Photo by Joseph Kerski

1

Managing tribal resources and protecting the environment

Native American tribal governments are some of Esri's original customers. Tribal forestry, range, and fisheries programs have used GIS for several decades now. The extensive use of GIS by tribal governments in support of natural resource and environmental management should not come as a surprise. Native Americans have strong personal, cultural, and spiritual ties with the earth. A Tribe's cultural identity is inextricably tied to the places they and their ancestors have lived and worshiped. The animals and plants that inhabit tribal areas represent a natural living fabric over these lands, which provide the food, shelter, and medicines that rejuvenate and sustain Native American People. There are many individuals and unique threads, or assets, which contribute to this fabric. These assets can be abstracted in a GIS, allowing them to be better understood in the context of complex, ever-changing landscapes.

By embracing GIS technology, a Tribe can conduct a detailed inventory of current natural resources as well as incorporate traditional ecological knowledge on that resource's quality and health generations back. Traditional knowledge and information technology are not mutually exclusive. By incorporating the wisdom and experiences of tribal Elders into a common framework with current observations on natural resources, environmental trends become obvious.

As the relationships and dependencies within ecosystems are better understood, the state of tribal natural resources can be projected. GIS can spatially model dynamic relationships, allowing natural resource management practices to be virtually tested and rated on their reflection of the Tribes' values and long-term objectives. The health and abundance of the community's natural environment is a major factor in the health of the tribal community. GIS provides an integrated approach to visualizing these complex environments and analyzing the relationships within them. Through spatial analysis, unique models can be developed to help set priorities, suggest appropriate harvesting methods, and assist in developing long-term sustainable management practices. Tribal lands are not infinite, and Tribes are increasingly challenged to maintain a limited footprint. This situation often requires tribal lands to be used in multiple ways; however, ill-advised land-use changes are likely to impact other tribal interests. Therefore, a multi-dimensional framework, such as a GIS, is required to provide visibility of these complex relationships and dependencies. GIS provides a platform for integrating diverse layers of information into a common operational view where the relationships across natural resource and environmental assets provide important context. GIS allows critical areas to be mapped, managed, and protected so that scarce and sacred resources can be maintained for future generations while economic development opportunities are maximized.

GIS professionals from three tribal governments have contributed to this chapter on the use of GIS for the management of natural resources and the environment; they include the Confederated Tribes of Siletz Indians, Squaxin Island Tribe, and Confederated Tribes of Grand Ronde, with usual and accustomed areas reaching across the US states of Oregon and Washington. Each Tribe has applied GIS to unique management challenges and has shared their stories and approaches here for the benefit of other tribal and indigenous communities.

Using GIS to protect critical wildlife habitat

Brady Smith, GIS Planner; and Mari Kramer, Assistant Tribal Forester
Confederated Tribes of Siletz Indians
Siletz, Oregon

The Siletz Tribe is a confederation of a number of western Oregon Tribes on one reservation. Prior to treaties and removal, individual villages were autonomous and each one acted politically independent. Tribal members took only what was needed and respected the land, fish, and wildlife. With ample territory for their subsistence needs, villages and populations did not infringe upon each other's hunting areas. These principles allowed for the Siletz ancestors to call western Oregon home for thousands of years.

In fulfillment of treaty promises, western Oregon Tribes were moved to a 1.1-million-acre Coast (Siletz) Reservation established in 1855. However, most of the reservation was opened to settlement by presidential and congressional actions in 1865, 1875, and 1892. In 1954, the Western Oregon Termination Act was passed, ending federal recognition of the Siletz Tribe. After many years of complex negotiations, the Siletz Tribe was restored to federal recognition in 1977. In 1980, the Tribe had 3,630 acres of original reservation timberland and thirty-six acres known as Government Hill returned as reservation land in Siletz, Oregon. Following restoration, the Siletz have worked diligently to recover as much of their ancestral lands as possible. Today, the Siletz Tribe has managed to acquire additional acres of timberland and real estate, through purchase or gift, within the original reservation boundaries.

