach OK? 4. How will you accommodate and/or hold accountable people who move at different speeds? 5. What commitment will be required of those who may join later in the process? 6. Do you have people who can take notes, create templates and rough drafts, handle meeting logistics, etc.? 7. Do you have a communications person who can attend all or some of your meetings?
Set clear and realistic expectations about roles, pace, and required time commitment. ⇒ One group cannot do it all. So, you can either scale your time and energy to meet your project ambitions or scale your ambitions to the time and capacity you have available. Either way, team members should clearly understand their roles and responsibilities and how they fit into the project's overall purpose and process. They also need to be aware of the expected time commitment for both meetings and "off-line" work. You may want to consider creating a team charter or documenting the agreed-upon roles and responsibilities in some way.	
In addition to engaging the right subject matter experts, you will need to fill other key roles. ⇒ Determine how you will staff for activities that do not require scientific expertise, such as taking notes, handling meeting logistics, creating templates, writing first drafts, incorporating comments, etc. Additional support for these functions allows core team members to focus on their areas of expertise, and relieves them of	

carrying the whole project in addition to their regular workloads.	8. Do your team members have their supervisors' approval to spend the time the project calls for? Does the supervisor think the project is important and meets organizational needs, or is more work required to get their buy-in? 9. Are you able to offer some compensation to help defray the costs of people's time (especially if they are volunteering or work for a nonprofit organization)? 10. How will your organizational leadership react if the assessment yields bad news? Are they sufficiently committed to the process to let the science lead? Are there ways to increase their comfort level?
Strongly consider including a communications person on the team if outreach is an important end goal. ⇒ The health assessment process can still be based upon and driven by science, but if one of your goals is to share your results with a broader audience (see Phase II), then having a communications person on the team will help you develop the story you want to tell.	
Get buy-in from organizational leadership. ⇒ Those in supervisory or leadership roles may have different views on the importance of a project like this, or perhaps may not see its value at all. Consider who you need to get buy-in from and what their priorities are. This will not only affect core team participation but also, project scope and duration. In addition, consider how your organization and/or key individuals will react if negative findings or bad news come out of this assessment process.	

Your Notes

Step 5. Determine when and how to engage expertise beyond the core team

Best Practices and Key Considerations	Questions
Based on your project's goals and breadth, determine if you need to engage a larger group of scientists or managers. ⇒ We recommend that the core team be responsible for the project, but that you engage outside expertise as needed (see Phase V). Having a small group responsible for the final product can make things more streamlined; however, it is likely that a broader range of expertise will be needed if you are doing a fairly comprehensive health assessment. For a smaller effort with limited amounts of information, this may be less of an issue. On the other hand, goals such as gaining scientific credibility or broader stakeholder buy-in may also determine who else you want to engage.	1. Would your project benefit from, or does it require, expertise beyond that of your core team? 2. Do you want to establish subcommittees or working groups in addition to your core team to tackle specific topics? Or will core team members be responsible for coordinating with outside experts in less formal ways as needed?

Engage subject matter experts beyond your core team early on.

⇒ Invite external experts to participate now, or let them know that you will want to engage them at some future point. This will help you understand the range of expertise available and allow them to plan their time for involvement at a later date.

There are multiple ways to engage outside experts.

⇒ You may choose to engage them in brainstorming health indicators and metrics and setting specific metric thresholds (see Phase III), and/or peer reviewing the final product (see Phase V). This can be done in several ways, including workshops* (see also Phase V); smaller, focused subcommittees; one-on-one; or some mix of approaches. However, you will want to be strategic and mindful of their time, especially if they are not being paid to help you.

*One approach is to host a large workshop, during which you engage technical experts on different topics. While the level of discussion and peer exchange that comes from this kind of forum can be powerful, these events take more capacity to plan and execute. A smaller and/or more targeted group might work better depending on the relationships among subject matter experts and your goals (e.g., if you just need a very practical interpretation of science for particular management purposes).

3. Is it beneficial to engage subject matter experts early on to vet ideas, get buy-in, establish credibility, etc.? Or will you wait to get their input when the material is more developed?

4. Should you engage a larger group because one of your priorities to move lots of people toward a collective goal or outcome?

5. Do you want a larger group of scientists involved to build credibility with the public, managers, or other scientists?

6. Would a science advisory group, peer review, or endorsement letters serve the same purpose?

7. Will you want to have your final product peer reviewed?

Your Notes

Phase II. Goals and Audiences

In addition to establishing your project's team and organizational structure, you must determine your project's purpose(s) and audience(s) right at the beginning.

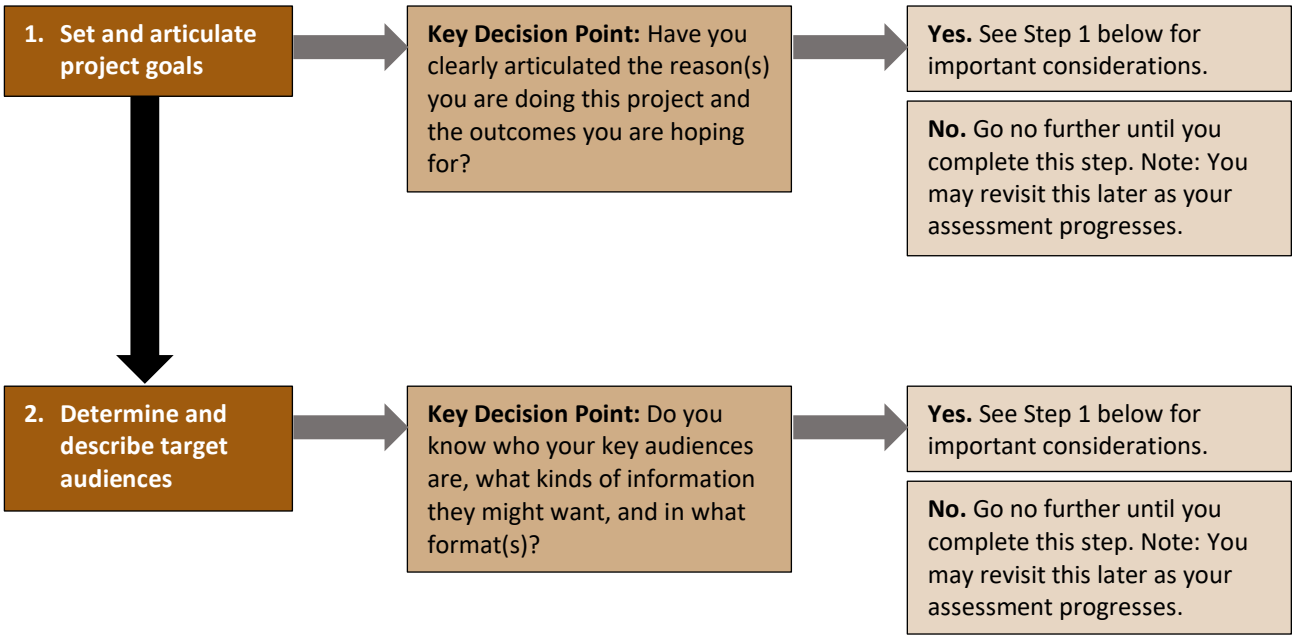
It is likely that you will generate more ideas for ways to measure ecological health than you can realistically implement. In addition to your goals, your intended audience is one of the key filters and guideposts you will come back to repeatedly during your process. It determines almost everything about your project, including who you have on your core team, whether (and how) you engage other subject matter experts, the scope of your health assessment and the health indicators you consider, and what your final products will be. ***It is particularly important to be clear about the purpose of your assessment. Is it solely to inform land management and/or science, or do you also have other, more public-facing goals? (See Step 1 below.)***

A note on process. . .

As mentioned in the introduction to Phase I, Phases I and II can take place in the order described here, but they are closely linked and one affects the other. It is likely they will progress in at least somewhat of an iterative fashion, or perhaps at the same time.

Phases I and II are essential and should be given adequate time and attention regardless of the order in which you do them. Go no further until you have these two pieces figured out.

