

Chapter 3 – Vital Signs

INTRODUCTION

In September 2001, GLKN’s Technical Committee laid out a plan for identifying and prioritizing Vital Signs. The plan called for scoping workshops with park staff to generate lists of monitoring issues and questions, development of conceptual models to examine important ecosystem attributes and linkages, focus workshops to get input and review from science peers, and an iterative process of management and science review (Fig. 4). To maximize efficiency, the Committee expected the monitoring program to emphasize Vital Signs common to all or most of the nine parks. Efficiencies in study design, data collection, data management, and reporting are greatest at the base of the effort pyramid (Fig. 5) and Network monitoring of these common issues will benefit most from consistent designs that produce comparable data. Conversely, the Committee expected that the least amount of Network effort would go towards single park issues. These issues often require park-specific knowledge, are frequently short-term, and, due to economies of scale, are most efficiently conducted by park staff. Nonetheless, some critical single-park monitoring needs may be best met by Network efforts.

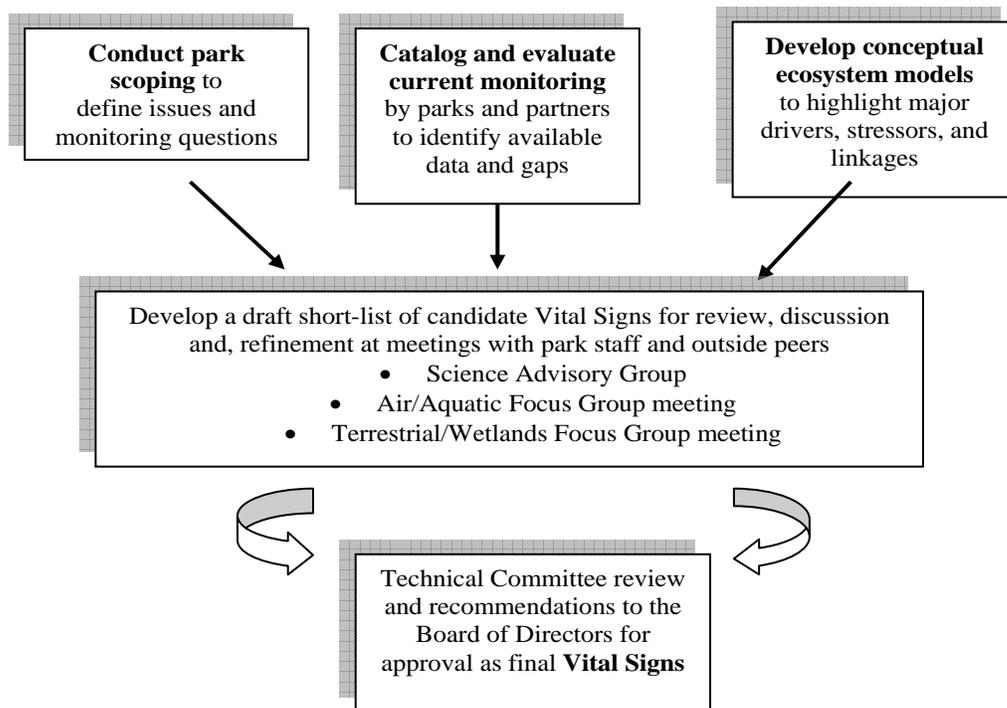


Figure 4. The Great Lakes Inventory and Monitoring Network’s process of defining issues, gathering information, and drafting a list of candidate indicators for review.

