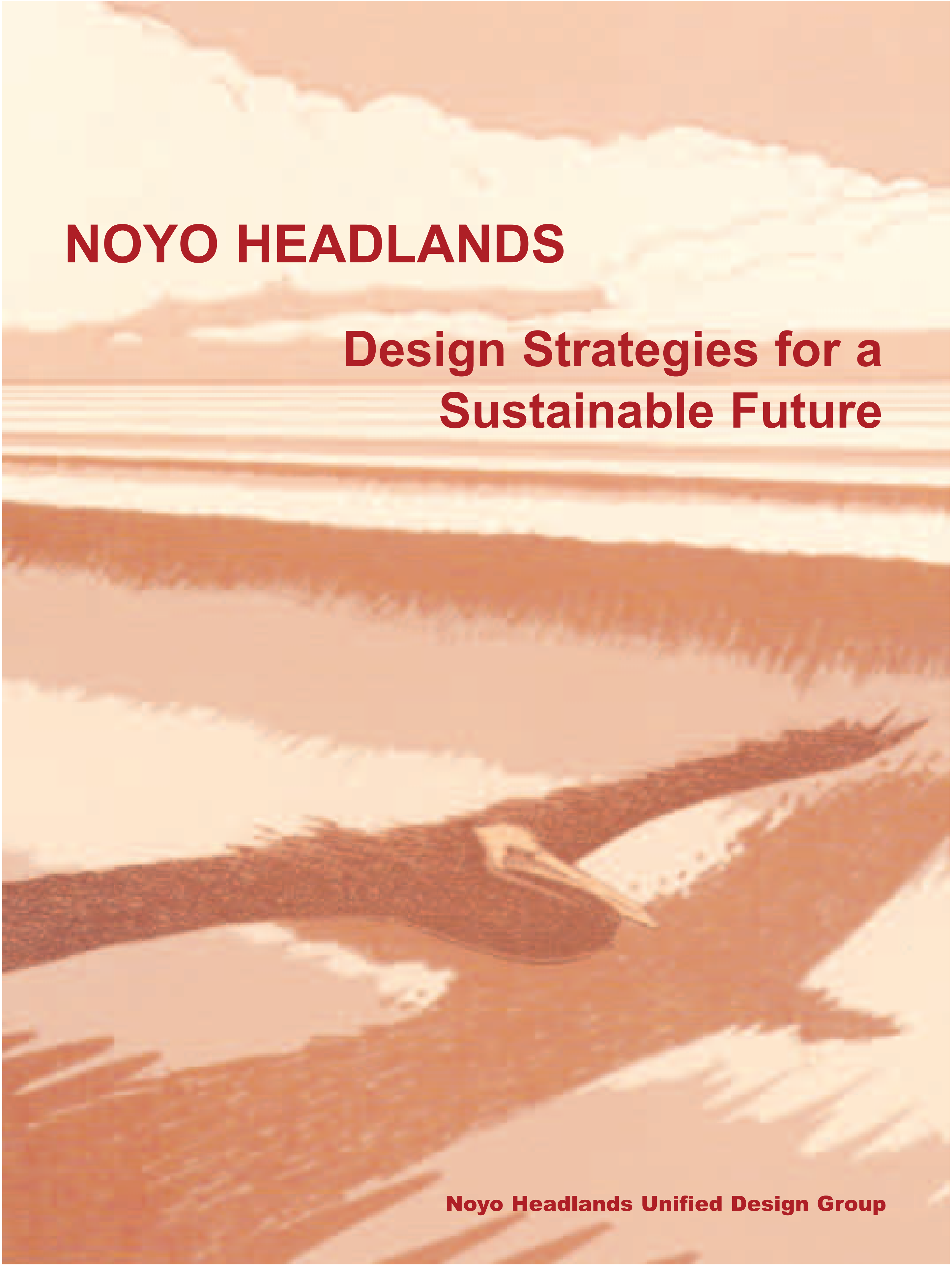

NOYO HEADLANDS

Design Strategies for a Sustainable Future

Noyo Headlands Unified Design Group

Credits

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Acknowledgments

This project was made possible by a generous grant from the Bellavista Foundation.

The following individuals graciously contributed technical expertise, advice, or photographs: Paul Abramson, Kenneth & Gabrielle Adelman, Cindy Arch, Justin Augustine, Julie Bargmann, Mimi Bashaw, Mara Baum, Sharon Bowers, Jason Bradford, Christina Carpenter, Daniel Dickson, Jason Dose, Daphne Edwards, Rochelle Elkan, Tina Fabula, Erica Fielder, Shirley Frericks, Karen Gaffney, Matt Gearhart, Dan Gjerde, Greg Grantham, Don Gustofson, Doug Hammerstrom, Steve Heckeroth, Kerry Heise, Tom Honer, Lori Hubbart, Craig Hunt, Rosey Jencks, Gwen Johnson, Philip Johnson, Matthew and Barb Knecht, Douglas Kot, Joern Langhorst, David Lehrer, Patty Madigan, Bill Maslach, Marcia McNally, Adina Merenlender, Joan Nassaeur, Brad Olson, Rich Owings, Rene Pasquenelli, Juan Pena, Nancy Philips, Suzahna Poliwka, Michael Potts, Ted Rabinowitsh, Gary Ratway, Linda Ruffing, David Russell, Debra Scott, Steve Sheldon, Teresa Sholars, Bob Spies, Kathrine Springman, Robin Stark, Roger Sternberg, Diana Stuart, Judy Tarbell, Brian Teitelbaum, Alis Valencia, Peter Warner, Rixanne Wehren, Andy Whiteman, Diana Wiedemann, Jane Williams, Skip Wollenberg, Jim Zanetto.

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North Coast Action's early sponsorship of community visioning efforts for the Noyo Headlands and their ongoing attention to the planning process, particularly related to site contamination, has contributed to NHUDG's efforts.

The City of Fort Bragg provided aerial photographs, supporting documents, and information. With funding from the California Coastal Conservancy, they hired consulting firm Moore Iacofono Goltsman, Inc., whose concepts informed this report.

NHUDG is a nonprofit group under the 501(c)3 auspices of the Coastal Land Trust, who provided administrative support.

About the Noyo Headlands Unified Design Group (NHUDG)

With a reverence for the heritage of the North Coast and a vision for the possibilities of the future, the Noyo Headlands Unified Design Group endeavors to foster the planning and implementation of an integrative and viable natural restoration plan for the Georgia Pacific mill site. NHUDG advocates the creation of a unified plan for the future Noyo Headlands development that is based on the Hannover Principles, which "insist on the rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition."

NHUDG grew from efforts sponsored by North Coast Action (NCA), which began holding community forums on the future of the 434-acre property in the spring of 2003. In January, 2005, a "design day" charette brought together some civic leaders and local design and building professionals to envision a sustainable future for the Noyo Headlands. This report grew from the ensuing investigations.

About this document

This report does not offer a single plan of what should happen on the Noyo Headlands. Rather, it outlines a sustainable approach to the planning and design of the Noyo Headlands. Its central question is: How can Fort Bragg's coastline make a transition from its current state – separated from the city, and relatively barren – to a sustainable Noyo Headlands – integrated with the city and overflowing with life? It answers this question in four parts:

Part I: Remediate addresses the site contamination. It emphasizes the need for an open, participatory remediation process, respecting the industrial and pre-industrial histories of the Noyo headlands, taking a cautionary approach to cleanup, and considering innovative cleanup approaches. Appendix A provides additional detail about the cleanup process.

Part II: Restore presents opportunities for ecological restoration and stewardship. It focuses particularly on soils, historic waterways, plant communities, and wildlife.

Part III: ReBuild discusses key principles of ecological design and green building. After introducing the basic concept of ecological design, it applies it to five elements of building and infrastructure: energy, food, stormwater, water, and wastewater. Appendix B is a visual summary of this chapter's key ideas.

Part IV: ReInhabit considers how the guidelines from Parts I-III fit into a planning and design process. Beginning with a wide-angle lens, it considers how ecological ideas can permeate an economic development strategy. It discusses regional and local transportation linkages that could be created with the site. It then zooms in, to consider how ecological design and green building can permeate the master plan of the site, the street and block network, and smaller-scale design and placemaking strategies.

This report is a working document intended to provide a framework within which to organize the community's evolving vision of a sustainable future for the Noyo Headlands.

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I. Remediate

Citizen Participation, Cleanup of Contamination, Honoring the Past, and Looking to the Future

The remediation of the Noyo Headlands is the biggest challenge in transforming it from a relic of its industrial past to a vibrant center for Fort Bragg revitalization. Addressing the contamination is the link between the past and the future. Taking responsibility now will allow future generations to benefit from the Fort Bragg coastline.

A. Begin Remediation with an Open and Inclusive Process

1. Address toxins head-on with a thorough site investigation.

Industrial sites that may be polluted justifiably make people nervous. Current inhabitants and potential future residents could be exposed to hazardous substances. Developers could incur liability, or their development might be seen as dangerous. Even with liability removed, contaminants discovered later could lead to major inconvenience – construction delays, or even demolition, to allow further cleanup.

A complete site investigation is crucial to overcoming these understandable concerns and successfully redeveloping the mill site. A thorough site investigation generates the information needed to prepare the site for its next use. It decreases risk to investors. It alleviates worry among local residents. It builds support and enthusiasm for future projects on the site.

> "**The single most fundamental characteristic that distinguishes brownfields from other types of real estate properties…is the presence or perception of contamination by hazardous substances…. The degree of knowledge regarding the presence, type, source, extent, and severity of the contamination directly influences project success.** This degree of knowledge must then be applied to the project in terms of marketing, redevelopment, financing, and legal or regulatory strategies and options… **The more information obtained in this phase, the greater the potential for success becomes.**"
>
> - "Characteristics of Sustainable Brownfields Projects," July 1998, U.S. EPA, 500-R-98-001, www.epa.gov/brownfields/pdf/sustain.pdf

Case Study: Lake Okeechobee, FL. Untreated pollution got stirred up, jeopardizing tourist revenues and restoration investments.[1]

In Lake Okeechobee, Florida, untreated pollution thought safely left on the lake bottom is jeopardizing this year's tourist revenues and up to $8.4 billion in restoration investments. Contaminated agricultural sediment that had settled on the lake bottom was churned up by last year's hurricanes, leaving the water "the color of hot cocoa."

The muddy water will block sunlight, killing plants. The chemicals attached to the sediment will promote algae blooms. These will further block sunlight, and also deplete the lake of oxygen that fish need. Without plants or oxygen, many fish are expected to die.

Figure 1: Chuck Hanlon, a South Florida Water Management District biologist, checks water clarity in Lake Okeechobee in Glades County. Sunlight now penetrates about 16 inches — not deep enough for the lake's plants.

"What we have going on here is a flat-out disaster," said biologist Paul Gray, a Lake Okeechobee expert for the Audubon Society of Florida.

With fish dying and the water too dirty for boating, the multimillion dollar fishing industry of the area has already begun to suffer. Attendance at a local fishing tournament was only 17% of last year's attendance. Mayor J.P. Sasser told reporters for the Palm Beach Post that the worst is still coming.

"What you're going to find this summer is this lake is going to turn just as green and just as slimy as anything you've seen in a science fiction movie," he said. "When that starts, no one will get on that water."

This is an unfortunate example of the consequences of inadequate cleanup. Had the lake bottom pollution been properly addressed, Lake Okeechobee would not be experiencing this ecologic disaster and people would not be suffering the economic consequences. Hurricanes in Florida, earthquakes in California – these rare but recurring events are certain to happen eventually, and cautious cleanup approaches should plan for such natural "disasters."

2. Involve the community in the investigation and cleanup process.

Citizens provide knowledge, energy, political will, and financial support for city activities. Therefore, community involvement in the cleanup process is essential to its success.

(a) Consider forming a Community Advisory Group that constructively engages citizens with the pollution cleanup problem.

One way communities are successfully participating in cleanup actions is through Community Advisory Groups. This committed group of citizens works cooperatively with regulatory agencies and businesses. These tactics have most commonly been used when the site is publicly controlled, particularly Superfund sites and military base closures. They have also been used when the site cleanup is being done by one or more private businesses, as in Chattanooga, Tennessee. From its experience, the U.S. Environmental Protection Agency has found the following guidelines to be valuable:[2]

- Community Advisory Groups (CAGs) should be formed as early as possible.
- The community must take the initiative in Community Advisory Group formation and operation.
- Community Advisory Groups must be inclusive and independent.
- Access to good technical expertise is important.
- The Community Advisory Group must recognize what is possible and work within those limits.
- Community Advisory Group leaders must be "in it" for the long haul.
- Community Advisory Groups are more effective than public meetings.
- The need for additional resources is a common concern.
- Community Advisory Groups can give the community more influence in site-related decisions.
- Community Advisory Groups can speed up the process.

(b) Learn lessons from other communities' participation programs.

Many knowledgeable resources examine other communities' participation in brownfields remediation. For example, a report entitled *Brownfields Redevelopment: Meeting the Challenges of Community Participation*, by the Oakland-based Pacific Institute for Studies in Development, Environment, and Security, concludes that the following lessons are fundamental to any remediation participation program: [3]

- Know the community (and be known).
- Seek out a diversity of opinions and stakeholders.
- Provide effective and regular communications to keep community actors informed throughout the redevelopment process.
- Recognize and address credibility and trust issues.
- Integrate brownfields redevelopment with other community priorities. Flexibility in framing the issues will allow for a broader and more integrated response.
- Continue to create policy and financial incentives for projects with public benefits and community involvement.

- Improve community capacity.
- Use facilitators wisely.

(c) Achieve the highest possible form of "citizen participation."

In evaluating different possible ways to involve residents in decision making, those that allow citizens to participate most actively and with the greatest power should be favored. Shelley Arnstein studied a number of situations where citizens participated in planning processes.[4] She concluded: "There is a critical difference between going through the empty ritual of participation and having the real power needed to affect the outcome of the process."

A typology showing levels of public participation.[5]

Low ↓ High

Information
The least you can do is tell people what is planned.

Consultation
You offer a number of options and listen to the feedback you get.

Deciding together
You encourage others to provide some additional ideas and options, and join in deciding the best way forward.

Acting together
Not only do different interests decide together what is best, but they form a partnership to carry it out.

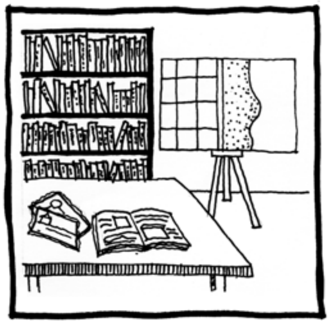
Supporting independent community initiatives
You help others do what they want - perhaps within a framework of grants, advice, and support provided by the resource holder.

(d) Build a public understanding of the cleanup process, and involve citizens in every step.

Remediating a polluted site, from beginning to end, involves many decisions and tasks. There are five major steps in the process. Each step has a different focus. A public understanding of these steps facilitates effective public participation. For example, by creating a public understanding of the process, concerns can be voiced at the appropriate times. At every stage, there are crucial roles for citizens and valuable benefits they can provide.

In each step, excluding citizens risks possible delays, extra costs, or undermined support for the project. To fully take advantage of residents' knowledge and interest, a structured venue for involvement should begin early, be continual, and in a cooperative, problem-solving role.

Figure 2 below shows the steps of the cleanup process, along with the rewards of ongoing, active citizen participation. For more information on this process, Appendix A contains two additional tables. One lists the decisions made in each step, and the other highlights details related to each step that are important to achieving a sustainable site restoration.



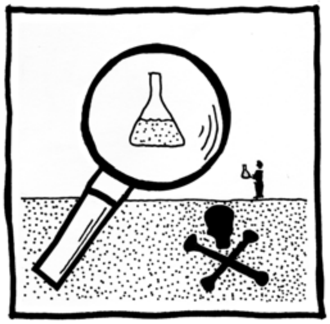
SITE INVESTIGATION – PLANNING

What contaminants might be out there? Where should we look?

Citizens Provide: Information, fears, and rumors about contamination. Knowledge of community. Vision of site future.

Citizens Involved →
Contaminants discovered early.
Testing plan addresses contamination fears.
Testing plan supports future vision.

Excluded →
Toxins may be discovered later.
Unaddressed fears may undermine support.
Data quality may be inadequate – e.g., detection levels too low – retesting required.



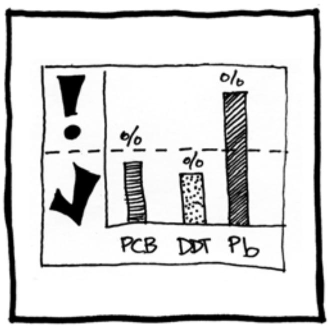
SITE INVESTIGATION – IMPLEMENTATION

- The search for contaminants -

Citizens Provide: Independent oversight and involvement with site investigation.

Citizens Involved →
Community believes all pollution discovered.
Public understands decisions made during investigation.
Public educated about contaminants' and locations.

Excluded →
Rumors of inadequate testing may undermine project marketing / support.
Lack of knowledge about contamination may cause people to overestimate the problem.



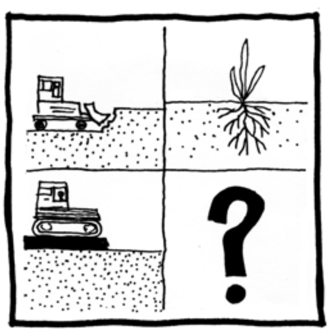
RISK ASSESSMENT & CLEANUP GOAL-SETTING

What dangers are present? To what level should the site be cleaned?

Citizens Provide: Knowledge of local use of area. ("People eat clams from the bay"). Community vision for site, including acceptable compromises.

Citizens Involved →
Community educated about current dangers.
Health risks to community addressed.
Decisions and tradeoffs reflect community values; compromises are acceptable.

Excluded →
Ways contaminants could harm people may go unnoticed.
Community may not understand why decisions or tradeoffs had to be made.
Tradeoffs made without public input may not be as appropriate as another equally-feasible tradeoff.



SITE CLEANUP – PLANNING

What methods of cleanup should we use?

Citizens Provide: Vision of site future and timeline for development. Knowledge of public priorities and attitudes towards cleanup methods..

Citizens Involved →
Town educated about cleanup methods.
People assured cleanup will solve problem.
Technologies' pros/cons evaluated by community.
Most locally appropriate technology selected.

Excluded →
Public may worry cleanup is not thorough.
Public may not understand cleanup methods.
Cleanup approach may not be consistent with citizen's vision for the site's future.

SITE CLEANUP – IMPLEMENTATION

- The cleanup process -

Citizens Provide: Knowledge of community priorities and attitudes. Independent oversight of site cleanup.

Citizens Involved →
People understand, support cleanup activities.
Timeline and methods are locally appropriate.
People assured cleanup is thorough.
Knowledge of process allows community to understand difficulties that arise.

Excluded →
Cleanup process may affects town in unpopular ways.
Expected difficulties that arise may look like mistakes.
Rumors of cleanup problems may undermine project.

Figure 2: A typical remediation planning process has five major steps. At each step, there are valuable rewards from citizen involvement and risks incurred if citizens are not involved.

Case Study: The South Puget Sound Superfund Area Community Advisory Groups. Two different community participation projects had two very different results. What lessons can we learn?[5]

Since 1990, Citizens for a Healthy Bay has been involved in the Commencement Bay and South Puget Sound Superfund area. In 2001, they compared two area projects they had been involved with – the St. Paul Waterway Cap Site and the Mouth of Hylebos site.

St. Paul Waterway Cap Site – Successful Community Participation	Mouth of Hylebos Site – Community Marginalized
The responsible parties…. • Actively engaged the community at the beginning of the process. • Invited the community to partner in the remedial action. • Listened to the public's concerns and responded appropriately. • Regularly updated and informed the community, even when there was no change. Therefore… • Community owned a stake in the outcome and advocated for its completion. • Achieved quick and successful cleanup. • All stakeholders gained. • Partial delisting from Superfund. • Once dead zone returned to diverse, thriving aquatic community.	The responsible parties…. • Did not contact the community – community learned of project by accident. • Community perceived their issues and concerns were not seriously considered. • Conducted insufficient studies to address community's questions. Therefore… • Relationship between community and responsible parties became adversarial and contentious – Atmosphere of anger, distrust, and inflexibility. • Overwhelming public opposition to project. • "Battle" lines drawn = winners and losers. • Delay of one year. • Loss of community support to involved businesses.

Lessons Learned:

- Community is a primary stakeholder in all sediment remediation actions
- As a stakeholder, the community must be at the table early in the discussion process
- Acknowledge validity of public perspective:
  - effective 2-way communication, minimize 'techno-speak' and jargon
- Community must be part of team working to remedy the problem
- All community concerns must be considered and addressed at some level
- Communication and integrated participation are keys to success

Case Study: Non-scientific Citizen Group Conducts In-Depth Evaluation of Bioremediation as a Cleanup Technology[6]

An ordinary group of citizens in southern Idaho, with no expertise in hazardous waste or environmental technologies, were able to reach a surprising level of agreement on the use of bioremediation when they studied the issues at length in a "consensus workshop" approach developed by scientists at Oregon State University.

When the process began, this group of ten Idaho residents knew very little about this complex and sophisticated cleanup technology, which uses bacteria to break down or change contaminants. By the time the process was complete, the same group had prepared a 35-page report outlining their understanding of the technology, its relative merits compared to other approaches, their concerns, recommendations and consensus about its use.

"A key question is how to involve citizens in decisions about a cleanup technology like bioremediation," said Denise Lach, a co-director of OSU's Center for Water and Environmental Sustainability. "In the consensus workshop, a citizen panel decides what questions are important to ask in learning about a particular technology. The panel meets over a period to time to learn about the technology from professionals they have identified and, in the end, to reach consensus about its use."

The group was recruited through ads in four Southern Idaho newspapers, and they were diverse in age, gender, occupations, education, and other factors. About all they had in common, by design, is that they knew little or nothing about bioremediation.

Pretty soon, however, the local citizens were identifying the types of experts they wanted to interview, learning the complexities of the science involved and discussing options in great detail. Concerns were discussed on everything from the mutation of bacteria to long-term clogging of aquifers, changing politics and alternative technologies.

Their consensus report can be found at www.cwest.orst.edu/nabir/index.htm.

Case Study: Chattanooga, Tennessee. Highly inclusive methods turned a city from "the most polluted city in the United States" to a worldwide leader in sustainability.[7]

In 1969, a report by the U.S. Department of Health Education and Welfare (HEW) called Chattanooga the "worst polluted city" in the United States. Chemical manufacturers had polluted the waterways. The city's air quality problems were so extreme that the U.S. EPA reportedly considered taking over the air quality program. Cars had to use their headlights during the day. Many residents suffered from cancer and asthma.

All this changed when local citizens became involved in collaborative processes for planning a better future. In 1978, the City of Chattanooga established a Citizen Advisory Committee to work cooperatively with local industry to solve pollution problems.

Then, several farsighted community and civic leaders created Chattanooga Venture, a nonprofit organization devoted to environmental, social, and economic renewal of the city through full citizen participation. In 1984, they organized Vision 2000, a massive visioning process involving 1,700 citizens over 20 weeks.

Chattanooga's efforts revitalized their city. Vision 2000 instigated 223 projects and programs, created 1,381 permanent jobs and 7,300 temporary construction jobs. It triggered a total financial investment of $793,303,813.00 into the community ($2,778.00 per person).

By 1999, Chattanooga had been named one of twelve "Best Practice Cities" in the world by the United Nations Habitat II Conference, highlighted by the President's Council on Sustainable Development, and chosen as one of ten "Most Enlightened Towns" in the country by the Utne Reader. According to city leaders, their incredible success occurred because:

"Virtually every major project undertaken in Chattanooga during the nineties bore these trademarks: input and involvement from people whom the project would affect, a plan that reflected their ideas combined with the contributions of experts in the field, and a partnership of players to make the plan into a viable development."

B. Use Remediation to Bridge the Site's Past and Future

The Noyo Headlands' remediation is the beginning of its future. All landscapes tell stories. The Noyo Headlands' story should be one connecting the past to the present, and showing Fort Bragg's direction as it moves into the future.

1. Preserve the industrial site history.

(a) Preserve buildings and other material from the industrial past.

The mill site's former operations are part of Fort Bragg's history and heritage. Many Fort Bragg residents have personal histories of working at or living near the mill site. The mill history is also part of what makes Fort Bragg unique and interesting – what gives it character – both to residents and potential visitors. Therefore, redevelopment should not erase the physical pieces of this past, but should instead preserve it. The buildings will have different meanings to people – some may see a cautionary tale about pollution and industry, while others may see a nostalgic story about hard work or providing lumber for homes. Preserving aspects of the site will allow us to honor the power of the past, and interpret its meaning as we move into the future.

Figure 3: In Duisburg Nord, Germany, preserved buildings become interesting parts of the park landscape.

Currently, many buildings of the former mill are scheduled for demolition. However, even small pieces of former structures, such as the concrete archways of Gasworks Park (see Figure 4), can remind visitors that a place was once very different than it is now.

Figure 4: Gasworks Park, in Seattle, WA, is the site of an old foundry, and now a popular city park.

(b) Creatively consider reuse possibilities for buildings & structures.

Buildings can be reused in a number of creative ways. They could serve their current function for a cottage-based industry, as they would if a kiln on the lumber mill site were continued to be used as a kiln for drying lumber. The outer structure could be maintained while the interior and the use of the building changes, such as when old warehouses are converted into apartments.

Figure 5: Duisburg Nord, Germany. Former ore bunkers have been restored to be a climbing wall (left), and a gasometer tank serves as a scuba diving pool (right).

(c) Honor former mill workers' connection to the site by finding meaningful roles they can play in the remediation and interpretation process.

As a site transforms, it is important to remember the people who worked on the site – some spent years of their lives there. As pollution is discussed, they may feel worried that they were exposed to toxins. They may also feel their own past is being considered a polluting eyesore that is being bulldozed and hidden. Therefore, remediation processes should take particular care to involve workers in the cleanup and address their concerns. It honors their existing connections, gives authenticity to any historical interpretation that may occur, and involves them in the site's transformation into the future.

Case Study: Duisburg Nord, Germany. Former workers assisted with cleanup and gave tours of their former workplace to visitors.

When Duisburg Nord closed, the former workers continued to live in worker housing adjacent to the factory, a daily reminder of their lost job. When reuse planning began, they opposed it. They resented that an out-of-town designer planned to create a park out of their former livelihood. But outreach efforts involved them in planning the park. And when the park was opened, some began to hang around the blast furnaces again. A few described their old jobs to visitors – the oppressive heat of the furnaces, the enormous pulleys in motion. Their experiences brought the place alive. The workers liked sharing their memories, and they liked being able to stay connected in a meaningful way to the site where many had worked for decades. Eventually, the practice was formalized and the workers were hired as docents to give site tours.

(d) Transform the meaning of industrial materials through art installations and gardens.

Materials from past industrial uses can be placed in different contexts to transform the meanings people see in them. When surrounded by carefully tended gardens, or when made into sculpture, industrial elements look cared for, rather than abandoned – beautiful rather than decrepit.

Figure 6: Duisburg Nord, Germany. A sculpture garden made from found industrial materials reveals the beauty in the metal.

Figure 7: Duisburg Nord, Germany. Wild vegetation and gardens contrast with the industrial buildings. Duisburg Nord receives many tourists who appreciate that its "new look" respects the industrial past while celebrating its shift toward a more environmentally-friendly future.