Phase II. Flow Chart of Steps and Key Decision Points



Phase II. Goals and Audiences

Step 1. Set and articulate project goals

Best Practices and Key Considerations	Questions
Determine which goal(s) you are trying to achieve very early in this process. In Step 1 of Phase I you broadly determined your project purpose and need. Here, you will further refine and define your goals. Because ecological health assessments may serve many possible goals, this point cannot be stressed enough: **Early on, you need to be clear about why you are doing this project and how far you want (or have the capacity) to go. These decisions will affect everything else you do.** A goal statement might read something like the following: • To synthesize and distill the best available knowledge about Mt. Tam's natural resources in a way that can be used to make resource management decisions, track change over time, and is clear and compelling to the public. • The objectives of this assessment are to evaluate and report on current conditions of key park resources, to evaluate critical data and knowledge gaps, and to highlight selected existing stressors and emerging threats to resources or processes. This report and the spatial datasets provided with it are intended to inform and support Golden Gate National Recreation Area (managers and scientists in developing recommendations for improving or maintaining natural resource conditions in the park. • The goals of The State of Our Chicago Wilderness—A Report Card on the Ecological Health of the Region, are to assess changes in the condition of the region's natural communities since the publication of the Biodiversity Recovery Plan, document the condition of available data, measure progress toward achieving Biodiversity Recovery Plan objectives and make recommendations for future report cards.	1. What are your goals for doing an ecological health assessment? 2. What kinds of questions are you trying to answer about your landscape? 3. Are you primarily interested in aggregating existing data and creating a shared understanding of available information? 4. Do you want to identify data gaps? 5. Do you want to create a baseline? 6. Are you planning to track trends over time? 7. Will you want to aggregate individual metrics to look at broader ecosystem health? 8. Are you including human elements (e.g., recreation, working lands, environmental justice, socio-economic health), or infrastructure (e.g., trail corridors)? 9. Will your goals affect the geography that your assessment covers? 10. Do you hope to create systems that can be used to share data in the future? 11. How does this project relate to your management and stewardship goals—will you include recommended stewardship actions based upon condition and trend thresholds?
It is particularly important to know if you are doing this assessment solely to inform land management and/or science or if you also have other, more public-facing goals. ⇒ If your goals include communicating your findings with the public, funders, legislators, etc., you need to clearly	

define those audiences and your goals for each (see the next step). If you are looking to either entirely or partially create a baseline and/or use this to plan to track future research, land management, etc., your process and your final outcomes may look quite different.

Considerations may include the following:

- Delving into management implications/tools after the assessment is complete, and budgeting the time needed for that in your process.
- Specifically selecting indicators that are (or relate to) management priorities or requirements (e.g., threatened and endangered (T&E) species).
- Specifically selecting indicators for which there are actions that can be taken to affect their health.
- Being more (or less) rigorous about the quality or level of data you use (or not), and how you store, manage, share, and analyze that data (see Phase IV).
- Creating final products that are more (or less) technical.

Be willing and prepared to reevaluate your goals as you go.

⇒ As with many things related to ecological health assessments, you want to be as clear as possible early on, but may need to adjust as you go. For example, if part of your project involves assessing and aggregating existing data, it can be challenging to fully articulate goals or objectives before you know the nature of the information you have. Consider pausing once the data have been assessed (see Phase IV) to evaluate if/how it affects your project goals.

12. Do you want to document work you have already done to support your ecological health indicators?

13. Do you hope that what comes out of this project is used to:
    - make specific management decisions?
    - prioritize or advocate for future resource work?
    - reset organizational goals around resource management?
    - influence budgets or work plans?
    - demonstrate success?
    - generate broader regional interest or collaboration around these resources?
    - affect legislation or regulations?

14. If you have multiple goals, which are primary?

15. How will you know if you reach your goals?

Your Notes

Step 2. Determine and describe target audiences

Best Practices and Key Considerations	Questions
Figure out who you want to serve with this project and describe those audiences as specifically as you can. ⇒ Your intended audiences will affect which resources you include in your assessment, how you frame and organize it, how technical your approach and language are, how you handle sensitive data, and the end products you aim for. The more precise you can be about your audiences, the better able you will be to define what you are trying to do. You can always prioritize among audiences if you have a long list, but some focus is necessary.	1. Who are your primary audiences for this project? (Be as specific as possible.) 2. Which are highest priority? 3. Do you know what they are most interested in and in what formats they might prefer to receive information? 4. Do you have time to survey them to get more a more accurate sense of what they want? 5. Importantly, what would you like your audiences to do with the information you provide? 6. What kinds of materials will you need to produce? 7. How might the audiences affect other aspects of what you are going to be doing? 8. How do ideas get picked up within your own organization? Does putting something on paper make it a driver, or will there be more to do? Does this jibe with other important objectives, timelines, management cycles, etc.?
Decide what type(s) of final product(s) you need to meet your goals and speak to your intended audiences. ⇒ Get a good sense of the kinds of outreach materials you ultimately want to produce and what format you want to use; consider looking at other examples for ideas (see Appendix).	
Consider how your goals and intended audiences may affect other aspects of your project. ⇒ Perhaps you adjust the scope of your indicators and metrics and how you choose to define them. What you include in the assessment will then affect the budget, capacity, and skill sets you need to engage, and when you need to engage them. The level of technical detail you are aiming for will also be important for setting expectations with your subject matter experts. Finally, at this point, you may want to think about the nexus between your project's results and other organizational goals.	

Your Notes

Phase III. Scope, Methodology, Definitions, Indicators, and Metrics

In Phase III, the team you established in Phase I determines and refines the fundamental pieces of your ecological health assessment (including geographic and taxonomic scopes), and initial set of indicators, metrics, thresholds, conditions, and trends. ***This is also where you select your methodology and approach***. It is worth taking a look at other examples (refer to Appendix) to see what others have done; for answers to specific questions, consider reaching out to those whose projects seem the most similar to the one you're planning.

No matter your approach, make sure to crosswalk your choice of geographic area with your goals and intended audiences to ensure that you are answering the right questions for the right place and the right people.

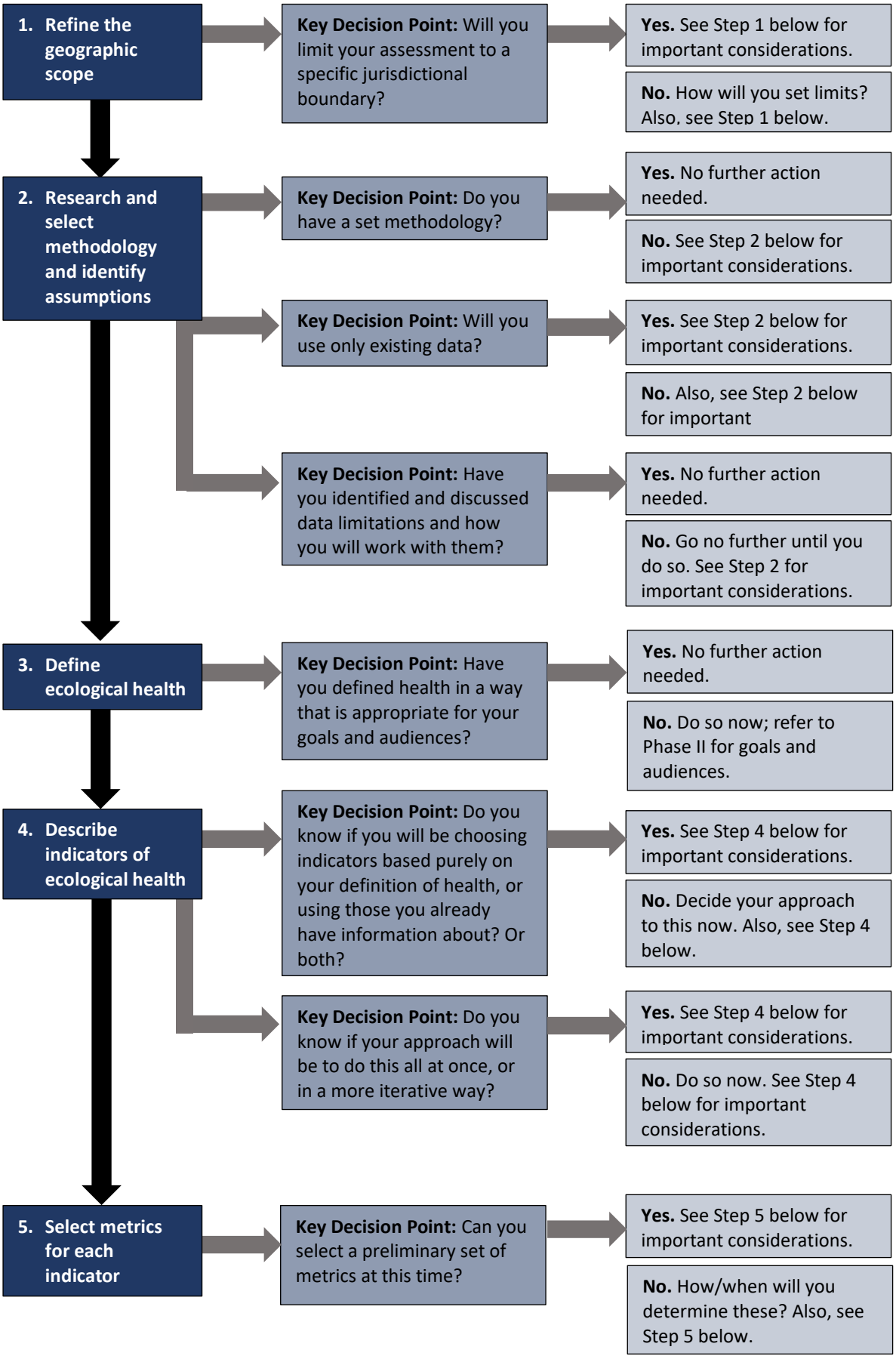
Key decisions you will tackle in this phase include:

- ***selecting a geographical scale that makes sense for your overall project goals and the resources in question;***
- ***determining if you are starting with a blank slate, building off existing information, or something in between;***
- ***understanding your assumptions and data limitations;***
- ***defining ecological health, selecting indicators, and describing the metrics for each indicator; and***
- ***creating a template for how to summarize indicators.***

A note on process. . .