The Tribe realized several years ago that GIS could be an effective tool for land management. In the early 1990s, GIS was used primarily for tracking forest management activities. The GIS program has faced a variety of challenges over the years, including turnover of experienced personnel, which hindered the overall success of the program. After a number of years of not having a dedicated GIS person, the Tribe reevaluated the value of GIS, and a position with stable funding was created in 2004 that would serve all tribal programs. This resulted in a more centralized approach to GIS, allowing key information to be shared between tribal departments. Today, the Tribe's GIS platform provides decision support for the following tribal programs: Tribal Administration, Real Estate, Planning and Community Development, Fish and Wildlife Management, Forestry, Culture, and Education.

The Siletz People have always tried to protect land, fish, and wildlife for future generations. However, their environmental stewardship was dealt a severe challenge in 1999 when a ship, the M/V *New Carissa*, ran aground just north of the entrance to Coos Bay. Approximately 25,000 to 140,000 gallons of tar-like "bunker" fuel were lost to the marine environment. The impact was devastating, particularly on wildlife. Over 260 marbled murrelets, a threatened bird species, were killed in the event. As part of a settlement with the responsible party, approximately 4,260 acres of timberland were purchased to compensate the public for injuries to marbled murrelets caused by the spill. The land is located within the Siletz River Basin and consists of predominantly commercial timberlands.

The Siletz Tribe was selected as the land manager over two conservation groups, and the property was transferred with a conservation easement, restricting activities on the land to create habitat for the threatened species. As part of the conservation easement, the Tribe had to develop a management strategy that would protect habitat while generating enough revenue to maintain the land.

The first step was to develop a baseline report for the property. This initial report included information on the property's natural resources (timber, fish, wildlife, soils, streams, and vegetation), adjacent land ownerships, property boundary surveys, water rights, road use agreements, and other relevant management information. The information was collected from various sources, including timber cruises (sample measurements of sections of forests that are used to determine an estimate of the amount of standing timber volume that the forest contains), wildlife surveys, property line surveys, state and county records, and GPS data collected by the Tribe. An unforeseen obstacle in the collection of data, between the start of the project and the completed report, was a change in the property boundary as a result of a new land survey. This boundary change required the redevelopment of several GIS layers that were critical to the accurate analysis of the data. GIS was a valuable tool in developing the baseline report narratives, tables, and maps. It was also a key tool in developing the property management plan.

The desired outcome for the management of the property is to have areas that would serve as a habitat for marbled murrelet as well as areas that would generate revenue for property management activities. To implement this management strategy, a polygon layer with three protection area categories (Highest, Buffer, and Standard) and two sub categories each was developed using the baseline information. These protection areas dictate where different types of management activities will occur on the property. Areas designated as the Highest Protection Area (HPA) classification are occupied marbled murrelet habitat as well as unoccupied suitable habitat. Buffer Protection Areas (BPA) include buffers of

300 feet around the HPA to protect habitat areas from disturbance and for development of future habitat. Standard Protection Areas (SPA) are the remaining areas not classified as either HPA or BPA.

By using GIS to map the protection areas for the property forest, managers realized it would be difficult to manage all activities on the property. Some management activities would need to occur within habitat areas, whereas other higher impact activities would need to be limited to areas where there was no habitat. Following a review of the baseline report, a list of planned activities for the property was identified. In order to effectively model where these activities would be allowed, GIS overlays were used to guide appropriate zones for various activities, which were referred to as "overlay zones." Based on GIS analysis, a final strategy was presented to the conservation easement grantees and the Siletz Tribal Council in the form of a management plan. In addition to the documents developed in support of the final plan, GIS was used during the public outreach related to the program. Large-format maps were used to help inform the public about the plan. This helped to effectively convey the Tribe's management strategy to the public and to the conservation easement grantees.

GIS allows tribal natural resource managers to visualize, plan, and monitor future management activities while considering protection areas and overlay zones. It also helps ensure that the management strategy is consistent with stipulations outlined in the conservation easement by establishing the areas that will become habitat. Using GIS helped the managers understand what areas on the property would produce the revenue to manage the property and what areas would be managed as protected habitat.

