Strand Map Service Roadmap – Objectives for 2010

NSDL Technical Network Services, January 2010

Purpose of this Document. The purpose of this document is to outline planned changes and additions to this established NSDL service that NSDL Technical Network Service will be working on in 2010. This updated version reflects feedback and comments received on a draft Roadmap that was circulated, presented and discussed at the 2009 NSDL Annual Meeting and a subsequent online commentary period.

Audience of this Document. The audience for this Roadmap is NSDL stakeholders. This includes: (1) current and prospective NSDL grantees and the NSDL Resource Center, (2) key project partners such as AAAS/Project 2061, (3) users, including individual science educators and educational institutions and organizations interested in using the Service in their own sites and products, and (4) NSF personnel.

How to Comment on this Roadmap. While the official request for comments period is over, we always welcome suggestions and comments. Please contact TNS directly (http://nsdl.org/about/contactus/) or post your ideas in the discussion forum associated with this document on the NSDL Community site at https://www.nsdlnetwork.org/ .

Background on the Strand Map Service. The Strand Map Service is the technical system underpinning the NSDL Science Literacy Maps available in NSDL.org. It was originally developed though a two-year NSDL Service award in late 2002 to early 2004 by the University of Colorado, UCAR, and AAAS/Project 2061. As such, work on the Service was finished prior to the inception of many of the existing Pathways. With additional NSF support in the form of two small service grants, the NSDL Science Literacy Maps application in NSDL.org was created and all AAAS/Project 2061 content was cataloged and modeled in the Service. This content includes all the Benchmarks for Science Literacy developed by AAAS/Project 2061, as well as the Strand Maps published through the Atlas of Science Literacy (Volumes 1 and 2) in conjunction with the National Science Teachers Association, and information on common student conceptions. This body of information constitutes one of the nations' most thorough and most researched models of K-12 STEM learning goals and learning progressions. The Strand Map Service makes both this "raw content" and a variety of knowledge map visualizations based on this content freely available to portal and application developers through a web service API. The Service has been operated and supported by the NSDL Core Integration team since 2006, and since Fall 2008 by NSDL Technical Network Services. The Service is released under an open source license and can be installed and operated locally. There have been no significant additional developments made to either the Strand Map Service or the Science Literacy Maps application since the application's release in 2006.

2010 Strand Map Service Roadmap

There is significant stakeholder interest in a variety of changes and additions to both the Strand Map Service and the NSDL Science Literacy Maps, and to the "surrounding" services that help to connect NSDL content to the AAAS Benchmarks and Maps and to connect NSDL with end-users. Input that informed this draft roadmap came from the stakeholder groups described earlier, as well as two workshops that took place earlier this year (AAAS Content Alignment Workshop – March; Climate Literacy Workshop – October). Suggested changes and additions falls into the following broad categories:

- Aligning resources to AAAS Benchmarks and state standards

- Integrating and featuring resources and collections from NSDL Pathways and other collection providers in the NSDL Science Literacy Maps
- Visualizing new concepts spaces other than the AAAS model using the Service
- Integrating state standards into the Service and being able to see the relationships between a particular state's standards and the AAAS Benchmarks and Strand Maps
- A variety of potential new features for improving the visualizations, printing capabilities, etc (see Appendix A).
- Updating the NSDL Science Literacy Maps interface to support Web 2.0 personalization capabilities and user-contributed content
- New interaction models for embedding targeted and contextualized audience and/or domain-specific visualizations into third party portals and applications
- Deployment site consulting and technical support for integrating the Service into third party sites and applications
- Sustaining the accuracy, currency and vitality of the AAAS content over time
- Improved marketing and dissemination approaches

Clearly, this list comprises an extensive amount of work that NSDL Technical Network Services could not reasonably take on all at once. Here, we will review our overarching goals for this line of work in 2010, specific actions that we are undertaking, and options being considered.

Overarching Goals for 2010: We will focus on improving the utility of the NSDL Science Literacy Maps for: (1) showcasing multi-disciplinary STEM content being develop and curated across NSDL and (2) supporting the ongoing efforts of the Resource Center to extend the reach and usage of NSDL through partnerships with educational organizations and institutions. As currently architected, the Strand Map Service is a "read-only" application offering visualizations of the AAAS content. We propose to extend this architecture to support "writing" of new content into the data store. This extension will support AAAS to sustain the content over time and lay the groundwork for eventually enabling the Service to visualize new concepts spaces other the AAAS model. TNS will continue to provide deployment site consulting and technical support to NSDL grantees or third parties interested in integrating the Service into their portals and applications.