2. Place historical preservation efforts within a larger historical context.

The history of the Noyo Headlands[8] is in many ways a microcosm of how changes in economic ownership patterns have affected communities throughout the country. Collective Native American use of the Headlands ended forcibly, and private industrial ownership began. The Headlands then changed hands, from local, to regional, to global corporations. With the sale of the mill site, Fort Bragg residents have the opportunity to return the Noyo Headlands to local community control. Historical preservation efforts should place the story of the mill within this larger historical narrative.

The Noyo Headlands could also make clear the long history of Pomo Indian groups in the area. A portion of the Headlands is already planned for expanding Pomo land just south of the Noyo Headlands. A Pomo Indian Cultural Center could tell the story of historical Pomo inhabitation and current cultural practices. Plans for such a Cultural Center, already relatively advanced (see Figure 8 below), show that it could provide critical historical perspective and contribute to the diversity of the Noyo Headlands.

Figure 8: A display showing a possible Pomo Indian Cultural Center at the charette held by the Noyo Headlands Unified Design Group on January 9, 2005. A site plan and an architectural plan for the building have been drawn, and two perspective paintings show what it might look like.

A Brief History of the Noyo Headlands[9]

For eight to ten thousand years before the arrival of Europeans in the Fort Bragg area, the She-bal-na-pomas, Kal-il-na-pomas and the Camebell Poma (Coast Yuki) used the Noyo Headlands.

In 1855, fifty-one white men, including twenty-six lumber company employees, threatened that without federal protection, there would be "Indian war." Thus began military oppression of local Indian groups. A military fort named Fort Bragg was sited 1.5 miles north of the Noyo River; the Mendocino Indian Reservation was established in 1856; and in 1865 three hundred Indians were marched from Mendocino to Round Valley.

Meanwhile, the Headlands passed into lumber ownership. A.W. McPherson acquired the headlands. Michigan lumber companies, seeing the depletion of midwestern forests, dispatched C.R. Johnson to buy the property in 1884. He declared himself mayor of the new lumber town. From there, a lumber empire spread along the Mendocino Coast, under the name of the Union Lumber Company.

Eighty years and three generations later, the global lumber company Boise Cascade bought the Headlands, and then sold it to Georgia Pacific (GP), the "world's largest wood products company."[10] Environmentalists were charging that old growth forests were nearly exhausted and foresting practices were unsustainable. Then in 1996, a shortage of large logs forced GP to close their big band mill. GP had already begun focusing its lumber operations elsewhere. Shortly thereafter, GP closed the mill and put the mill site up for sale.

In 2003, the local citizen's group North Coast Action held activities with local residents to begin planning a sustainable and democratic future for the Noyo Headlands. Current planning efforts will determine how this story continues.

3. Make the remediation process a path to the Noyo Headlands' future.

(a) Use a visible and educational remediation process.

Remediation processes can be beautiful and educational. For example, the 35-acre Testing the Waters park in Vitondale, PA, lies just beyond a former coal mine. Water draining from the mine is highly acidic. The water becomes less and less acidic as it runs down a canal lined with limestone, through aeration basins, and into a wetlands. A "litmus garden" along the canal will communicate the water's transformation. Vegetation will slowly shift from the burning colors of cherry trees to the cooler colors of blueberry bushes.

This park was designed by D.I.R.T. Studio, started by Julie Bargmann. Bargmann was named in Time Magazine's "Innovators: the Time 100 of the Future" issue for her work in bridging pollution cleanup and landscape design.

As remediation begins, the design of the Noyo Headlands' public spaces could present the cleanup process and the site's industrial past in a beautiful and educational way.

Figure 9: San Francisco, CA. At the Hunters Point Superfund Site, a fence keeps public view far from cleanup activities. Most cleanup sites are fenced – often with opaque fencing that blocks the public's view of activities. Sometimes safety concerns make this unavoidable, but other times, more public access and involvement could be allowed if remediation technologies were carefully chosen.

Figure 10: Bybee Park, Palo Alto, California. The main path passes around a "telephone pole field" – an art installation on a former landfill. The sagging and shifting of these poles over time will reveal the underground settling of the landfill.

(b) Use the remediation process to provide jobs.

Remediation and pollution cleanup is a growing field that requires both skilled technicians and unskilled labor. This spending can employ local workers. In Wilmington, Delaware, the city and state drafted an agreement that asked the state agency overseeing local cleanup to cooperate with the city's Personnel Department and Disadvantaged Business Program. This ensured that brownfield activities provided local employment.[11]

Job training programs may be required for this idea to work. The City of Los Angeles' Brownfields Program received a U.S. EPA grant to provide free training in environmental field technologies to residents of local communities. Volunteers were certified in asbestos removal, lead paint removal, and as hazardous waste handling. The group enrolled 50 students annually and placed 80 percent of its graduates with jobs.[12]

(c) Link remediation infrastructure with future uses of the site.

The remediation process should be integrated with future plans for the site, rather than being considered a delay or intermittent use. Facilities built for the cleanup can be a lasting investment in the land's infrastructure, if carefully planned. Raised boardwalks built to prevent contact with polluted soil can later serve as pedestrian pathways through restored areas. In South Burlington, VT, a greenhouse built during remediation has had a long lifespan. It has served as a demonstration project of Living Machines (see page 68) with large glass tanks that used biological methods to clean the town's sewage. After the demonstration projects ended, the greenhouse was converted to grow mushrooms from brewery waste, while the tanks were used to raise fish for sale.

Figure 10: A greenhouse sits on a former brownfield site in South Burlington, Vermont. This greenhouse originally contained water tanks known as Living Machines that were used to purify sewage. It was later converted to a waste-to-food aquaculture facility where spent grain from a local brewery was converted to mushrooms, fish food, and fertilizer.

C. Be Cautious to Prevent Further Harm

1. Clean up the site to the highest possible cleanup standards.

What does it mean to clean a site to the "highest possible cleanup standards"? Before cleanup, government agencies and landowners will negotiate a target level of pollution expressed in "parts per million" or "parts per billion," and cleaning will proceed until pollution is reduced to that concentration. How do regulators determine this target number?

Cleanup standards are usually determined on a site-specific basis, but tables of generic targets do exist. These are known as "preliminary remediation guidelines." The EPA Region IX guidelines are the strictest used nationwide. The California Water Quality Control Board's San Francisco Region recently released guidelines that are stricter and better. These consider other possible routes for contamination to spread, and they assume that any polluted site probably has more than one pollutant.

However, even these guidelines are probably not strict enough for the Fort Bragg mill site and would represent a failure to adequately safeguard public health. Site-specific guidelines should be calculated because this site is exceptional in many ways – the assumptions made when determining the generic guidelines are not strict enough. Since the site is near the ocean, a sensitive ecological receptor, particularly high standards should be applied.[13]

The Noyo Headlands May Require Higher Cleanup Targets Than Some Other Brownfields

The San Francisco Regional Water Quality Control Board has a table of preliminary cleanup targets – possibly the strictest preliminary targets in the country. But they caution that even these strict targets are probably not strict enough for sites if they are: [14]

- adjacent to shoreline
- affected by tides or erosion
- having high rainfall
- having groundwater tables fewer than ten feet underground
- having a high public profile
- where endangered species are present near the site,
- and that have three or more carcinogens or five dangerous non-carcinogens possibly present.

The Noyo Headlands probably meets all these conditions. The North Coast Regional Water Quality Control Board typically requires site-specific risk assessments, and this risk assessment should account for these factors.

When setting target cleanup levels, as detailed in Appendix A, there are certain specific ways that cleanup targets are decided, and certain points of compromise and negotiation in determining what level of cleanup is required and feasible. Key issues include the future potential uses of the land, the depth to which testing and cleanup occurs, the consideration of pathways by which pollution might spread, and the treatment of chemicals below detection limits. Cleanup on the Noyo Headlands should particularly consider some community members' desire to grow food locally.

2. Use cautionary design tactics to prevent contact with contamination.

Ideally, all contamination would be cleaned up. But in some areas, low levels of contamination are likely to remain. When hazardous chemicals are present, preventing their spread should be a high priority.

Sometimes, brownfield sites are cleaned, covered with grass, and appear completely safe. Sometimes during bioremediation, a site appears completely natural, and may attract wildlife to eat from plants. Site design on the Headlands should avoid these mistakes.

The following guidelines are summarized from a guide by University of Michigan Professor Joan Nasseaur.[15]

Separate clean stormwater from contaminated soil and groundwater. Paving, rooftops, or an impermeable barrier under the ground can prevent stormwater from carrying toxins or becoming polluted itself.

Avoid landscape design strategies that encourage contact with contaminated areas. People and animals can also be physically separated from contaminated areas by fences, roads, or waterways. But fences are imperfect, so design strategies should also discourage use of a site. Vegetation used for bioremediation should not be edible to local wildlife or people. Even physical contact should be discouraged. Animals, including pets, can carry contaminated soil or plant parts on their fur, spreading them to other places. Since native vegetation often provides the most food and habitat for wildlife, a site should be thoroughly cleaned before being restored with native plants, particularly if contamination is near the surface or could be taken up by plants. In ponds, steep edges that emergent aquatic vegetation cannot grow on will discourage use by wildlife. Unfortunately, the grassy lawns that wildlife generally avoid are the ones that most invite human use.

Communicate risks. Beautiful vegetation causes people to think an area is "natural," and therefore safe. But where vegetation is being used to clean the soil, or where it covers low levels of contamination, it is important to communicate the danger. Key principles include the following:

- Discourage perception of possibly contaminated areas as natural landscapes.
- Encourage perception that possibly contaminated areas should not be entered.
- Discourage informal recreational use where contamination remains.

Communicating danger in the landscape is a difficult challenge. Vegetation, even when planted in non-natural arrangements, does not show that the landscape may be dangerous. Preserving remnants of industrial buildings or materials can communicate that the landscape was recently industrial and may have some contamination. Ultimately, the only safe path is to anticipate possible ways people will use a place and clean it to those levels. If it cannot be cleaned, then contact with soil and water should be entirely prevented.

3. Clean up pollution completely before declaring the site ready for development.

At many cleanup sites, some amount of hazardous waste is left in place because the parties involved feel it is impossible, impractical, or too costly to fully remove the contamination.

In these situations, agencies usually attempt to protect people from exposure to pollution through institutional controls – often legal methods by which an institution monitors or prevents contact with or spread of contamination. These controls can include plans to monitor nearby pollution levels, zoning ordinances to limit people's activities, and restrictions on nearby fishing and hunting.

However, despite good intentions, these policies often fail. Plans might change, knowledge of the dangers fades over time, and often no single party is held responsible for ensuring that these policies continue to protect surrounding communities over time.

Contamination Left In Place is Often Not Appropriately Monitored

Senators Barbara Boxer (D-CA) and Jim Jeffords (I-VT) recently asked the General Accounting Office (GAO), the independent branch of the federal government, to examine how well institutional controls are protecting communities from hazardous waste at cleanup sites. This report[16] found:

"At the overwhelming majority of sites examined, EPA remedy decision documents failed to identify how the institutional controls would be implemented, monitored or enforced. Specifically:

- Two-thirds of the older hazardous waste sites reviewed by the GAO where residual contamination remained in place after cleanup lacked ANY controls to minimize future exposure.
- 82 of 93 recent Superfund remedy decision documents fail to identify who is responsible for monitoring the controls.
- 11 of 15 recent Resource Conservation and Recovery Act remedy decision documents fail to identify who is responsible for enforcing institutional controls."

D. Use Innovative Processes To Clean Contamination

1. Learn about biological and ecological approaches.

(a) Recognize the benefits of using ecological processes to remediate toxins.

Bioremediation and other ecological processes are one of the most promising approaches to pollution cleanup. According to the United States Geological Survey,[17] bioremediation can significantly reduce cleanup costs for the following reasons:

- **Treating contamination in place.** Most of the cost associated with traditional cleanup technologies is associated with physically removing and disposing of contaminated soils. Because engineered bioremediation can be carried out in place by delivering nutrients to contaminated soils, it does not incur removal-disposal costs.
- **Harnessing natural processes.** At some sites, natural microbial processes can remove or contain contaminants without human intervention. In these cases where intrinsic bioremediation (natural attenuation) is appropriate, substantial cost savings can be realized.
- **Reducing environmental stress.** Because bioremediation methods minimize site disturbance compared with conventional cleanup technologies, post-cleanup costs can be substantially reduced.

(b) What are bioremediation and phytoremediation?

Bioremediation is a process in which living organisms, particularly bacteria or other microorganisms, degrade or transform organic contaminants into less dangerous molecules.

Phytoremediation uses plants to degrade, extract, contain, or immobilize contaminants from soil or water. Phytoremediation is actually a number of related activities, including phytoextraction (when chemicals are taken up into plant material), phytodegradation (when chemicals are broken down by the plant or root-related microorganisms), and phytostabilization (when chemicals are held in place by the plant so they cannot spread).

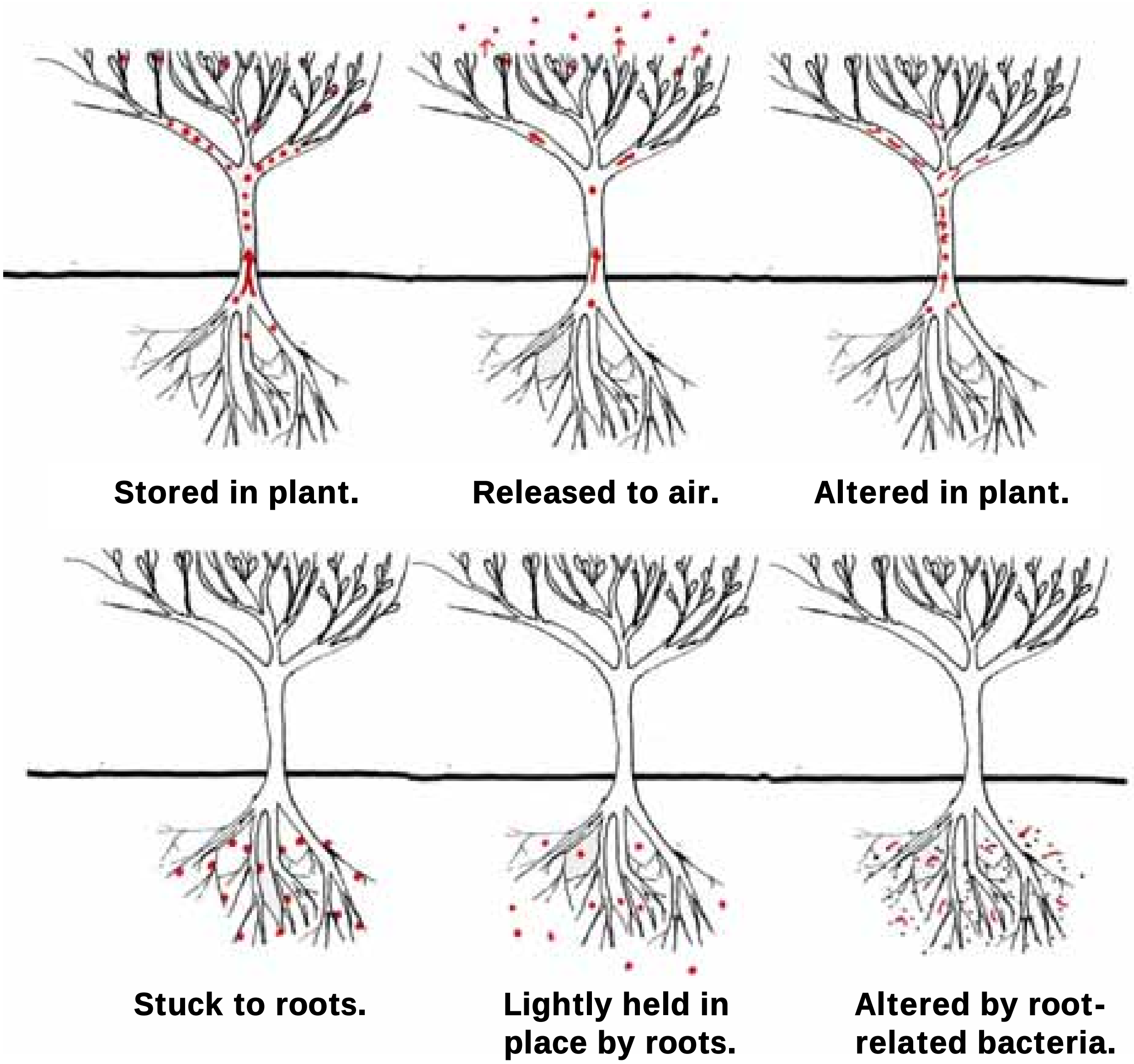


Figure 11: Phytoremediation can control pollution in many different ways. The pathways on the right, ones that actually alter hazardous substances to their harmless relatives, are preferred methods. Some methods gather the pollution into the plant, where it must be disposed of or recycled. Some methods simply hold pollution in place. These are generally used only in minor cases when researchers believe pollution will eventually degrade on its own.

Case Study: Bemidji, Minnesota. In 1979, A Crude Oil Spill Mysteriously Stopped Spreading. The Reason? Microbes Were Naturally Breaking Down The Oil![18]

"In 1979, a pipeline carrying crude oil burst and contaminated the underlying aquifer. USGS scientists studying the site found that toxic chemicals leaching from the crude oil were rapidly degraded by natural microbial populations. Significantly, it was shown that the plume of contaminated ground water stopped enlarging after a few years as rates of microbial degradation came into balance with rates of contaminant leaching. This was the first and best-documented example of intrinsic bioremediation in which naturally occurring microbial processes remediates contaminated ground water without human intervention."

However, bioremediation and phytoremediation must be done carefully. Only organisms already locally present should be used, otherwise the new organisms could be invasive or could spread to unintended areas. Sometimes, microbes and plants used in this remediation are genetically engineered, even though the long-term effects of genetically-modified organisms are not known.

Because they depend on ecological processes, bioremediation and phytoremediation depend on conditions that foster the microbes or plants, such as the right nutrients, weather, and oxygen in the soil. However, conditions can be modified using greenhouses, stirring the soil or adding oxygen.

2. Use innovative methods of cleanup.

(a) Remediate in place ("in situ") whenever possible. Avoid incinerating or landfilling waste.

Remediating soil in place is the best option – it reduces the disturbance, limits the possibility of further spreading pollution, and it saves money. Further, it means that Fort Bragg is taking responsibility for its own pollution. If soil and groundwater cannot be remediated in situ, it is best to remediate it elsewhere on the site.

Incineration and landfilling are two types of treatment to specifically avoid. Pollution moved off-site does not disappear, it moves to another community – often a low-income one. No landfill is risk-free. Pollutants commonly leak through the landfill liner and pollute groundwater. Many hazardous waste landfills are now Superfund sites or were specifically excluded from being named as one.[19]

Incineration also pollutes other communities. Although burning can sometimes transform chemicals into less dangerous molecules, no process removes all the danger. Dioxins are a very dangerous, cancer-causing chemical. One particular incinerator built by the U.S. Environmental Protection Agency (EPA) in Jacksonville, Arkansas, ended up releasing 800 times more dioxins than the EPA considers safe. During the years of its operation (1992-1993), the dioxin blood level of nearby residents increased by 22%.[20]

(b) Be proactive in researching and requesting innovative cleanup methods.

This report has focused on bioremediation and phytoremediation, but many other innovative technologies are also promising. Because the U.S. Environmental Protection Agency is actively promoting innovative technologies, it makes many resources available for learning about them on its Innovative Technologies website, http://www.epa.gov/tio/remed.htm

Two resources are worth mentioning. First, the *Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup* (EPA # 542-B-01-001 http://clu-in.org/roadmap) provides a step-by-step guide to the site assessment and cleanup process, with a focus on incorporating innovative technologies.

Making informed decisions about cleanup technologies requires technical advice. Therefore, it is important to find a remediation firm that can assist in the search for the most appropriate remedy. Because technology is changing very quickly, many remediation firms will not be informed about or offer innovative cleanup methods, such as bioremediation, phytoremediation, and others. The *Brownfields Technology Primer: Requesting and Evaluating Proposals That Encourage Innovative Technologies for Investigation and Cleanup* (EPA 542-R-01-005, http://www.epa.gov/tio/download/misc/rfpfinal.pdf) was designed to help site owners and others prepare Requests for Proposals (RFPs) that request the use of innovative technologies and to evaluate the subsequent proposals.

Case Study: Hybrid Poplars Clean Contaminated Groundwater at a Fraction of the Cost.[21]

As part of the Superfund Basic Research Program, Drs. Milton Gordon and Lee Newman at the University of Washington have discovered that hybrid poplars convert toxins such as trichloroethene (TCE) – a contaminant also found in mill site groundwater – into harmless chemicals. The trees convert TCE to safe substances, not storing it nor releasing it into the air.

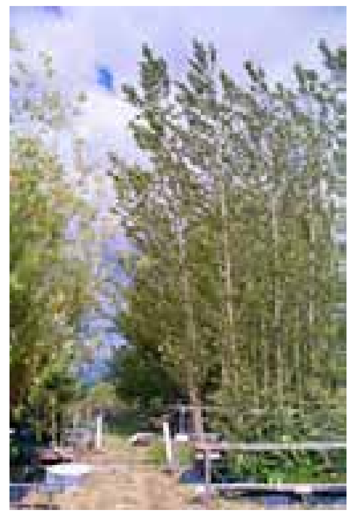


Figure 12: Hybrid poplars that can clean TCE.

TCE and other organic solvents are difficult to remove from groundwater using conventional methods. But a three-year field trial found that over 95% of the TCE was removed from test plots, "by simply planting the trees and letting them grow." Experiences in Medford, Oregon and Keyport, Washington show that this method costs only 25-30% of standard methods. In Keyport, a conventional approach was going to cost $10.5 million, but the poplar-based phytoremediation ultimately cost only $3.3 million.

Poplars may or may not be an appropriate strategy on the windy, coastal Headlands. However, this success story suggests that a site appropriate plant-based remedy may exist.

Case Study: "The Restorer" – A Solution for the Mill Pond?[22]

Figure 13: Image of Restorer in Baima Canal, China. Restorers can either be free-floating or linear.

Figure 14: Conceptual sketch of a lake restorer.

Ocean Arks International, a non-profit organization started by aquatic scientists John and Nancy Jack Todd, has developed a method for treating ponds contaminated with metals, organic matter, and sludge – all of which may be problems in the Noyo Headlands mill pond.

A raft of vegetation known as "The Restorer" floats on the pond. Solar-powered pumps circulate up to 10,000 gallons a day of water through different ecological cells on the raft. The first three cells contain microbes that digest toxins. The next six cells use wetland plants and animals to filter the water and to use excessive nutrients for their own growth.

In the mid-1980's, Cape Cod's 13-acre Flax Pond had become so polluted from landfill leachate that fishing and swimming were closed down. In 1991, a Restorer began operating. In 2 years, the sediment in the pond went down by two feet. Biological life – birds, plants, phytoplankton –returned to the pond, and swimming could begin again.

E. Conclusion

The remediation of contaminants on the Georgia-Pacific mill site is the first step Fort Bragg takes in recovering its coastline. Actions that bridge the past to the future, through community-based efforts, will best set the course toward a sustainable Noyo Headlands.

II. Restore

Soils, Waterways, Plant Communities, and Wildlife

"The restoration ethic allows us once again to belong in nature. Throughout most of our species' history, we were a part of nature. Our challenge now is to rediscover that role and play it well."

- Steve Packard, 1993

Restoration on the Noyo Headlands is critically important. Ecosystems regulate themselves when a mix of organisms and processes balance one another. Until this basic level of health is restored, the Noyo Headlands cannot exist in a sustainable or self-sustaining state.

The task of restoration is one that can re-integrate Fort Bragg residents with the Noyo Headlands. Restoration is an activity that requires many people. It is an activity that can be approached as research, job training, education, and as a business. The ultimate goal of restoration is not a "wilderness," a place that excludes humans. The ultimate goal is to learn skills and methods that allow people to interact with natural systems in a beneficial way, rather than a harmful way, and to begin to realize the benefits this can have.

A. Establish the Foundation: Restore the Soil

1. Why restore the soil?

Healthy soil is the foundation for a beautiful and healthy environment. As every gardener knows, healthy soil is crucial to a bountiful garden. According to the U.S. Department of Agriculture (USDA), healthy soil has five major benefits:

Figure 15: Rich soil provides many benefits.

- Healthy soil regulates the movement of water, such as rainwater. By allowing rain water to soak in, it allows rain to recharge wells, while it minimizes flashfloods elsewhere. Good soil is neither too wet nor too dry, but has the right amount of water available for plants.
- Healthy soil cycles nutrients. Carbon, nitrogen, phosphorus, and many other nutrients are stored, transformed, and cycled through soil. In unhealthy soil, nutrients are either locked away or washed into streams where they cause problems. Healthy soil has nutrients available.
- Healthy soil keeps plants healthy. By suppressing plant diseases and its water- and nutrient- regulating functions, soil health reduces the cost of caring for lawns and vegetation.

- Healthy soil filters potential pollutants. Street runoff or atmospheric deposits can contain pollutants. But the minerals and microbes in soil filter, buffer, degrade, immobilize, and detoxify organic and inorganic materials.
- Healthy soil supports structures – both ancient and modern. Archeological treasures associated with human habitation are protected by soils, and buildings need stable soil for support.

Soil is not just a collection of material. Healthy soil contains a balance of water, air, minerals, and organic matter. Soil health depends on two issues. (1) Soil biodiversity occurs when diverse micro-organisms form a food web within the soil. This food web cycles nutrients, keeping them available for plants. (2) Soil structure is healthy when a mixture of particles and organic matter allow air and water to pass into soil.

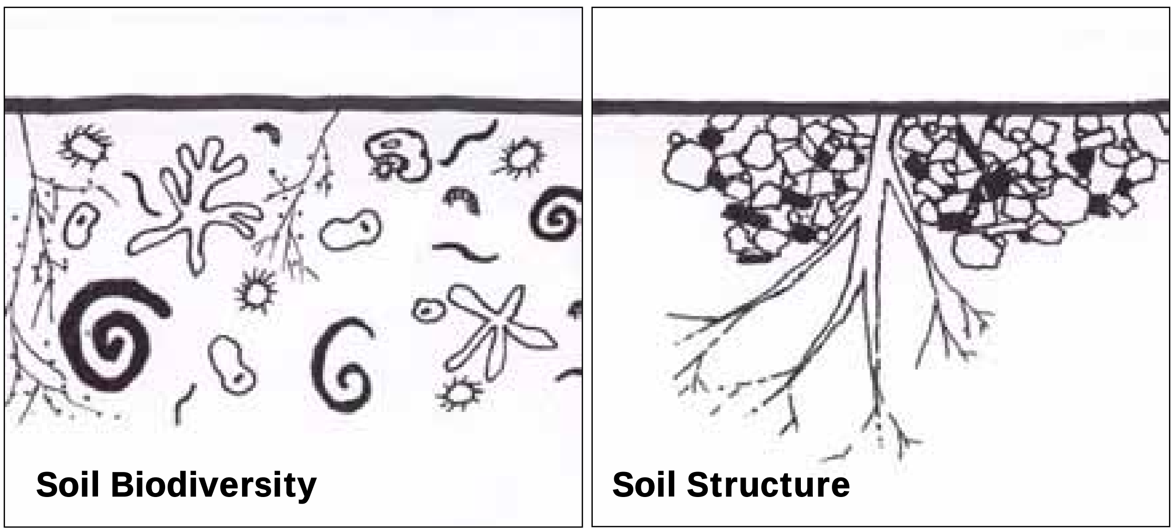


Figure 16: The two key issues to healthy soil are a diverse group of microorganisms, which cycle nutrients, and soil structure, which allows air and water to enter.