Currently, the geographic information about this property is stored in a geodatabase managed by ArcGIS Server. Data is used in several different platforms, including ArcGIS Desktop, ArcReader, and ArcGIS Server. It has also been recently incorporated into a web map application, which allows for easy access to the data for non-GIS users. Without the use of GIS in this project, the development of an effective management strategy would have been difficult to accomplish in the relatively short timeline required. This investment in GIS has also led to new opportunities for the Tribe and its resources. The GIS system was leveraged to support a successful grant for habitat restoration on a critical fish spawning stream on the property. The project will provide habitat restoration for salmonids and lamprey eels along seven miles of the stream. A helicopter will be used to place nearly 500 logs, half with root wads, in the stream to improve the habitat for the fish. GIS supported the planning of this project and supported the identification of source trees, helicopter staging areas, and in-stream placement sites for the logs. In these examples, GIS provided both a framework to support tribal decision making and the consideration of various land management strategies, as well as an actionable tool to aid in habitat restoration activities.

Developing a tribal natural resource atlas

Levi Keesecker, Quantitative Services Manager, Natural Resources Department
Squaxin Island Tribe, Washington State

Members of the Squaxin Island Tribe are Native Peoples of Puget Sound, an inland waterway that travels far from the ocean through a mystical braid of channels and islands between the fortress of the Olympic

Mountain Range to the west and the Cascade Range to the east. Squaxin Island tribal members are descendants of maritime people who lived and prospered along the southern extent of the sound for untold centuries. Because of their strong cultural connection with the water, they are also known as the People of the Water: the *Noo-Seh-Chatl* of Henderson Inlet, *Steh Chass* of Budd Inlet, *Squi-Aitl* of Eld Inlet, *Sawamish/T'Peeksin* of Totten Inlet, *Sa-Heh-Wa-Mish* of Hammersley Inlet, *Squawksin* of Case Inlet and *S'Hotle-Ma-Mish* of Carr Inlet. Through a treaty with the US government, one small island, four-and-a-half miles long and a half-mile wide, was reserved as the main area for all of the Tribe to live. The island was named after the People of Case Inlet and became known as Squaxin Island. Tribal headquarters are now located in Kamilche, between Little Skookum and Totten Inlets, where today hundreds of acres of land have been purchased and a thriving tribal community has been established. Despite the many interests and priorities of the Squaxin Peoples, the natural landscape and its resources remain a primary focus for the Tribe. Since 2003, the Squaxin Island Tribe has been applying GIS technologies to manage fisheries, watersheds, streams, environmental monitoring, and to plan future development. Tribal resources are not unlimited and often-difficult decisions need to be made as to where the Tribe can make the most impact in improving sensitive habitats.

The annual return of salmon to tribal waters is a fundamental cultural and subsistence resource for Native Peoples of the Northern Pacific Coast. The family of fish generally referred to as "salmon," or salmonids, follow a complex life cycle that begins with juvenile fish starting out in streams and rivers and migrating out to the open ocean to mature. Once fully matured, the salmonids return to the same freshwater pools where they began their lives to spawn the next generation.

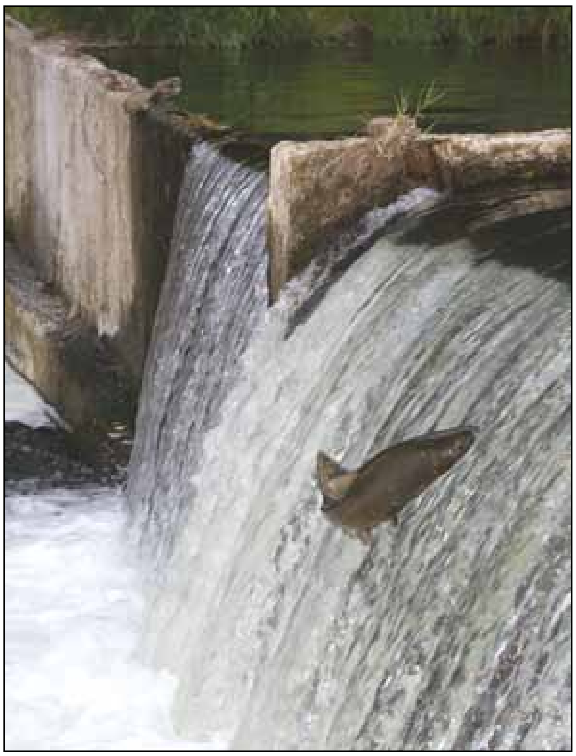

Figure 1. Mature salmon return to their freshwater spawning grounds. From Shutterstock, courtesy of Daniel W. Slocum