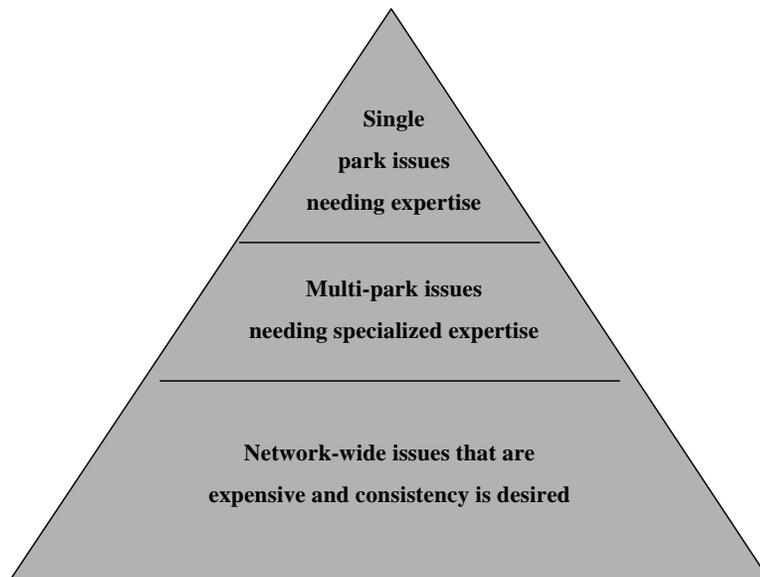


Figure 5. Effort pyramid showing the envisioned application of funding and staff time towards monitoring in parks of the Great Lakes Inventory and Monitoring Network.

STEPS TAKEN AND RESULTS

The process for determining Vital Signs was recommended by the Technical Committee and adopted by the Board in September 2002 (Table 12). The Network and partners completed the process via seven steps, which are described briefly below and in more detail in Route (2004):

1. Conducted park scoping workshops and gathered partner information
2. Developed conceptual models of park ecosystems
3. Drafted a candidate Vital Signs list
4. Refined the candidate list and assigned initial priorities
5. Obtained peer review of the Vital Signs selection process
6. Conducted focus workshops to further refine and score the candidate Vital Signs
7. Conducted final deliberations and prioritization

Step 1 - Park Scoping and Information Gathering

The Network began holding park scoping workshops in January of 2002 (Table 12). At these workshops, the Network engaged 150 park staff and local partners and developed a list of over 200 monitoring issues and 140 monitoring questions (Route 2003, Route 2004). Issues and questions were grouped into 12 “monitoring themes” across the Network. Park scoping was an important beginning to GLKN’s iterative process of refining Vital Signs. It helped engage and inform park staff, grounded the process in the parks - where data will be collected and used, and helped Network staff better understand the issues. It also helped identify the expertise needed for conceptual models and for the Science Advisory and Focus Groups. Most importantly, the themes and monitoring questions identified at these scoping workshops, together with the conceptual models, formed the basis of the Network’s candidate Vital Signs list.

Table 12. Summary of meetings and workshops held by the Great Lakes Inventory and Monitoring Network to develop a process and then choose and prioritize Vital Signs.

Date(s)	Event/Place	Participant Group	Result(s)
September 18-20, 2001	Fall Technical Committee meeting, Ashland, WI	Eleven-member Technical Committee representing each park and the regional and Network coordinators	Agreed on the park scoping process to identify monitoring issues and questions; recommended a vision for effective monitoring
November 5, 2001	Fall Board of Directors meeting, Delavan, WI	Five-member Board including three park superintendents and the regional and Network coordinators	Adopted the Network Charter and the park scoping process as recommended by the Technical Committee
January – May, 2002	Scoping workshops held at each of the nine park units	Attended by 150 NPS staff, local science partners, and Network staff	Informed park staff, developed lists of monitoring issues, grouped and prioritized issues into monitoring themes, and developed initial monitoring questions
April 3-4, 2002	Spring Technical Committee meeting, Marquette, MI	Eleven-member Committee and Network staff	Recommended the process for refining Vital Signs through models and science review panels; determined which conceptual models should be developed
September 5-6, 2002	Fall Board meeting, Ashland, WI	Six-members including four park superintendents and the regional and Network coordinators	Reviewed and adopted the process for refining Vital Signs as recommended by the Technical Committee
October 8-10, 2002	Technical Committee meeting, Isle Royale, MI	Eleven-member Committee and Network staff	Developed draft Network-specific provisos to the Servicewide goals for monitoring
April 8-9, 2003	Joint Technical Committee and Board meeting, Ashland, WI	Eleven-member Committee, six-member Board and Network staff	Reviewed and adopted Network provisos to the Servicewide goals for monitoring
June – October, 2003	Development of conceptual models, at various locations	Eight NPS and partner scientists with backgrounds in important ecosystems	Developed six stressor-based conceptual models to highlight critical processes, stresses, linkages, and potential indicators
September 15-19, 2003	Staff meetings, Ashland, WI	Five members of the Great Lakes Network staff	Developed an initial short-list of potential Vital Signs for deliberation by the Technical Committee
October 7-8, 2003	Technical Committee meeting, Madison, WI	Eleven-member Committee and Network staff	Agreed on criteria and then refined and scored the draft list of candidate Vital Signs
October 9, 2003	Board of Directors meeting, St. Paul, MN	Six-member Board	Reviewed initial Vital Signs list and agreed to the criteria and general process for refining the list
October 29, 2003	Science Advisory Group meeting, Ashland, WI	Ten scientists experienced in long-term monitoring and statistics	Received peer-review of the selection process and a straw poll on “best bet” and “no go” Vital Signs
February 3-4, 2004	Aquatic/Air Focus Group meeting, Marine on St. Croix, MN	Fourteen aquatic and air resource scientists and Network staff	Refined the draft Vital Signs list, scored them on ecological significance and measurability, and began listing metrics
February 18-19, 2004	Terrestrial/Wetland Focus Group meeting, Ashland, WI	Nine terrestrial and wetlands scientists and Network staff	Refined the draft Vital Signs list, scored them on ecological significance and measurability, and began listing metrics
March 1-12, 2004	Park staff meetings held at each park	Key natural resource and management staff at each park	Re-scored each Vital Sign based on information from Science Advisory Group and Focus Groups
March 18, 2004	Spring Technical Committee meeting, St. Paul, MN	Eleven-member Committee and Network staff	Reviewed and adopted the Vital Signs list with recommendations to flesh out specific questions and address park needs under certain Vital Signs
April 8, 2004	Spring Board meeting via conference call	Six-member Board	Adopted the draft Vital Signs list and initial prioritization as recommended by the Committee