The two key risks to soil are compaction and erosion. Compaction destroys soil structure, causing the death of the microorganisms in the soil. Erosion washes away the topsoil, that which contains the developed structure and diversity, leaving behind sterile sediment without the micro-organisms needed to support plant life. Erosion also harms fish by carrying sediment into streams and water bodies.

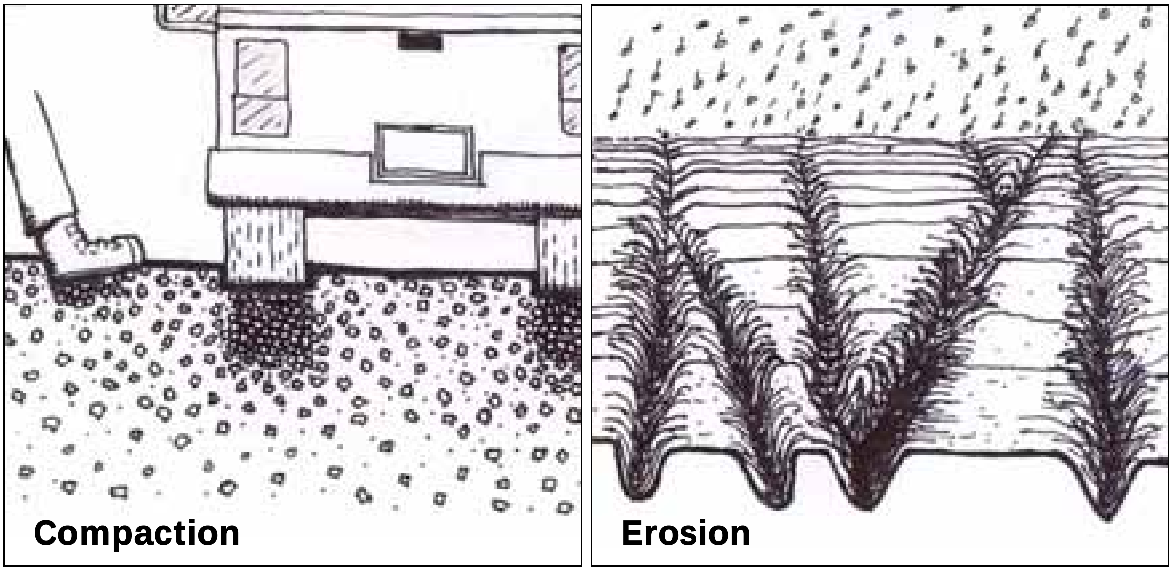


Figure 17: The two key risks to soil are compaction, which destroys soil structure, and erosion, which washes away the most productive layer of the soil.

2. Protect soil from further harm.

The first step in restoring the Noyo Headland's soil is to prevent further damage. Preventing damage to soil is much easier and faster than repairing it. Topspoil takes many years to develop. To some extent, deep compaction simply cannot be remedied.

Therefore, during construction, soil erosion and compaction should be minimized. The most important step is to protect any portions of the site that are not yet damaged, as shown in Figure 22 below. Other detailed instructions for preventing damage to the soil during construction, as well as information on long-term urban soil protection, including language for potential city codes, are available from the USDA and from Oregon's Department of Environmental Quality.[23]

3. Address compaction problems.

Although very deep compaction cannot be addressed, plowing techniques known as ripping or subsoiling can remediate compaction down to 20 inches. Loosening compaction is a precursor to developing good soil structure and biodiversity.

4. Restore the soil ecosystem.

Restoring an ecosystem in dead mineral dirt requires two steps: adding nutrient-rich organic matter to the site, and "seeding" it with a diversity of soil organisms. The biodiversity and nutrient content of the soil can begin to be remediated simply by tilling four inches of compost into the top eight inches of soil. Returning biota to the top twelve inches of soil can restore its natural adsorption, infiltration, and evapotranspiration for most rain events.[24]

A very specific method for restoring the soil ecosystem has been developed by Dr. Elaine Ingham, a professor of microbiology at Oregon State University. She points out that an analysis of nearby undisturbed soil should reveal the typical balances appropriate for local plant communities. A series of tests can reveal what is present, and lacking, in the compacted soil. Compost teas are the liquid from soaking compost in water that contain all the soluble nutrients, as well as representatives of all the species in the compost – bacteria, fungi, protozoa, nematodes and microarthropods. Like using a small packet of yeast to make bread, inoculating soil with a few of each species will allow them to reproduce and create a balanced food web.[25]

B. Daylight the Waters of the Site

1. Consider restoring the site's historical water flows.

Although the site has long been used by people, understanding the site's historical topography and ecosystems is valuable in understanding how ecological factors, such as weather and bedrock, affect the site. When possible, restoring the site's historical ecology and water flows is often best. A site's creek patterns are often determined by factors beneath the ground, such as groundwater flows and bedrock. Resisting these tendencies usually involves piping, pumping, concrete retaining walls, and other expensive engineering solutions. Restoring the pre-existing creeks can add to the site's diversity, creating a beautiful focal point for the site's ecological restoration and social renewal.

2. What are the site's historical water patterns?

The Noyo Headlands were not always flat and fairly dry, as they are now. Historically, Soldier's Harbor was a small estuary where creeks met the ocean. The creeks' pathways carved out a small valley in the center of the site.

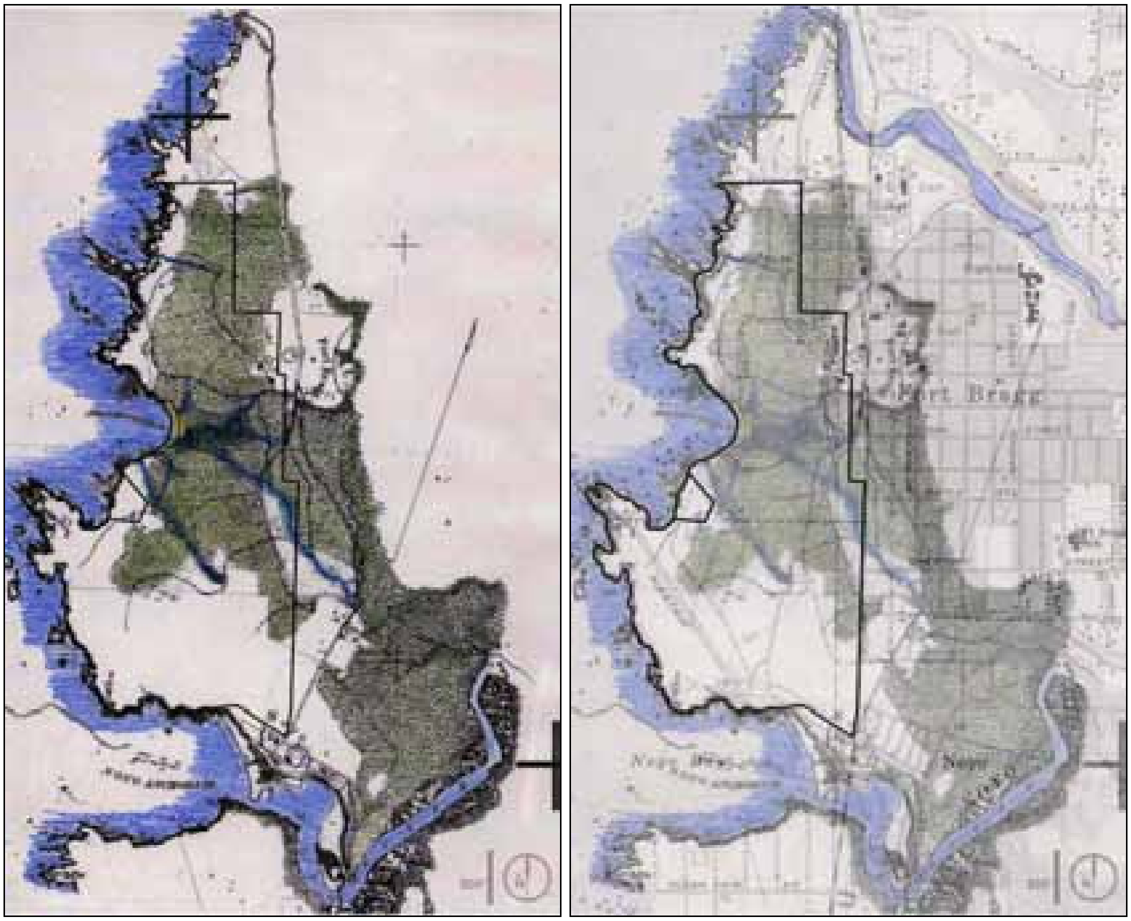


Figure 18: 1873 map showing historic creek paths (left, color added), overlain by relatively current conditions (right, 1980).

A map from 1873 shows a low-lying estuary area fed by several creeks. Three waterways flow across the Noyo Headlands directly into Soldiers' Harbor. One entered the headlands at what is now Hazel Street, one at Alder Street, and a smaller one at Oak Street. Another creek appears to have originated in a spring on the Noyo Headlands and then flowed to the ocean.

By 1890, the City of Fort Bragg had been established, and houses were being developed. The Oak Street waterway seems to already have been filled or covered over. But Alder Creek continued to flow through town. It flowed across Franklin and Macpherson Streets, crossed by small bridges, and under Main Street in a pipe. By 1890, Alder Creek had already been dammed to form a mill pond approximately half the size it is today. But on its downhill edge, it continued to flow freely into the ocean.

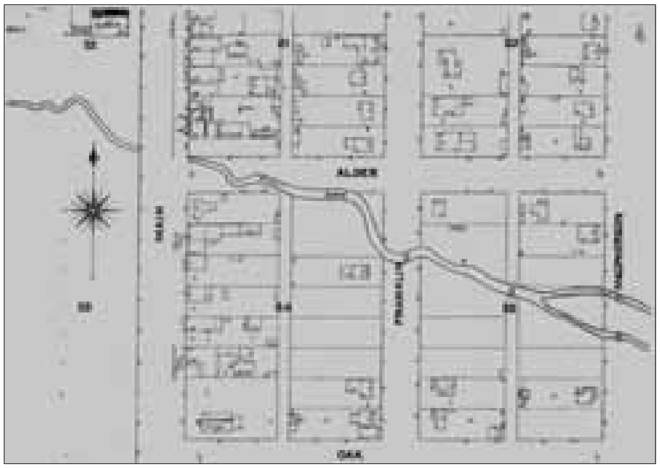


Figure 19: 1894 map showing Alder Creek crossing MacPherson and Harrison before crossing under Main Street and flowing onto the headlands.

By 1909, Alder Creek seems to have been moved into pipes underground. The Hazel St. creek continued to flow across the headlands into the mill pond. Now, all three waterways are underground in the City of Fort Bragg's storm sewer system, which takes them to the sewage treatment plant. However, the creek flows continue underground. These water flows could be brought to the surface and restored.

Figure 20: Digger Creek (left) and Ten Mile River (right), though very different sizes, both show a floodplain area around a creek.

The restoration of these creek corridors should carefully emulate patterns of nearby creeks. Many urban areas constrain their creek widths, making them little more than culverts. But more recent creek restorations allocate a wide enough creek corridor to accommodate natural flooding patterns and creek meanders. An adequately wide setback would also allow walking trails within this corridor, creating an alternate route down to the beach at Soldiers Bay.[26]

Figure 21: Historically, three creeks entered the Noyo Headlands and flowed down into a estuary and bay, and a fourth creek originated on the Noyo Headlands and flowed off separately.

C. Restore Coastal Headland Plant Communities

1. Protect existing plant resources.

Certain portions of the site are likely to contain some native plant resources. A plant survey should be done to determine what rare and native plants occur on site. These areas should be protected. Such areas can provide seeds and soil microbes for restoration efforts.

RARE PLANTS THAT MIGHT BE ONSITE

- Mendocino coast indian paintbrush
  - *Castilleja mendocinensis*
- Marsh violet
  - *Viola palustris*
- *D*eceiving sedge (in wet areas)
  - *Carex saliniformis*
- Dwarf alkali grass
  - *Puccinellia pumila*
- Blasdale's bent grass
  - *Agrostis blasdalei*
- Swamp harebell
  - C*ampanula californica*
- Feather Reed Grass
  - *Calamagrostis foliosa*
- Dune wallflower
  - *Erysimum menziesii var. Menziesii*
- North Coast phacelia
  - *Phacelia insularis var. Continentis*
- Coast Buckwheat
  - *Eriogonum fasciculatum*
- Howell's spineflower (historical)
  - *Chorizanthe howellii*

Figure 22: These less-disturbed portions of the site, including areas along the bluff and in the wooded areas, may contain native plants whose seeds can be used in restoration. These areas may also contain healthier soil or host small wildlife populations.

2. Eliminate invasive plants.

The bullies of the plant world, invasive species take over land or water that native species need. They have aggressive tactics and can spread very quickly. Controlling their spread is like controlling a wildfire.

Invasive species should be reduced or eliminated before beginning restoration. This should be done while the site is still highly disturbed and ecologists need not worry about compressing soil or disturbing other plants. On this site, monitoring may be even more important. On much of the site, no vegetation is growing, and careful monitoring could prevent invasive populations from ever getting established.

Every invasive species needs to be fought with special tactics.[27] However, a general, overarching strategy includes the following:

- map existing invasive plants and create priorities for their removal.
- minimize soil disturbance during the removal activities.
- control the spread of invasive plants around the edges of the problem.
- prioritize new colonies – the "spot fires" that can easily be eliminated.
- install constant monitoring to allow early detection of new invasions.
- plant native species and do restoration efforts that will give them the advantage.

INVASIVE SPECIES THAT SHOULD BE REMOVED OR PREVENTED[28]

Pampas grass *Cortoderia jubata*
Scotch broom *Cytisus scoparius*
Eucalyptus *Eucalyptus sp.*
Monterrey pine *Pinus radiata*
Himalayan blackberry *Rubus sp.*
Gorse *Ulex europaeus*
Iceplant *Carpobrotus sp.*
Sweet vernal grass *Anthoxanthum odoratum*
Quaking grass *Briza maxima*
Purple velvet grass *Holcus lanatus*
Wild radish *Raphanus sativus*
Coast dandelion *Hypochoeris radicata*

Figure 23: Pampas grass on the southern bluff will be one of the more challenging invasive species to eliminate.

3. Plan and restore model ecological communities.

(a) Imitate local ecosystem patterns.

Plants occur in patterns on land. While uses for other portions of the land are being developed, portions of the Noyo Headlands could be restored as examples of native plant communities, with educational displays and pathways. If developed to imitate local plant communities, this could provide habitat for many different animals, and birdwatching habitat for visitors and residents to Fort Bragg. Descriptions of the communities and the animals that depend on them are found on the following pages.

(b) Ecological restorations should be community-led and benefit the community.

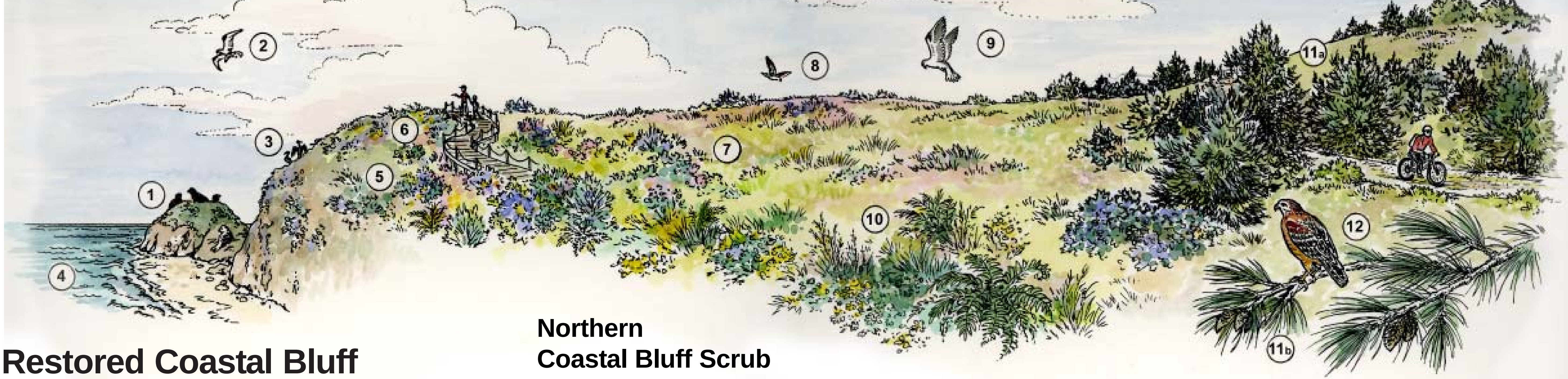
Restorations that involve the public have many benefits beyond a restored landscape – they educate people, and they can provide jobs or job training about restoration methods. Therefore, community-based restorations are growing in popularity and official support. For example, the National Oceanic and Atmospheric Administration (NOAA) has a community-based restoration program, which "provides funding to catalyze the implementation of locally-driven, grass-roots habitat restoration projects that will benefit living marine resources, including anadromous fish."

In Fort Bragg, a number of local groups could form a coalition to restore the Noyo Headlands, such as local schools and churches, the Mendocino Botanical Gardens, the Fort Bragg Garden Club, the Audubon Society, and the California Native Plants Society.

4. Establish native planting guidelines for the site.

Future development on portions of the site could support the ecological restoration by using native landscaping. Native landscaping uses less water, and provides more food and habitat for birds and other animals.

Ecological Communities



Restored Coastal Bluff

Some portion of the southern Noyo Headlands could be left as open space for future generations. What might restored plant and animal communities look like on a coastal bluff?

Nearshore Waters and Rocky Intertidal

Here, the ocean meets rock in a splash of salt spray.

1. Marine mammals use offshore rocks as haul out areas.

2. An osprey hovers over the shallow bay spying fish to catch.

3. Pelagic cormorants nest on small ledges of steep cliff faces and may return to that nest several years in a row. They dive up to 180 feet and use their webbed feet to look for food underwater.

4. Fish, such as salmon and rockfish, provide necessary nourishment to birds and marine mammals, and also to people.

Drawing: Marsha Mello. Assistance:Tina Fabula, Bill Maslach, Greg Grantham. Sources: Natural History of Cal. (Schoenherr, 1995), Intro. to Cal.Plant Life (Ornduff et al, 2003); Prelim. Jughandle State Reserve Plant List (Sholars, 2003).

Northern Coastal Bluff Scrub

The bluff is a rocky cliff face, flattening at the top, which is buffeted by strong winds. Many native plant species may still be found here.

5. Coast buckwheat flowers have a special relationship with blue butterflies, who feed and mate almost exclusively on their flowerheads. Other plants here include sea pink, seaside daisy, yarrow, bluff lupine, and wallflower.

6. Ceonothus, coyote bush and bracken fern populate the Northern Coastal Scrub found up on the flatter coastal terrace, intermingling with patches of Coastal Prairie.

Coastal Prairie

Pockets of grasslands interspersed with low shrubs create pastoral bluff areas.

7. Grasses and wildflowers grow on the Headlands, mixing with Northern Coastal Scrub.

8. The northern harrier hides its nest in low shrubs near the ground.

9. Raptors like white-tailed kites and northern harriers eat mice and other small animals that live in open grassy areas. These birds depend on open, undeveloped marsh or grassland areas to see their prey. Insects above the grasses are food for other birds.

10. Typical plants of this area include seaside wooly sunflower, hair grass, red fescue, wild strawberry, sword fern, and reed grass.

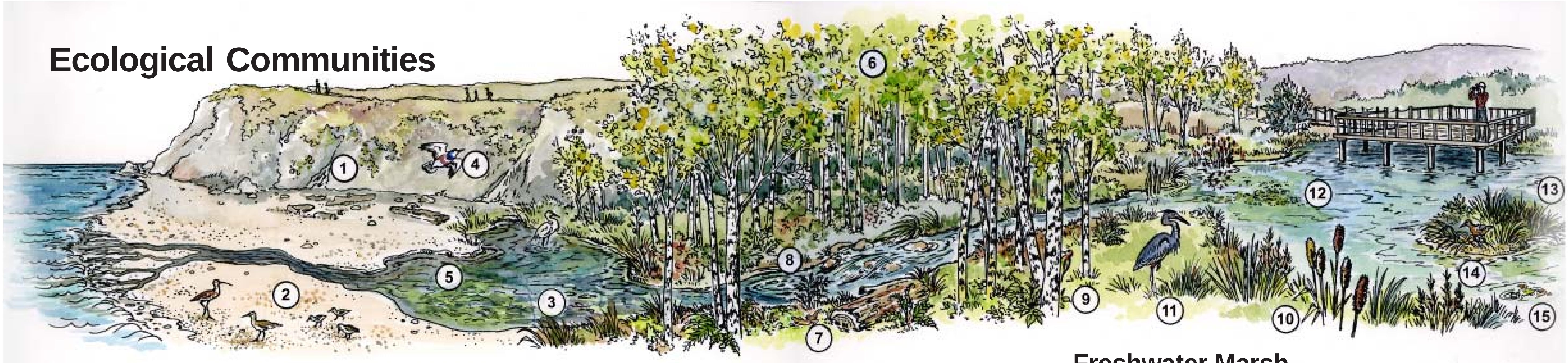
Closed-Cone Pine Forest

The two native pines that grow here are often stunted and shaped by the wind. Their closed pine cones open and release seeds during hot summer days or when triggered by wildfire.

11. The native species shore pine (a) and bishop pine (b) are often bent and twisted from the strong onshore coastal breezes.

12. The red-shouldered hawk nests in shrubs and trees, near the open or riparian habitat where it finds food.

Ecological Communities



Sandy Beach

A creek meets the beach as a shallow corridor meandering through shifting sand.

1. Here you'll find dune colonizers like driftwood and searocket.

2. Many birds such as curlews, whimbrels, godwits, and dunlins search for food on sandy beaches.

Estuary

Protected from the waves by twists in the creek's path, here plants can take root. Estuaries are highly productive ecosystems.

3. Eel grass starts the estuary food chain by providing fish habitat and trapping small food particles for worms and snails. These are then eaten by fish and birds.

4. Many migratory waterbirds feed in estuaries and mudflats. The most common here are great blue herons, western kingfishers, and egrets.

5. Young salmon use estuarine areas like this to feed before they spend their life as adults in the ocean.

Restored Riparian Corridor

Soldiers Bay was created by creeks carving their way down to the ocean. Now, these creeks are underground in pipes. If these waters were returned to the surface, what might it look like?

Riparian Forest

Protected from the wind, with a constant supply of fresh water, here trees and animals that cannot live on the open headlands flourish.

6. Trees arrange themselves in bands, depending on how close to water their roots need to be. Typical riparian trees include red alder (a) and willow (b).

7. The creekbed and wet forest floor host many amphibians: frogs, newts and the Pacific salamander.

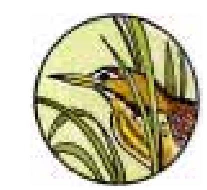
8. Deep, cool plunge pools with sandy bottoms can support steelhead trout and coho salmon.

9. Riparian habitat provides nesting habitat for many birds, including the red-shouldered hawk, warblers, vireos, and sapsuckers.

Freshwater Marsh

A shallow freshwater marsh fed by creeks and stormwater runoff can filter contaminants in stormwater while providing habitat for plants and animals.

10. Shallow waters of wetlands provide habitat for emergent plants like rushes, tules, sedges, and cattails, which filter water and absorb extra nutrients.



11. Herons, and relatives like the American Bitterns, often stop in marshes to feed.

12. Floating on the water are aquatic plants, like duckweed, whose hair-like roots help filter the water.

13. Islands in the freshwater marsh provide safety from people and resting habitat for the western pond turtle, waterfowl, and others.

14. Virginia rails depend upon freshwater marshes for their existence. Because they are secretive and solitary, and because many marshy areas have been drained or altered, these birds are rarely seen or heard.

15. Red-legged frogs find optimal habitat in this combination of freshwater marshes for breeding, backwater pools in a riparian alder corridor for feeding, and open grasslands above streambanks for dispersal.

D. Wildlife and Habitat

Adequately addressing wildlife issues will need to occur during the master planning portion of the process. The three basic steps to protecting wildlife are preserve (existing habitat), connect (to larger areas of habitat), and restore (habitat in currently-degraded areas).

1. Identify and preserve existing habitat areas.

Protecting existing undisturbed areas is the best way to create habitat. Although there are very few such areas on the Noyo Headlands, those areas shown in Figure 23 may already be providing animal habitat. Top priority should be assigned to habitat of threatened or endangered species, species that are particularly sensitive to human activity, habitat that is regionally unique, and areas that support large numbers of native species. Consideration should also be given to habitat that is rare locally or may have educational value.

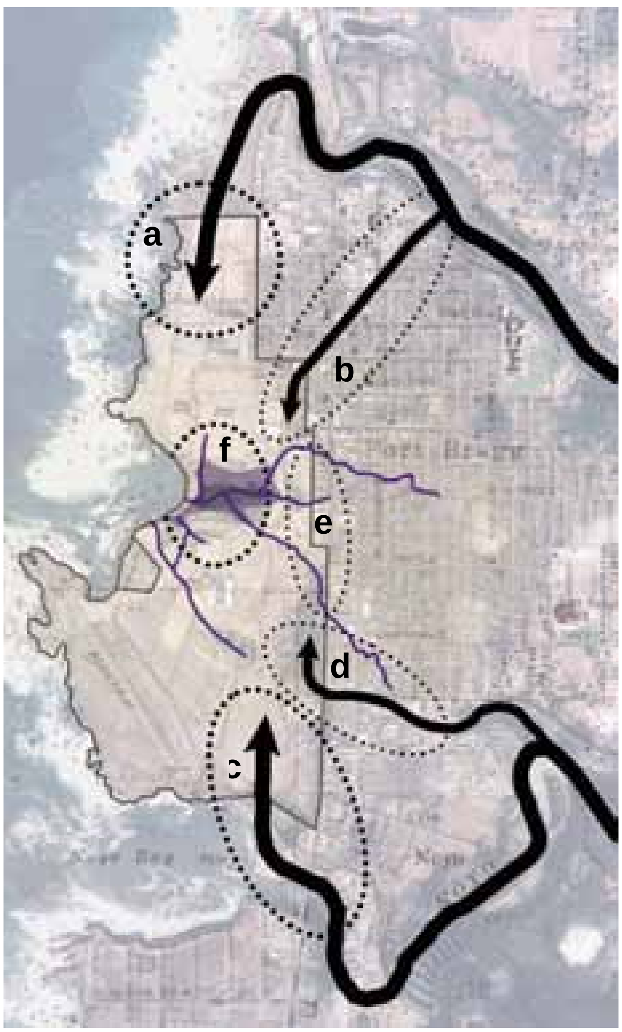


Figure 24: Key opportunities to establish wildlife corridors between the Noyo Headlands and other wildlife refuges.