When the Squaxin Island Tribe set out to optimize the impact of its natural resource management programs for the benefit of salmon populations, it leveraged GIS to model the areas of highest impact and vulnerability of salmonids habitats. Tribes as well as local governments and nongovernmental organizations in South Puget Sound often have difficulty prioritizing near-shore conservation and restoration projects. This is due to the limited amount of funding for restoration projects, the large amount of near-shore habitat in the region, considerable variation in habitat quality, and a complex tapestry of land ownership along the shoreline. Using GIS, the Tribe developed a Juvenile Salmonid Near-Shore Project selection tool to aid local governments and nonprofit organizations in selecting areas for habitat restoration and conservation projects. This project was funded by a grant from the Washington State Salmon Recovery Funding Board.

The process began with a detailed requirements gathering phase, which identified what type of information product would be most effective given the needs and technical capacity of end users of the system. Gathering detailed requirements from the community that will eventually use the GIS tools is critical to successful GIS implementations. Thoughtful advance consideration of the users' needs is required to appropriately apply the capabilities of GIS technology to the challenge at hand. Taking the time to meet with potential users and to inform and engage tribal leaders not only allows the collection of important requirements for the GIS system design, but also obtains support and buy-in along the way. Giving users a voice in the design of the system allows them a sense of contribution and ensures that the system reflects the broad needs of the Tribe. When broad user requirements are obtained, the stakeholder community feels as though it contributed to the system design and the resulting analysis was accomplished in part through its efforts. Following the requirements process for the Squaxin Island Near-Shore Project selection tool, it was determined that the final product should be a simple-to-interpret map that clearly depicts areas of high conservation or restoration value. In order to determine where the high value areas were located, a methodology was adopted from a previous study in neighboring Mason County, Washington (Anchor Environmental 2004).

One of the powerful abilities of a GIS is incorporating a variety of data elements into a composite view of a given environment. It is one thing to independently map current land-use practices along the shoreline, land ownership, and areas where salmonids are known to be present. One approach taken by the Squaxin Island Tribe is to bring these and many other spatial data layers together to depict the environment in its totality by modeling the impact these layers have on a given outcome, in this case the habitat quality for salmonids. GIS modeling referred to as geoprocessing provides this capability, allowing multiple layers of spatial data to be considered together in a comprehensive view of the environment being modeled. Once a model is authored, it can be run over large areas limited only by the availability of the spatial data used by the model. In the case of the Squaxin Island geoprocessing model, the Mason County model was modified and scaled to allow the analysis of all of South Puget Sound with over 400 miles of shoreline. Using the ModelBuilder framework with ArcGIS Desktop, geoprocessing models can be designed, tested, and run.

Using the ModelBuilder framework, the Squaxin Island Juvenile Salmonid Near-Shore Project selection tool applies GIS modeling on a larger scale to prioritize the restoration benefit of parcels along southern Puget Sound, based on a significant number of input layers and a variety of tools that contribute to the final output. As in our simple examples shown here, GIS layers (blue rectangles) are coupled