Sustainability and Extensibility to New Concept Spaces

Recommendation:
- Begin work on sustaining the accuracy, currency and vitality of the AAAS content.

Option:
- Extend the Strand Map Service architecture and API to support inputting of new concept spaces.

Work to be performed: AAAS/Project 2061 has expressed interest and willingness to take on primary ongoing responsibility for maintaining the content in the Strand Map Service. TNS will work with staff at AAAS/Project 2061 to enable them to write content changes directly into the Strand Map Service as needed, ideally by enabling their existing editing tools to interoperate with the SMS database. The Service data store at AAAS/Project 2061 will be considered the authoritative source. We will work with AAAS to set up processes for synchronizing the authoritative source at AAAS with the operational NSDL deployment. This effort to enable AAAS to maintain the content store will lay the preliminary groundwork for extending the Strand Map Service to support new concept spaces. Should sufficient NSDL stakeholder interest materialize, the Service data model and API could then be extended to supporting inputting new concept

spaces. Appendix B illustrates the architectural and API changes envisioned to support inputting new concept spaces.

When: Now through early 2010 to enable AAAS to maintain the content; early 2010 to late 2010 to support inputting new concept spaces.

Stakeholders impacted: AAAS/Project 2061, NSF, NSDL grantees and users

Rationale: AAAS/Project 2061 owns the benchmark and strand map content; they continually update, extend, and modify this content as a result of ongoing work and new research. It is duplication of effort for TNS personnel to take their changed content and re-catalog it for the Service. This approach will benefit NSDL grantees and users by ensuring they have reliable access to the most up-to-date AAAS content and ongoing access beyond the lifespan of TNS funding. NSF has invested significantly in the development of the AAAS content; this approach would help to ensure broader access and dissemination of this content over time. This work to support AAAS/Project 2061 to "write" updates to the Strand Map Service is the first step towards supporting additional concept spaces as it will require the basic architectural shift from the "read-only" application model of the current Service. It would be a logical extension of this work to develop a more generalized approach to updating and writing to the content store in order to support new concept spaces (see Appendix B). Recently funded NSDL projects such as the CLEAN Pathway have expressed interest in using the Strand Map Service to model new concept spaces (climate literacy learning goals). This functionality was also of great interest to many prospective grantees applying for funding in 2009. Feedback received on the draft Roadmap suggest that this capability could be useful for the higher education community to take advantage of this service by enabling faculty to create their own strand maps of learning goals for their courses.

Improving Support for Standards and Showcasing NSDL Standards-Aligned Content

Recommendations:

- Improve the performance of the Content Alignment Tool (CAT) and take steps to guarantee access to the CAT by the NSDL community
- Extend the NSDL Collection System to show related benchmarks to support aligning resources with AAAS Benchmarks
- Implement a mapping table from ASN-IDs to SMS-IDs (the SMS internal representation of a AAAS Benchmark) in order to support displaying resources that have been aligned to ASN identifiers.
- Develop a "benchmarks" collection containing selected resources from NSDL Pathways and other collection providers on core science topics.
- Feature state standards in Strand Map Service interfaces such as the NSDL Science Literacy Maps application

Option:

- Work with Teachers' Domain to add support for their standards lexicon in the NSDL Collection System

Work to be performed: The Center for Natural Language Processing (CNLP) at Syracuse University has expressed interest and desire to continue to make the CAT available to the NSDL community. Further work is needed by CNLP to improve the reliability and accuracy of these suggestions and to improve the robustness of CAT performance overall. Additionally, a formal arrangement is needed between Syracuse University and NSDL to ensure long-term access to the CAT for the NSDL community. TNS proposes to support the work of CNLP and to include in these negotiations provisions for long-term access to the CAT for NSDL grantees. CAT is already embedded into the NCS to support cataloging processes around aligning resources with science content standards, including both national and state standards. Catalogers would

like to select a AAAS Benchmark recommended by CAT and see a visualization of related benchmarks as one or more of these are also likely to be relevant. This visualization is already supported in the Strand Map Service and it will be straightforward to embed this capability into the NCS.