2. Create wildlife connections.

Habitat fragmentation is one of the largest causes of species extinction. It forms "islands," where wildlife is cut off from needed resources and mates. Therefore, new habitat should connect to larger wildlife refuges, such as nearby forests. The following connections are available here:

a. The most complete habitat corridor passes from the timberlands east of Fort Bragg, down Pudding Creek and across Glass Beach.

b. The Skunk Train tracks also connect the headlands to Pudding Creek. Vegetation could be planted along the railroad track, at a distance that would not interfere with trains.

c. The Noyo River provides habitat for many birds and animals, though restoring the harbor area would improve this corridor.

d. The Haul Road borders are vegetated halfway into town. However, it would take creativity and cooperation to find a path for wildlife through town and across Highway 1.

e. Restored creek channels could provide links for wildlife to travel through the Noyo Headlands. But a creative solution would be needed to allow animals to cross Highway 1.

f. A restored estuary would create aquatic habitat already linked to a large wild area.

3. Improve habitat by restoring local landscape features.

Restoring local landscape features can occur on two different scales, for two different benefits. Restoring larger areas provides habitat for interior species, those species that require a certain amount of contiguous land area to have a buffer zone from threats, such as dogs.

However, even mimicking natural landscapes on a very small scale in developed areas provides benefits for some species. Planting native vegetation in backyards will benefit birds and make any landscape less foreign for wildlife, even if they cannot use it as their primary habitat.

4. Address wildlife issues at both large and small scales.

An excellent, detailed guide to the process of protecting wildlife during development is "Managing Development for People and Wildlife," published by the Great Outdoors Colorado Trust Fund.[29] Its key principles are as follows:

Seven Biological Principles For Habitat Protection at Landscape Scales.	
Principle 1	Maintain large, intact patches of native vegetation by preventing fragmentation of those patches by development.
Principle 2	Establish priorities for species protection and protect habitats that constrain the distribution and abundance of those species.
Principle 3	Protect rare landscape elements. Guide development toward areas of landscape containing "common" features.
Principle 4	Maintain connections among wildlife habitats by identifying and protecting corridors for movement.
Principle 5	Maintain significant ecological processes in protected areas.
Principle 6	Contribute to the regional persistence of rare species by protecting some of their habitat locally.

Principle 7	Balance the opportunity for public recreation with habitat needs of wildlife.
Five Biological Principles for Wildlife Conservation at the Site Scale.	
Principle 1	Maintain buffers between areas dominated by human activities and core areas of wildlife habitat.
Principle 2	Facilitate wildlife movement across areas dominated by human activities.
Principle 3	Minimize human contact with large native predators.[30]
Principle 4	Control numbers of mid-sized predators, such as some pets and other species associated with human-dominated areas.
Principle 5	Mimic features of the natural local landscape in developed areas.

5. Use restoration to create jobs, job training, and a new local specialty.

Restoration is a growing field nationwide and receives significant government funding (see page 76). Restoration projects, such as revegetation with native plants, can require a significant amount of labor. Restoration projects that occur on the Noyo Headlands should be integrated with a strategy for developing a restorative economy (see page 70). The components could include job training in remediation and restoration, academic research in innovative cleanup technologies and how to integrate these with ecosystem restoration, environmental education and ecotourism related to remediation and restoration, and employment in cleanup, restoration work, and sustainable building.

E. Conclusion

Ecological restoration should be an integral part of planning and building on the Noyo Headlands. From the beginning, the remediation of soil and water contamination should also work toward this ultimate goal. Remediation and restoration have the same two objectives – creating healthy ecological systems on the Noyo Headlands, and involving Fort Bragg residents in this environmental stewardship. They both could contribute to making the Noyo Headlands a model of restorative development.

III. Rebuild

Ecological Design & Green Building Tools

The development of the Noyo Headlands presents a unique opportunity. In building a new place, residents can carefully decide how they wish to live and build. These decisions should be made with concern for the entire community, including other species and future generations.

A. Discover How Ecological Design Differs From "Business as Usual"

1. What are ecological design values and strategies?

"Ecological design" is a method of building that seeks to improve environmental and social conditions by integrating building systems with living processes. It is a collection of values ("shoulds"), beliefs ("whys"), and strategies ("hows").

The Hannover Principles: Design for Sustainability, by William McDonough and Partners, is one set of these values and beliefs. These principles were developed for the city of Hannover, Germany as it prepared to host the world exposition of 2000 (EXPO 2000). Hannover wanted to ensure that all building and development for the fair was environmentally sustainable. The Hannover Principles were guidelines provided for design competitions to prepare the city for the fair.[31]

The Hannover Principles: Design for Sustainability[32]

1. Respect for nature. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

2. Interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognizing even distant effects.

3. Attention to subtle influences. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.

4. Responsibility for consequences. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist.

5. Nontoxic. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.

6. Cycles and recycling. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.

7. Renewable energy. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.

8. Humility. Understand the limitations of design. No human creation lasts forever, and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.

9. Learning. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity.

Implementing these values requires changing the way places are built. Sim Van der Ryn is a retired architecture professor from the University of California, Berkeley and the founder of the Ecological Design Institute. In the early 1990's, Van der Ryn and his eventual coauthor Stuart Cowan found that approaches to sustainability were too technocratic. They felt that sustainability requires fundamentally different design strategies. They outlined five key strategies, listed below, that emphasize local particularities, ecological processes, and inclusive design methods.

Five Strategies of Ecological Design[33]

1. Solutions grow from place. Ecological design begins with the intimate knowledge of a place. It is small scale and direct, responsive to local conditions and people. If we are sensitive to the nuances of place, we can inhabit without destroying.

2. Ecological accounting informs design. Trace the environmental impacts of design and use this information to determine the ecologically sound design possibilities.

3. Design with nature. By working with living processes, we respect the needs of all species. Engaging processes that regenerate rather than deplete, we become more alive.

4. Make nature visible. Making natural cycles and processes visible brings the designed environment back to life. Effective design helps inform us of our place within nature.

5. Everyone is a designer. Listen to every voice in the design process. As people work together to heal their places, they also heal themselves.

2. Why consider a new approach to infrastructure?

Most current infrastructure shares some basic flaws. Large power plants, large sewage treatment plants, landfills – these use the same basic strategy, and they have similar problems. For example, Figure 25 below illustrates a number of problems with traditional methods of generating power.

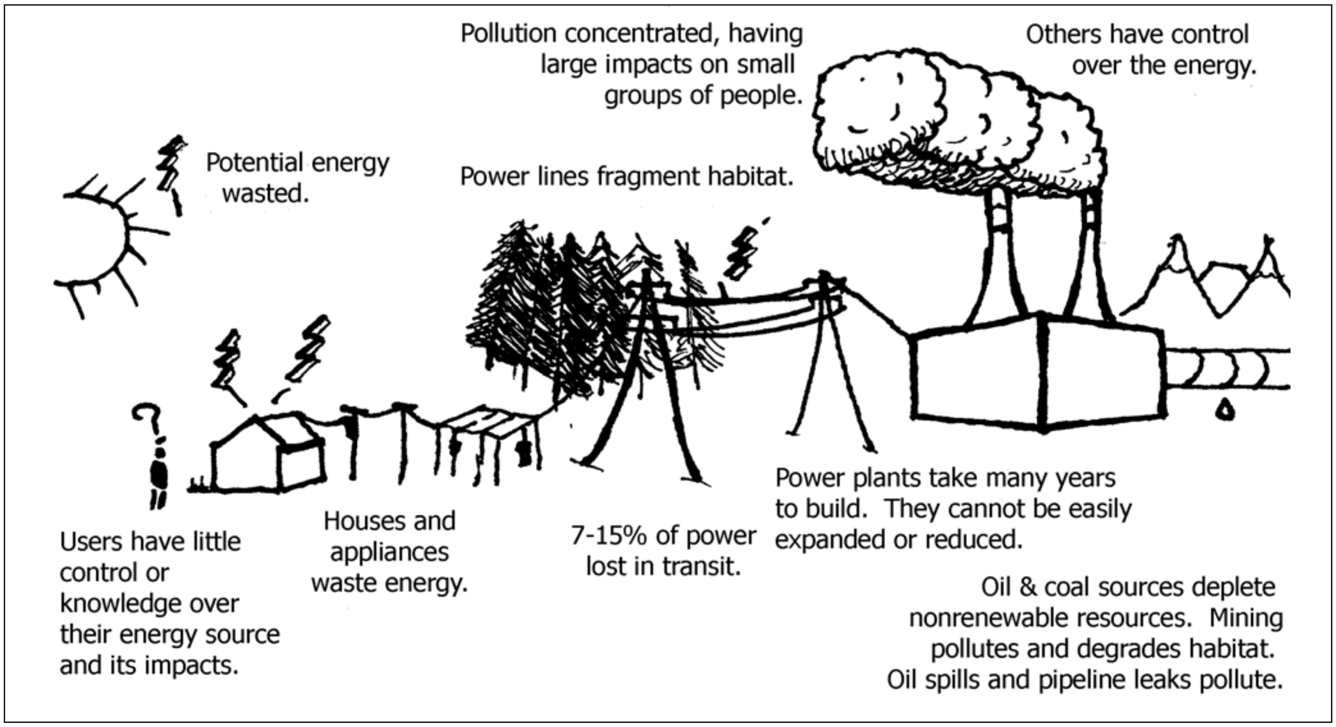


Figure 25: The problems with conventional energy infrastructure.

Similarly, large-scale sewage treatment plants require high infrastructure investments in pipes. Pipes break, causing leaks – sewage leaks out, and stormwater leaks in. Then, the water must be treated in a large quantity. Sewage contaminants are now concentrated in one place, and they are released back to the ecosystem at the same location. (More discussion of sewage treatment occurs in the "wastewater" section.) A less centralized approach could avoid these problems.

Because of these recurring issues, ecological designers take a different approach to infrastructure. Figure 26 below compares conventional infrastructure planning with ecological design.

A building, neighborhood, or city can be thought of as an animal – it requires food, water, and energy, and it produces wastes. These flows entwine the human community with the larger ecosystem. Ecological design involves rethinking how city infrastructure channels these flows of material.

The new ways of thinking about infrastructure require careful planning and engineering. But their smaller size makes mistakes less costly, and they can more easily be adapted to changing circumstances. They often replace fossil fuel energy with biological processes. These benefits usually make them less expensive over the long run. They also provide many secondary benefits, such as education, local empowerment, and a cleaner and healthier environment.

Conventional Infrastructure Planning	Ecological Design
Centralized, large	Decentralized, small
Rigid, "permanent"	Flexible, adaptable
Distant, separated, isolated	Integrated, mixed together, linked
Serves a single purpose	Provides multiple benefits
Hidden, impersonal, "out of sight, out of mind"	Visible and educational, gives feedback
Material passes quickly from source to sink	Material is stored, used many times, and recycled (closed loop)
Mechanical – requires high fossil fuel input	Biological processes do much of the work
Dependent upon distant institutions	Locally self-sufficient
Environmental impacts concentrated, off-site	Environmental impacts dispersed, kept local

Figure 26: The differences between conventional and emerging approaches to infrastructure.

B. Five Issues in Ecological Design and Green Building

Redeveloping the Noyo Headlands in an environmentally-friendly manner requires reconsidering life support systems through the ecological design perspective explained above.

Five key areas – energy, food, stormwater, water supply, and wastewater/sewage treatment – are explored below. Similar explorations should also address topics including building materials, construction methods, and transportation. A visual primer on the five areas addressed is found in the Design Toolbox in Appendix B.

1. Guidelines for Energy

The Noyo Headlands could bring the city closer to energy independence, reducing pollution while helping the local economy. Figure 26 above illustrates the problems with conventional electricity generation, which is currently the nation's single largest source of greenhouse gases.

Pacific Gas & Electric supplies Fort Bragg residents with energy. A very rough estimate suggests that Fort Bragg residences and businesses might use approximately 60 GWh of electricity every year, an average of 5000 MWh each month.[34] As of 2002, the sources of energy produced by PG&E are 56% natural gas, 31% coal, 9% hydropower, and 3% wind – only 12% from renewable sources.[35] This means Fort Bragg residents are unintentionally contributing to global warming and resource depletion, both of which may have negative impacts on the city in the future.

(a) Goals for the Noyo Headlands

The following could be energy-related goals for the environmental performance[36] of development on the Noyo Headlands:

- Noyo Headlands could generate more power than it uses.
- Noyo Headlands' energy generation could bring Fort Bragg closer to energy independence.

(b) Emphasize energy efficiency.

A wide range of simple changes in construction techniques and materials can improve a building's energy efficiency. ENERGY STAR is a rating system by the U.S. Environmental Protection Agency. New homes with the ENERGY STAR rating have tight construction, tight ducts, improved insulation, high-performance windows, and energy-efficient heating and cooling equipment; they are 15% more efficient than existing state energy regulations.

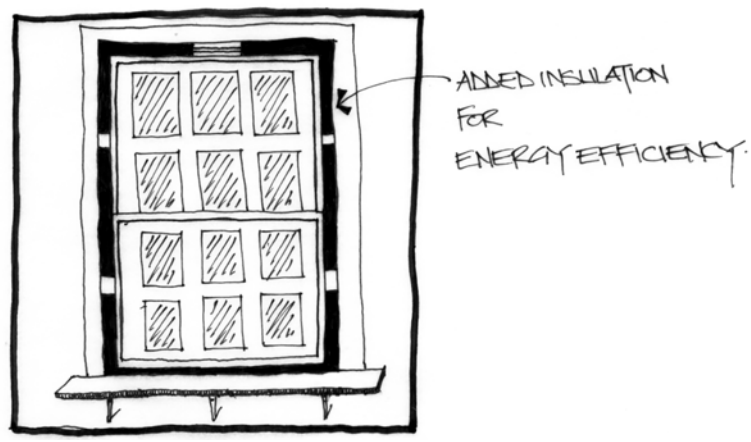


Figure 27: Building construction methods affect a house's energy efficiency.

City building codes can encourage or require buildings to do better than state (Title 24) regulations require. For example, Marin County's Building Energy-Efficient Structures Today (BEST) program gives expedited processing and fee waivers to any building project that exceeds Title 24 requirements by 10%, that generates 75% of its energy with renewable sources, or that fulfills a list of energy efficiency measures. Marin County's Big & Tall Ordinance requires that houses larger than 3500 square feet match the energy performance of a 3500 square foot house, either by being more efficient or by generating their own electricity.[37]

(c) Build with passive solar design.

Simple building design strategies can allow the sun and wind to heat and cool a building. Before air conditioning, almost all houses were passively heated and cooled using sunlight and cool breezes. Since 44% of a person's electric bill typically goes to heating and cooling their home, passive design strategies can have a major influence on electricity expenses.

Passive solar design is a highly efficient renewable energy technique because it uses energy in the same form that it arrives – heat is used to create heat. Converting solar radiation to electric current to heat loses energy in the transitions.

Unlike "active" solar strategies, such as photovoltaic panels, "passive" solar design requires almost no special technology, so initial building costs are comparable. However, it does require careful planning to collect heat from sunlight, store it until needed, and then distribute it.

Passive solar design strategies also require strategic site planning. To have solar exposure, buildings need to have their long edge facing south. They also need to be appropriately spaced, or else one house will shade the next. A building casts a shadow twice its height during winter. Therefore, design of neighborhoods should protect solar exposure. These principles are illustrated in the Design Toolbox found in Appendix B.

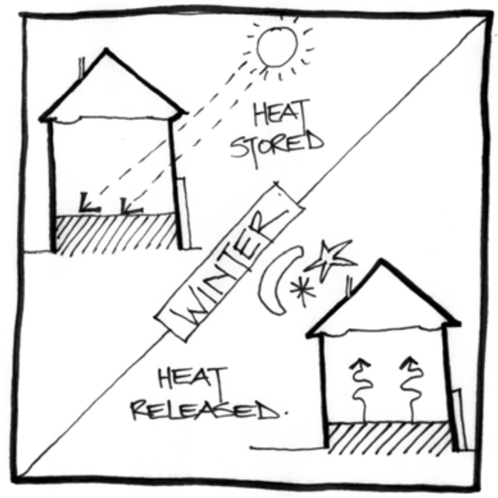


Figure 28: Passive solar design stores heat in thermal mass to regulate indoor temperatures.

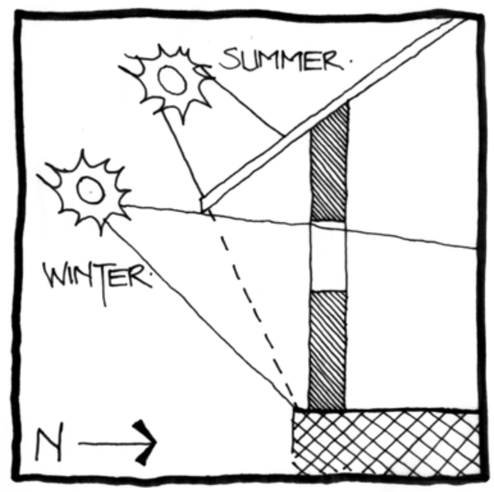


Figure 29: Overhangs can allow sun in the house when heating is needed, but block it when cooling is needed.

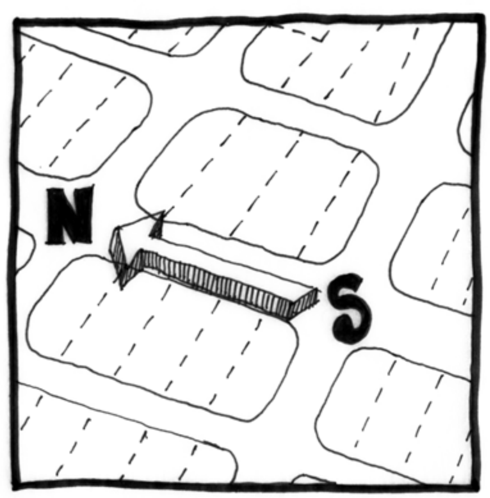


Figure 30: Block and parcel layouts should allow houses' long sides to face south for best solar exposure.

The Advantages of Passive Solar Design[38]

High energy performance. Lower energy bills all year round.
Investment. Independent from future rises in fuel costs, continues to save money long after initial cost recovery.
Value. High owner satisfaction, high resale value.
Attractive living environment. Large windows and views, sunny interiors, open floor plans.
Low Maintenance. Durable, reduced operation and repair.
Unwavering comfort. Quiet (no operating noise), warmer in winter, cooler in summer (even during a power failure).
Environmentally friendly. Clean, renewable energy doesn't contribute to global warming, acid rain or air pollution.

(d) Generate energy on the Noyo Headlands.

Many methods for generating energy from renewable sources are available:

Solar. Solar power can generate electricity or heat. For residential use, the best strategy is to first install solar water heating panels until all the house's hot water and space heating needs are met, since it is more efficient, and then use remaining roof space for photovoltaic cells.[39]

Methane co-generation. Methane is a gas released when organic matter breaks down in the absence of oxygen, especially at landfills, composting sites, and sewage treatment plants. Methane is also the most potent greenhouse gas, causing twenty times the greenhouse effect of carbon dioxide. Burning methane converts it to carbon dioxide while producing electricity.

Wind. Wind is the fastest growing area of renewable energy growth, and it produces energy more cheaply than fossil fuels. However, wind resources are very site-specific. A year-long study could monitor yearly wind conditions to determine if wind is an appropriate technology on the Headlands. One large wind installation is being built just outside Petaluma, due to the work of community member Robert Gold. With European countries upgrading wind systems, a number of highly functional wind generators are available at a reasonable price. Bird mortality is a concern, since Fort Bragg is on the Pacific Flyway, but reports of bird deaths may be overestimated.

Hydropower. Hydropower systems harvest gravitational energy, in the form of falling water. Because of the water being released from the sewage treatment plant, and because of the possibility of restoring the creeks to the surface, hydropower may be an option on the Headlands.

Marine power. Currently in Arcata, California, a pilot wave energy project is reportedly undergoing environmental assessment.[40] The system harnesses the rise and fall of the waves to pump water up a pipeline to shore, and a hydropower system uses this falling water to generate electricity. Another marine energy source is ocean currents, which are 1000 times more "energy dense" than wind currents. San Francisco is currently considering installing a turbine powered by the tides that surge under the Golden Gate Bridge.[41]

(e) Plan for energy generation.

The U.S. Department of Energy is encouraging local communities to take control of their own energy future by creating a comprehensive local energy plan.[42] Other communities are going further (see San Francisco Community Choice Case Study below).

The first step is to determine the current energy needs of Fort Bragg, or of just the Noyo Headlands development. Then, planning to meet these needs can begin. Many tools exist to address those needs, from building guidelines that encourage good energy practices, to arrangements in which cities provide electricity to residents.

The Community Choice Law (California, AB117, 2002, Midgen) is a fairly recent development that helps local communities better control their energy future. A city agglomerates its utility customers, negotiates purchasing agreements with energy providers, and sets its own rates. Individual customers can opt out of the city's system. The city then has control over how to meet local energy demand. They can emphasize efficiency improvements, find renewable sources, and use conventional power to fill in the gaps.

To further pursue renewable energy generation, the City of Fort Bragg, private entrepreneurs, or some collective semi-public unit such as a Noyo Homeowners Association could generate electricity themselves. The City or a nonprofit group might also provide information for others to generate electricity. These approaches are not mutually exclusive. Marin County just installed a 90 KW solar installation to reduce County energy costs. They also used mapping software to analyze the county's solar energy potential, and sent letters to buildings with high potential for energy generation.

Case Study: San Francisco Adopts Community Choice Legislation[43]

In May 2004, the San Francisco City Council voted to determine its own energy future using the Community Choice Law (California, AB117, 2002, Midgen). This means it will agglomerate its utility customers, negotiate purchasing agreements with alternative energy providers, and set its own rates. The City can also use profits to pay for energy efficiency improvements.

The City will now be administering a competitive purchasing plan and negotiating directly with power providers to provide power to its aggregated city customers. The City will determine where the power comes from. They have set an initial goal that 40% be renewable sources.

By bundling together many types of renewable energy methods, and filling the gaps with nonrenewable energy sources, Community Choice cities are expected to be able to provide energy at rates lower than those of PG&E. They can devote their energy profits toward incentives for energy efficiency. They also can keep their energy investment within the local community.

San Francisco is already being quite creative. For example, a new 50 MW solar power "plant" is being split among a dozen commercial rooftops. These are businesses with high afternoon power demand, the hours when solar is most effective. Without changing how they pay their energy bill, these companies will now be buying power right from their own rooftop. No energy will leak from transmission lines, and efficiency gains will then benefit the whole community.

With San Francisco in the lead, forty-eight other California municipalities and counties, or 17.5% of California investor-owned utilities' electricity demand, have followed.

2. Guidelines for Food

"We're only truly secure when we can look out our kitchen window and see our food growing and our friends working nearby." -Bill Mollison, co-founder of Permaculture

Harvest Market, Safeway, and Purity foods together import 319,000 cases of produce/year, according to a very rough estimate.[44] For Harvest Market alone, a 40-foot tractor trailer travels from the Central Valley to Fort Bragg six days a week. Some of that food has traveled to the Central Valley from farms even further away. It has spent many days in transit since leaving the farm. Almost every supermarket faces these same concerns. Nationally, the average food product has traveled 1500-2500 miles and spends seven to fourteen days in shipment. Up to 50% of all food spoils during this journey.[45] So, vegetables are now bred not as much for flavor or nutrition, but for their ability to endure this long, rough trip.

In contrast, a strategy of local food production has the following advantages:[46]

Food Quality

Food is fresher, therefore better tasting and more nutritious.[47]
Food can be grown for its nutritional value or taste, rather than its ability to withstand travel.

Environmental Impacts

Environmental effects of transportation are lower (fossil fuel usage, air pollution, and noisy traffic).
Food production provides a good reuse for sterilized greywater and compost.
Food production can beautify neighborhoods and protect open space..

Economic Benefits

Without added fuel costs, food can be less expensive.[48]
Eliminated fuel costs could improve wages for growers and food sellers.
No food spoils during transit.
Food production can create jobs.

Community Quality of Life

Locally growing food makes high-quality produce affordable to all.
Gardening activities promote community connections.
Gardening activities promote a healthy, active lifestyle.
Vegetable gardens encourage eating a diet of healthy vegetables.
Children learn where food comes from, and about healthy soil and its many lifeforms.

Local Self-Sufficiency

Communities have control over how food is produced (e.g., fewer pesticide residues).
Food independence means food security (e.g., if a mudslide blocked the highway).

Food production in cities provides diverse benefits that are starting to be recognized. The 2006 United Nations World Urban Forum will showcase strategies developed through a million dollar research program conducted in three cities.[49]

Figure 31: Lawns can be replaced with edible landscaping.

(a) Goals for the Noyo Headlands

The following could be goals for the food production on the Noyo Headlands:

- Maximize the amount of food grown on the Noyo Headlands.
- Strengthen the local food economy with greenhouses and commercial food production.

(b) Encourage food growing by residents.

Food production can be integrated into buildings and landscapes in many attractive ways. Many people already enjoy growing some portion of their own food. The following ideas provide a starting point.

Figure 32: In cities, using vertical planting space increases food production.

Replace lawns, trees, and ornamental shrubs with edible landscaping. This is the easiest step toward local food production. Even in the urban city of Vancouver, one-third of a typical city block could be used to grow food.[50]

Use intensive growing methods to produce a large amount of food in a small space. Biointensive gardening, promoted by John Jeavons, increases production through closely-spaced planting, deep trenching, growing a diversity of foods, and using compost as fertilizer. According to his figures, a person who ate only vegetable foods could support their annual food needs on a yard 15' by 20'.

Figure 33: Rooftop gardens are another place to grow food.

Grow food in creative places. Creative planting solutions increase food growth and make beautiful spaces. Food can be grown on rooftops, climbing up walls, and along city streets.[51]

Neighborhoods with shared, semipublic open space allow shared gardening work. Village Homes (see case study, page 76) demonstrates that food production works well in a neighborhood with shared open space. Fruit trees line pathways, and annual sales of an almond crop bring revenue for community activities. Shared open space means that compost piles, greenhouses, tools, and, most importantly, the land itself can be shared. In contrast, in a neighborhood filled with fences, non-farmers may have unused green space, while the farmers among them have too little space.

Community gardens on relatively small urban parcels have proven successful. Gardens do not need to be large. The San Francisco League of Urban Gardeners has over one hundred small neighborhood gardens throughout the city, many built on simply one vacant house lot.

Commercial food production and the reuse of the greenhouses should be considered. Commercial farms can also be fairly small. Fairview Gardens, surrounded by suburban development in Goleta, California, is a twelve-acre island surrounded by tract homes and shopping centers. It produces more than 100 different fruits and vegetables, feeds 500 families, and employs more than twenty people.[52] The Food Project, in Boston, Massachusetts, has a thirty-one acre farm in nearby Lincoln, and three smaller lots in Boston. It employs over 100 young people and twenty-five full-time staff and engages nearly 2,000 volunteers annually. It grows over 250,000 pounds of chemical-pesticide-free food each season.

When asked, the produce managers at Harvest Market, Purity Foods, and Safeway all expressed enthusiasm about buying from local growers. They would be willing to share advice to help new growers learn from difficulties they have observed in the past.