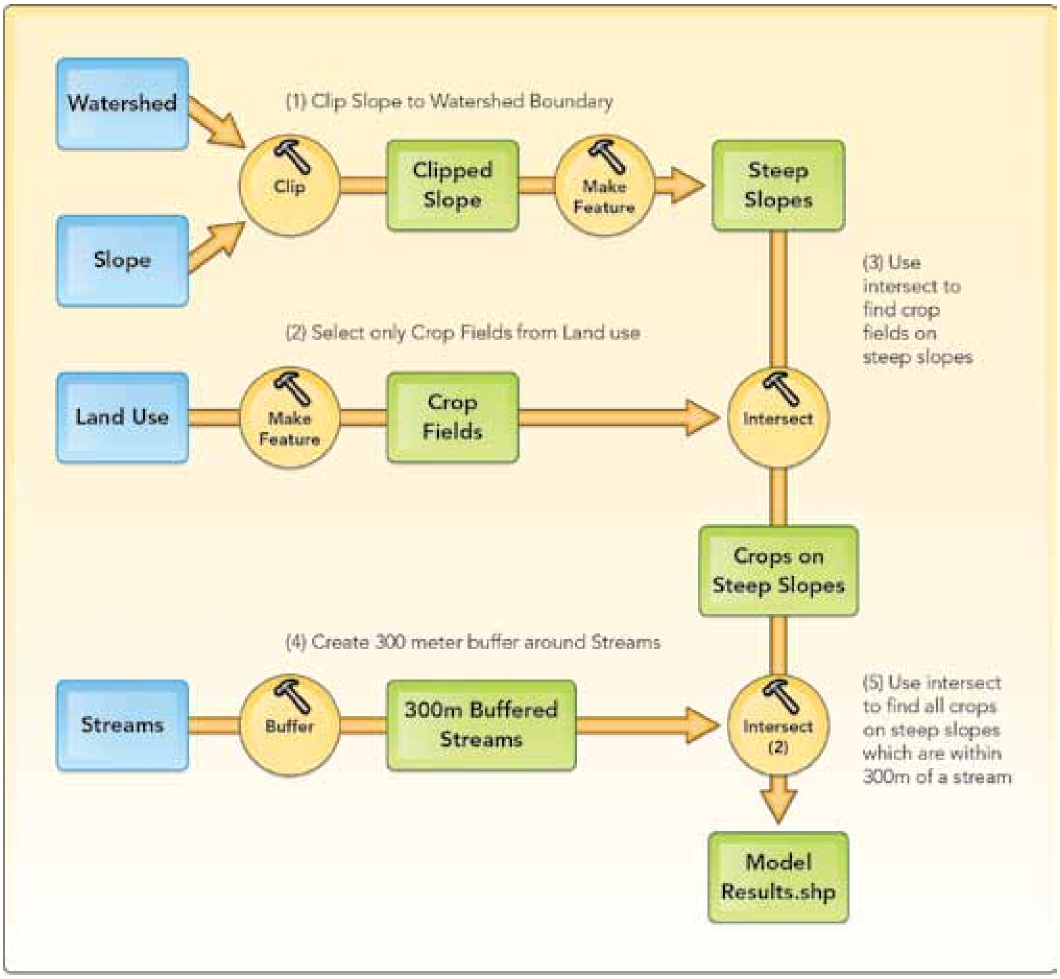

Figure 2. In this sample model, multiple criteria are considered to determine which crops on steep slopes are within 300 meters of a stream.

with a series of geoprocessing tools (orange circles) and output layers (green rectangles) to author a complex analysis. In this model, geoprocessing tools are used that assign a positive or negative "weight" to input layers based on their contribution to salmonid habitats. Weighting can be thought of as allowing each layer (or attributes within a layer) to have a vote in the final output of the model.

ModelBuilder also supports the nesting of one model within another. In this way, a model that initially excludes areas that are not relevant to the test can first be invoked to reduce the areas that are participating in the subsequent analysis. Other subroutines may iterate a model based on data that changes on a daily or monthly basis. In this way individual records in a table can be taken one at a time and run through the model, resulting in a mosaic dataset that shows change and trends over periods of time and over large geographic areas. The Juvenile Salmonid model is in fact a series of models that together provide a final composite result. Initially a set of three, limiting models are run, excluding areas that include features that would limit salmonid use, such as the presence of docks or overwater structures. Once these areas are excluded, a series of nine benefit models are run, which identify habitat features that would benefit salmonids, including proximity to a salmon-bearing stream, pocket estuary, presence of intertidal vegetation, or forage fish spawning beaches. This approach of building a beneficial and limiting model is that it allows you to determine areas that should be good for salmon (high benefit) that have high limiting scores, which would potentially be restoration sites. Areas with high benefit and low limiting are ideal conservation sites and are used to guide land acquisition activities by the Tribe and conservation trust organizations.