Once you get to Phase III, Step 5 (selecting your indicators), the process becomes very iterative, and may even be undertaken in parallel with Phase IV data collection and management.

Phase III. Flow Chart of Steps and Key Decision Points



Phase III. Geography, Methodology, Definitions, Indicators, and Metrics

Step 1. Refine the geographic scope

Best Practices and Key Considerations	Questions
Find a balance between a geographical scale that makes sense jurisdictionally and one that reflects ecological systems and meets your overall project goals. ⇒ You have to draw a line somewhere, and you may be tempted to set it at the edge of your property. However, limiting your ecological health assessment to jurisdictional lines can seem artificial for resources that span larger areas. Furthermore, geography determines who this assessment is relevant to, how much support you may get for it, and how widely the final product(s) will be used. On the other hand, the more people/entities involved, the longer and more complicated the project may become. Expanding your geography beyond your jurisdiction may also mean that you are considering resources over which you have no say. Unless other land managers are at least somewhat invested in this process, it will be challenging to show that you are affecting the health of those resources over time (if that is one of the goals you set in Phase II). ***Make sure your geography makes sense for your goals and intended audiences so you are answering the right questions for the right place and the right people.*** Based on your priorities, for larger or more complex geographies, you may want to consider creating a ranking matrix to help determine which areas to include. You may also consider limiting the geographic scope for some things, but expanding it for others. Finally, it is possible to start with a smaller area and then expand it later; however, a shift in scale can introduce unanticipated complexities, especially for comparing change over time.	1. Who needs to be involved in setting the geographic scope for this project? Who gets to make the final decision? 2. Do you need to have clearly defined boundaries based on the organizations/agencies involved? Or can it be more flexible for certain resources that transcend boundaries, or where you have broader data sets? 3. Are there advantages to limiting or expanding your geography based on your goals (e.g., looking at regional or larger ecological health vs. a focus on one area for targeted management, funding, outreach, etc.)? 4. Do you have time, capacity, and buy-in for a larger effort? 5. Can you eliminate certain areas if they are not of interest to *all* of the organizations on your team? 6. Can you eliminate certain areas because they are already being covered by other projects, programs, organizations, etc.? Can you fold in or complement what those groups are doing?

Your Notes

Step 2. Research and select methodology and identify assumptions

Best Practices and Key Considerations	Questions
Choose a methodology to use for your project now. ⇒ This is likely to take some time as you consider and discuss your options. It may be helpful to refer to the table in the Appendix, which provides a number of examples of other ecological health assessments that used a variety of methodologies ranging from science- and data-focused approaches to more flexible and public-facing. Some included peer review, some did not. The approach you ultimately choose should reflect your goals as well as the realities of your time, skill sets, budget, etc.	1. What methodology will you use, and how will you choose it? 2. What are the limitations of your potential methodologies? Do you have the capacity and resources to administer them? Which one(s) will best help you meet your goals? 3. Are you limiting yourselves to existing data, or is this an opportunity to undertake new studies? 4. In the absence of data, is expert opinion/best professional judgement OK? 5. If you have less robust indicator data for a particular area, will you limit metrics to only what can be measured across all geographies? Or will you have different sets of metrics/measure different areas separately? Will you extrapolate data about a species or habitat from one area to an area for which you may have less information? 6. What are your time/capacity/funding limitations for future tracking/updating metrics? (This may affect what you choose to include and if/how you can track trends, and on what time scale.)
Understand your assumptions and your data limitations early in the process. ⇒ Agree on either using only existing data or collecting new information as a part of this project (see advice in Lessons Learned From Others section). Determine if you will include expert opinion or professional judgement in addition to existing data. Discuss if/how you will accommodate uneven data sets (e.g., collected at different times or with different protocols). It is also important to have a sense of how major data limitations (e.g., lack of a vegetation map) may affect which indicators you choose. Identifying priority data gaps that increase the breadth and certainty of your ecological assessment is important as a basis for future work. **<u>Note: This is where Phases III and IV begin to overlap and become more iterative.</u>**	

Your Notes

Step 3. Define ecological health

Best Practices and Key Considerations	Questions
Refer back to your goals and audiences to help set and refine your definition of ecological health. ⇒ How you define health is the thread that runs through the rest of the project. For example, it will affect the indicators you select to measure health (see Step 4 below). It will also be a big part of how you define success if one of your goals is to improve ecological health. There is no one way to define something as complex as ecological health. And, although the definition can be science-based, there is always an element of subjectivity. A wealth of literature exists on the topic, but you will also want to consider what your audience(s) will best relate to. For the public, you may focus on certain aspects; for science and management, you may choose others. Establish a rationale for your definition of ecological health that works for your goals, and be able to describe it clearly.	1. What qualities (e.g., resilience, natural processes, functions, species biodiversity, public uses, etc.) would your landscape have or support if it were healthy? 2. Is your goal to maintain, or to measure against a historical condition? Do you have a reference value, or are you managing for ecosystem resilience and function in the face of change? 3. Are there particular aspects of health that resonate with your audiences? 4. Based on your audiences, how technical can your definitions be?

Your Notes

Step 4. Describe indicators of ecological health

Best Practices and Key Considerations	Questions
Determine if you are starting with a blank slate, only building off existing information, or something in between. ⇒ If you are starting from scratch, you can determine how you want to define and measure health and then set up indicators, metrics, and data collection to answer specific questions (within budgetary and other realities). If you are only using existing information, you may just choose indicators that you can say something about. Or, you may choose a mix of both approaches. Don't necessarily start by limiting yourself to what you think you can do with existing data. That may be what you ultimately use to filter the information, but it can be worthwhile to consider indicators that seem overwhelming in order to weigh the benefits of trying to include them.	1. Will you do new work to measure health by your definitions and ideals, or are you trying to make sense of the information you already have? 2. What indicators can help answer specific questions about ecological health, as determined by your definitions (Step 3)? 3. Is it valuable to identify things that are important health indicators but that you don't have information on so you can prioritize later work to address those gaps? 4. Do you want to look only at individual species? Communities? Guilds? A mix? 5. What about physical processes or resources like hydrology, air quality, or soils? 6. If you start with a broad list of indicators that you intend to narrow down as you go, at what point in the process will you do that and how? Based on that, who should be involved? 7. Who ultimately decides what is included—or not? 8. Can you do it all now, or do you need to break your analysis into smaller pieces to take on over a longer time? 9. What was your reasoning and process for choosing specific indicators and metrics?
You can do it all at once or take an incremental approach, but there are pros and cons to each. ⇒ The good news is that these kinds of projects are scalable in many ways, based on many different considerations. It may be that pragmatically, you only have the capacity to look at a very limited set of indicators. If that is the case, you will want to carefully work through your goals, criteria, and rationales to figure out where you want to start, and to see if starting small is still valuable. You could look at a more limited set of indicators now, show progress, get buy-in or additional resources, and do more later. However, the downside is that the project will take longer, and it can be hard to keep your core team or subject matter experts engaged over longer periods of time or for multiple iterations.	
Have a rationale for why you choose the indicators that you do, and be able to explain that rationale. If you are working with multiple partners, you may choose to consider indicators only if they are relevant to <u>*everyone*</u> involved. You may do just certain kinds of systems (e.g., terrestrial resources). You may take one system (e.g., grasslands) and delve into all of its components, or you may go with a much broader range of resources at a higher level. There are many points of decision and no one set of right answers, although the goals and audiences you set in Phase II should guide you. Regardless of what you decide, you should determine your approach and rationales now so you can use them	

as a basis and as a filter throughout the rest of your process.

To make sure you are documenting the same kinds of things for each indicator, and to avoid having to go back and reformat everything later, we recommend that you create a template now that you will use to summarize indicators, metrics, conditions, trends, supporting data, and any other aspects you might want to include in your final summary.

How you approach setting the range of taxonomic groups, communities, or processes you include as ecological health indicators may vary widely.

⇒ However, the primary considerations will likely be (1) which species, systems, or processes reveal something about ecological health based on your definition(s) (see Step 3 above); (2) what you have data on and the quality of that data (see Phase IV); (3) whether you also want to include data gaps and outstanding information needs; (4) what you want to include (or not), based on your project goals and what your intended audiences are most interested in (see Phase II); and (5) what you have the capacity, time, and budget to do.