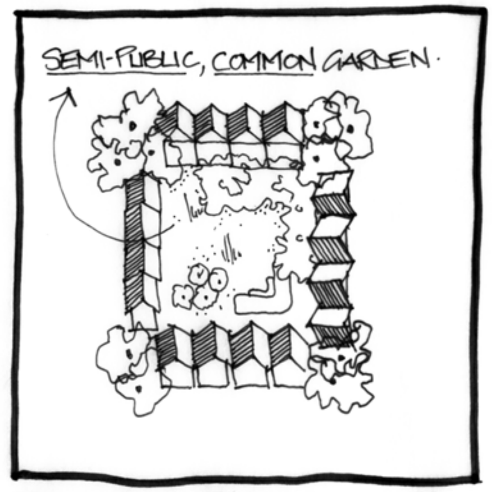


Figure 34: If a block has shared open space, non gardeners can share their land with gardeners.

Figure 35: Community gardens can fit in spaces as small as a single house lot.

Figure 36: Commercial farmers could reuse existing greenhouses.

> ### "But what about the contaminants?"[53,54]
>
> The site assessment should adequately evaluate the suitability of different areas of the site for agriculture. The U.S. General Accounting Office identified 130,000 to 425,000 contaminated vacant industrial sites that could be safely converted to agricultural purposes when properly redeveloped.[55] Many community gardens in inner cities have been built on contaminated sites. Typically, potential community gardeners test the soil and use container gardens or hydoponics in contaminated areas. They may also improve the soil themselves. Since urban gardens most often have to worry about heavy metals like lead, gardeners augment the soil with compost or lime to raise the pH, which makes heavy metals less mobile. They may also use phytoremediation with plants like sunflowers, or grow fruiting plants and vegetables (e.g., peppers, eggplants) that take in fewer metals than tubers or leafy greens.[56] The situation deserves appropriate caution, but because of agriculture's many benefits, it deserves consideration.

(c) Create an overarching food plan for the Headlands.

An overall plan for the Headlands should provide agricultural space equivalent to that needed by its residents. Rough calculations suggest that on a vegetarian diet, supplemented by a few eggs each week, 100 people could be fed from just over seven acres. Fourteen people might be employed full-time as farmers to grow this food.[57] Therefore, Noyo Headlands' gardens could supply food equivalent to new residents' needs for vegetables and eggs.

The food plan for the Noyo Headlands could then consider how to feed others in the Fort Bragg community. Already, there are neighborhood farmers in the region who plant extra rows and donate these vegetables to the food bank.

3. Guidelines for Stormwater

Rainstorms and the water cycle are important in keeping ecosystems functioning well. However, cities interfere with the water cycle. Surfaces like concrete and roofs keep water from soaking into the earth. They shed water quickly, and it rushes to storm drains and creeks, causing flash floods. It does not travel slowly through vegetation as it heads to the river, nor does it slowly percolate through the ground into reservoirs that supply wells and springs.

Worse, this stormwater runoff can carry contaminants from yards and roads, such as pesticides, oils, and heavy metals. A recent document from the U.S. Environmental Protection Agency (EPA) found that one-third of all water quality problems were caused by stormwater runoff.[58] So, stormwater cannot be simply transported to the ocean. But, if combined with city wastewater, it increases the burden on the city sewage treatment plant.

The City of Fort Bragg is currently considering how to renovate the mill ponds to provide stormwater treatment. This is a very strategic way of addressing stormwater pollution, because it cleans stormwater cost-efficiently, while also creating a small water oasis. Other suggestions in this section may be able to support this fundamental strategy and diversify Fort Bragg's stormwater strategy on the Noyo Headlands.

(a) Goals for the Noyo Headlands.

The following could be goals for the stormwater-related environmental performance[59] of development on the Noyo Headlands:

- Biologically filter all stormwater onsite.
- Absorb most water within a neighborhood.
- Overall, discharge no stormwater to sewage plant or ocean.

(b) Treat as close to the source as possible.

The Bay Area Stormwater Management Agencies Association (BASMAA) found that **the closer to the source of runoff the water is treated, the less expensive the solution**. Their handbook *Start at the Source*[60] focuses on simple techniques individual buildings and neighborhoods can use to reduce runoff, keep it clean, or clean it before it leaves the site.

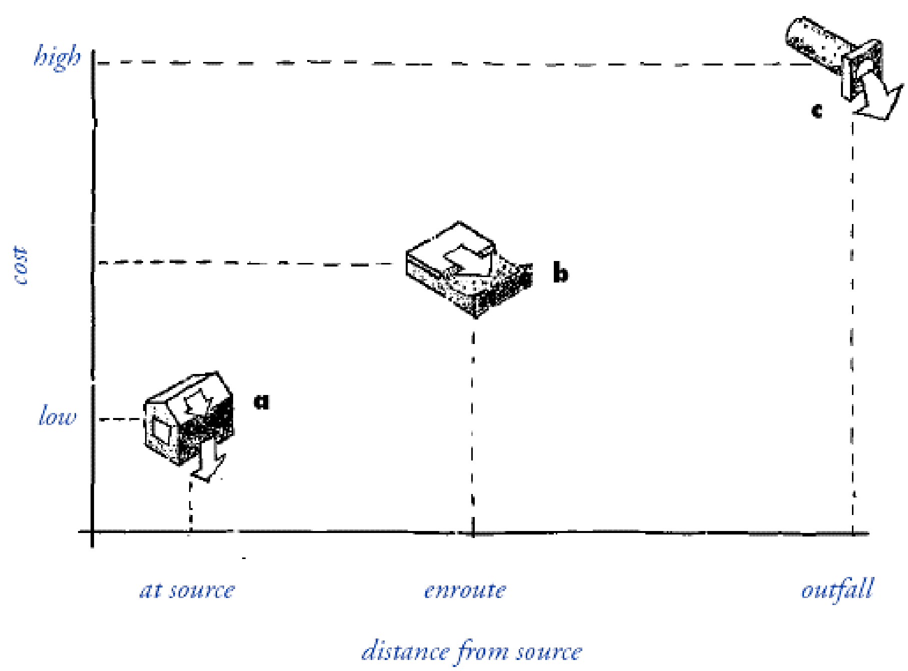


Figure 37: Cost of treating stormwater increases as the stormwater moves further from its source.

The Village Homes neighborhood (see case study, page 76) demonstrates the savings of this solution. Therefore, any future Noyo Headlands' developments should use simple landscape interventions that reduce the costs of storm sewer infrastructure.

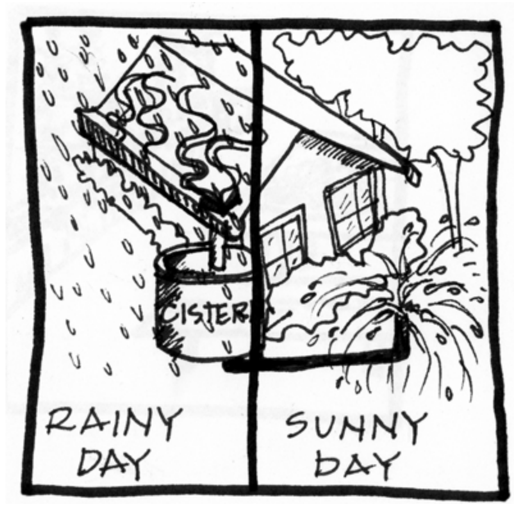


Figure 38: Rainwater can be caught and reused.

To encourage the use of on-site solutions, the City of Fort Bragg's building and landscaping guidelines could be augmented with strategies to minimize the stormwater burden that the City must bear. To ensure that developers have no financial incentives to ignore low-cost on-site solutions, City development exactions should reflect the full long-term cost of constructing and maintaining stormwater infrastructure, especially in light of increasing regulatory strictness about this source of water pollution.

(c) Separate stormwater from polluted areas.

Rainwater is relatively clean, but driveways and streets are not. Covering areas where cars are stored or repaired, or providing dedicated areas where this runoff can absorb into the ground, are two ways to keep this contaminated runoff from polluting streams or harming aquatic life, such as fish.

(d) Catch and reuse rainwater.

Catching rainwater from roofs, storing it, and using it later for watering lawns is a simple solution that reduces the intensity of water flow during a storm. The impact this delayed release of water could have on local ecology should be considered, but often these impacts have already occurred, with fresh drinking water.[61]

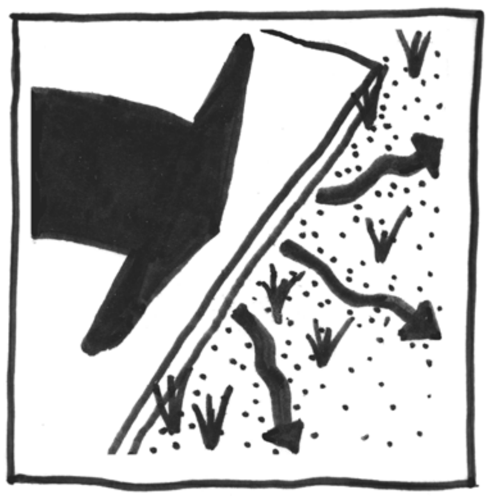


Figure 39: Runoff should be dispersed across impermeable surfaces like gardens, which slow and clean the water.

(e) Reduce impermeable area and disperse stormwater.

In many cities, impermeable materials, such as asphalt and roofs, cause water to flow away, rather than soaking into the ground. Permeable materials such as vegetated areas allow water to percolate down into the soil.

Replacing "slick" surfaces like pavement with "rough" materials like grasses slows runoff and cleans it. Vegetation slows water down. When runoff is going slowly, it cannot carry heavy particles. These particles are caught by plants or fall to the ground.

Asphalted areas should channel stormwater outward, toward grassy areas, to be absorbed or filtered. In places where asphalt or other impermeable surfaces are necessary, they should not collect stormwater to a pipe and carry it away. Parking lots and streets can be bordered by planting strips that collect this runoff or filter it as it travels. If a parking lot is very large, it needs a correspondingly large area to filter the stormwater. Interspersing stormwater treatment planting strips with smaller areas of asphalt is better than having a large parking lot next to a large grassy area.

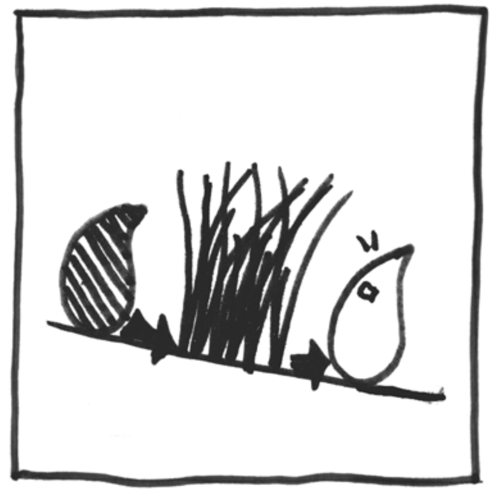


Figure 40: Plants can filter stormwater.

Parking areas should be kept as small as possible. To do this, creative parking strategies can play an important role. Cars can be parked underground, on streets, or on rooftops. The Design Toolbox in Appendix B has a number of possible parking solutions.

Figure 41: Large parking lots increase runoff. Instead, put cars on the roof, or create a second story for parking.

(f) Maximize water absorption into the ground.

Stormwater runoff can be funneled to small basins where it can absorb into the ground. The success of this solution depends upon the geology of a site, because the soil must absorb water. Since the Noyo Headlands is a coastal terrace whose upper soil is generally sandy, with some silt and some gravel, an infiltration strategy appears feasible.[62]

Many different site design strategies allow water to absorb into the ground, by including depressions into the design of yards, neighborhoods, and cities. These basins fill with water when it rains. But since they dry out between storms, they can be designed to safely double as parks, ampitheaters, or ball playing fields. Individuals can even create "rain gardens" in their backyards since the moistness of this depression will likely host a different group of plants, even without irrigation.

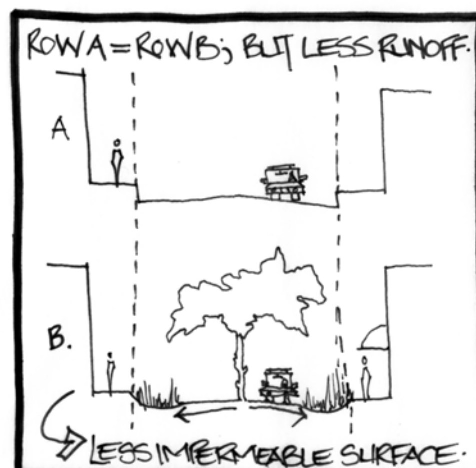


Figure 42: Adding planting strips and swales to streets reduces and cleans runoff.

(g) Clean water as it travels, using swales and a "green streets" strategy.

As explained above, **grass and other dense vegetation slow water and filter it**. "Swales" are narrow grassy strips that can be placed adjacent to streets and parking lots. Swales are somewhat like ditches, but since they are wider and shallower, and since they dry out completely between storms, they are much more attractive and safe. **Water only has to travel for 100-250 feet, or 5-9 minutes, in a swale to be almost completely clean.**

Streets with attached swales are known as "green streets." The swale filters out any oils or chemicals from the street. These streets look similar to regular streets, except the planting strip between the sidewalk and street is slightly concave, so stormwater runs into this grassy strip and is cleaned. The regional transportation agency in Portland, Metro, is now encouraging the use of green streets throughout the entire region.

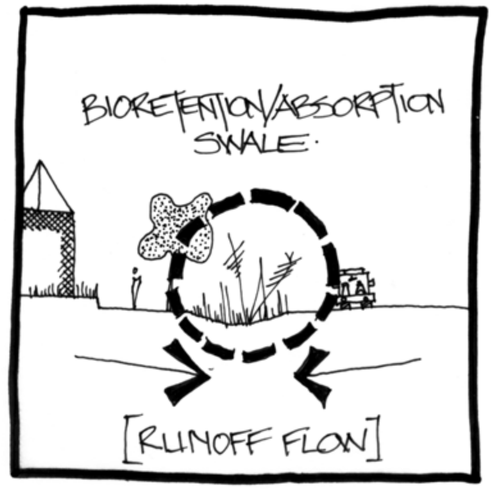


Figure 43: Swales are concave planting strips that filter runoff..

4. Guidelines for Water

The City of Fort Bragg has been working for over a decade to improve its water efficiency and secure a reliable water supply. New development on the Noyo Headlands should support these efforts by using minimal water, and by demonstrating water-saving techniques for other buildings to copy. Development on the Noyo Headlands is being built from scratch, so it is not limited to only high payback, end-of-pipe interventions, such as appliance retrofits. The water cycle throughout the whole house can be reconfigured to conserve this important resource.


Figure 44: Native plants require less irrigation and effort than a lawn. They also benefit local wildlife like birds.

(a) Goals for the Noyo Headlands

The following could be water-related goals for the environmental performance[63] of development on the Noyo Headlands:

- Minimize water use.
- Recover any increase in water use by increasing the efficiency of an already-efficient Fort Bragg water system.

(b) Practice water-efficient landscaping.

An average of 60% of residential water use goes to landscaping. Landscaping efficiently is an easy way to save money. Planting with native plants and reducing lawn areas reduces lawn-related water use.[64]


Figure 45: Irrigating with drip lines at night, or watering deeply but less often, keeps plants healthy with less water.

Better irrigation practices can also reduce water use. These include using drip hoses, watering at night, and watering more deeply, less often, so plants develop deep roots. Public education campaigns can educate homeowners about efficient irrigation methods. The City currently bans watering that causes water to flow off properties. Perhaps other guidelines could augment this, inspired by other communities' "waterwise landscaping ordinances."[65]

Finally, **irrigation is an ideal use for non-potable water**, including rainwater, greywater, and recycled water.

(c) Minimize water use in homes and buildings.

The City of Fort Bragg has a retrofit program for businesses and public uses to install higher-efficiency, low-flow appliances. Development on the Noyo Headlands is being built from scratch, and can therefore use cutting-edge water saving technologies. An interactive tour of a water-saving house presented by the California Urban Water Conservation Council is found at http://www.h2ouse.org/.

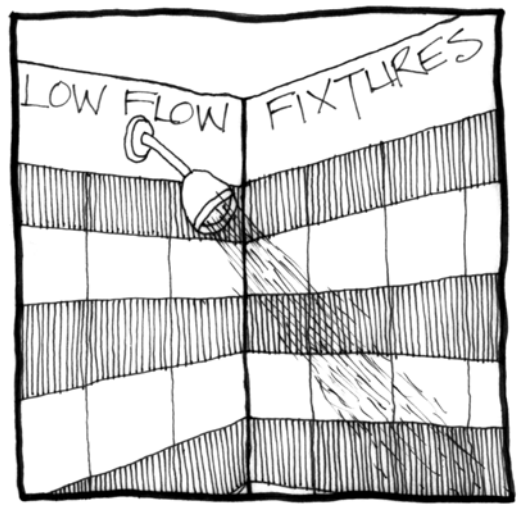


Figure 46: Low flow fixtures provide the same benefits using less water.

Prevent leaks. Many places, leaks are the largest use of water, and they provide no benefit. Construction should pay attention to avoiding leaks, and use high quality materials to prevent future leaks.

Minimize water used for flushing. Toilets are the largest water user in the typical home. They use drinking water to move waste down a pipe. Reducing water use in toilets is the highest priority of many water districts' conservation projects. Ultra-low flow toilets can reduce water used for flushing to only 1.2 gallons/flush – slightly more efficient than currently required.[66]

Dual flush toilets save even more water. These toilets have two buttons – a half flush for liquid waste and a full flush for solid waste. One study found these save 26% more water than even ultra-low flow single-flush toilets, and that of the users, more than 85% rated them either "good" or "satisfactory," and 66% would definitely recommend dual-flush toilets to others.[67] These are already mandatory in Australia, common in Japan, and some San Francisco Bay Area utility districts offer incentives that subsidize their purchase.

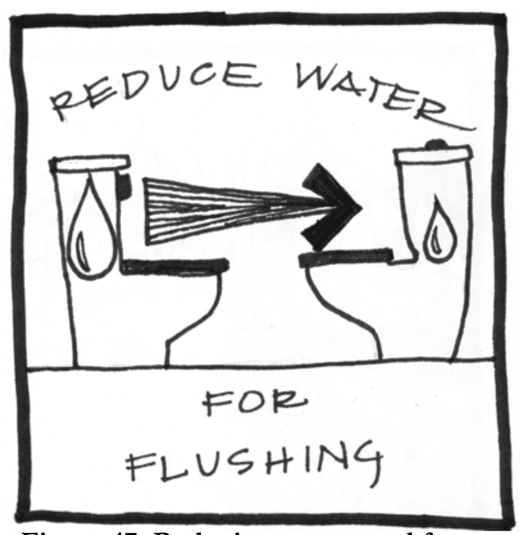


Figure 47: Reducing water used for flushing saves water and the effort of then sterilizing it.

A final option are **composting toilets.** Also called "dry toilets," these use no freshwater to convey waste. They convert toilet waste to fertilizer. They require more maintenance, but they recycle valuable nutrients as fertilizer for non-food crops.

Use other low flow appliances, especially washing machines. Washing machines are the second largest water user in a typical home and should therefore be a high priority. Showers, dishwashers and sinks also are available in low flow varieties.

Automate water conservation. Water waste often happens unintentionally. For example, a person might accidentally leave water running when the spaghetti pot suddenly boils over. Recognizing this, new sinks have sensors or foot pedals that make water automatically stop running if a person steps away.

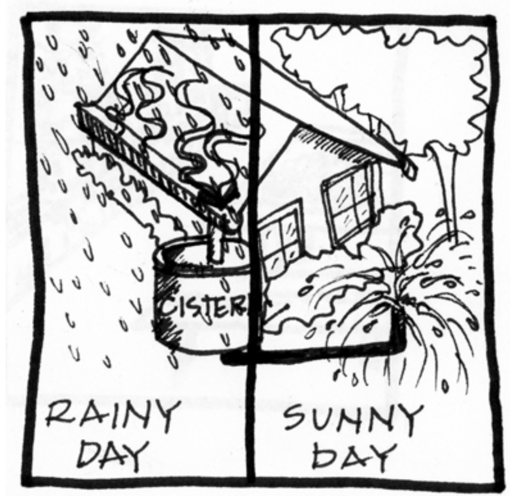


Figure 48: Catching and using rainwater can cut household water use in half.

(d) Harvest and reuse rainwater.

Capturing rainwater and using it for irrigation, toilets, washing cars, and other uses that do not require drinking water can reduce annual water consumption by 50%, according to Portland city green building officials.[68] Reusing rain also addresses the problems of stormwater discussed above.

Rainwater harvesting systems collect water from a building's rain gutters in storage tanks, either above or below ground. Then, on sunny days, the water is reused.[69]

(e) Reuse and recycle greywater.

Water that goes down the drain often could be used again. Water from washing machines, showers, and sinks – "greywater," as opposed to "blackwater" from toilets – often can be lightly filtered and used again. This will be discussed in more detail below.

5. Guidelines for Wastewater & Sewage

Wastewater and sewage treatment are central components of a development's environmental sustainability. The wastewater system influences water use, groundwater quality, energy use, and nutrient recycling.

The City of Fort Bragg is currently planning to construct a wetlands system for the final stages of sewage treatment here. Local residents discovered that in Arcata, California, a wetlands was serving as bird habitat while providing walking trails for the city. The wetland-treatment marsh is a strong beginning to an ecological wastewater design strategy for the Noyo Headlands. The following ideas can supplement and diversify this approach.

Although considered in separate sections here, **water supply and wastewater treatment should be considered a single system.** Wastewater and sewage simply continue the water cycle after water is used in homes and businesses. When sewage systems are considered alone, many opportunities for efficiency are missed. When wastewater considerations are planned as part of the water supply and disposal network, many options become possible. Therefore, many of these recommendations overlap with those above.

(a) Goals for the Noyo Headlands

The following could be wastewater-related goals for the environmental performance[70] of development on the Noyo Headlands:

- Developments could treat their own waste, to create model alternatives to sewage plants.
- Nutrients in waste should be reused as fertilizer.
- Greywater should be reclaimed and reused.

(b) Reduce wastewater volume.

The easiest way to sustainably "treat" wastewater is simply *not* to create it in the first place. The principles of minimizing water use are explained in detail in the previous section. Another way to reduce the amount of wastewater treated is to **recycle greywater**, as discussed below.

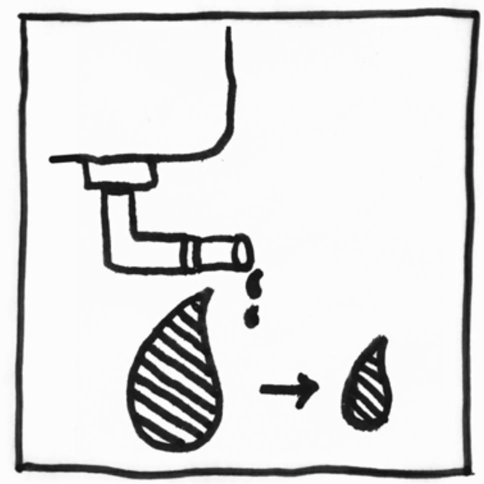


Figure 49: Conserving water also lowers the amount of wastewater to be treated.

(c) Reduce wastewater contamination.

Public education and friendly visual reminders near sinks can prevent unnecessary contamination of water. Some contamination of water is necessary – dishes do not get clean unless the water gets dirty. But some contamination serves no purpose. For example, food scraps should be composted, not washed down the kitchen drain.

Industrial chemicals, especially, should be reduced. Since the vast majority of water is only minimally polluted, that water should be treated without having to treat every drop of water for heavy metals and hazardous materials.

As the organic and chemical loads of wastewater go down, some treatment processes will operate more quickly and others could be eliminated altogether. The final remaining wastes after treatment, such as the sludge from the sewage treatment plant, will not be contaminated with difficult-to-remove contaminants such as metals that make it difficult to reuse them.

Figure 50: Keeping contaminants out of wastewater makes it easier to reuse water or reclaim nutrients in waste.

(d) Separate different types of wastewater and treat them separately.

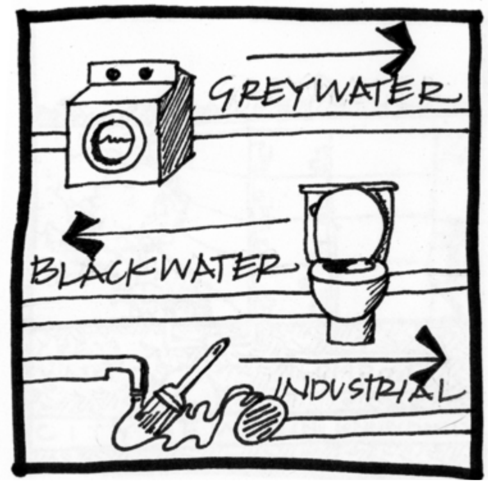


Figure 51: Separating wastewater from different sources makes treatment more efficient and recycling more feasible.

Separating different types of wastewater allows each type to be most efficiently treated and reused. Wastewater from different sources is very different. Each type contains contaminants that are most efficiently removed in different ways. Each type presents different opportunities for recycling and re-use. Once mixed together, every drop of water has to be treated for the worst contaminant that any drop might contain.

Lightly-used greywater from the shower, washbasin, and bathtub is the greatest portion of wastewater, around 40%. It contains a very low amount of nutrients, and poses very little public health hazard. With a little treatment, this water could be used directly for irrigating non-food.

Sewage or blackwater, the water from toilets, is about one-third of wastewater.[71] It would ideally be treated separately from other types of water. It poses the greatest threat to public health, but also is richest in nutrients. Many even recommend separating liquid waste (urine) from solid waste (feces) using a "separating toilet." [72]

Industrial water – for example, from the drain at a car wash – contains more metals, greases, and solvents than domestic wastewater. If possible, this should be treated onsite.

Stormwater should also be kept out of the town sewer treatment system whenever possible. Stormwater contains certain contaminants – heavy metals, for example – not common in domestic wastewater.

Currently, sludge – the solids that remain after wastewater is treated – is usually polluted. Though it has many nutrients plants need, its reuse as fertilizer is often criticized, because of these pollutants. Keeping industrial waters and stormwaters out of the normal wastewater stream could avoid this problem.

Why keep wastewater separate? More explanation.

An old saying[73] explains – "If you put a spoonful of wine in a barrel full of sewage, you still have sewage. But if you put a spoonful of *sewage* in a barrel full of *wine*, you again get sewage." This is the situation with wastewater, since some types are "wine" compared to others. Mixing waste means that *every* drop of water needs treated for the contaminants that could be contained by *any* drop, and reuse is difficult.

(e) Reclaim nutrients.

Wastewater and sewage contain many nutrients that originated in the soil and are required for soil fertility. Officials in Sweden calculated that the nitrogen and phosphorous in the country's human waste could replace about 20% of that used in commercial fertilizers. As it is, phosphorous is obtained by mining phosphate rock, particularly in Florida, where high-quality deposits are being depleted, and where new mines are being opposed because of concerns that they would pollute drinking water supplies.[74]

Figure 52: If toilet waste were properly sterilized and recycled, it could provide nutrients equivalent to 20% of commercial fertilizers.

Fort Bragg residents may wish to reduce their contribution to fertilizer mining problems. Methods for recycling sewage for fertilizer, within cautious public health safeguards, could be considered.

Wetland treatment systems, such as the one Fort Bragg is currently considering, reclaim nutrients in a different way. Nutrients are accumulated by the marsh plants, which then feed birds and fish, and the nutrients enter the food cycle.

(f) Reuse and recycle greywater.

Greywater recycling and reuse saves water and reduces burdens on the sewage treatment system.