Step 2 - Conceptual Modeling

Following the park scoping workshops, GLKN commissioned the development of conceptual models to examine major ecosystems and processes in the nine parks. The Technical Committee selected six models at their October 2002 meeting. The authorship, purpose, and approach to the conceptual models are summarized in Chapter 2 of this plan. All models were peer-reviewed, refereed, and published as an in-house technical report (Gucciardo et. al. 2004).

Step 3 - Developing a Candidate List

Network staff used the conceptual models, results of park scoping workshops, and information on partner monitoring to draft a list of candidate Vital Signs. Initially, the Network considered 80 indicators under development by the U.S. Environmental Protection Agency (EPA) and Environment Canada for assessing progress towards goals of the Great Lakes Water Quality Agreement (Bertram and Stadler-Salt 2000). Although some of the indicators were used, many did not apply. The draft list of candidate indicators drew most heavily from the park scoping workshops and the conceptual models.

Step 4 - Refining the Candidate List and Assigning Initial Priorities

In October 2003, the Committee adopted criteria and weighting factors for scoring Vital Signs (Table 13). Candidate indicators were scored on: “Management Significance” weighted at 40%, “Ecological Significance” weighted at 40%, “Measurability/Sensitivity” weighted at 20%, and “Legal/Policy Mandate” as a tie breaker. To assess the value and performance of a Vital Sign, participants scored them for each criterion using a point scale of: very high= 5 points, high= 4 points, medium= 3 points, low= 2 points, very low= 1 point, no value= 0, or unable to score= null. The Committee decided to weight Management and Ecological Significance equally because ecological integrity is a primary management concern in all national parks (NPS 1991). The Committee reserved the scoring of Management Significance for park staff - acknowledging their need use the monitoring data to make management decisions. Ecological Significance was scored by both parks and Focus Groups; however, Focus Group scores were provided to parks as peer review and not used in final score calculations. The criterion Measurability/Sensitivity was scored only by Focus Groups, because they generally have the best knowledge of the quantitative measures and ecological linkages critical for judging this criterion. Although 20% seems low for this important criterion, the Committee believed more in-depth information would surface when GLKN and its partners analyze available data and begin developing protocols. Thus a low weighting at this juncture would allow a Vital Sign to remain viable until more complete information becomes available. For each criterion, four or five statements were provided to help participants apply the criteria consistently (Table 13).

After adopting the criteria, the Committee discussed the candidate list and made minor adjustments. The nine park representatives on the Committee then conducted an initial scoring of each Vital Sign. (Network staff facilitated and participated in discussions but did not score Vital Signs). The “Legal/Policy Mandate” criterion was intended as a tie breaker, but has not yet been applied. Nonetheless, legal concerns and agency mandates, such as sensitive and harvested species, were considered under

Management Significance (see bullets under criterion 1 in Table 13). The criteria, scoring process, and initial scores were brought to the Board for their concurrence in October 2003. The result was a draft, prioritized list of candidate Vital Signs.