Building on the CAT and NCS, TNS will support the Resource Center, working with Pathways and other collection providers, to develop a high quality, highly curated small collection that embodies the "best of the best" of NSDL resources for selected science topics. Selected resources will be aligned to AAAS Benchmarks and educationally-specific metadata such as grade level will be provided as necessary to augment the existing records. TNS will showcase these resources in the Top Picks tab in the NSDL Science Literacy Maps interface. These augmented records can be shared back to the contributing collections. The Strand Map Service uses SMS-IDs based upon the Benchmark identifiers developed by Project 2061 to uniquely identify individual benchmarks. This is a different representational system than the ASN-IDs used in other parts of NSDL, including the CAT and NCS. In order to locate and display NSDL resources that have been aligned to AAAS Benchmarks using the ASN-ID representation, the SMS will need to be able to map between these two representational systems. One approach is to generate and maintain a mapping table between these two systems. A vexing challenge is synchronizing these mappings as they continue to evolve over time, since the two representational systems are maintained by different organizations and are modified at different rates.

Feedback from NSDL stakeholders has highlighted the need to support state standards in NSDL tools and services. The Strand Map Service already has the ability to display different standards frameworks that have been aligned to the AAAS Benchmarks. Work here will focus on how best to visualize this information in different application settings such as the NSDL Science Literacy Maps and a state-based application such as Indiana's Learning Connections. Additional "under-the-hood" work will be needed to enable a multi-site deployment model that supports site-based customization. For instance, the Indiana deployment will want to feature Indiana standards whereas a Massachusetts deployment would want to feature MA standards, even though both deployments are relying on the same underlying Service. Feedback received on the draft Roadmap suggested that TNS also consider the option to add support for the Teachers' Domain lexicon in the NSDL Collection System. Additionally, feedback indicated that there is considerable support for recommendation #1: improving the CAT and securing long-term access to this service on behalf of NSDL; there is also interest in convening a mini-technical summit on the general topic of standards representations and interoperability within NSDL.

When: Throughout 2010 and into early/mid 2011.

Stakeholders impacted: NSDL grantees, particularly collection developers and Pathways, will benefit from reliable and ongoing CAT operations. NSDL users will benefit from having more standards-aligned resources in NSDL. The Resource Center and educational organizations and institutions interested in embedding the Strand Map Service and/or NSDL standards-aligned content in their portals and applications.

Rationale: CAT is an important service for NSDL; several Pathways use it in their cataloging processes and it is embedded in core NSDL tools. There are currently no formal arrangements for ongoing support and maintenance of this service between Syracuse University and NSDL. In the short-term, this activity would lead to immediate improvements in CAT performance; in the long-term, it would provide a framework for ensuring continued NSDL grantee access to this useful tool. The addition of the related benchmark visualization has been requested by AAAS/Project 2061 to support the work being conducted as part of their recently funded NSDL Integrated Services award. This work involves training catalogers and other personnel in Pathways and Selection Services projects to align resources to AAAS Benchmarks.

The NSDL Science Literacy Maps is an important marketing tool for the Resource Center as they seek partnerships with educational organizations and institutions. Such partnerships should help to increase the reach and usage of NSDL, and may contribute to sustainability in the long-term. Discussions with these

organizations to date have highlighted two areas of high interest: interest in using the Strand Map Service to feature their state standards and/or interest in embedding NSDL standards-aligned content in their portals and applications. Often, these prospective partners want both; i.e., to embed the Service into their application and use it to feature NSDL content aligned to standards, as well as their own locally curated content. Developing a "benchmarks" collection would directly support these partners and also support NSDL grantees by enabling us to showcase some of the outstanding resources and collections being developed by NSDL projects within the Science Literacy Maps application in NSDL.org.