In houses, very simple systems are often the most successful. Small-scale greywater systems can be as simple as hooking a garden hose up to a bathtub drain. A quick summary of possible public health concerns that could arise, how to prevent them, a critique of current California standards, and suggestions for the best possible public health regulation of greywater are available from greywater design professionals at Oasis Design.[75]

Water in larger buildings can be recycled. This might be appropriate for the proposed marine research center. Some buildings, such as the C.K. Choi Center (see case study, page 67) and the Lewis Center at Oberlin College (see case study, page 86) have their own greywater treatment systems. Currently, New York City is offering rewards to owners of commercial buildings who retrofit their buildings in a similar way.[76]

Figure 53: Greywater can be recycled and reused in many small ways.

Recycled wastewater systems in neighborhoods, campuses, or cities are also feasible. Recycled water systems are especially appropriate when new neighborhoods or campuses are being built. For example, the University of California is planning to include a campus greywater recycling plant at its new Merced campus in the future.[77] The California Urban Water Conservation Council recommends greywater recycling systems at the neighborhood or city scale. Greywater from all water sources is combined, lightly filtered, and then piped to nonpotable uses such as irrigation, toilets, and cooling towers. The City of Fort Bragg "shelved" the idea of a water recycling plant in 2003. However, as it has been adopted by an increasing number of communities, perhaps the City's concerns have been addressed, or perhaps it is feasible for new development on the Noyo Headlands even if still not appropriate for the whole city.

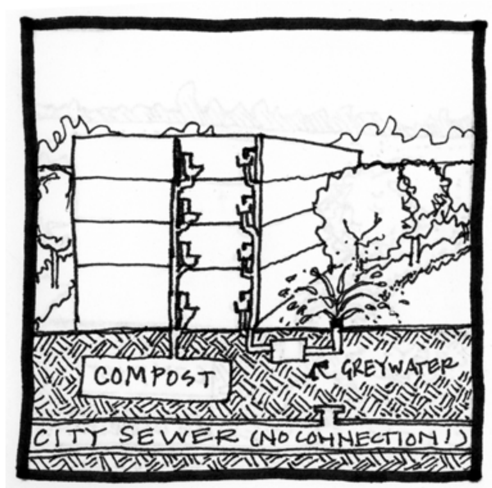


Figure 54: Buildings do not need to connect to the city sewer if they compost toilet waste and recycle and treat their own greywater.

All water recycling systems require a dual water supply pipe network – two sets of water delivery pipes and two sets of wastewater pipes. Because pipes are underground and inside the walls of buildings, water recycling systems are much more affordable when part of the initial construction.[78]

(g) Create a flexible, "off the grid" sewage system.

Rather than moving all the water to a central location for treatment, **water should be treated as close to its source and reuse as possible**. Alternative methods mentioned above are often the same cost as conventional methods because they save the cost of hooking into the existing system. Transporting waste costs money for both pipes and sometimes for pumping. Pipes clog and break, and fixing these takes money. Where pipes crack, sewage

Figure 55: To maximize benefits of any future water recycling plant, two sets of water supply pipes should be built.

leaks out and pollutes groundwater. Nationwide, an estimate 20% of pollutants do not reach the treatment plant.[79] Some pipes in the Fort Bragg area are suspected of having leaks, which is a difficult problem to address once it occurs, but completely prevented by treating most sewage and greywater onsite.

Figure 56: Biological systems to treat water solve the human problem of waste and return nutrients to the ecosystem in a beneficial way.

A number of off-the-shelf solutions are available for both single buildings and housing clusters that allow them to treat their waste onsite. New Noyo Headlands development can serve as an example of various methods by which buildings and neighborhoods can be "off the grid."

Decentralizing sewage treatment creates a **more flexible, responsive system**. Complex, multi-stage processing plants last decades and take long-term planning to build. They can usually improve only marginally over what they were designed to do.[80] A flexible system allows the treatment system to change as public health standards increase, and as more is learned about the effect of contaminants.

C.K. Choi Building, University of British Columbia, Canada: Composting Toilets and On-Site Greywater Recycling and Treatment Reduce Water Use and Eliminate Connections to City Sewer

The C.K. Choi Building is not hooked up to the city sewer system, and it has sharply reduced its water use. The following principles explain how it accomplished this:[81]

- Low water use fixtures are used throughout the building.
- Composting toilets (Clivus Multrum) reduce water use by as much as 1,000 litres (264 gallons) of water per day.
- Water reductions enable the project to exist without a sewer connection.
- The gray water system uses a subsurface constructed wetland to filter and clean water naturally.
- Wastewater from sinks and the composting "tea" from the toilets are filtered through the grey water trench. The plants and microbial life clean the water naturally.
- The Vancouver Health Department has tested the fecal coliform of the water and found it to contain 10 parts per 100 ml. (Swimming is allowed up to 200 parts, and stormwater contains 1000-2000 parts).
- A 7,000 gallon cistern below the stairs collects rainwater to irrigate the landscape in summer months.

The C.K. Choi Building excels in other aspects of sustainability:

- Its average annual energy costs are 50% less than average, due to an aggressive strategy to light, heat, and cool the building with the sun and natural ventilation (even without any photovoltaic panels assisting).
- It was built from materials salvaged as other buildings were being torn down. The construction contract required recycling or reuse of construction waste, which diverted 95% of potential trash from the landfill.

The project cost was lower than the amount budgeted, which was budgeted as though this were to be built using conventional practices.

(h) Use ecological treatment methods.

Systems that mimic ecosystem functioning save resources by harnessing ecosystem processes to do work. Most methods of wastewater treatment are biological – using bacteria – but they do not connect these bacteria to a larger ecosystem. Instead, these bacteria themselves become a waste. Ecological systems create a food web that begins with the microbes fed by the nutrients in wastewater.

Living Machines, invented by Ocean Arks International, are one ecological design technology worth further consideration. Wastewater flows through a series of large glass tanks stored in a greenhouse. Each tank has a balanced food web adapted to the particular strength of the wastewater (untreated, partially treated, etc.).

Wastewater treatment marshes – with surface or subsurface water flows – are another ecological method worth considering. The City of Fort Bragg is already planning to augment its wastewater treatment plant with a marsh. This can potentially provide habitat for birds traveling the Pacific Flyway. Perhaps a few small, on-site wetlands might be appropriate at other building projects on the Noyo Headlands, to demonstrate to other communities that those wetlands can work even for single buildings or housing clusters.

C. Conclusion

Ecological design principles and environmental "best practices" should underpin design and planning processes on the Noyo Headlands. Living in a place entwines people with local ecosystems through flows of energy, nutrients, and water. Simple, small-scale interventions throughout the Noyo Headlands will make obvious the myriad interconnections that exist, and allow humans to participate positively.

IV. Re-Inhabit:

Integrating Ecological Concepts Into A Planning and Design Process

The previous chapters have presented basic elements of sustainability in remediation, restoration, and building. How do these combine to form a sustainable development plan for the Noyo Headlands? This chapter summarizes the ideas presented into a step-by-step framework for planning and design, starting with the regional planning framework – economic development, transporation, ecosystems, and infrastructure. It then considers the Noyo Headlands site itself – the site's open space plan, land use allocation, block and street network, and street design. Ecological concerns can permeate each of these levels to give the Noyo Headlands a distinctive identity as a model of sustainable development.

A. City Process

1. Establish a declaration of principles that guide Noyo Headlands planning.

Establishing a declaration of commitment to sustainability principles can help focus long term planning. This could either occur as an update to the City of Fort Bragg's existing Statement of Position Regarding Reuse of the Georgia-Pacific Mill Site or as a separate statement focused on environmental concerns.

Cities throughout the world have made overarching statements that govern not only single sites, but also citywide activities. The city of Bahía de Caraquez, Ecuador, for example, experienced two dramatic natural occurrences – first an earthquake, followed by rains triggered by El Niño, which led to massive landslides. Facing substantial rebuilding, Bahía declared itself an EcoCiudad (Spanish for "ecocity") and began revegetation on all susceptible hillsides in Bahía, a citywide composting program, and other ecological activities that were applied throughout the city.[82]

Several cities have also created long-range plans focused specifically on environmental sustainability. Example plans are available online for both San Francisco (http://www.sustainable-city.org/Plan/Intro/intro.htm#PlanHistory) and Cleveland (http://www.ecocitycleveland.org/). The infrastructure analysis of issues such as energy, water, food, and wastewater, recommended in Part III: ReBuild could be expanded to become a entire sustainability plan for Fort Bragg, if substantial citizen support existed for this idea.

2. Formalize ongoing citizen participation.

Three citizen participation activities have occurred in Fort Bragg – one set was coordinated by North Coast Action, one set was coordinated by Georgia-Pacific Lumber, and one set was coordinated by the City of Fort Bragg. These have yielded much information and the beginning of a site master plan for the Noyo Headlands.

Fort Bragg residents expressed interest in continuing to shape the future for the Noyo Headlands. To harness this energy, a formal ongoing citizen participation framework should be created to continue the work of these groups and allow citizens to further develop their ideas.

As outlined in Part I: Remediation, a Citizens Action Group should be established to assist with planning the site remediation. Other formalized groups should be created around specific issues or ideas, such as development of the coastal trail and a network of walking and biking paths. The participation process could continue forward as **working groups that report back to City staff**. Another option is to **formalize alliances with existing organizations**. For example, the Mendocino County Audubon Chapter is an organization that could be officially requested to create recommendations for bird habitat on the Headlands.

Alternatively, local or national non-governmental organizations could be invited to take a significant role in redevelopment planning as partners with the city. In Chattanooga (see case study, page 9), extensive citizen participation and redevelopment of brownfield areas was led by Chattanooga Venture, a local nonprofit organization. Nonprofits can play key roles in community development and city planning. For example, affordable housing development nonprofits often do strategic planning about which areas they will target for new buildings, which ultimately changes the face of the city.

B. Regional Planning Framework

1. Plan for restorative economic development.

Economic development is a driving force in the Noyo Headlands reuse planning process. Creating a sustainable plan requires the integration of sustainability concepts into the economic development plan. An economic development plan focused on creating "a restorative economy" could be supported by Noyo Headlands development.

(a) What is a restorative economy?

A restorative economy is an economic system organized to improve the overall well-being of the local place, including natural ecosystems and the people of the surrounding community.

A restorative economy produces what people need locally. A restorative economy strives to succeed within local ecological limits, while minimizing the environmental impact on the outside world. Re-localizing the economy would keep money and attention local, instead of draining resources to other places. As skills and capacities expand – to produce food, energy, clothing, crafts, and more – Fort Bragg will become more self-sufficient and better equipped to determine its own future.

A restorative economy not only respects local ecosystem but continually improves its natural resource base. It not only sustains but continually adds to one of its fundamental assets – local ecosystems, sometimes called "natural capital." Many communities were economically devastated when overfishing and river damming made fishing industries no longer viable. We should prevent similar crashes in the future, and restore resources like fish populations that are depleted now.[83]

A restorative economy continually gives back to the community. Just as businesses depend on local environmental resources, they depend on the people of the surrounding community. Local residents can serve as employees, purchase the goods sold, and create a positive city environment for all company activities. An often-retold story claims that Henry Ford, founder of Ford Motor Company, paid his workers enough to buy a Ford car, and that his commitment to employee well-being brought long-term economic returns. Similarly, in the nineteenth century, many early business leaders were civic boosters who built roads and sewers, founded schools, and started newspapers. They did this for their own profit – if more people moved to town, more people bought their products and raised the value of real estate they owned. A restorative economy recognizes that the people and city infrastructure are businesses' civic resource base, and that they need should be maintained and improved over time.

A restorative economy aims to improve the "quality of life," not its "quantity." Economic development could occur without improving the lives of average people in Fort Bragg. One way to maintain focus on quality of life, rather than growth, is through the use of indicators. A community group or the City of Fort Bragg could, with community input, develop a set of indicators that will be monitored to maintain the focus on the issues that residents care about. These indicators identify why people want economic development, to make sure that widely-held goals are being achieved.

Such a list might include the following indicators: residents receiving a living wage, residents paying an affordable amount for their housing, and young adults remaining in the community. It could also include indicators of people's health, such as pollution-related illnesses, and levels of physical activity. Without maintaining focus on quality of life, commercial transactions could increase without making the average resident's life better, even while he or she has to endure greater traffic and crowding.

(b) Why seek a restorative economy?

A restorative economy is key to long-term prosperity. In Northampton, Virginia (see case study, page 73), people recognized that they were currently impoverished when the fishing industry collapsed due to unsustainable environmental practices. Therefore, their economic redevelopment plan tied development goals with environmental protection goals.

There are many reasons that a restorative economy creates a more prosperous community:

- Short-term business decisions that erode a business's ecological foundation eventually undermine its ability to continue producing its service.

- Sustainable local practices could insulate Fort Bragg businesses from external shocks that may occur because of global resource depletion. For example, many scientific indicators suggest oil is becoming increasingly scarce, and costly. If Fort Bragg's needs are met locally, prices will not rise if transportation costs increase. Fort Bragg will also avoid any transportation difficulties caused by price shocks.

- Producing basic needs locally will keep money spent on those needs in the local economy. Money spent on basic needs is more dependable than money spent on luxury goods or specialty services. It also avoids having a portion of every purchase price devoted to the cost of transporting that material from elsewhere.

- Sustainable living and spending time in healthy or natural areas are "growth industries." Every year, more money is spent in the fields of ecological restoration and green building (see "Ecological Restoration is a Growing Industry," page 76).

- Maintaining the health of ecosystems saves money. Ecosystems naturally provide services. Soil absorbs stormwater and prevents flooding. Vegetation cleans air and moderates temperatures. Studies have calculated the exact cost of replacing these services and found them to be high. For example, when the Mississippi River Valley's wetlands were drained and the river channel altered, it destroyed the river's ability to protect communities from flooding. In 1993, flooding property damages cost $12 billion. The Army Corps of Engineers has spent large sums attempting to replace that flood control with engineered techniques.[84] Similarly, had the former Alder Creek not been dammed, current costs associated with replacing the dam or restoring the creek would have been averted. Engineering solutions like this dam have short life spans and require high amounts of energy to maintain, while designs using ecosystem processes do not require such high human inputs.

- The steps of creating a restorative local economy have benefits other than economic prosperity. They can also create rich ties within a place, giving people the security and satisfaction of knowing the people who grow their food, the craftspeople who make their clothing and furniture, and the windmill or solar panels that supply their energy.

Case Study: A Sustainable Economic Development Framework, EcoTourism, and an Eco-Industrial Park

In the early 1990s, Northampton, a rural county of 13,000 residents on Virginia's coast, created a unique economic development strategy. **Their strategy explicitly acknowledged that the strength of the economy depends upon healthy natural and human communities.** Its goals are to:

- Develop agriculture industry / Protect productive land
- Develop seafood and aquaculture industry / Protect water quality
- Develop heritage tourism industry / Protect natural and cultural assets
- Develop arts, crafts, local products industry / Preserve culturally-diverse and authentic community
- Develop research, education industry / Protect natural, cultural systems
- Develop new industry / Protect sense of place, quality of life, and groundwater

Figure 57: Cape Charles sustainable STIP site plan.

Their efforts to protect the natural environment have paid off. In 1991, the Virginia Coastal Program researched bird habitat requirements and strengthened local habitat protections. In 1993, the bird migration was celebrated in the first annual Eastern Shore Birding Festival. It annually brings in several hundred thousand dollars in ecotourism.[85]

A county brownfield site was chosen as the site of a new eco-industrial park (see page 75), the Port of Cape Charles Sustainable Technologies Industrial Park (STIP). Its first tenant was a solar panel maker. A set of site covenants ensures that the businesses, and their industrial practices, are environmentally friendly. A list of performance-based sustainability criteria establishes a "point" system of both social and environmental criteria. Companies do not have to meet all criteria, but must meet a certain minimum, and earn financial rewards for attaining higher point totals. Points are awarded for:

- hiring more local people,
- paying higher wages and benefits
- providing training,
- establishing recycling links,
- preventing pollution,
- making bigger investments in their companies and the community,
- buying local products and services

(c) Develop a local economy on the Noyo Headlands.

The economic development plan should begin with the cleanup of site contamination and the restoration of site ecosystems.

Brownfields cleanup and ecological restoration are both growing sectors of the economy (see page 76). They are a priority for state, federal, and private funding. **The redevelopment of the Noyo Headlands could spark a new local industry that integrates brownfields cleanup, ecological restoration, long-term environmental research and stewardship, and sustainable living.** The components could include **job training** in remediation and restoration, **academic research** in innovative cleanup technologies and how to integrate these with ecosystem restoration, **environmental education and ecotourism** related to remediation and restoration, and **employment** in cleanup, restoration work, and sustainable building.

Successful precedents for each of these ideas exist elsewhere. But **merging restoration and economic development into a unified plan could make Fort Bragg unique**. This plan can provide a model for other communities by demonstrating one way the ecological renewal of a site can be a source of a town's own economic renewal. **The Noyo Headlands can be a Living Classroom of community-based environmental stewardship and inhabitation.**

Economic development should help the community progress toward self-reliance in areas like food and energy.

In addition to the restoration-based industries and ensuing ecotourism, commercial development on the Noyo Headlands could:

- Expand local food production.
- Expand local energy production.
- Expand local craft and textiles production.
- Expand local manufacturing of sustainable building components.
- Expand the number of architecture and landscape architecture firms that specialize in environmental planning and sustainable building design.

Each of these will be important in making Fort Bragg more sustainable. Detailed plans for each industries' space needs could be part of the site development planning process. Just as a group of citizens organized by Fort Bragg's Community Development Commission is studying marine research centers, similar task forces could develop detailed plans needed to attract food producers, craftspeople, and sustainable building and design professionals.

In both Willits, and here on the Coast, local groups have formed that are developing these concepts. Since 1994, the Willits Economic LocaLization (WELL) has been holding community meetings and developing programs along these lines. Recently, CELL, the Coast Economic Localization, has begun holding meetings and bringing speakers to the coast to develop our programs here.

Eco-industrial linkages between groups should improve businesses' efficiency and environmental performance.

Eco-industrial activities are those that focus on achieving symbiotic relationships among industrial processes, making one company's waste "food" for another company's products. For example, wood scraps from the construction of prefabricated homes can provide raw materials for small crafts. Because both businesses save money (on landfill fees or supplies), each is more efficient and more profitable. Pollution and waste are also reduced.

The Port Charles Sustainable Technologies Industrial Park, described in the Northampton case study (see page 73), shows one method for managing the environmental activities in an eco-industrial park. Site covenants establish a point system for determining occupancy and provide financial incentives that refund a small percentage of a business's lease or taxes to especially sustainable occupants.

A sustainable Noyo Headlands will draw tourists.

Many of the case studies in this document demonstrate that environmentally sustainable development can spark tourism. Some tourists come to learn about sustainable development, but most come because sustainable development can create places that are beautiful or interesting for other reasons. Northampton, Virginia, mentioned above, and also Arcata, California, now host bird-watching festivals because their restoration efforts improved bird habitat. Even some green developments receive tourists; Village Homes' website (see case study, page 76) explains its tour policy – not something most suburbs have had to establish.

Activities developed specifically for tourists should reinforce sustainability concepts.

Tourism can use sustainable practices and teach ecological concepts. For example, a train-to-bike tour could carry cyclists from Willits to Fort Bragg, where they can travel by bicycle along the coast. Bike-oriented facilities and marketing could make Fort Bragg a destination for active young adults from the Bay Area. As the planning process of the Noyo Headlands continues, many other ideas for onsite activities will arise.

Ecological restoration is a growing industry nationwide.[86]

Ecosystem restoration has surged in the past five years, with announced multi-year projects exceeding $70 billion worldwide and annual revenues in the US of more than $1 billion a year, industry sources say.

"From an ecological restoration standpoint, there's something on the order of tens of billions of dollars in the pipeline just in this country," says Bowers, who also is chairman of the Society for Ecological Restoration International in Tucson, Ariz. The group has 2,500 members and 14 international chapters - most of those added in just the past decade.

Some projects are easy to count. Chesapeake Bay is a multiyear, $19 billion cleanup project, Bowers notes. Another mammoth project is the Everglades wetlands restoration in Florida, with $8 billion appropriated. And billions more are being spent in the United States on restoring estuaries, watersheds, rivers, deltas, and fish species such as salmon.

Ecological restoration is a major part of a "huge, almost entirely hidden" economic sector in which more than $1 trillion is being poured into restoration, much of which benefits the environment, says Storm Cunningham, an ecorestoration advocate in Alexandria, Va.

This rapid growth seems permanent enough that universities are now beginning to train graduates for these jobs. Clemson University in South Carolina announced plans in Fall of 2004 to create a Restoration Institute by bringing together professors of architecture, urban planning, and the sciences in an effort to graduate students who are able to meet a new generation of complex challenges.

Diverse Local Food Production As A Route To Local Economic Development[87]

Economic development and environmental protection are the twin goals of Sustainable Urban/Rural Enterprise (SURE). The road they chose to achieve these goals was diverse local food production.

This civic nonprofit in Richmond, Indiana, is promoting economic development by strengthening economic ties between rural Wayne County and its urban center. Although most of the state is farmland, the emphasis on corn and soybeans means that Indiana imports many other vegetables. By encouraging local farms to plant diverse crops rather than simply corn and soybeans, and by linking these farms with restaurants, SURE is keeping the county's food money in the local economy, improving revenues for nearby farms, making the farms themselves more economically sustainable, and making the county's food system more sustainable.

Because SURE is focused on community-based sustainability, it is pursuing a number of other projects, including a sewage-treatment wetlands and local energy production.

According to the EPA, SURE's example has inspired community initiatives in Sarasota, Florida; Cambridge, Massachusetts; the Hopi Nation in northern Arizona; Austin, Texas; Santa Fe, New Mexico; and Lancaster County, Pennsylvania.

2. Create pedestrian, bicycle, and transit links to the Noyo Headlands.

(a) Link Fort Bragg to the Noyo Headlands via visual connections.

After being cut off from the mill site for many decades, the removal of the fences will mark a new beginning for the Noyo Headlands. The design of the mill site should invite residents to explore. Pathways onto and through the site should communicate the site's history, and the community values that will shape its future.

The site could create a distinctive image for the city – of a place that is beautiful (from the presence of a restored and healthy environment), self-sustaining (through sustainable production of food and other necessary products), and having a unique character (by having growth come from community efforts, slowly, with allegiance to its own institutions and history).

Being able to see the site will have a subtle, but important impact on how residents and newcomers perceive Fort Bragg.

Key ideas related to visual connections include:

- Determining locations that will serve as "gateways" to Fort Bragg, where visitors are welcomed with a distinctive view of the headlands.
- Building elevated "gazing platforms" downtown. Interpretive panels could explain the view.
- Protecting view corridors at east-west streets.
- Designing a few key site landmarks that emphasize the site's history and future direction, such as a Pomo Indian Cultural Center and a restored mill site building.

(b) A transit hub should anchor the Noyo Headlands development.

The Noyo Headlands is ideally situated to become a "transit-oriented development." Transit, or public transportation, can convey people to and from the Headlands, including people who do not drive, such as the elderly. **Mendocino County's coastal area is well-designed for public transportation because there is one major route that connects four dense centers of activity** – Cleone, Fort Bragg, Caspar, and Westport. A low-cost or free shuttle that traveled this route at regular intervals would be a minimum expense compared to its benefits. Each of these places has a number of homes and businesses within walking distance of a potential transit stop.

(c) Walking and biking should be the primary modes for traveling throughout the Noyo Headlands.

The areas adjacent to Fort Bragg's downtown should emphasize the pedestrian environment. The Headlands are adjacent to downtown Fort Bragg and therefore are a natural hub of social and commercial activity. Fort Bragg has many businesses and residences within easy walking distance of each other. Businesses, homes, and offices should be clustered within one-quarter mile of each other, and streets should be attractive and interesting places.

Use traffic-calming street design. During the twentieth century, 250 million Americans were maimed or injured in automobile accidents.[88] Tools that slow traffic and make the street more pleasant for pedestrians include: frequent stop signs, diagonal parking or even tree planters that jut into the street, pedestrian bulbouts, blurred boundaries between the road and pedestrian environment, special pavings in crosswalks, or possibly elevated or blinking light crosswalks.

The recently-purchased Coastal Trail corridor should be the beginning of a system of pedestrian and bike pathways. These should include different types of paths – scenic slow paths, as well as an efficient long-distance bike/jogging path that has connections to key destinations.

Universal access guidelines set by the American Disabilities Association should be followed. Everyone benefits when a site is accessible to those in walkers, with baby strollers, on crutches, or in motorized buggies. Fort Bragg currently contains many accessibility guidelines in its building code, but development on the Headlands could update those guidelines to include the most recent "best practices."

Bicycle-oriented facilities could make it possible for people to commute to work in Fort Bragg by bicycle. These facilities could also serve Highway 1 bicycle tourists.
Facilities include shower facilities, bike parking, dedicated bike lanes on paths, and bike rentals for transit riders.

3. Consider ecological systems at the regional and site scale.

The City of Fort Bragg, or a firm that specializes in environmental site master planning, should conduct an analysis of how the site will integrate with larger ecological flows. This will guide the site planning but should consider the regional ecosystem. Key issues have been outlined in Part II. Specifically, areas of study should include:

- A native and rare plant survey and a long-term plan for the restoration of plant communities, and how these could be integrated with environmental education and research.
- A hydrological survey that focuses on historical stream corridors, but that also includes an analysis of stormwater flows on the site and identifies particular locations for detention basins.
- Wildlife found along the Noyo River and Pudding Creek corridors and other nearby coastal terraces, how they might use the site, and what habitat corridors they would need to travel to and from the Headlands.

The Mendocino Land Trust's Coastal Conservation Plan (April 2003) is an excellent resource for considering how the Noyo Headlands could fit into the larger region's ecosystems. They have identified certain priorities, which include coastal wildlife corridors, the completion of a coastal trail, and the preservation of a coastal terrace with high habitat value.[89] A sustainable plan for the Noyo Headlands may help achieve all these goals.

4. Determine regional infrastructure needs.

Before taking action or starting any development, the infrastructure areas outlined in Part III: Rebuild should be considered in more detail. For the Noyo Headlands to achieve its potential to improve the area's sustainability, a more detailed look at the city's needs (e.g., for energy) and a more detailed look at Noyo Headlands' opportunities (e.g., to produce energy) should occur. This step might include:

- refining the estimates of how much energy, food, water, and other resources the Noyo Headlands development and Fort Bragg as a whole will need.
- suggesting different alternatives for meeting those needs.
- weighing their relative merits.
- suggesting an overall approach.

Then, using this information, planners can begin to evaluate different methods for addressing those needs, as outlined in Part III. This work may be supported by the efforts begun by the Coast Economic Localization group (see page 74). This work will underpin the site planning and design, as discussed below.

C. Site Planning and Design: Using Ecological Design as a Technique for Placemaking

Of the many buildings built every year, very few create *places*. Places are locations that are more special than their surroundings, that become the center of community social life, and that people remember with affection.

Placemaking is the activity of turning a lifeless space into a well-loved place. These are efforts that create the site's identity or the image it evokes in people's minds.

Fort Bragg's downtown revitalization efforts have already given the town a functional set of design guidelines for placemaking. On the Noyo Headlands, similar guidelines should especially focus on ecological design issues mentioned in Part III and the Design Toolbox.

Placemaking strategies that grow from ecological issues will create a unique identity for the Noyo Headlands. They could create an identity for the mill site as a place that is beautiful (a restored and healthy environment), self-sustaining (sustainable production of food and other necessary products), and having a unique character (from historical preservation and community involvement).