The results of the Juvenile Salmonid Near-Shore Project selection model identified the near-shore areas most important for conservation or restoration. As a result of this GIS analysis, future habitat restoration efforts are now prioritized based on a defensible consistent geographic analysis for South Puget Sound. In addition to benefiting the Tribe, this project benefits nonprofit organizations and local governments, as it allows them to target resources more efficiently. GIS provides a common framework for collaboration across a complex multi-jurisdictional landscape. Three local governments in the Puget Sound region have adopted the results of the model into their shoreline management plans as it represents the best available science on priority habitat areas for Puget Sound. Other nonprofit organizations have incorporated the model into their conservation programs. Oftentimes, landowners will contact these organizations for guidance on improving their land for the benefit of the environment. These organizations are able to use the GIS model output to locate the landowner's parcel and determine if it is an area of high or low restoration value in order to recommend the most appropriate conservation measures.

Increasingly, Tribes lead natural resource management negotiations across the private, governmental, and nonprofit stakeholders. The use of GIS is a powerful tool, allowing Tribes to inventory, track, and protect the health of critical resources. As Tribes are able to bring more land back into tribal jurisdiction, land acquisitions can be prioritized based on the highest return in habitat and natural resources for the benefit of the Tribe and surrounding communities. As Tribes adopt GIS technologies and make investments in key spatial data, staff, and technology, a new era of decision support and collaboration is emerging. GIS and spatial analysis can inform managers on how to apply limited program resources in a manner that ensures the highest gain. At Squaxin Island, GIS is used to better understand and protect threatened resources.

References

Anchor Environmental. 2004. Greater Mason County Near-Shore Habitat Assessment. Prepared by Anchor Environmental for Squaxin Island Tribe.

GIS for timber sale planning

Jason Bernards, Forester; and Volker Mell, GIS Coordinator
Confederated Tribes of Grand Ronde, Oregon

Since time immemorial, numerous Tribes lived in their traditional territories in western Oregon. Their territories extended from the Columbia River south of the Klamath River, and from the crest of the Coast Range to the crest of the Cascade Range. Beginning in 1853, these Tribes signed treaties with the US government, ceding away their traditional homelands for a permanent reservation in the Coast Range. In 1856, the Rogue River, Umpqua, Shasta, and Takelma Peoples were relocated from Table Rock and Umpqua Reserves to the Grand Ronde Reservation in northwestern Oregon. They joined the Kalapuya, Chinook, and Molalla Tribes and Bands from the Willamette Valley and the Columbia River that joined the reservation from the east.

In 1954, the Grand Ronde Reservation was terminated by the federal government. Termination was a devastating federal policy that severed the relationship between the Tribes and the federal government, resulting in the loss of federal services and benefits to the tribal members. In 1983, the federally recognized status of the Confederated Tribes of Grand Ronde was restored, and the Reservation Act of 1988 restored 9,811 acres to the Tribe, which is located between Salem and the northern coast of Oregon in the Coastal Mountain Range. The Tribe is now a sovereign Nation with the ability to protect its distinct differences, ways, and customs as an indigenous People while providing governmental services to the tribal members. The Tribe's vision is to be a community of caring people, dedicated to the principles of honesty and integrity, building community, responsibility, and self-sufficiency. The Tribe promotes personal empowerment and responsible stewardship of human and natural resources and strives to be a community willing to act with courage in preserving tribal cultures and traditions for all future generations.

The natural resources of the 9,811 acres of forested land managed by the Grande Ronde Natural Resources Department (NRD) provide timber production, fish and wildlife habitat, and recreational use. The Grand Ronde NRD uses GIS for day-to-day decision support on forest management, wildlife biology, and environmental protection issues. Since the natural landscape is constantly changing, field NRD staff collect GIS data on a regular basis, along with their other primary activities. This constant field data collection when incorporated into the NRD GIS platform allows finite lands under tribal jurisdictions to be managed effectively for multiple uses with the highest return. One benefit of this platform is support for efficient timber planning and harvest activities while protecting sensitive wildlife areas.