Table 13. Criteria and weighting factors used to prioritize Vital Signs for the Great Lakes Inventory and Monitoring Network, 2003 - 2004. Criteria adapted from Dale and Beyeler (2001).

Each of the following, except “legal /policy mandate” was used to score Vital Signs by participants who ranked them very high (5), high (4), medium (3), low (2), very low (1), none (0), or null in regards to its value for monitoring. The value “none” equaled zero in calculations, while null was valueless (i.e., no opinion). The criterion “legal mandate/policy mandate” was ranked as very high, high, or none depending on whether there were federal/state mandates, federal/state policies, or no mandates/policies, respectively.

1)	<p>Management significance (Weight = 40%; scored only by park staff)</p> <ul style="list-style-type: none"> • Has direct application to one or more management decisions or helps assess management actions. • Helps anticipate or predict impending change in an important resource that could be averted by management action. • Contributes to increased understanding of important resources or ecological processes that ultimately leads to better management. • Data are of high public interest. • Involves resources that are harvested, consumed, endemic, alien, threatened, endangered, or of special concern.
2)	<p>Ecological significance (Weight = 40%; scored by both park staff and focus workshop participants; however, focus workshop participant scores were used only as a recommendation to park staff)</p> <ul style="list-style-type: none"> • Has a strong defensible linkage with the resource it is intended to represent. • The resource or process the attribute represents has high ecological importance based on conceptual models and ecological literature. • The attribute responds to change in a predictable, ecologically explainable manner. • The attribute is integrative over time and provides ecological context or supporting evidence to data from other indicators being monitored by the park or others.
3)	<p>Legal/Policy mandate (No weighting - tie breaker; scored only by park staff)</p> <ul style="list-style-type: none"> • Scored as “5” if mandated by federal law, “4” if by state law or NPS policy, and “n/a” if no laws or mandates apply.
4)	<p>Measurability and sensitivity (Weight 20%; scored by focus workshop participants only)</p> <ul style="list-style-type: none"> • Reliable and effective methods exist for collecting and analyzing data in a consistent and repeatable manner. • The cost of collecting a significant sample is not prohibitive. • Measurements are sensitive to change such that a trend will be apparent if present (high signal to noise ratio). • Human errors in measurement are either low or can be explained.

Step 5 – Review of the Vital Signs Selection Process

In October 2003, Network staff convened a 10-member Science Advisory Group (SAG) to get peer review of the Network’s program with emphasis on the process of choosing and prioritizing Vital Signs. This advisory group includes scientists with many

years of experience in long-term ecological monitoring as well as experts in focal resources of the Great Lakes and upper Mississippi River Basins (Appendix D). More details on the findings of this meeting are reported by Route (2004).

Prior to the meeting, Network staff provided group members with background information on the program, objectives of the meeting, an outline of the selection process, the candidate Vital Signs list, and the criteria for scoring the Vital Signs. The group felt the Network had a valid process that allowed both managers and scientists sufficient opportunity to scrutinize the Vital Signs. Members of the SAG reviewed the candidate list and had no immediate suggestions for improvement. Each member identified their top “best bets” and those they felt the Network shouldn’t monitor. Results of this straw poll were summarized and provided to the parks for consideration in adjusting their scores.

Step 6 - Conducting Focus Workshops

In February of 2004, GLKN held two workshops – one focusing on Vital Signs related to aquatic and air resources, and one focusing on terrestrial and wetland resources. The Air/Aquatic Focus Group consisted of 14 invited scientists and the Terrestrial/Wetland Focus Group had nine invited scientists (Appendix E). Participants were selected for their knowledge and experience with monitoring natural resources in the region. Prior to each workshop, Network staff provided participants with background information on the program, meeting objectives, web access to the conceptual models, the candidate Vital Signs list, and the criteria for scoring the Vital Signs. At each meeting, participants discussed each Vital Sign and refined and added to the list, but did not delete Vital Signs. Network staff facilitated the meetings and prompted discussion on the ecological significance, measurability, and sensitivity of each Vital Sign.