Embedding the Strand Map Service into Third Party Portals and Applications

Recommendation:

- Continue to provide deployment site consulting and technical support for integrating the Service into third party sites and applications

Work to be performed: The work to be performed varies considerably, depending on each site's needs and existing technical infrastructure. Additional features listed in Appendix A will be considered on an "as needed" basis as we work with specific deployment sites and partners. Specific deployment sites and or NSDL community partner efforts planned for 2010/2011 include:

- Middle School Portal 2: Use the Strand Map Service to embed appropriate middle school benchmarks, related benchmarks, and learning progression visualizations into the Math and Science Guides being developed by MSP2.
- AAAS/Project 2061: Complete the NSDL Collection System upgrade as described earlier.
- Indiana State Department of Education: Develop mechanisms and processes for embedding the Strand Map Service into their Learning Connections Portal
- Denver Public Schools: Continue to support the deployment of the Strand Map Service to middle and high school Earth science educators in DPS
- Continue to seek new partnerships and deployment sites. Prospective new partners or deployment sites with whom discussions are underway:
    - Massachusetts State Department of Education (led by RC)
    - Georgia State Department of Education (led by RC)
    - Montgomery County School District, Maryland (led by TNS and AAAS/Project 2061)
    - California County Educational Technology Consortium (led by TNS)
    - SMILE Pathway (led by TNS)

Update the NSDL Science Literacy Maps Application

- Option: Update the NSDL Science Literacy Maps interface to support Web 2.0 personalization capabilities and user-contributed content

Work to be performed: TNS is working with Recker (PI: Instructional Architect) and Sumner (PI: Curriculum Customization Service) to consider how the Web 2.0 personalization capabilities in these two learning applications can be made more broadly available as an NSDL platform service. An attendant issue is how to integrate personalization capabilities into NSDL.org. One option is to make the capabilities available through the NSDL Science Literacy Maps application. TNS will work closely with the Resource Center, science educator end-users of the current application, and prospective deployment sites and community partners to gauge interest in pursuing this option. Should this work go forward, it would commence in

mid/late 2010 and proceed into 2011. Feedback received on the draft Roadmap suggested that there is interest in personalization capabilities and interest in IA project capabilities, if the IA service can be architected such that it can be embedded in a third party portal and assume its look-and-feel. Additionally, feedback indicated that there is considerable support for convening a mini-technical summit on the personalization capabilities and interoperability of “personal collections” across NSDL.

Appendix A

SMS Development – New Features

This table describes new features that have been identified over the past months by SMS users, interested groups and key partners.

JavaScript API / CSIP	Information Bubble	Middleware / Viz Engine	Other
• * Ability to place labels/icons on the benchmarks or change their appearance, for example to indicate how many resources are linked • Ability to insert map-level information via API, similar to the misconceptions view, for example to show related research or scholarly research. • Single benchmark view (? – Joel SMILE) • Ability to add and/or move benchmarks/nodes • Limited/narrowed interface – smaller and connected/linked to all results (SMILE) • Ability to move/manipulate layouts to format the maps for printing • Show/add weights and annotations on the links (graph edges) • Ability to have a visual correspondence with the print version (for AAAS trainings, etc). • Ability to query CSIP or JS-API by NSES standard to pull up the corresponding benchmarks	• Implement NSDL Top Picks and Related Resources as built-in tabs in the API. Currently these appear only in the Science Literacy Maps and are not available to other clients from the API (*this work is in progress). • Add a tab that shows related research or scholarly research • Add a "notes" tab to capture personal notes • Show a tab that displays only the resources from a given pathway, from NSDL collections, for display in a pathway site. Have NSDL provide the tool/code to do this easily. • Show state standards in the tabs • Indicate benchmark importance - Show totals of number of ancestors/descendents of the benchmark (count the number of links – one deep or more)	• Ability to add third-party maps (ocean literacy maps, climate literacy maps, etc.) • Ability to import from third-party formats (CMap, GraphML, etc). • More continuity among the different strands – How do they cross over? A link to jump to the benchmark on a different map, for example, for shared benchmarks like in Atlas 2 • Ability to add benchmarks/nodes, from other AAAS maps, or new ones • Right click on a benchmark and see all the maps it resides in, or a tab in the InfoBubble • Show nearest neighbors on SMS maps (ancestors and descendents – Ted) • Ability to move or place benchmarks on the map in a specific x, y location in the map • Model/store/describe in the NDR • Generate a PDF for printing the maps tiled across multiple pages • Generate custom topology using existing benchmarks, for example to show middle school benchmarks only • Ability to add my own nodes, or select a map that just shows the benchmarks I need, for example to teach a particular unit	• Tutorials – Provide simple, straight forward tutorials for pathways leaders to use in training catalogers/assoc editors. • User guide: Describe how to do your own search service implementation, for the pathways search use case for example: display only certain maps with pathways data in them only • Align state standards to the benchmarks (proposed by Larry Chew and others) • Package the NCS/NDR and SMS as a bundle to allow groups a one stop solution to implementing the Maps with their own resources. Would require implementing an SMS client and NCS configured to work together out of the box to generate an SMS view over resources.