Other advice to consider:

- The group can brainstorm indicators, or one person can propose a list and get buy-in. Choose an approach that works for your team.
- Allow enough time to have many discussions as you work through the numerous options and possibilities and come to agreement on your approach.
- Keep referring back to your primary goals and audiences as you work through all the possibilities.
- Consider creating a set of criteria you use to objectively determine if you want to include a particular indicator based on your goals, audiences, geographic scope, and how you define overall health.
- Consider creating a conceptual model of the system that makes transparent the key drivers of health as you have defined it; use this to choose indicators of those drivers/components.
- Be aware that personal passions for certain species or systems can also drive what people feel are priorities. Having a way to objectively filter the possibilities (see criteria and conceptual model suggestions above) can

help, but you should balance that with a need for people to be invested, to be passionate, to give their time, and to be advocates for this work. • Ideally, your indicators are measurable, have low amounts of data "noise," and reveal things about other aspects of ecosystem health. • Do not select only elements that are in crisis, as it will skew the presentation of overall health. For similar reasons, we also recommended against choosing things that are either very common or very rare. • Selecting specific species with lots of data makes it easier to see how they are doing and how the health assessment was done. When looking at broader categories with a mix of data quality (e.g., plant communities), that may be less clear.	

Your Notes

Step 5. Select metrics for each indicator

Best Practices and Key Considerations	**Questions**
Define what "health" means for each indicator. ⇒ Depending on the resource and your goals, your definition will vary widely. You may look at current research or other models (such as those in the Appendix) to see how ecological health is defined for specific resources. You will also likely want to consider what aspects of health you have data or expert opinion on and how that works within the framework you chose in Step 2. The definitions of health you want to focus on may also be based on what your audience and goals for this project are. In general, this is a good time to set (or reinforce) expectations about the goals and audiences for this project, and in particular, what they mean for the degree of technicality you want in the ways you define and describe metrics and their thresholds.	1. What is a meaningful and achievable way to measure health for each indicator? 2. What is measurable and can be used to indicate changes in condition and trend? 3. What is currently being measured? 4. What do you or others have data on? 5. What would you like to measure but can't/aren't, and so should be noted as a data gap?

Identify at least a preliminary set of metrics for each indicator that allows you to measure its health by your definition.

⇒ You can iterate and adjust as you go, but it is advisable to come up with a preliminary set of metrics at this point. With your core team of experts thinking about how to measure the health of your proposed indicators, you can better see where your challenges lie and plan accordingly. What you develop here will also give others you engage something to start with. The specificity of your metrics can vary among indicators, and the unknowns are captured in confidence levels (see Phase III) and data gaps. For later reference, document and describe why and how you are making these decisions.

Set draft thresholds if you can, or determine your approach to doing so.

⇒ You need to set the line for when you consider an indicator's condition or trend to have changed (e.g., from stable to declining). For some things, quantitative thresholds will be easier to set (e.g., endangered species, recovery plans, or aspects that have been well monitored). Or, a logical break may appear once you review the data and confer with resource experts. For others, you will have to make your best call on what the measures of health are and how to assign a value to those measures. This will require lots of back-and-forth with resource experts. These valuable discussions will help you work through hard questions and get buy-in, and are well worth the time they require. It is also important to come up with a plan for how to work through the inevitable differences of opinion, and when/how to proceed if you cannot reach agreement.

6. If you have multiple partners involved in this process, do they have similar management thresholds to trigger stewardship actions for a given resource?
7. What is a meaningful change signal for each indicator and metric?
8. How long will it take to see change over time for each indicator or metric?
9. Should you consider certain indicators or metrics because it is important to be able to show change more quickly?
10. How will you move forward if you cannot get consensus on a metric or threshold?

Your Notes

Phase IV. Data Collection and Management

The data you have to work with will largely drive the scope of your project and its outcomes. Data collection, quality control, and management can be among the most time-intensive parts of the project, but exactly how long they take and what is involved depends greatly on the project's scope, how much information you need about how many different things, and how much additional data you decide to collect.

In this phase, you will create your data-sharing platform, file-management system, and access permissions; take a thorough inventory of data and other information; and develop an understanding of their quality and usability.

If you already have much or all of the information you will need in-house, the data-gathering piece will be much more straightforward. You will, however, still need to find, consolidate, and investigate its quality; see if it is usable; organize it; and so forth.

If you plan to acquire data from multiple sources, discovering what is out there, how accessible it is and in what form, and then checking its quality and attributes can take much longer and come with more unknowns. ***However, there are a range of approaches you might choose depending on how much time you have, your data management capacity and skill sets, and cost.***

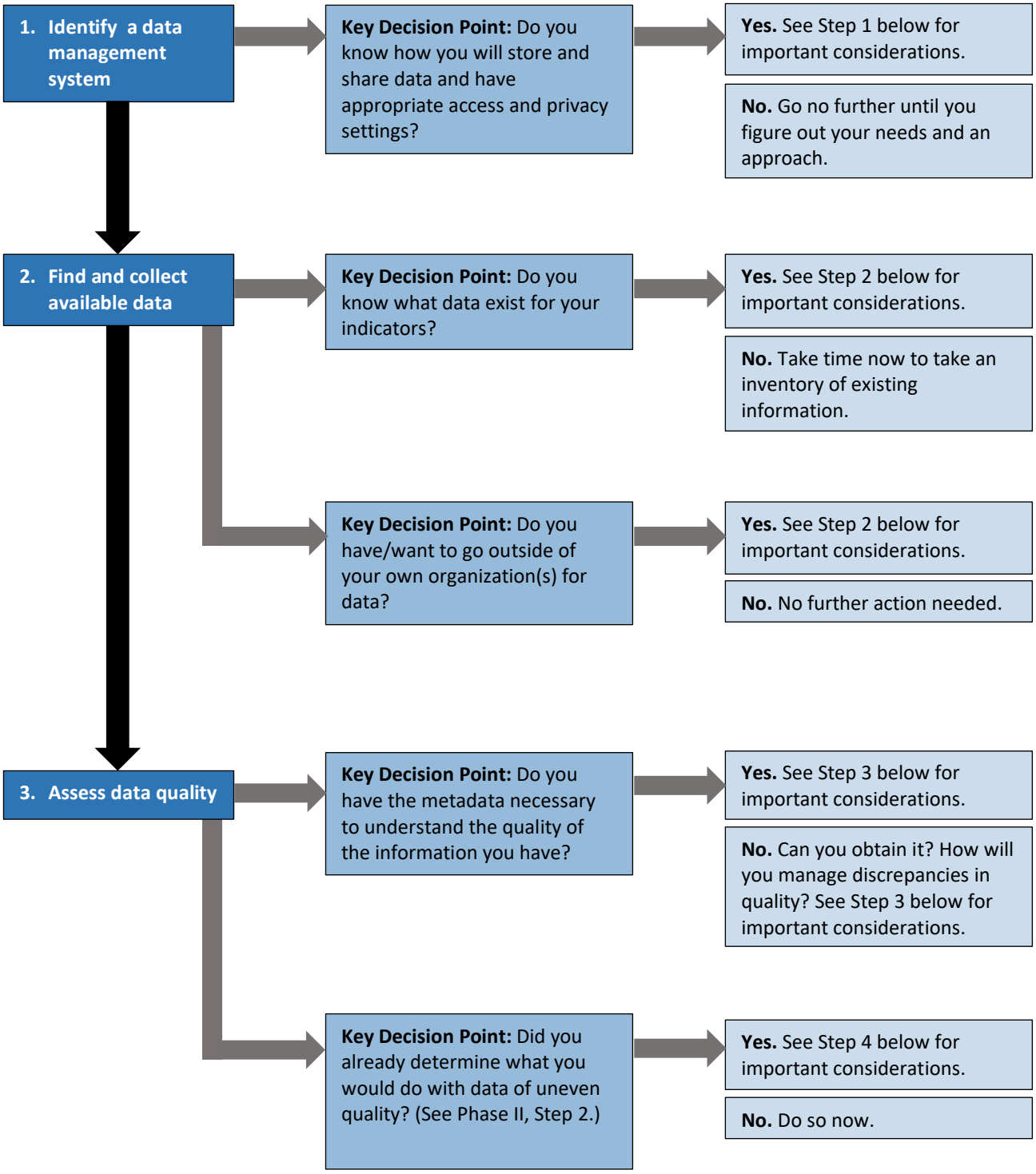
A more effort-intensive approach would be to create a data management system and do all of your own data gathering and quality verifications. On the other end of the spectrum, you might have individual researchers do an assessment of available information for their area of expertise and then bring that together into a readily available existing data/information sharing system. You could also have the researcher do the entire analysis and then make the data (including metadata) available. Even if you go this route, it is still recommended to have your team's data person follow up with researchers about the current state of their data. However, this may be as straightforward as simply asking for their published data.

Regardless of your approach, data management is a very important and demanding aspect of ecological health assessments and you need to allocate enough time to it. You also need to dedicate a data lead (see Phase I, Step 3) and have the core team support this process.

A note on process. . .