At each of the two 1½ day-long meetings, participants spent approximately eight hours discussing the Vital Signs. The two groups added nine Vital Signs, combined four others into two, and made minor name changes to some Vital Signs. These changes were documented in a summary narrative (Appendix F). Participants took about one hour to score the Vital Signs on Ecological Significance and Measurability/Sensitivity as described in Table 13. Network staff originally intended to average Ecological Significance scores across both the Committee and the Focus Groups; however, the number of participants in the Focus Groups (23) would have swamped scores by the nine park representatives. To ensure park views were well represented, yet the recommendations of Focus Groups were considered, we provided Ecological Significance scores and notes from the focus groups to the parks for their consideration in adjusting scores. Participants had the option of not scoring a Vital Sign if they had insufficient knowledge of the resource and two participants in the Air/Aquatic Group had to leave early. Hence the number of persons scoring varied between the groups and among Vital Signs.

Step 7 - Final Deliberations and Prioritization

Network staff summarized scores and discussions from the Science Advisory Group and the two focus groups and provided it to the parks for consideration (Appendix F). The information included recommended changes to the candidate list, the addition of potential measures, important discussion points and linkages, and average scores for each Vital Sign. Network staff then asked the park representatives on the Committee to engage

their park staff with this new information and confirm or adjust their original scores. Parks were given two weeks to deliberate and adjust scores. Six of the nine parks discussed and adjusted their scores; three were satisfied with their original scores.

Network staff calculated draft weighted scores as:

$$\text{Weighted Score} = (\text{MS} \times 0.4) + (\text{ES} \times 0.4) + (\text{SM} \times 0.2)$$

Where: MS = the average of the adjusted park scores for Management Significance

ES = the average of the adjusted park scores for Ecological Significance

SM = the average of focus workshop participant scores for Measurability and Sensitivity

The Committee discussed the draft weighted scores at their March 2004 meeting and recommended that it advance to the Board without further adjustment at this time. The Board met in April, 2004 and approved the list and the priority order of the Network's 48 Vital Signs (Tables 12 and 14). Both the Committee and Board noted, however, that certain Vital Signs should eventually reflect specific needs of individual parks. For example, the T&E Vital Sign (#47) should list the species of concern for each park. Network staff will define specific objectives, refine monitoring questions, and determine measures for each Vital Sign prior to developing protocols. The Committee agreed that Network staff would address the list in the general order of the final scores, though exceptions would be made for efficiencies gained by grouping Vital Signs in protocol packages or when costs can be shared by partnering with other agencies. Network staff have taken the original 140 monitoring questions (see Route 2004) and started refining them in preparation for protocol development (Appendix G).

The Network, including partner parks through the Committee and Board, will ultimately need to factor in logistics and cost of monitoring. Consideration will be given to the original vision for efficiency and quality data (see provisions #1 and #3 page 11; Fig. 4). Together we will determine how many of the Vital Signs can be monitored well and which of them should be monitored by the parks. This 'final' list is our best attempt to determine Vital Signs, but it may change as monitoring questions and measures are further defined, and as protocols, logistics, and costs are better understood.

Following the Vital Signs process, Network staff organized the GLKN Vital Signs into the National I&M Program's "Vital Signs Monitoring Framework" (Table 15). This framework helps illustrate the ecological breadth of the Vital Signs – from species health to geological processes – and will provide consistency for reporting Vital Signs among the NPS's 32 monitoring networks across the nation.

Table 14. Prioritized Vital Signs for the Great Lakes Inventory and Monitoring Network. The order is based on the parks' average scores for management (40%) and ecological significance (40%), and focus group's assessment of measurability and sensitivity (20%).