1. Let sustainability concerns generate the Noyo Headlands' open space framework.

(a) What is an open space framework?

In creating a site plan, often the first step is setting aside certain spaces as protected land, or acquiring them into public ownership. This public space framework identifies community focal points, such as a central park or gathering area, and also the parts of the site where human impact should be minimized.

How should these areas be located? In this case, the public space framework should grow out of information about site contaminants and remediation methods, restoration, and large-scale ecological infrastructure.

Figure 58: Parks, public spaces, and other areas to be preserved can be selected for their ability to support ecological goals. For example, preserving the greenhouses would support bioremediation, ecological restoration, and food production.

(b) What could be key elements of a public space framework for the Noyo Headlands?

Remediation Areas and Base of Operations

The public space framework should reflect key ideas from Part I: Remediation. Therefore, areas should be set aside that:

- Will require the most time for remediation, or that are suitable sites for making the remediation process educational, possibly using biological methods.
- Could reflect Fort Bragg's logging heritage, such as key buildings.
- Could provide larger historical context for the Noyo Headlands, such as space for a Pomo Indians Cultural Center.
- Could provide public access during the remediation, thereby making it more visible.
- Will be needed as a base of operations for the remediation process.[90] Particularly, the existing greenhouses may be very useful in propagating plants for bioremediation.

Restoration Areas and Base of Operations

The public space framework should reflect key ideas from Part II: Restoration. Therefore, areas should be set aside that:

- Have high ecological value, such as those with rare native plants, relatively undisturbed soil, or any remaining habitat value.
- Might provide valuable wildlife connections between ecological areas on the site and larger nearby reserves.
- Could be large enough to provide sheltered habitat for a few important species.
- Could be restored as demonstration ecosystems.

- Will be needed as a base of operations for the remediation process. The greenhouses may have continued value during this process.

Ecological Infrastructure

Figure 59: Biological systems to treat water solve the human problem of waste and return nutrients to the ecosystem in a beneficial way.

Studies of infrastructure needs may identify particular uses of land – for example, a windmill might be the best way to generate electricity. The public space framework can emerge from these ecological infrastructure needs. One of the benefits of ecological infrastructure is that it often does provide multiple benefits, particularly the creation of attractive and interesting green spaces.

The ecological infrastructure is already affecting the open space framework. The City of Fort Bragg has begun planning a wetlands area for wastewater polishing. This marsh will simultaneously provide recreation space for the public; a similar project in Arcata has become a mecca for bird-lovers.

Other aspects of public infrastructure can also be integrated into open space planning. Ideas include:

- Windmill Park (or Waterwheel Park). Areas for energy generation could become iconic centerpieces to the Noyo Headlands design. Windmills are noticeable landmarks that could create the Noyo Headlands' identity. A waterwheel is another energy-generating feature that could become a focal point of the Noyo Headlands.
- Noyo Gardens. A large, diverse food area could be part of a public park.
- Alder Creek Overlook and Soldiers Beach. If the community supported the daylighting of the three creeks, they could be an ecological backbone for the Noyo Headlands and support several public amenities, such as a scenic overlook and an educational pathway to the ocean. These could link downtown Fort Bragg to the wastewater treatment wetlands that the City of Fort Bragg is in the early stages of planning.
- Infiltration Ampitheater. The stormwater strategy may involve creating one large infiltration area, or several smaller areas. These collect water during heavy rains but dry out between rains. These areas can provide hillside seating overlooking sports fields or a stage for public performances.

2. Have a sustainable land use plan.

(a) What is a land use plan?

A land use plan determines where different types of land uses – residences, businesses, and so on – will go on the site.

(b) What are key elements of a land use plan for the Noyo Headlands?

The Noyo Headlands land use plan should:

- **Rely upon a restorative economic development strategy.** Industries and businesses that are envisioned on the Noyo Headlands should contribute to the environmental and social sustainability of the Headlands.

- **Phase growth in, building coastward from the existing Fort Bragg community.** Development should grow slowly westward from Highway 1. Having building occur incrementally outward from where the Noyo Headlands meets the current city fabric will give it a stronger sense of connection to the town.
- **Have a land use plan that encourages diversity.** Neighborhoods that have a mix of shops, homes, offices, and parks tend to be more vibrant and lively. Having different kinds of housing available also means that a diversity of income-groups will be able to afford housing on the mill site.

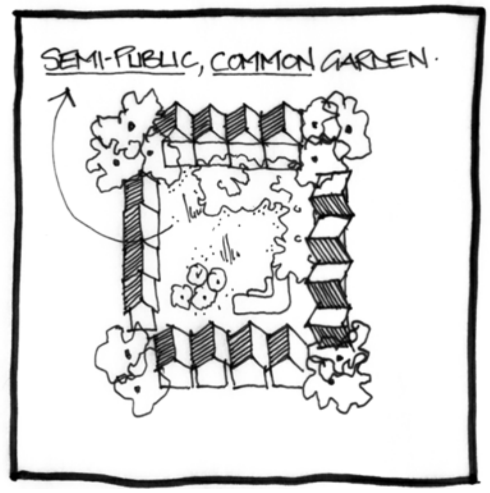


Figure 60: The block pattern can make space within the city grid for ecological infrastructure and gardens.

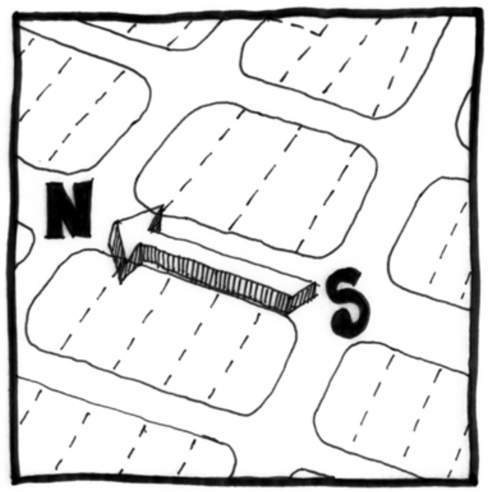


Figure 61: The street and block pattern is important in ensuring solar access.

3. Plan streets and blocks for sustainable infrastructure.

(a) What is the street and block network?

The street network is the system of streets and paths that allow people to travel throughout the site.

(b) What are key elements in a Noyo Headlands street and block network?

The design toolbox identifies some key issues to consider when determining street and block networks. They include the following:

- The arrangement of streets and blocks is

  very important for solar access. Houses should

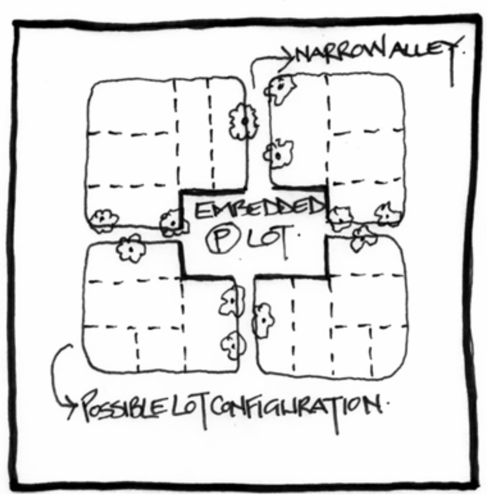


Figure 62: The block pattern can also allow creative parking solutions.

have their long edge facing south, the side on which the sun passes.

- Shared space in the center of the block can be used for decentralized ecological infrastructure, such as food growing, wastewater recycling, stormwater absorption, and composting garden waste. This block pattern also strengthens community life, as the Village Homes case study shows.
- Although a broad overview of urban design “best practices” is beyond the scope of this document, block patterns and street design can also significantly affect the social life of a community, as explored by groups such as the Congress for the New Urbanism, the Project for Public Spaces, and Metro, the Portland regional transportation agency.

4. Use ecological symbols as part of a vibrant street and public space design.

Streets can take up as much as 25% of the land area in a city. They are the most basic public space, and their land area usually far outstrips cities’ park holdings. Therefore, green design guidelines for streets can have a powerful impact on the experience of a city. Building and landscaping design guidelines also affect this street experience. Key opportunities include:

- Street widths should preserve solar access for houses on the north side of the street. For a solar access during the winter months, a house needs to be twice as far from an object as that object is tall.
- Streets can clean stormwater by using swales. Described in more depth in the stormwater section, swales are shallow, vegetated depressions that clean stormwater. The Green Streets Handbook, by the Portland Metro Transportation Association, shows how streets can reduce their impact, particularly by treating their own stormwater runoff.
- For streets to encourage pedestrian activity, they should feel lively and have many interesting

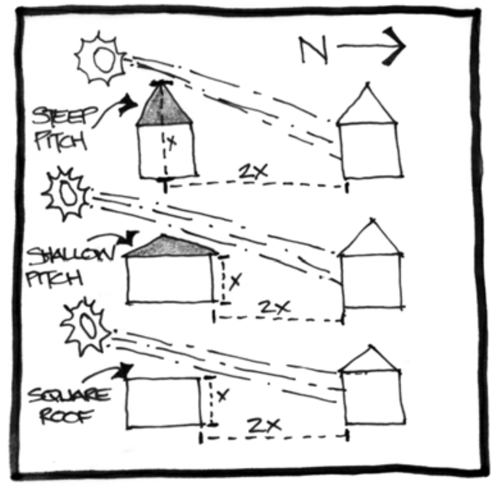


Figure 60: Street design can protect solar exposure.

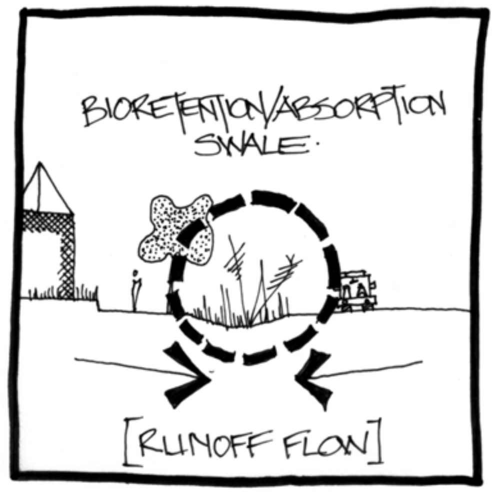


Figure 61: Street designs can incorporate swales.

Figure 62: The ecological design tactic of replacing grass with native or food plants can make places more diverse and interesting.

things to look at. Ecological design tactics can contribute to this. Fruit trees and other edible landscaping, stormwater swales, native vegetation, and other ecological strategies can add beauty to streets.
- Public art that makes natural processes visible, from windchimes to rainwater fountains, could be encouraged.

5. Construct a few model buildings or neighborhoods.

A few model developments could set the tone for all Noyo Headlands development, and attract other similar-minded developers. These model developments could be single buildings, or they could be small neighborhoods. Several lists of model buildings are available.[91] Many of these also provide data on costs of construction, which suggest that environmental building is no more expensive initially, and less expensive in the long run, than conventional building. The following two case studies were both widely-publicized for their sustainability innovations.

Case Study: The Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Ohio. It produces energy, treats its own sewage, and teaches college students about their connections to the ecosystem.[92]

"The entire center is a learning environment, not just the classrooms," said David Orr, professor of Environmental Studies at Oberlin College.

According to Orr, most buildings teach their users that their location is irrelevant, that energy can be squandered, and that its materials' origins and disposal do not matter. One interviewer summed it up: "What we learn from our buildings…is that we are not part of the greater universe, that we are not part of the problem, that there is no problem."

Orr decided to build something that not only helped the environment, but also taught its visitors *how* it was helping the environment. Beginning in 1992, Orr organized meetings of students and environmentally-minded architects, engineers, and builders. Together they established high goals. These included:

- Discharge no wastewater (drinking water in, drinking water out).
- Generate more electricity than used.
- Use no materials known to be [toxic].
- Meet rigorous requirements for assessing full costs over the lifetime of the building.
- Landscape to promote biological diversity.
- Use its design and operations to teach.
- Promote ecological competence and mindfulness of place.

"We intended," Orr summed up, "a building that caused no ugliness, human or ecological, somewhere else or at some later date."[93] The result is the Adam J. Lewis Center for Environmental Sciences. Displays in the lobby, and the building's website, let visitors monitor its energy generation, energy use, and wastewater treatment by a Living Machine (see page 68) and outdoor wetlands.

It was named by the Department of Energy as one of thirty Milestone Buildings of the 20th Century, and by the American Institute of Architects as one of the top ten green buildings (2002).

Case Study: Village Homes, Davis, California. A safe, sustainable residential neighborhood.

Village Homes is a housing development in Davis, CA, whose environmental innovations made it the unmatched leader in green development for many years. [94]

Completed in 1981, with 220 detached houses and 24 rental apartment units on 60 acres, its density is equivalent to a typical subdivision. What makes Village Homes distinct is how it organizes those dwellings, how the houses are built, and what happens in the green space.

Energy. Housing lots are narrow but long, for maximum solar exposure. House design emphasizes passive solar heating and cooling, and solar hot water, and most have solar panels.

Community Green Space, Food Production, and Pedestrian Friendly Design. Houses are clustered in groups of six to eight, facing out on a small green space, like a green cul-de-sac. Cars approach from behind, on very narrow streets. (Streets are so narrow that the designers had to do field tests with the fire department to prove their trucks would still be able to get through.) These small green areas then connect to a long open green area that connects all the houses. No fences divide this green space.

In the green space are community gardens, a commercial organic garden, an almond orchard, fruit-bearing trees lining the paths, and vineyards. Not only can residents pick fruit from trees, they celebrate the food together in an annual harvest festival. Pedestrian and bike paths weave through the development. The pedestrian-friendly design means that residents own an average of 1.8 cars/household, compared to 2.1 cars/household for a typical development.

Figure 63: The path and swale systems in Village Homes.

Residents collectively own and manage the green space, apartment buildings, and commercial space through the Homeowners Association. This has built community ties. The average person knows forty-two people in their neighborhood, while residents of other neighborhoods only know seventeen neighbors. Residents spend 3.5 hours a week with friends from the neighborhood, compared to a vicinity average of 0.9 hours a week. Residents report that, on average, 4.0 of their best friends live within the neighborhood, while the average is 0.4 for people living elsewhere nearby. **This has powerful results: the crime rate is 10% of the Davis average.**

Stormwater. Swales and detention basins catch and infiltrate the stormwater from the site. Omitting the storm sewers saved $800/lot (1980). Because city planning officials believed that storm sewers were going to have to retroactively be installed later, they required the original builders to post a large monetary bond. The bond was returned several years later when a "once every hundred years" storm hit. Village Homes' system not only absorbed its own water, but it also handled water from neighboring subdivisions whose sewers overflowed.

The design of the Village Homes neighborhood, and the energy efficiency of the houses, caused homes to sell for $10-$25 higher, per square foot, than other houses in the area.

6. Establish site design guidelines & incentives for green building.

The design of the Noyo Headlands should incorporate a system for rewarding sustainable building practices.

Currently, over forty local or national programs[95] certify sustainably-built homes, and other programs certify commercial buildings. Fort Bragg could adopt one of these, adapt it for local use, or create another program from scratch.

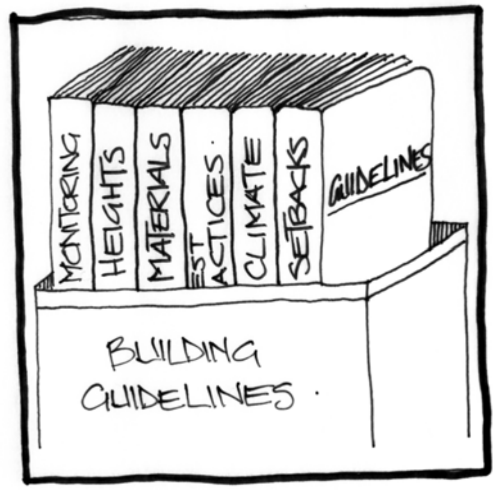


Figure 64: Building guidelines and incentives address issues of sustainability in the most detail-oriented way.

One particularly influential program is the U.S. Green Building Council's (USGBC's) LEED Building ™ Rating System. This ranks commercial buildings as having met a certain level of environmental performance. Similar standards are now being developed for residential homes and mixed-use neighborhoods by the USGBC. Other agencies adapt or borrow this system. For example, the Port Charles Sustainable Technology Industrial Park (see case study, page 73) requires any new tenant to achieve LEED's "silver" standard. The City of Portland has modified the LEED standards to meet local conditions and goals.

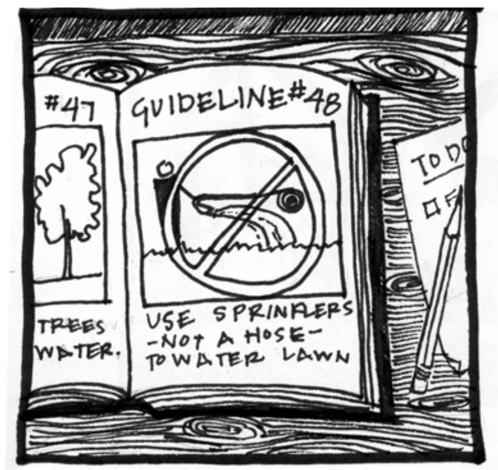


Figure 65: Irrigation and vegetation guidelines are also important.

Municipalities have also developed their own green building guides. The State of Minnesota has been a leader in helping its municipalities foster green design. Their Internet-based sustainable design guide (found at http://www.sustainabledesignguide.umn.edu/) considers environmentally concerns for every step of the building process. Minnesota's model was adapted by Oakland, who took their guidelines and made them appropriate for Oakland's climate and concerns. Other cities with notable sustainable building programs include Portland, Oregon; Seattle, Washington; Santa Monica, California; and Austin, Texas.

D. Conclusion

Ecological design concepts and environmental "best practices" should permeate the planning and design phases of the Noyo Headlands. They should be integrated into early planning; regional planning on economic development, transportation, and ecology; and site-specific design efforts. Maintaining a focus on environmental concerns at every scale of design and planning can create an image of the Noyo Headlands as a beautiful, vibrant, and unique model of sustainability activities.

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If we eat…	vegan food	a few eggs/week	one chicken/week	one cow/year
…each person needs (sq.ft.)	3,000	3,500	24,300	67,300
...Fort Bragg needs[1, 2] (acres)	610	712	4,945	13,695
…farms could employ up to (people)	1,221	1,424	9,890	27,390

Source: Jason Bradford, http://www.greentransitions.org/WEL/Rotary05.pdf, slide 45

(1) This assumes a population of 7000 and adds 25% for roads and farm infrastructure.

(2) This assumes that farming is done by hand. Farming could be done using draft horses, which would double the needed acreage, and then need only 25% of the workers (divide by 4.17). Of course, farming methods will vary and be determined by individual farmers. No tractor calculations were included, but solar-electric tractors could also be considered.

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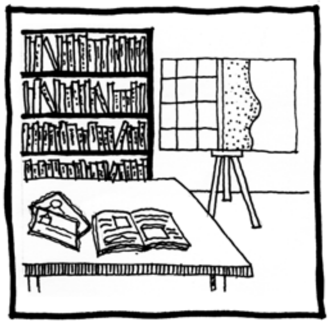
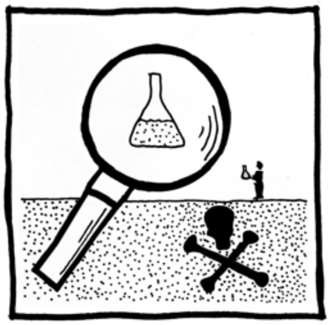
Appendix A: The Remediation Process



SITE INVESTIGATION – PLANNING

What contaminants might be out there? Where should we look?

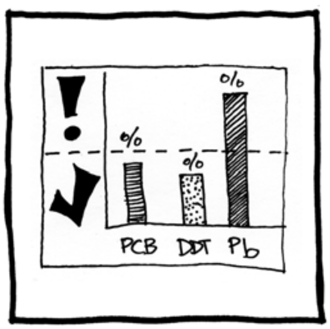
In this step, a plan for investigating the site's contaminants is created. Historical research and worker interviews suggest what contaminants may be present. Then, investigators create a work plan outlining where they will look for contaminants, what contaminants they will test for, and what laboratory methods will be used to analyze soil and water samples. These decisions should be influenced by the community visions and goals for the site, so that testing can be adequately rigorous.



SITE INVESTIGATION – IMPLEMENTATION

- The search for toxins -

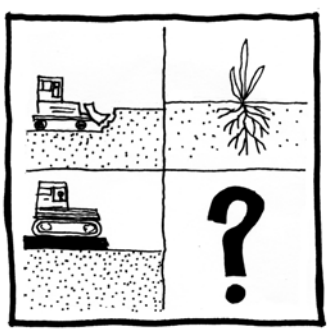
In this step, the site's soil and water are tested for contamination. Samples are gathered and analyzed in a laboratory. The testing plan is revised based on field discoveries. Testing continues until a complete, three-dimensional picture of the site contamination is obtained. A long-term monitoring plan may be created to determine whether pollution is spreading.



RISK ASSESSMENT & CLEANUP GOAL- SETTING

How dangerous is it? How much should it be cleaned?

In this step, all possible ways contamination could spread (e.g., stormwater) are analyzed to determine the risk to people and ecosystems. By considering the quantity of contaminants present, how dangerous each is, the ways people or ecosystems may be exposed (based on pathways by which the pollution may spread), and how long this exposure might last (especially based on future plans for the land – houses, businesses, agriculture, etc.), researchers evaluate the risk that pollution poses now and in the future. They take action to stop any current dangers. They determine appropriate cleanup targets for each contaminant.



SITE CLEANUP – PLANNING

What methods of cleanup should we use?

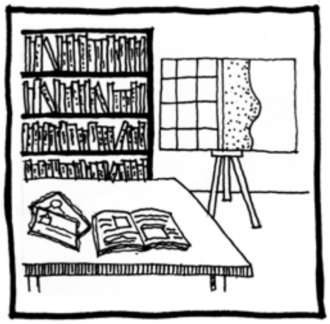
With contaminant cleanup targets from the previous step, a Remedial Action Plan is made. Key questions include: What is the budget and timeline? Can renovation and construction activities be coordinated and occur simultaneously? Possible cleanup methods are listed, and their pros and cons are evaluated. Cost, effectiveness, timeline, and how they could be integrated with future reuse plans are all considered. The plan should also explain how the contamination will be monitored during and after cleanup, and whether the site will have long-term monitoring or controls on how it is used.

SITE CLEANUP – IMPLEMENTATION

- The cleanup process -

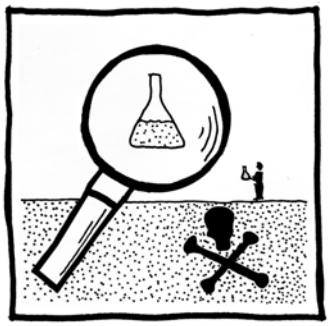
In this step, the logistics of cleanup are finalized and carried out. Field trials may be conducted to determine the best cleanup method for these particular site conditions (e.g., soil type). As more is learned about the site's pollution, and how it responds to particular cleanup methods, the plan is modified and adapted. Ongoing testing monitors the decreasing pollution levels until the target levels are reached. Long term arrangements, including monitoring wells and legal restrictions on the site, may be established.

Figure 1: A typical remediation planning process has five major steps. Each step involves different questions, decisions, and activities. Understanding these steps is important to developing a sustainable site remediation.



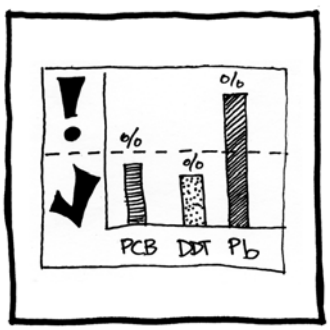
SITE INVESTIGATION – PLANNING

The community, especially workers, should help identify potential locations of contaminants.
The site planning, including research into past activities, should occur publicly and encourage public comment and additions.
Community Advisory Group should be established so that citizens can be involved in the cleanup process from the very beginning.
A toxicologist should be retained by the city or citizen's group to protect the public interest.



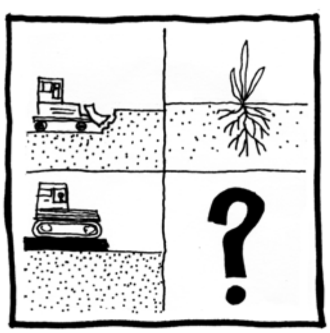
SITE INVESTIGATION – IMPLEMENTATION

Data quality should support all possible desired future uses (e.g., if laboratory detection levels are high, no information is gained about lower, but still harmful, levels of toxins.)
Samples should be analyzed for all likely breakdown products of suspected contaminants.
Testing should also include nearby ecological reservoirs (e.g., Soldiers Bay).
The depth to which the site is tested and cleaned should be at least 15 feet (or groundwater).
Community should be educated clearly about contamination and its location.



RISK ASSESSMENT & CLEANUP GOAL- SETTING

Residents should be educated about risks of contaminants and how they might be exposed.
Risk assessment should consider the chemicals in combination, not as if a person were being exposed to each one at a time.
Risk assessment should assume that Fort Bragg residents already carry above average body burdens of chemicals, due to past mill site activities.
The risk assessment should consider the site's proximity to the ocean, local fishing activities, and evidence that some contaminants bioaccumulate in marine animals.
Risk assessment should consider the relatively high local risk of an earthquake or landslide.
Chemicals not detected should be considered present at 75% of laboratory detection limits.
Cleanup targets should support local goals, including creek restoration and agriculture.



SITE CLEANUP – PLANNING

The cleanup plan should be integrated with site restoration, not done in isolation.
The community should be closely involved in evaluating cleanup methods.
If possible, the cleanup should leave the site clean. The plan should try to avoid capping, monitoring, or legal controls – the pollution might pose a danger in the future.
Landfilling or incineration should be a last resort – these could contaminate other places.
The cleanup RFP should encourage the use of innovative technologies and even experimental methods that allow scientific research into sustainable remediation techniques.
"In situ" remedies that keep soil in place minimize cost and reduce contamination spread.
Biological alternatives that begin to restore the site's fertility should be encouraged.

SITE CLEANUP – IMPLEMENTATION

The cleanup process should be visible and educational. Residents should be educated about the cleanup methods that will be used.
Cleanup implementation should involve and benefit the local community, economically and educationally. The cleanup RFP can emphasize the city's desire for local jobs, job training, the use of local contractors, and the participation of community groups.
The cleanup timeline should be determined by social and environmental concerns, not by the timeline of development and financing.
Citizens should be aware of the trial-and-error nature of some biological cleanup methods, although these methods are often faster in the long term.

Figure 2: A typical remediation planning process has five major steps. In each step, certain details are crucial in obtaining a cleanup that most benefits the community and future generations.

ABOUT THE DESIGN TOOLBOX

This toolbox was intended as a primer on sustainable building techniques, and a “visual executive summary” of Part III, “Rebuild: Ecological Design & Green Building Tools.”

Like Part III, this toolbox discusses energy, food, water, stormwater, water supply, and wastewater/sewage. Similar analyses should be done for transportation, building materials, and construction practices.

For each topic, the first page provides an overview. It proposes goals and lists benefits of the strategy. It identifies the four main strategies for sustainability in this area, such as “minimize electricity used.”

Each strategy can be achieved in different ways, depending on the geographic scale under consideration (house, city block or neighborhood, or the Noyo Headlands as a whole). Therefore, each section contains a toolbox of specific ideas. These ideas apply the strategies at different scales.