The Grande Ronde NRD program has taken an enterprise GIS approach, which makes spatial data and services available to all tribal government programs through the centrally managed GIS department. In this model, the geodatabase is used to store GIS information from different tribal government offices in a secure manner. In the 1980s and early 1990s, GIS layers were traditionally stored in file formats such as an ArcInfo coverage or a shapefile. Using GIS layers stored as files becomes problematic when multiple individuals need access to the same information. There is also no support for security or compression or a simplified way to back up a large number of file-based GIS layers.

In the mid-1990s, the geodatabase was introduced to solve these data management challenges. Geodatabases now proliferate across the ArcGIS platform with a number of variations on the geodatabase model intended for individuals, workgroups, enterprise, and even large distributed organizations. At Grand Ronde, a number of tribal government offices have their data stored and centrally managed in a number of geodatabases on the GIS department's servers. The use of GIS varies across the tribal government offices. Some offices have only one or two occasional GIS users, while others, such as the NRD GIS Department, have four or five staff members using ArcGIS Desktop software on a daily basis. Across each tribal government office, GIS staff members are responsible for keeping their GIS information up to date. This is accomplished through a series of unique workflows where tribal government staff members edit data and conduct field observations to keep their information up to date. Despite the centralized management of data in the GIS department, the responsibility of keeping data current remains the primary function for each office based on its own mission within the tribal government.

One of the central geodatabases on the GIS server is dedicated to data that is commonly used by the natural resources department. There are several GIS layers stored in the geodatabase that are set up for versioned editing. Versioned editing allows GIS layers to be "checked out" from the master database for modification and updating. A versioned GIS layer might be taken into the field on a laptop and edited there based on field observations or modified locally while disconnected from the enterprise geodatabase. Each of the layers edited by NRD staff is assigned to a data steward, a reviewer who makes sure that edits made by the foresters and biologists to these layers are correct. This administrative step to authenticate the editing process assures that the incoming data into the GIS system is as current and accurate as possible and is a key part of the workflow. Once reviewed by an administrator, the versioned dataset is "checked in" to the master geodatabase.

Across an enterprise GIS framework, security is an important consideration. Not every tribal employee should have access to all of the GIS information in the system. In the case of Grand Ronde, access to the geodatabase is done through operating system authentication. The Grand Ronde IT Department manages several user-groups, which are used to control editing and viewing rights to the geodatabases. The Tribe also uses a geodatabase replication architecture to provide further security. In this way, multiple geodatabases are used in a hierarchy to allow concurrent multiuser editing while keeping the Tribe's master geodatabase secure. To accomplish this, a copy, or "child version" of the Tribe's master database, is created for the use of the NRD. Additional "children" databases are created for the use of the data stewards and subsequent child geodatabases for the NRD staff for editing. This model allows for additional security and control of local data as edits are rolled into the master database as approvals and reviews are completed. In the same manner, the versions edited by foresters and biologists are child versions of the data steward versions. This comprehensive system of versioning enables the Tribe to constantly edit all GIS data by the appropriate tribal employee.

To better understand how this GIS architecture serves the Tribe's information management needs, let's step through the GIS workflow that supports the planning of a standard timber sale. First, the NRD staff member opens a map document "Timbersale.mxd," which is stored on the file server. Foresters will usually create a file folder named after the timber sale to store temporary data, image files that are produced, and a subfolder storing data for field editing. ArcPad is a lightweight GIS application that runs on mobile devices, allowing GIS data to be updated in the field. Data checked out to ArcPad contains point