Vital Signs		Parks and focus groups
No.¹	Vital Signs name	weighted average²
42	Plant and Animal Exotics	4.3
1	Core Water Quality Suite	4.3
45	Terrestrial Plants	4.0
40	Bird Communities	3.9
43	Problem Species	3.8
12	Land Use / Land Cover Coarse Scale	3.8
47	Threatened & Endangered Species	3.7
14	Water Level Fluctuations	3.6
2	Advanced Water Quality Suite	3.6
46	Aquatic/Wetland Plant Communities	3.6
26	Weather, Meteorological Data	3.5
39	Amphibians & Reptiles	3.5
41	Mammal Communities	3.5
28	Fish Communities	3.5
13	Land Use / Land Cover Fine Scale	3.5
5	Trophic Bioaccumulation	3.4
25	Special Habitats	3.4
31	Mussels & Snails	3.3
44	Harvested Species	3.3
4	Sediment Analysis	3.3
35	Terrestrial Pests, Pathogens	3.3
19	Succession (forests, wetlands)	3.2
9	Toxic Concentrations in Sediments	3.2
48	Biotic Diversity	3.1
16	Fluvial Geomorphology	3.1
20	Trophic Relations	3.0
7	Air Contaminants	3.0
27	Phenology	3.0
8	Toxic Concentrations in Water	2.9
34	Terrestrial Invertebrate Communities	2.9
24	Soils	2.8
6	Health, Growth and Reproductive Success	2.8
30	Benthic Invertebrates	2.8
37	Diatoms	2.7
3	Aquatic Pathogens	2.7
10	Air Quality Related Values (AQRV)	2.6
36	Algae	2.6
38	Lichens & Fungi	2.5
15	Nutrient Dynamics/Biogeochemistry	2.5
21	Geological Processes	2.5
17	Aeolian, Lacustrine Geomorphology	2.5
18	Primary Productivity	2.5
29	IBI (index of biotic integrity)	2.4
33	Zooplankton	2.4
11	Soundscapes, Light Pollution	2.3
32	Freshwater Sponges	2.1

1= Vital Signs numbers are assigned by the Network for tracking purposes.

2= Tied Vital Signs will be addressed using the Legal/Policy Mandate criterion (see Table 13), and/or newly acquired information on the measurability and sensitivity of the Vital Sign, as well as the logistics and cost of implementation.

Table 15. Vital Sign scores for nine national parks in the Great Lakes Inventory and Monitoring Network. The Vital Signs and scores are linked to the NPS National Vital Signs Framework. Highlighted scores are those ≥ 3.0 on a scale of 0-5 with 5 being of very significant value as an indicator and 0 being of no value to that park (see text).