This phase and Phase III are sufficiently different to be separated in this guide, but in practice, they will likely overlap and affect each other quite a lot. ***Depending on how closely you plan to stick to only indicators or metrics you know you can say something about, allocating time to aggregate existing data and determine if it is usable may be something you pursue in the earliest parts of Phase III.***

Phase IV. Flow Chart of Steps and Key Decision Points



Phase IV. Data Collection and Management

Step 1. Identify a data management system

Best Practices and Key Considerations	Questions
Create your data-sharing platform, file-management system, and access permissions. ⇒ If you don't have any/many partners in this project or you already share data with them, this may be more straightforward. If you have many partners or new relationships—and especially if some have data-sharing limitations—you will need to establish a data platform and practices that work for your team. To maintain appropriate control and data privacy requirements, figure out a file storage and organization system that works for your particular set of indicators (see Phase III), and determine who will be given access and editing rights.	1. How will you share data and other information across agencies? Google docs for sharing? Excel or Access for data? Cloud-based platforms and GIS Enterprise? Other? 2. Will you centralize your data? Who will host it? 3. How will the data be organized based on the suite of indicators you have? 4. Who needs access? Is there one person who can function as the manager? 5. Do you need data-sharing agreements or agreements that address privacy issues? 6. How often are your assessment and its supporting data going to be revisited? Note: This may vary based on how long it takes to see change over time for different indicators, as well as your funding and capacity to do follow-up monitoring, among other things. 7. Have you ensured that your final data sets are archived in a way that will be accessible in the future and understandable to new people?
Think now about how you might want to update your health assessment over time so you can set your data systems up to support that (also see Phase V, Step 2). ⇒ You will need to ensure your data are readily available for repeating your analyses later if you want to update your assessment to show change over time, add new indicators, fill data gaps, etc. Your data storage system, how your data are archived, and who is responsible for documenting/maintaining all of it should be determined now, as it is likely that there will be staff turnover between health assessments.	

Your Notes

Step 2. Find and collect available data

Best Practices and Key Considerations	Questions
Take a thorough inventory of data and other information about your proposed indicators from both your own internal sources as well as potential external resources (e.g. university researchers, consultants, other organizations, etc.). ⇒ If you are the sole owner of all of the information you will need, then this step is relatively straightforward. If not, you will want to find out what raw data sets, reports, GIS layers, etc., exist and are likely to be applicable. Regardless of where the information comes from, be sure to document its sources. Aggregate the available data, recognizing that you will likely have to reformat some of it. You should do this part quickly so that you know what you have to work with—especially as you are determining your indicators and related metrics. However, this is usually a somewhat iterative process, especially once you start doing your analyses (see Phase V).	1. Have others collected data in nearby or comparable systems that you can extrapolate from to your own? 2. Are others willing to share their data sets? 3. Do they trust your data person to analyze it?

Your Notes

Step 3. Assess data quality

Best Practices and Key Considerations	Questions
Understand the quality and the comparability of your data. ⇒ Ideally, you will use the latest and most authoritative local pool of information to anchor your discussions and on which to confidently base your analyses. In reality, you may have some of that, along with a mix of less-recent or less-rigorous studies. You may also have both qualitative and quantitative assessments. This mix of information is fine, but you will want to note data quality as part of the confidence levels you set for each metric (see Phase V, Step 2). Consider (working with the data owner/producer if necessary) developing a set of criteria to determine if	1. What data do you have? How current is it? What's its quality? What's missing? 2. Are data sets about a particular indicator from different sources sufficiently comparable in terms of recency, format, methodology, resolution, and confidence to consolidate for analysis? Note: Determining this may be beyond the capacity of your data manager and

the information you are finding is usable with your methodology (see Phase III). This can be quick and straightforward, such as: How recent are the data, were they collected in a standardized manner, are they published, is it mainly within the right geography, do you trust this expert's opinion, etc. Identify and deeply explore any issues with your data early on. The data you work with will have a big impact on how long the project takes, as some data are very easy to analyze or merge from different sources, while others need much more initial work. Even multiple data sets from one source can vary in quality, as protocols change over time. Regardless of the source, you will need metadata about how the information was collected, when, etc., to determine if it can be compared or merged.	require additional follow-up with the producer/owner of the data. 3. Do the GIS layers you may want to compare share the same attributes? 4. If different sources of data about an indicator are not totally comparable, do you use them? If so, how do you track and note the differences? 5. If aggregations/rollups are desired (see Phase III), how might you do that with these data while maintaining the individual pieces? 6. Will you use qualitative as well as quantitative information for some things? 7. Are you going to work with data owners to clean up unusable data sets? Or, just eliminate them from your analysis?
Your Notes	

Phase V. The Ecological Health Assessment

Each project will take a slightly different path, but if you have generally followed the approach as it has been laid out so far, you should now have an idea of which indicators you want to consider, the metrics that might speak to those indicators, and the data you know you can apply to your analyses.

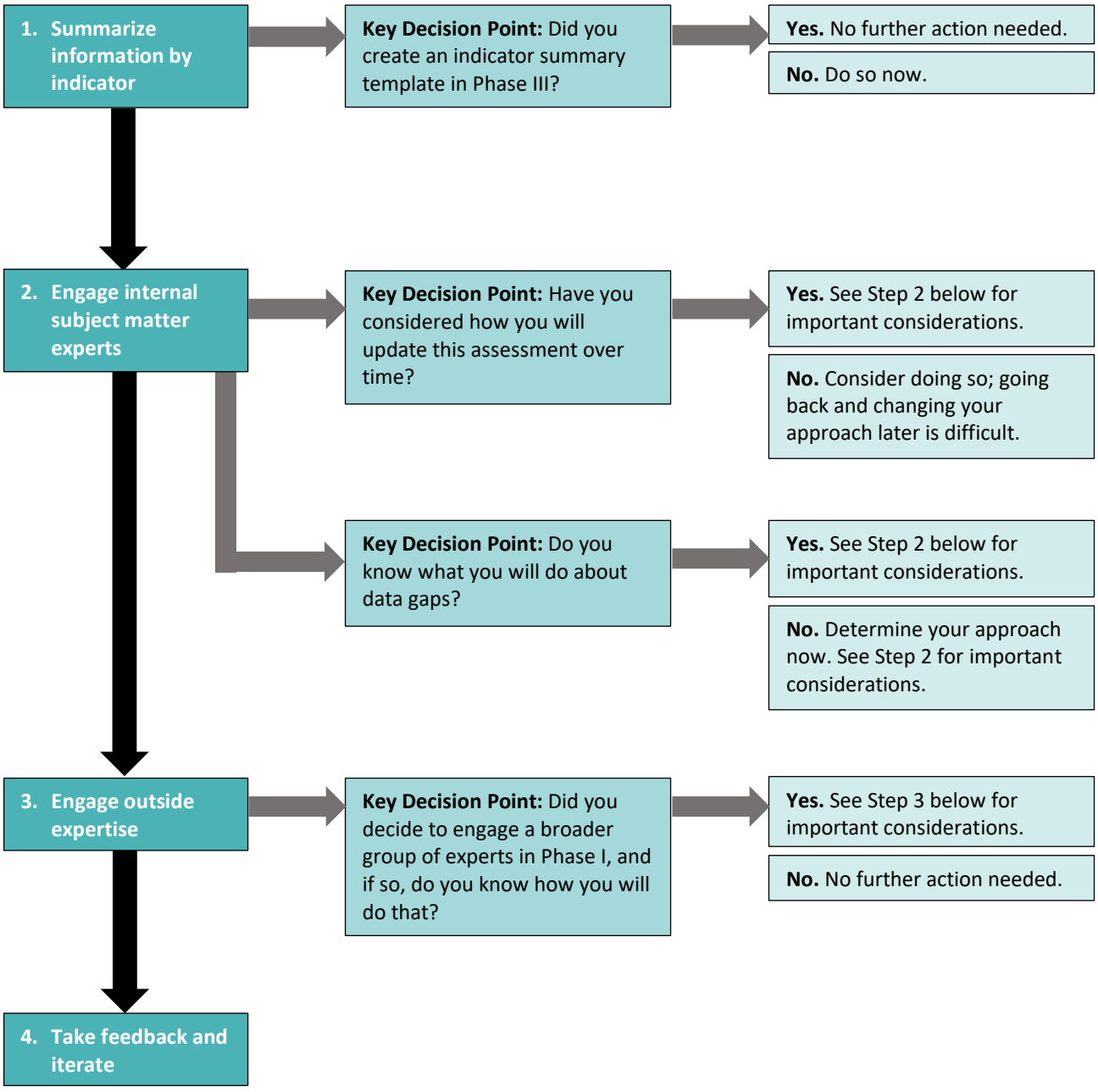
Now, it is time to assemble all the pieces and potentially involve others in your process. There are several ways to approach this, from doing it all with a small internal team to engaging a much broader range of outside expertise. ***The approach you take will depend on many things, including what best serves your goals and audiences (see Phase II) and what your time, budget, and internal skill sets allow.***

The approach that follows lays out a more involved process that first engages your core team of resource experts and then, a larger group through a workshop. ***In this case, the initial analysis was done internally, giving the outside experts something to react to and iterate on with the team, a process that worked well for us.*** This is certainly not the only approach you can use, and alternate ideas are presented below. Consider this guidance, and then scale your approach appropriately to meet your needs.