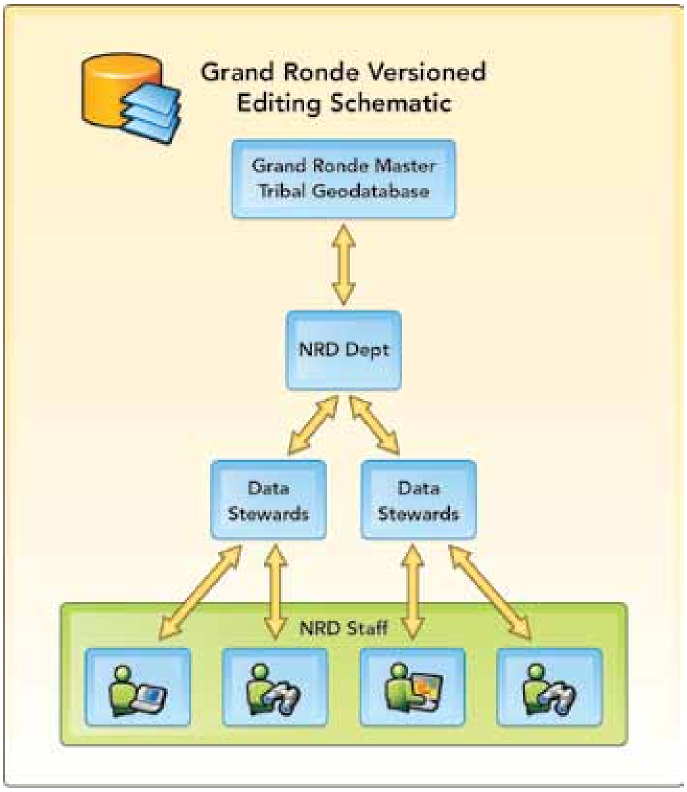

Figure 3. Grand Ronde NRD multiuser editing framework.

layers for roads, streams, and cut blocks, together with background data like aerial photos, contour lines, and the reservation boundary. The reason for not checking out versions of the original streams, roads, and cut boundaries is that due to a heavy canopy and steepness of terrain, it is not possible to collect accurate GPS data in all locations. The GPS availability, especially along streams, is spotty due to the even denser vegetation and the often restrictive topographic situation.

After the point data on proposed timber sales is acquired in the field, it is "checked back into" ArcGIS Desktop, using the ArcPad data manager extension. The GIS user then works with his or her version of the data to adjust streams, roads, and timber sale unit boundaries to the points surveyed with GPS in the field. The GIS user can then edit the data for better accuracy, relying on data layers such as high-resolution orthophotos and digital elevation models (DEMs) to amend the GPS data where the accuracy is questionable.

The data stewards who review the incoming data in this timber sale workflow are the timber and roads coordinator for the roads and timber sale boundaries; the biologist for the streams; and the silviculturist, or forester, for the stand boundaries. Edits done by multiple foresters in their versions of feature classes are verified against each other by the data stewards. The data stewards use the version changes tool in ArcGIS Desktop to compare the changes and decide if further field verification is necessary.

When the field edits are approved by the data stewards, they inform the GIS coordinator, who updates the master geodatabase. This versioned editing process of the central feature classes for the NRD improved the efficiency of the timber sale planning process. The data surveyed in the field is immediately available to all of the involved staff at NRD. Besides creating maps and updating existing GIS data, the NRD is using GIS to estimate the volume of board feet to be expected from a timber sale. After identifying the locations of all streams, roads, cutting block boundaries, and yarding roads, the forester can then use an array of geoprocessing tools, combined with the pre-sale timber cruise, to estimate the total volume removed from a cutting block. This is accomplished by removing non-forested areas from the cutting block so that an accurate estimate of board feet can be calculated. During this process, sensitive areas, such as elk meadows, can also be identified and protected from the commercial timber activities. The Grand Ronde regularly use geoprocessing tools, such as the buffer tool discussed earlier, and "cut polygon" and other tools, allowing the GIS representation to match the real world situation as closely as possible.

This use of GIS in support of the Grand Ronde NRD program makes it possible for the Tribe to manage the natural resources on the reservation in a comprehensive and holistic manner. The ecologic concept that everything is in some way connected in nature is showcased in the Confederated Tribes of the Grand Ronde's use of GIS to support the management of their natural resources for multiple use.