National Level ¹		Great Lakes Network ²									
Level 1	Level 2	Vital Sign number and name ³	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA
Air and Climate	Air Quality	#7 Air Quality	3.8	4.1	3.3	3.0	1.4	1.8	3.0	3.0	3.9
		#10 Air Quality (AQRV)	3.3	3.5	2.6	3.7	2.5	2.1	0.5	2.9	2.3
	Weather	#26 Weather	3.7	3.2	3.5	3.3	3.3	2.9	4.1	2.9	4.3
		#27 Phenology	3.5	3.0	2.9	3.1	1.9	2.7	3.9	2.7	3.1
Geology and Soils	Geomorphology	#17 Aeolian, Lacustrine Geomorphology	4.2	3.1	3.2	2.6	1.4	1.8	0.6	4.2	1.5
		#21 Geological Processes	2.2	3.7	2.1	1.8	2.2	3.8	1.4	3.0	2.1
		#16 Stream Dynamics	2.7	3.6	2.8	1.5	3.1	3.5	3.9	3.9	2.9
	Subsurface Geologic Processes										
	Soil Quality	#24 Soils	2.6	3.6	2.7	3.0	2.2	2.2	3.0	3.0	3.2
Water	Hydrology	#4 Sediment Analysis	2.8	2.7	2.8	4.0	4.0	2.8	4.0	4.0	4.0
		#14 Water Level Fluctuations	2.8	3.6	3.1	2.4	3.2	3.6	4.8	4.8	4.5
	Water Quality	#1 Core Water Quality Suite	4.1	4.5	3.8	4.9	3.3	4.1	4.5	4.9	4.7
		#2 Advanced Water Quality Suite	3.5	3.1	3.8	3.5	2.3	3.1	4.3	4.7	4.2
		#8 Toxics in Water	2.4	3.2	3.4	3.6	2.0	2.4	2.8	3.6	2.8
		#9 Toxics in Sediments	3.4	2.7	2.9	3.4	3.0	2.6	3.0	3.8	3.4
		#3 Pathogens in Water	3.0	4.4	3.4	1.4	1.8	3.0	2.2	2.6	2.4
		#29 IBI	2.5	3.1	3.1	1.7	2.9	0.5	4.5	2.1	1.7
		#30 Benthic Inverts	2.6	1.6	2.3	3.4	2.6	2.6	4.2	3.0	2.7
		#32 Freshwater Sponges		0.5	1.5	4.3	1.9	1.9	2.7	1.9	2.2
		#36 Phytoplankton	2.9	1.9	2.2	2.9	1.7	2.5	2.9	3.3	3.0
		#37 Diatoms	3.2	1.8	2.6	2.8	2.4	2.8	3.2	2.4	3.5
		Biological Integrity	Invasive Species	#42 Plant and Animal Exotics	3.6	4.2	4.6	4.8	4.8	4.0	4.8
Infestations and Disease	#35 Terrestrial Pests and Pathogens		4.2	3.4	3.2	3.4	2.6	2.2	3.4	4.2	2.7
	Focal Species or Communities		#46 Aquatic Plant Communities	3.1	2.5	4.0	4.7	2.7	3.1	4.3	3.9
	#31 Mussels and Snails		2.6	1.6	2.5	4.6	4.6	3.8	4.6	3.4	2.6
	#41 Mammal Communities		3.4	3.6	3.7	4.6	1.4	3.8	3.8	3.4	3.4
	#43 Problem Species		4.6	3.6	4.1	4.6	4.6	3.4	3.4	3.8	2.4
	#25 Special Habitats		3.8	2.9	4.0	4.2	1.4	4.2	3.4	3.8	2.8
	#38 Lichens and Fungi		2.8	2.2	2.4	3.2	2.4	2.4	2.8	2.4	2.3
	#45 Terrestrial Plants		4.3	3.8	4.1	4.7	3.9	3.5	4.3	4.3	3.3
	#28 Fish Communities		3.5	2.6	2.4	4.7	3.1	3.1	4.3	3.9	3.8
	#33 Zooplankton		2.9	1.1	2.0	2.9	2.1	2.5	2.9	2.1	3.1
	#34 Terrestrial Invertebrate Communities		2.9	2.8	3.2	4.5	2.1	2.5	3.3	2.5	2.4
	#39 Amphibians and Reptiles		3.4	3.0	3.6	4.6	3.4	3.0	4.2	3.4	2.9
	#40 Bird Communities		3.5	4.0	3.7	4.7	3.9	3.9	4.3	3.5	3.1
	#48 Biotic Diversity	2.8	2.0	2.7	4.4	3.2	3.6	3.6	2.4	3.0	
At-risk Biota	#6 Species Health, Growth and Reproductive Success	2.9	3.0	2.7	3.3	2.5	2.9	2.9	2.5	2.5	
	#47 T&E Species	4.0	3.3	4.1	3.6	3.2	3.6	4.4	3.6	3.3	
Human use	Point-source Human Effects										
	Non-point Source Human Effects	#5 Trophic Bioaccumulation	3.4	3.4	3.2	3.8	2.2	3.8	3.0	3.8	4.2
	Consumptive Use	#44 Harvested Species	4.2	3.6	2.3	3.0	1.8	4.2	3.0	4.2	3.7
	Visitor and Recreation Use	#13 Land use Fine Scale	3.0	3.8	3.4	2.4	3.6	4.2	3.4	3.8	3.3
Cultural Landscapes											
Ecosystem Pattern and Processes	Fire										
	Land Use and Cover	#12 Land use Coarse Scale	3.2	3.8	3.9	3.0	3.6	4.4	3.6	4.8	4.0
	Extreme Disturbance Events										
	Soundscape	#11 Soundscapes and Light Pollution	2.9	2.6	2.0	2.9	1.3	1.7	2.1	2.9	2.6
		Nutrient Dynamics	#15 Nutrient Dynamics	2.8	2.3	2.5	3.2	2.0	2.4	2.0	2.0
		#20 Trophic Relations	3.6	1.9	3.4	4.4	1.6	2.8	2.8	3.6	3.3
	Productivity	#18 Primary Productivity	2.8	1.6	2.3	2.8	1.6	2.4	2.8	2.0	3.8
#19 Succession		2.9	3.1	4.1	3.7	1.3	3.3	3.3	3.7	3.3	

1= Level names are from the National Park Service's Vital Signs Framework.

2= The Network assigned numbers for each Vital Sign to track changes through time.

3= For park acronyms see Table 3.