A note on process. . .

Steps 2 and 3 below are more iterative than linear, as you will be working through lots of feedback from technical experts. Also, now that you have a better handle on the information you have to work with, you may want to revisit your original goals and audiences to ensure that you have what you need to meet/engage them. If you find you do not, it is time to revise accordingly.

Phase V. Flow Chart of Steps and Key Decision Points



Phase V. The Ecological Health Assessment

Step 1. Summarize information by indicator

Best Practices and Key Considerations	Question
If you haven't done so already, think about how you want to present this information. Doing this now will ensure consistency and save time later. ⇒ If you didn't determine a format for how to present background information, current and desired conditions, metrics, conditions, trends, confidence levels, data sources, etc., for each indicator during Phase III, do so now. This will help ensure consistency among various individual/team efforts and make it much easier combine them into your final product(s).	1. What kinds of information do you want to have for each ecological health indicator to do your assessments, present in your final report or other products, etc. ?

Your Notes

Step 2. Engage internal subject matter experts

Note: This is where you will apply the methodology you selected in Phase III.

Best Practices and Key Considerations	Questions
Determine baselines, current conditions, and desired conditions for each proposed indicator. ⇒ To say something is healthy (or not), you need a baseline, reference point, or current condition to compare it to. A consistent and integrated approach for addressing this among indicators will provide a better overall view of system health. It will also facilitate discussions about indicators that may be at different scales (e.g., community or individual species) in similar ways.	1. Do you have data or expert opinion(s) about the current or baseline condition of your indicator resources? 2. If not, does this mean you don't use it, or is creating a baseline an outstanding data gap you want to note?

Determine the condition and trend for each draft metric for each proposed indicator.

⇒ Apply your chosen ecological health assessment methodology (see Phase III) and the data you have (see Phase IV) to your analyses, and assign a condition and trend for each proposed indicator's draft metric (see Phase III). Unless you have pre-established metrics from known sources and very good data, you will likely have to use your best professional judgment to set condition and trend thresholds. You will also have to apply your best professional judgement to adjust thresholds if the average metric score for each indicator doesn't match real-world observations. Be prepared for the rich and complex discussions that arise during this stage to take a significant amount of time. Be transparent about how decisions were made.

Include a confidence level for each metric and indicator.

⇒ Scientists generally prefer not to draw conclusions with incomplete information. However, it is very unlikely that you will have perfect data for your indicators, and you will still need your subject matter experts to put values on trend and condition thresholds. Pushing through discomfort with uncertainty and having robust conversations about what can and cannot be said allows you to provide an assessment based on deep expertise, best available information, and careful consideration. Assigning values to conditions and trends makes the conclusions you do draw more specific and therefore, more meaningful and defensible.

Including confidence levels with each metric helps provide a level of comfort with making statements based on incomplete data, and also makes clear to others the quality of the data and amount of professional judgement used.

Evaluate what else you might do with your draft indicators and metrics.

⇒ You now have your indicators and the metrics that speak to the condition and trends of each of those indicators. If this meets your goals, you can stop here. However, going beyond a straightforward analysis of individual indicators can reveal interesting things, or make it possible for you to talk about ecological health in different ways. Combining indicators to look at larger systems or goals is also more complicated and will likely take more time and capacity. Decide what you want to do now and make sure to leave time for the discussion, analysis, and production it will require.

3. What resources do you have to set a goal for what "healthy" would look like for each indicator (e.g., species recovery plans, studies, expert opinion)?

4. If you have good data sets, do you have statistical support to figure out your ability to detect trends?

5. How will you handle setting confidence levels?

6. What else might you do with individual indicators? Do you want to roll them up or combine them to look at the health of the larger system, filter for factors such as climate vulnerability or resources that can be grouped based on certain management concerns, and/or do creative things with data visualization?

7. If you are rolling up or combining individual indicators to say something about the health of a larger system, do you want to weight them in the overall health score to prevent bias toward those things you happen to have the most information on?

8. How often will you want to update your health assessment? Will you mainly be updating it as you track changes over time? Adding new indicators?

9. Will your updating frequency be based solely on the ecological realities of when things show change (and how often you get new data)? Is it beneficial to align with other program, planning, budget, and/or election timelines? To tie it to specific management or stewardship activities? To think of ways to show change over shorter timelines?

Thinking now about how to update this analysis over time (also see Phase IV, Step 1). ⇒ Determine how frequently you will want to update your assessment based on how often you collect data, how long it takes for a particular indicator or metric to show meaningful change, and the realistic limitations of your time and capacity. Then, think about how you will update each one to make sure that your analysis lends itself to doing so. Changing things later on can introduce many problems, especially in terms of using consistent approaches to see change over time.	10. Does the way you defined your indicators and metrics lend itself to updating? 11. Do you want to create a lifecycle graphic to track the updating process, check in on progress, plan how to keep it alive, and make sure it's being used? 12. What would you like to do with any data gaps you identify? Is there interest/financial support for filling them? Will you want to use them to align future work plans/budgets? Can these tasks be farmed out to researchers or other partners?
Determine what you would like to do with your identified data gaps. ⇒ Identifying data gaps can help spearhead efforts to fill them, coordinate future work, and increase your case for support. Be as clear as you can about what your data gaps are and what you need to get indicators to the point where you have a baseline, thresholds, metrics, etc.	

Your Notes

Step 3. Engage outside expertise

(If you decided to do so in Phase I)

Best Practices and Key Considerations	**Questions**
Determine whether the best approach is to engage other subject matter experts all at once, in smaller groups, or in another way (also see Phase I, Step 5). ⇒ A larger workshop gets everything done at once. It requires less time from volunteer subject matter experts and can also help broaden the taxonomic focus beyond topics about which individual staff members are most knowledgeable. Furthermore, the learning, peer exchange, and networking opportunities it offers can have benefits well beyond this project. For these reasons, we recommend having a larger group meet in one or two workshops if possible. However, if planning a larger event is more than you can manage, there are other approaches such as small working groups or having	1. Do you have the ability to have one (or more) larger workshops, or will you engage subject matter experts in smaller, separate groups, interviews, individual reviews, or some other way? 2. How will you organize the day? How will you break out areas of taxonomic expertise? 3. For people with multiple areas of expertise, is your workshop agenda set up so they can take part in all

relevant experts simply review particular sections of the analysis.	relevant conversations (i.e., they're not required to be in two places at the same time)? 4. What materials do you need to make available ahead of time so that newcomers understand your process and conclusions to date? Who is going to prepare those materials? 5. Are you open to discussion about how to define health, or what constitutes good indicators and metrics? Or are you simply looking for feedback on what you have already proposed? 6. Are there directions you would like to avoid because they are not feasible (e.g., there is no chance of starting a new data-collection effort, so the discussion must focus on what is known)? 7. What will you do if your subject matter experts cannot reach consensus on indicators, metrics, thresholds, etc.?
Prepare and provide materials to participants or reviewers ahead of time. ⇒ If you have workshops, organizing them into taxonomically focused groups works well. Whether asking for feedback in person or in some other way, you should prepare as much advance information as you can about proposed indicators, draft metrics, known data sources, rationale, etc., to provide a solid basis for discussion and give your participants/reviewers something to react to.	
Communicate specific and clear desired outcomes and limitations. ⇒ Passionate and knowledgeable people are bound to have lots to say when asked about their area of expertise. Be clear about the outcomes you need to get to by the end of the meeting or expert review, and any limitations around what is/is not up for discussion. It is important to communicate the project's goals and intended audiences, including how technical the discussion or final outcomes need to be. It can also be helpful to acknowledge that you may not reach consensus among multiple experts, and develop a plan for how to recognize and manage that ahead of time.	
Your Notes	

Step 4. Take feedback and iterate

Best Practices and Key Considerations	Questions
Determine the final list of indicators and their related metrics. ⇒ Use the workshop(s) discussions or other feedback to narrow down your initial list of indicators, determine which metrics you can apply now, where the data gaps are, set or reset thresholds, and so forth. This may involve exploring new data sources recommended by	1. How will you incorporate expert feedback or review into your analyses?

experts, or considering entirely new indicators or metrics. This may be a significant part of your ecological health analysis, so ample time should be allowed.	2. What is your plan for sharing the results of the workshop with participants?
Revise indicator summaries and share with workshop participants. ⇒ Revise your indicator summaries to reflect what was learned and/or decided at the workshop(s) or through your alternate expert engagement process. Share them with participants to ensure that you captured the discussion and findings accurately and to encourage their buy-in.	
Your Notes	