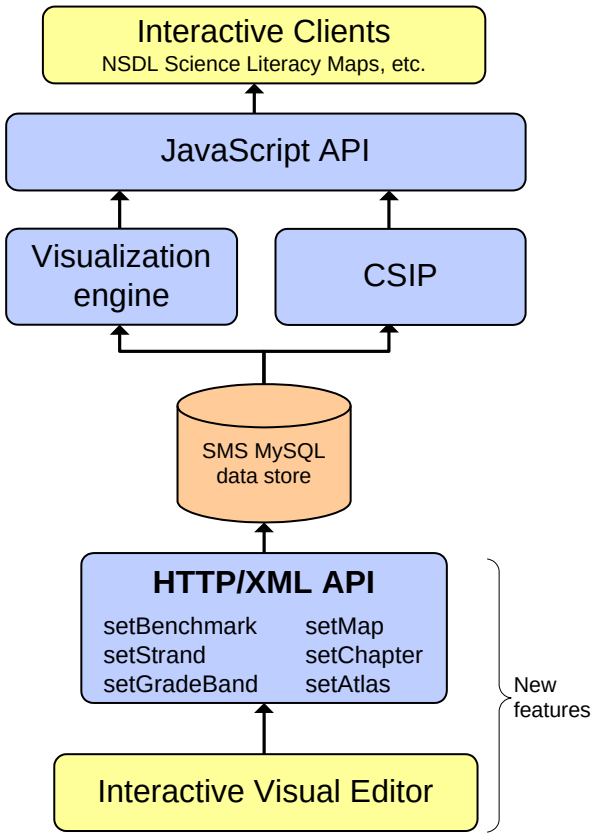
Appendix B

Implementation Plan for SMS version 1.3

The primary goals for this phase of implantation are to:

1. Add the ability to create, update and delete benchmarks, strands, grade bands, maps, chapters and atlases
2. Provide a Web-based editor for SMS benchmarks, strands, grade bands, maps, chapters and atlases
3. Provide a mechanism to import maps written in CMAP and/or other common formats

To support these features we propose adding an HTTP/XML API to the SMS that would directly update the local MySQL database. This API would have setter and getter methods to manipulate the objects in the SMS information space including benchmarks, strands, grade bands, maps, chapters and atlases. Writes would be committed to the database directly, which would remain the primary content store for the data model.



To support users, one or more clients would be developed using the API to allow real-time editing. We proposed implementing an interactive visual editor that would allow users to create, update and delete objects using an extended version of the current interactive map interface, for example by right-clicking to add a new benchmark in a map. An import feature would be implemented to allow users to load existing CMAP files into the editor. Another possible client implementation could be done using the NCS, which would allow cataloging using it's textual interfaces as opposed to a visual one.

The initial user audience would be catalogers involved in the development and maintenance of atlases and maps, as opposed to individual visitors who use the maps. The vision is to have multiple independent instances of the SMS, one per group, for example one for AAAS, one for Ocean Explorers, one for Climate Literacy, etc. Each group would be responsible for maintaining their own atlases and maps.

Versioning would be accomplished by creating a snapshot of the database and installing it at a reliable, unique, read-only versioned service URL for a long duration. For example, the current AAAS Science Literacy Maps are at http://strandmaps.nsdl.org/cms1_2, the next version would be released at http://strandmaps.nsdl.org/cms1_3 and so forth. Old versions would be kept available indefinitely to allow groups to update their clients to the new version and to support groups who are not able to update their clients. This versioning convention would be followed by the Science Literacy Maps and articulated as a best practice for other groups to follow.