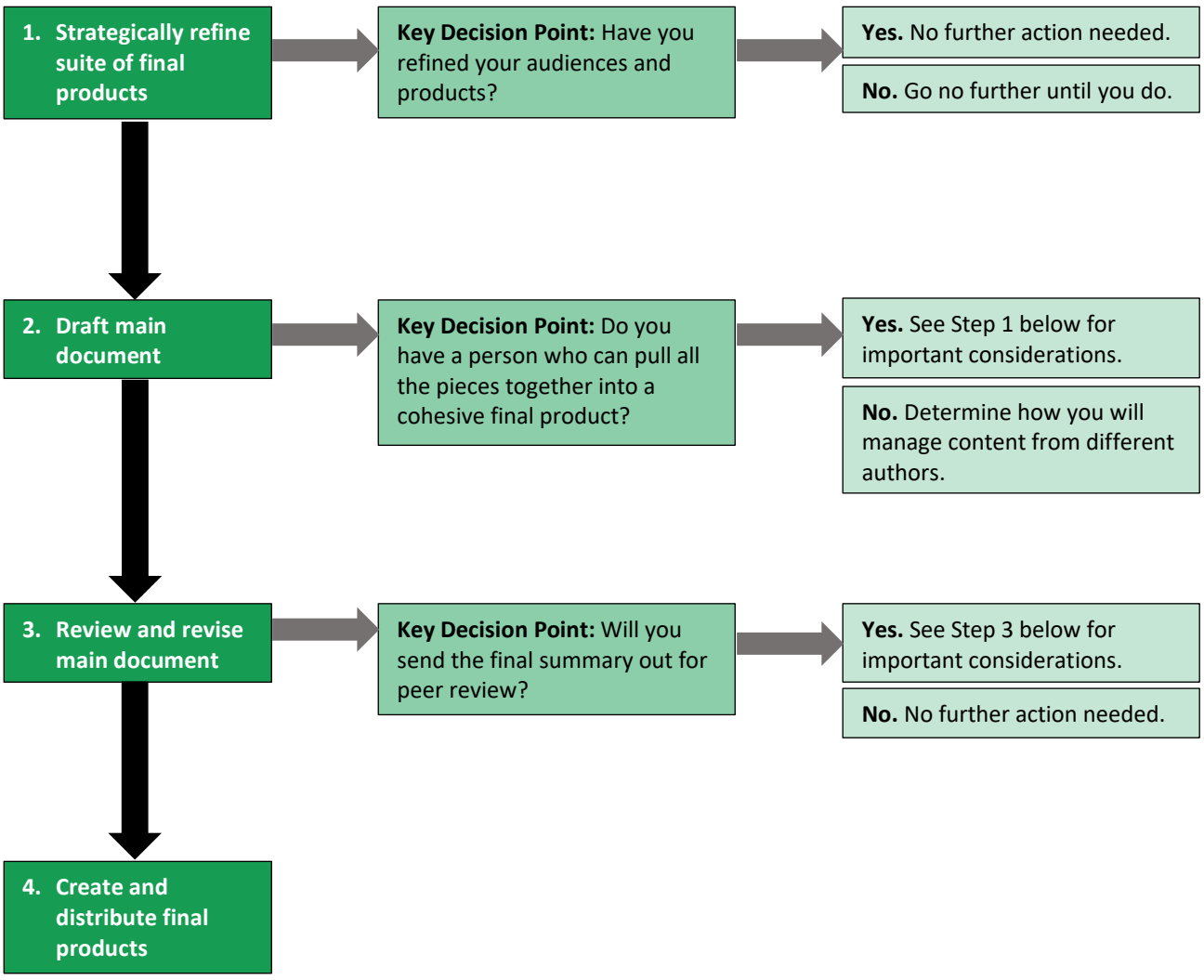
Phase VI. Final Products and Outreach

Ideally, you have been thinking about the final products you were aiming for since the beginning, when you were assessing your goals and audiences. With those outcomes in mind as you went through your process, what you ended up with lends itself to what you want to create now. For example, the kinds of indicators you chose or the way you described what constitutes "healthy" reflect what your audiences want to know and can be applied at this point. Or, the templates you used for each indicator are formatted in such a way that they can be used as the chapters of a longer report, or perhaps distilled into one-pagers.

Because each ecological health assessment effort will be very different in scope, goals, and audiences, there is no one "right" outcome. Look at what others have done (see Appendix) and reach out to some of them to see how well their final products worked.

For the purposes of providing some guidance and food for thought, however, a process for creating a report or a longer, more comprehensive summary of your analyses as well as shorter, more distilled versions of your findings follows. ***We recommend that you assign a single writer/editor to gather all the pieces from the various subject matter experts and assemble them into a cohesive final product.***

Phase VI. Flow Chart of Steps and Key Decision Points



Phase VI. Final Products and Outreach

Step 1. Strategically refine suite of final products

Best Practices and Key Considerations	Questions
Drill down into the details of what you are creating and who you are creating it for. ⇒ While ideally, you clearly defined your audiences during Phase II, you now have the advantage of knowing the results of your assessment. Think about how they affect what you want to share with your audiences, and how. Also, consider how you might want to tie your findings and any recommendations to other organizational priorities.	1. Have you described your target audiences and the information most important to share with them as specifically as you can? 2. Do you know what kinds of products you are going to produce for each audience? 3. Do you need specific report sections, handouts, graphics, etc., to direct attention to things like management actions, fundraising goals, or specific board-member concerns? 4. Should this be integrated with or explicitly tied to an organization's public communications, stewardship programs, particular projects, etc., and if so, will that affect what you create? 5. Do your proposed next steps align with organizational timelines for budgets, work plans, election cycles, etc., as well as with ecological reality? Does that alignment need to be specifically called out?

Your Notes

Step 2. Draft final main document

Best Practices and Key Considerations	Questions
Create a comprehensive summary of your process and your analyses. ⇒ Even if your process was heavily science-driven, you can summarize it in a more- or less-technical way, as appropriate for your audiences. Regardless, in addition to summarizing your findings, you will also need a summary of your processes and your reasoning to help others understand what the assessment is based on, who was involved, what information was used, what your limitations were, and how you reached your conclusions. Transparently documenting all of this helps build credibility now, and will be very useful to those who may be involved in future revisions or implementations of the assessment. For simplicity, we're calling this your "report," but it could take a variety of formats (see Appendix). ***We recommend that you assign a single writer/editor to gather all the pieces from the various subject matter experts and assemble them into a cohesive final product.***	1. Reflecting on your intended goals and audiences, how technical should your report be? How long? 2. How should the document be organized and formatted so that the end users find it easy to understand your processes and how you reached your conclusions? 3. Aside from health indicators, what sections does it need to have? For example, overviews, introductions, indicator roll-ups, data gaps, management recommendations, stewardship applications, etc. 4. What visuals need to be included to show your processes, symbology for condition or trends, resources, maps, graphs, etc.? 5. Do you have a standard format for things like tables, maps, graphs, species lists, and so on, so the report has a cohesive look and feel? 6. Have you involved your primary writer/editor in the process all along, or do you need to get them up to speed? 7. Have you budgeted enough time to allow for writing and review? (See Step 3.)? 8. Have you factored in printing time and costs?

Your Notes

Step 3. Review and revise main document

Best Practices and Key Considerations	Questions
Internal review is essential, and peer review can also lend important additional credibility to your final product. ⇒ Share the first draft of the report with your subject matter experts for their review. Ideally, they have taken a short break from the project and can come back to it with fresher eyes. Once you have incorporated the results of this internal review, you may also want to engage others in a round of peer review, especially if you involved a larger group of experts earlier on (see Phase V). While it adds time to the overall process, it also goes a long way toward broader buy-in and credibility.	1. How many rounds of internal review do you want, or need? 2. Will you do peer review? If so, is it just with those you engaged earlier (if you did) or is there an even broader group you'd like feedback or buy-in from? 3. Did you account for the time that this will take in your project planning?

Your Notes

Step 4. Create and distribute final products

Best Practices and Key Considerations	Questions
Use reviewed and approved content from your final report to create more targeted and distilled products. ⇒ A limited number of people will take the time to read a long report. Therefore, it is likely that you will need a shorter, more digestible version of your findings. The world of possibilities here is vast, but may include things like a funding prospectus, brochure, one-page handout, web page and/or interactive web tool, app, infographics, presentation, symposium, educational curriculum, and more.	1. Based on Step 1, what kinds of summary materials will be most engaging to your audiences? 2. Do people need things they can hand out or show at meetings? 3. Can it be digital, or do you also want/need printed materials?

Plan for how you will disseminate findings, summary materials, etc. ⇒ Sharing the results of your ecological health assessment can demand significant time and resources, depending on your audiences and goals. This part of the process can range from simply producing a final report or summary for a narrow, technical audience to full-scale public engagement. It is important to consider your rollout plan to ensure you have the necessary time and other resources.	4. What do you have the budget or time to create? 5. Do you want to produce some products now and some later? If so, what are your immediate priorities? 6. How will you share your results? Do you want to engage media? Do in-person presentations? Have targeted conversations? Have a big launch event?
Your Notes	

Appendix 1: Other Heath Assessment Efforts

Learning what others have done before embarking on your own ecological health assessment is a great idea. Before beginning the the ecological health assessment for Mt. Tamalpais, we reviewed numerous other assessment examples—some not even related to ecology or natural resources. These examples allowed us to understand the range of frameworks and methodologies that can be used, different ways to define health, how thresholds for change or action can be set, ways to organize and assess a large amount of complex information, and the use of iconography and other communications tools for a variety of audiences.

Although there was no one model we could just pick up and use, these examples were a valuable resource as we developed our own approach. Likewise, the efforts provided in the table below may not be a perfect match for what you want to do, and they not all *purely* ecological health assessments. However, we believe that they may offer potential models or ideas to explore as you undertake your own work.

Lead/Topic	Location	Status (as of November 2019)	Additional Information
Bay Area Open Space Council/ *Conservation Lands Network 1.0* (2011) and *2.0* (2019) regional conservation strategies	California	Complete	• Used existing data and innovative analytical and data visualization tools • Looked at the status of a wide range of upland habitat and related species conservation targets, including human impacts • Primarily for managers and decisionmakers • https://www.bayarealands.org/maps-data/
Bayland Ecosystem/ Habitat Goals Project	California	Ongoing	• Synthesizes existing science and projected changes through 2100 for a variety of wildlife, habitats, and natural processes • Makes recommendations for how to achieve healthy bayland ecosystems • Targets resource managers and policy/decisionmakers • https://baylandsgoals.org/
Chesapeake Bay Foundation/ *State of the Bay Report*	Mid-Atlantic	Ongoing, annual since 1998	• Covers a range of water quality, fisheries, and terrestrial and aquatic habitat indicators • Purposes include supporting awareness-building, advocacy, policy, and fundraising • https://www.cbf.org/about-the-bay/state-of-the-bay-report/
Chicago Wilderness/ *State of Our Chicago Wilderness Report* (2006)	Illinois	Complete	• Created to assess change since their *Biodiversity Recovery Plan* (1999) and progress toward its goals • Documented the condition of available data • Included a broad suite of terrestrial and aquatic communities, plant species, and wildlife assemblages • Included visions, goals, and recommended actions related to public and private landowner protection measures; ecological management, research and

Lead/Topic	Location	Status (as of November 2019)	Additional Information
			monitoring; education and communication; and the role of key players • https://www.csu.edu/cerc/documents/StateOfOurChicagoWilderness.pdf
Diablo Trust/Holistic Ecosystem Health Indicator Project	Arizona	Complete	• Used an integrated monitoring framework to assess and monitor ranchland sustainability • Included a wide range of ecological and social indicators as well as "interactive" indicators: land-use practices, awareness and public attitudes, collaborative process outcomes, and implementation of regulations • Integrated personal surveys, monitoring data, and data from other agencies/groups • Intended as a tool to help make management decisions • http://www.diablotrust.org/science • https://static1.squarespace.com/static/552e96e3e4b0f4284914859a/t/559ef699e4b01b3af99a6675/1436481206374/FINAL.2010.IMfoS.Report.pdf
East Bay Regional Parks District/ *East Bay Stewardship Network Ecological Health Assessment*	California	Underway (complete in 2020)	• Multi-jurisdictional, including noncontiguous lands. • Considering a suite of terrestrial health indicators, including individual species, communities, and larger systems • Primarily intended to create an ecological health baseline for land-management purposes • Becky Tuden, BTuden@ebparks.org
Georgia Department of Natural Resources/ *Coastal Georgia Ecosystem Report Card*	Georgia	Ongoing, annual	• Intended as tool for planning restoration activities and conservation as well as public communication • Looks at 12 indicators of human health, fisheries, and wildlife • https://coastalgadnr.org/ReportCard
Gladstone Healthy Harbour Partnership/ *Review of the use of report cards for monitoring ecosystem and waterway health* (2013)	Australia, worldwide	Complete	• Summarized how report cards have been used to communicate the results of aquatic ecosystem-health monitoring programs around the world • Compared and contrasted program frameworks, indicators, resources, communication strategies, and management links • http://www.rodconnolly.com/uploads/2/5/7/2/25722279/review-of-report-cards.pdf
Land Trust of Santa Cruz County/*A*	California	Complete	• Included an assessment of biodiversity, water resources, working lands, and recreation and healthy communities

Lead/Topic	Location	Status (as of November 2019)	Additional Information
Conservation Blueprint (2011)			• Intended to help inform management actions, improve coordination and collaboration, and increase funding opportunities • Used existing data and consultation/input from scientists, planners, farmers, foresters, and community members • https://www.landtrustsantacruz.org/blueprint/
Living with Environmental Change/Climate change impact report cards on agriculture and forestry, biodiversity, water, infrastructure, and health	United Kingdom	Last published 2016	• Included current climate change impacts and future projections • Designed for decisionmakers • https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/
Maryland Coastal Bays Program/Annual public-friendly report card summaries	Maryland	Last published 2016	• Used existing science to look at a limited range of habitat, species, and water quality indicators • https://mdcoastalbays.org/coastal-bays-report-card
National Park Service/Natural Resource Condition Assessments	Nationwide	Ongoing	• Uses a standardized framework and existing data to provide snapshots of current conditions, critical data gaps, and influences for selected natural resources • Provides credible science to assist with park management and stewardship activities, reporting, strategic planning, and public outreach • Website has guidelines, templates, and existing reports as reference • https://www.nps.gov/orgs/1439/nrca.htm
One Tam/ *Measuring the Health of a Mountain: A Report on Mount Tamalpais' Natural Resources* and related website and brochure (2016)	California	Complete, updates starting in 2020	• Comprehensive, multi-jurisdictional assessment • Considered a suite of plant and wildlife indicators, including individual species, guilds, communities, and systems; social/cultural health indicators were not factored in • Goals included creating a baseline as well as informing resource management and increasing stewardship and financial support • https://www.onetam.org/peak-health

Lead/Topic	Location	Status (as of November 2019)	Additional Information
Point Blue Conservation Science (formerly PRBO)/ *The State of the Birds of the San Francisco Bay* (2011)	California	Complete	• Summarizes the current state of knowledge on the Bay's bird populations and recommended climate change adaptation actions needed • Intended to guide habitat restoration, management, and acquisition and influencing public policy and public awareness • https://data.prbo.org/sfstateofthebirds/
Presidio Trust/ resource assessment	California	Underway	• Using the Urban Biodiversity Inventory Framework (http://ubif.us/) and existing in-house monitoring program data • Looking at vegetation indicators at restoration sites and in managed forests, invasive species, T&E species, and water quality • https://www.calacademy.org/urban-biodiversity-inventories
Puget Sound Ecosystem Monitoring Program	Washington	Ongoing	• Includes measures of ecosystem health to guide assessment of progress toward recovery goals • Interactive web tool highlights numerous indicators under categories that include human health and quality of life as well as species, habitats, and water quality • https://vitalsigns.pugetsoundinfo.wa.gov/
San Francisco Estuary Institute/*State of the Estuary Report*	California	Ongoing, biennial	• Synthesizes existing data on ecological and human health indicators, including water flow and use, fish, tidal marsh, flooding, resilience, and green space • Intended for public and media audiences and to evaluate progress toward restoration goals • https://www.sfestuary.org/our-estuary/soter/
Santa Cruz Mountains Stewardship Network/online atlas	California	Underway	• Using existing regional data • Looking at aspects of both ecological and socio-economic health • Not evaluating or grading health; goals are to create a baseline, to allow managers to see trends across the landscape, and to visualize factors like climate change and demographic shifts • Primarily for land managers; the public is not a target audience • http://www.scmsn.net/
Save the Redwoods League/*State of the Redwoods*	California	Complete	• An ecosystem-wide analysis of conservation goals with conditions and trends for four metrics • Used existing data and expert opinion • Audiences included interpreters, policy makers, funders

Lead/Topic	Location	Status (as of November 2019)	Additional Information
Conservation Report (2018)			• https://www.savetheredwoods.org/about-us/publications/state-of-redwoods-conservation-report-2018/
Urban Biodiversity Hub/centralized website	Worldwide	Ongoing	• Developing for cities around the world to learn how to measure and promote biodiversity and assess strategies • Consolidating information on urban biodiversity planning activities, strategies, assessments, guides, and other resources • https://www.ubhub.org/home
U.S. Forest Service/ *Watershed Condition Framework* (2011)	Nationwide	Complete	• Offered an approach on how to carry out integrated, ecosystem-based watershed assessments • Used 12 indicators to represent ecological, hydrological, and geomorphic functions and processes that affect watershed condition • Focused on aspects that can be influenced by agency management • Included approaches to target restoration work, coordinate with partners, and improve reporting • Interactive web map also available • https://www.fs.fed.us/naturalresources/watershed/condition_framework.shtml

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