Although these ideas are simple, when combined, they provide a whole-systems approach to infrastructure that is much different than the pipe-it-in-and-pipe-it-away approach that was current when conventional systems were first designed.

Because the tools in the toolbox can never be comprehensive, a blank box has been provided for listing other tools a person may wish to remember.

ENERGY

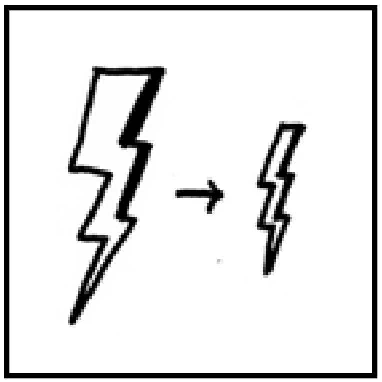
Goals

- Generate more power than needed for the Noyo Headlands.
- Bring Fort Bragg closer to energy independence.

Rewards

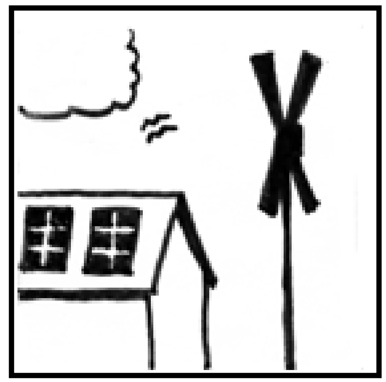
- Fort Bragg's contribution to energy-related pollution and climate change will be reduced.
- Energy costs may be lower, and energy money will remain in the local economy.
- Local control and security will be increased.

The Fundamentals



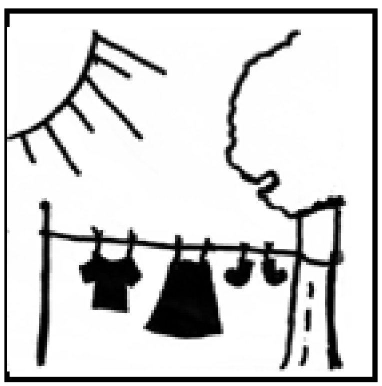
Use Less

Conservation strategies are essential in any energy strategy. Often, energy can be saved without sacrifice, simply by using more efficient technology.



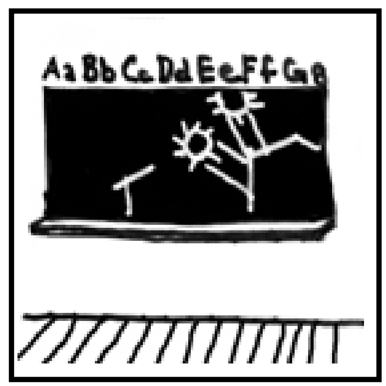
Generate

Wind, water, waves, sunlight, and garbage are just a few of the forces on the mill site that could be harnessed to generate electricity.



Use Directly

Energy is most efficient when used directly, rather than first changed to electricity. This is what makes sailboats, solar hot water, and clotheslines so efficient.

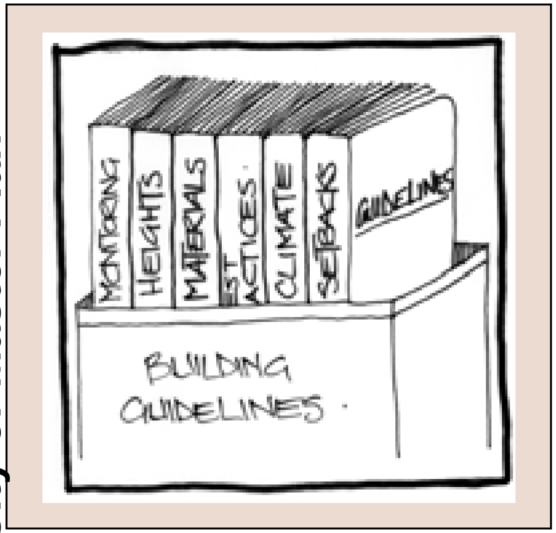


Educate

Energy is very easy to conserve when people are aware of common ways energy is wasted and know simple strategies they can use to save energy.

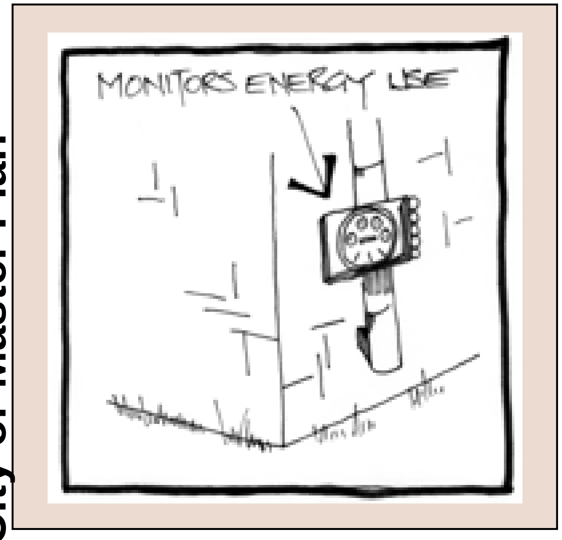
ENERGY

City or Master Plan



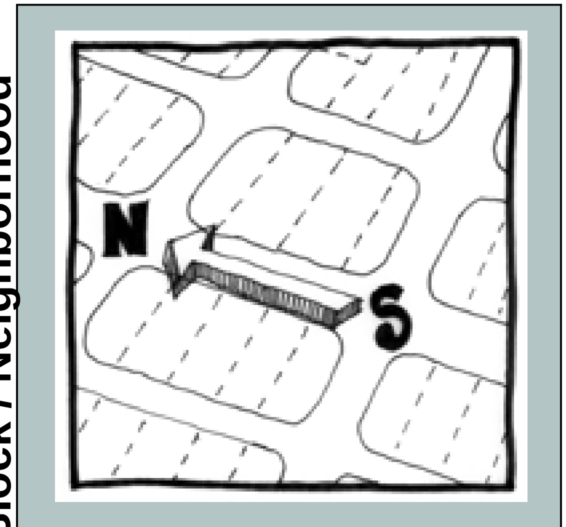
Building guidelines or incentives can require or reward efficiency.

City or Master Plan



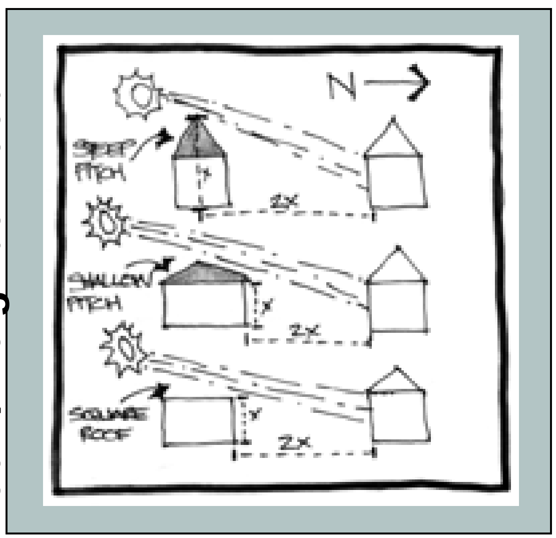
Public education can raise awareness of energy use.

Block / Neighborhood



Parcel alignments should allow houses to face south.

Block / Neighborhood

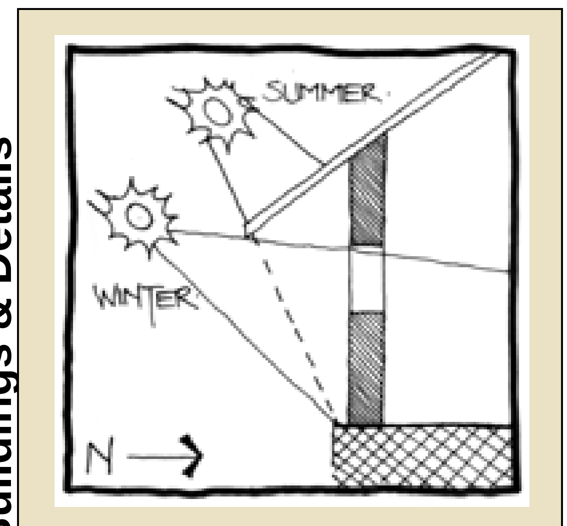


Street layout and setbacks should preserve southern exposure.

Buildings & Details

Thermal mass in floors or walls stores heat and releases it when needed.

Buildings & Details



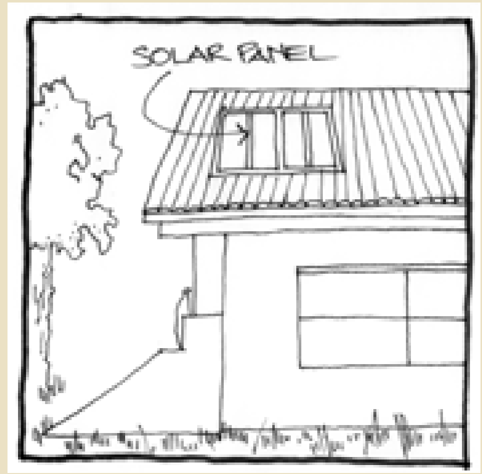
Overhangs allow heat to enter during the winter, but block heat when it is unwanted.

ENERGY

Buildings & Details

Simple techniques allow sunlight to be used directly.

Buildings & Details

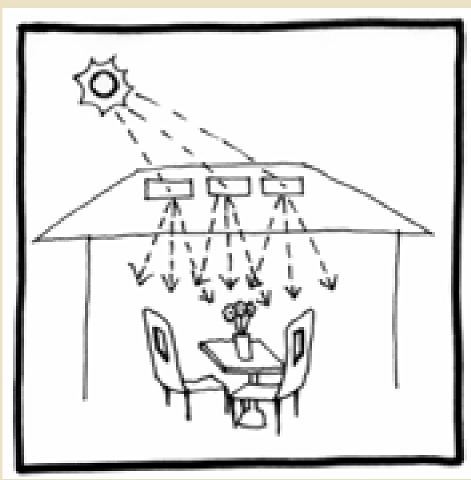


Photovoltaic panels can generate renewable electricity.

Buildings & Details

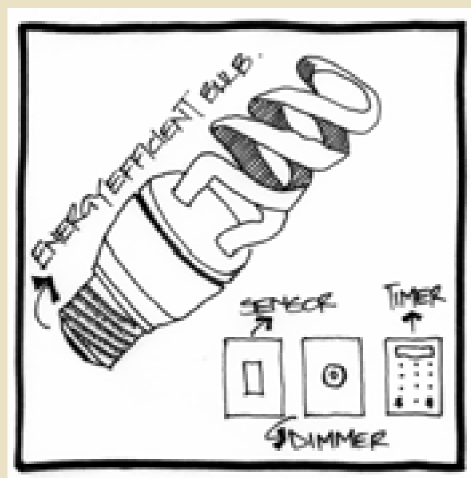
Solar hot water provides both hot water and space heating.

Buildings & Details



Skylights and windows allow daylight to replace electric lights.

Buildings & Details



Energy efficient appliances and sensors can have large impacts.

Buildings & Details

This list is only a beginning…

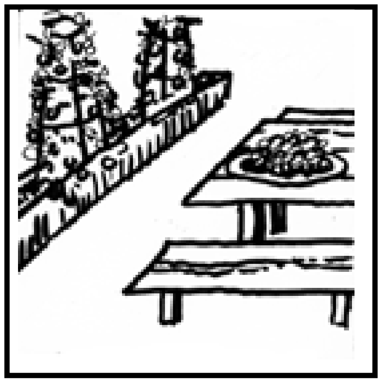
Goals

- Maximize food grown on the Noyo Headlands.
- Strengthen the local food economy with greenhouses and commercial food production.

Rewards

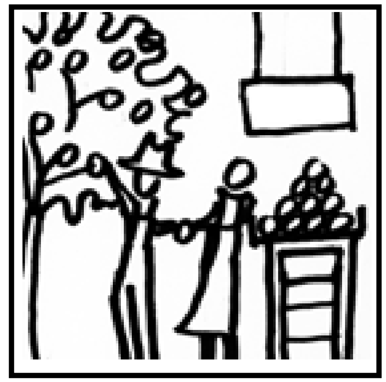
- Food could be fresher and more nutritious.
- Food production and transport will be more environmentally friendly. Food will be grown according to local methods (e.g., no GMOs).
- Food money will go to local growers and grocers, not fuel. Food costs could go down.
- Food will be available even if roads are blocked.

The Fundamentals



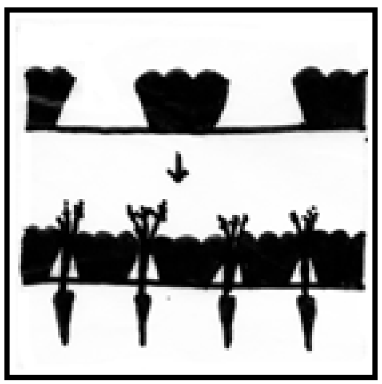
Grow Food

Food can be grown any place people eat. Food plants – e.g., grape vines, apple trees, and lettuce heads – are beautiful additions to buildings, yards, & neighborhoods.



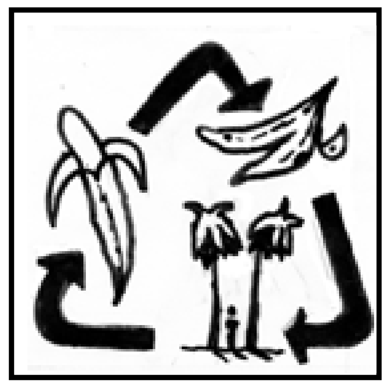
Connect

Connecting local food growers to local restaurants, food buyers, and groceries will strengthen the local food network.



Intensify & Diversify

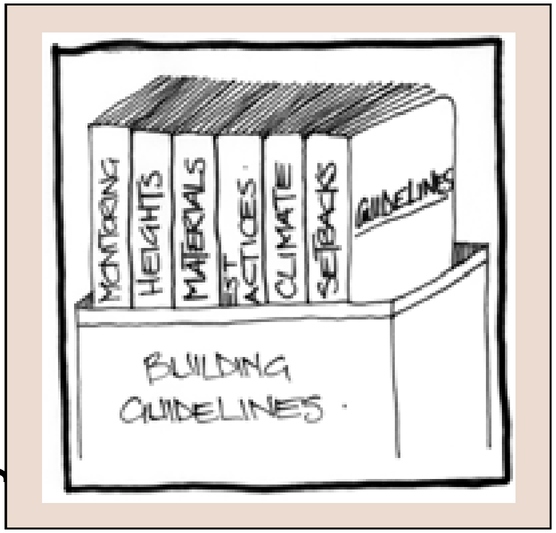
Planting diverse types of food intensely in a small space can increase the amount of food grown in a small area.



Recycle Nutrients

A sustainable food supply system requires that the elements from food re-enter the soil, completing the nutrient cycle.

City or Master Plan

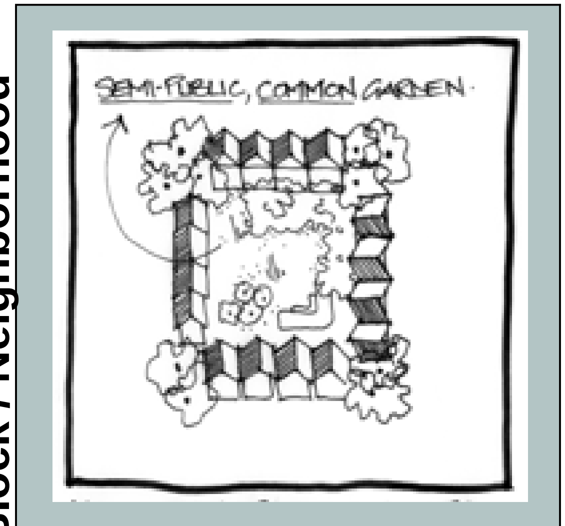


Building guidelines or incentives can promote food growing.

City or Master Plan

Community gardens provide food and many other benefits.

Block / Neighborhood

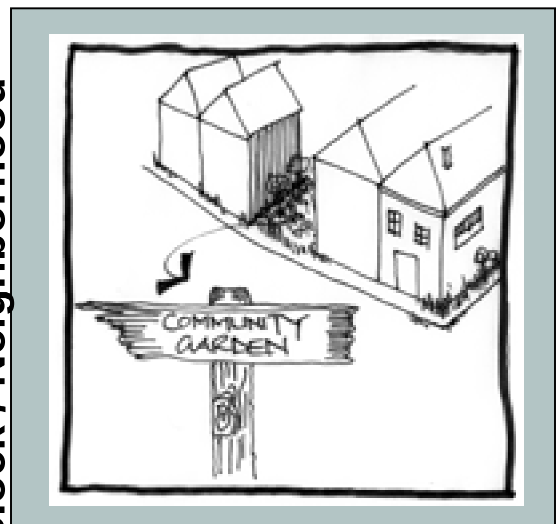


Connected yards let non-gardeners share space with gardening friends.

Block / Neighborhood

A commercial organic garden can be viable even on a small parcel.

Block / Neighborhood



Single house lots provide enough space for a community garden.

Buildings & Details

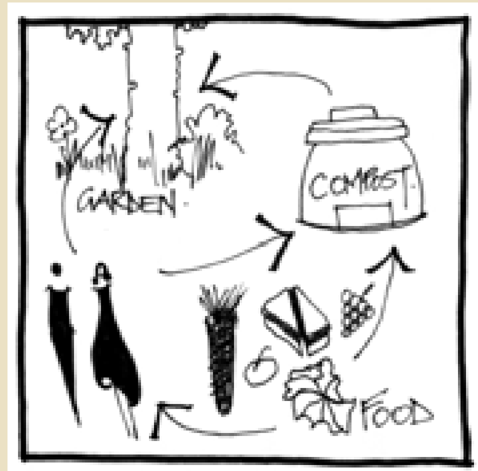
Conventional landscapes can be replaced with edible landscaping.

FOOD

Buildings & Details

Roof gardens are another place to grow food.

Buildings & Details



Composting recycles nutrients that are needed for healthy plants.

Buildings & Details

Using all available space and planting intensively will yield large amounts of food.

Buildings & Details

This list is only a beginning…

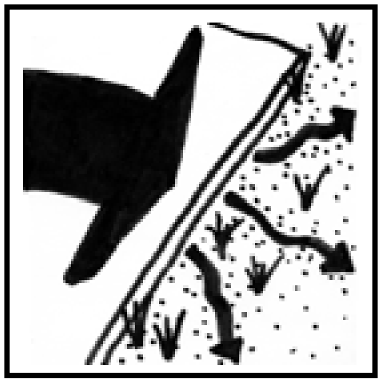
Goals

- Biologically filter all stormwater onsite.
- Absorb most water within neighborhoods.
- Discharge no untreated stormwater to ocean.
- Add no stormwater to city's sewer plant.

Rewards

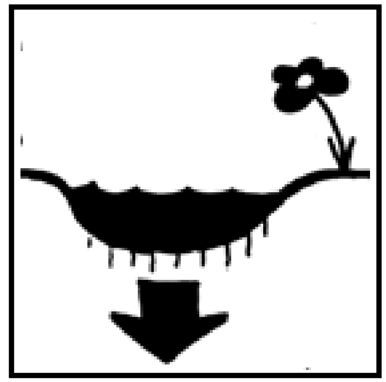
- Fewer storm sewer pipes will be needed.
- Runoff will not pollute creeks, pollute ocean, or harm aquatic life.
- Money may be saved by keeping stormwater out of the sewage treatment plant.
- Groundwater and wells may be recharged.
- Solutions double as parks or planting strips.

The Fundamentals



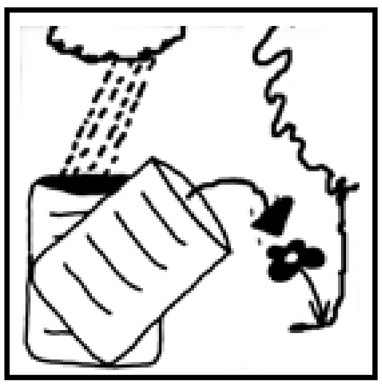
Disperse Runoff

Water should be spread out across vegetated areas to be slowed, filtered, and absorbed by soil. Barriers between water and soil should be minimized.



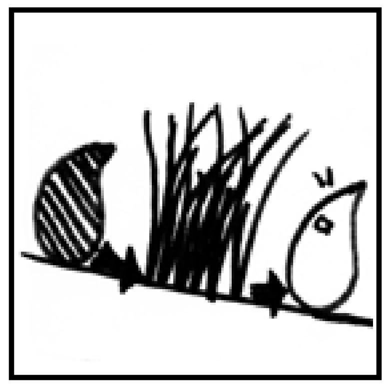
Absorb

Stormwater runoff can be directed to small or large basins where it can absorb into soil. This solution requires soil that "perks."



Catch & Reuse

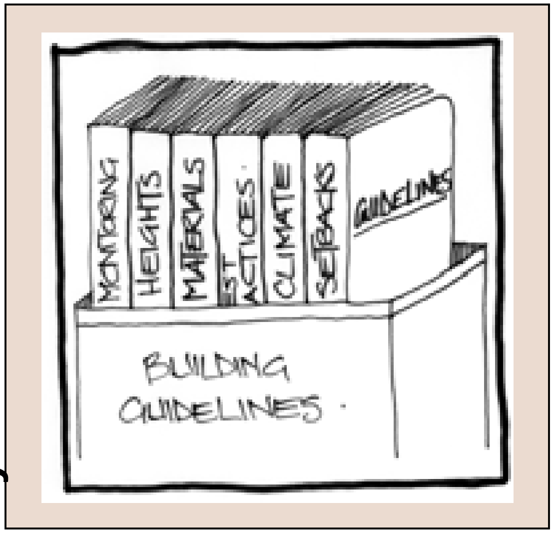
Rainwater is a valuable substance. If it is collected and reused, then it does not wash pollutants into streams or cause other problems.



Filter Enroute

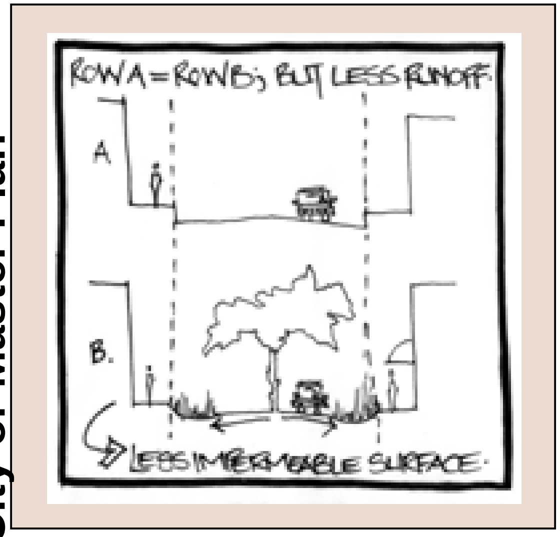
If stormwater flows slowly through plants for 5-9 minutes, or approximately 200 feet, the plants will filter out most pollution the water picked up.

City or Master Plan



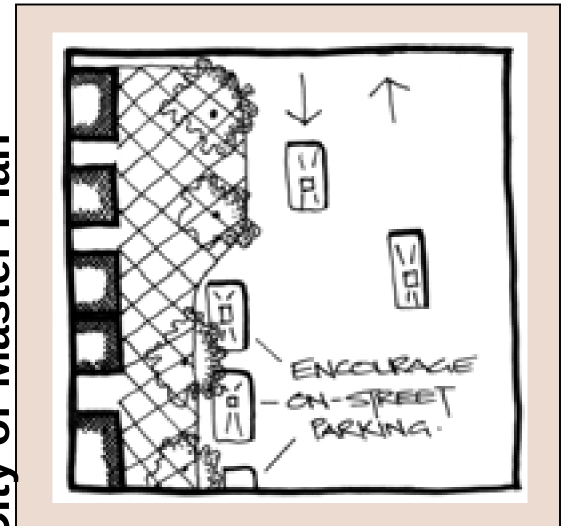
Building guidelines can address many stormwater strategies.

City or Master Plan



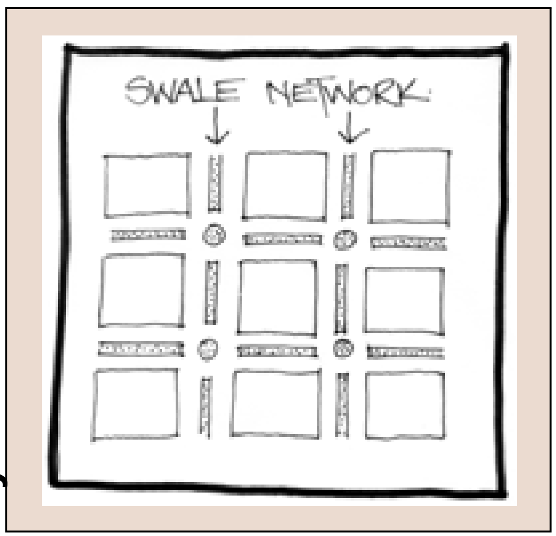
Impermeable surfaces on public land should be minimized.

City or Master Plan



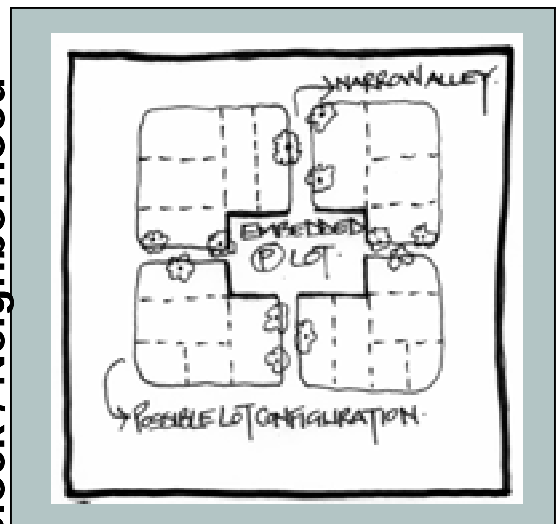
On-street parking uses less space per car than parking lots do.

City or Master Plan



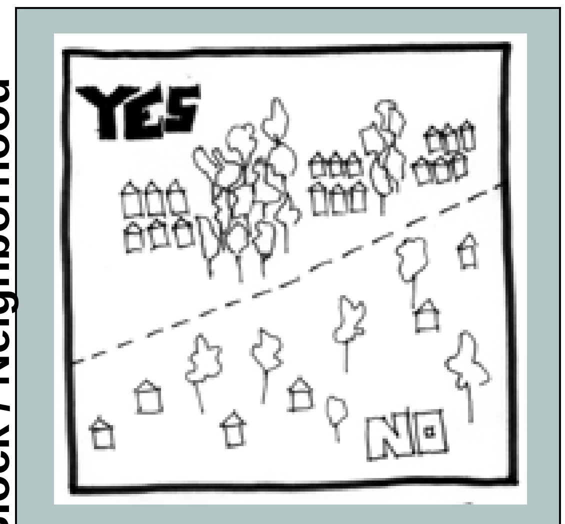
A “green street” network can filter stormwater as it travels.

Block / Neighborhood



Tucking parking in the interior of blocks allows nearby yards to filter runoff from parking areas.

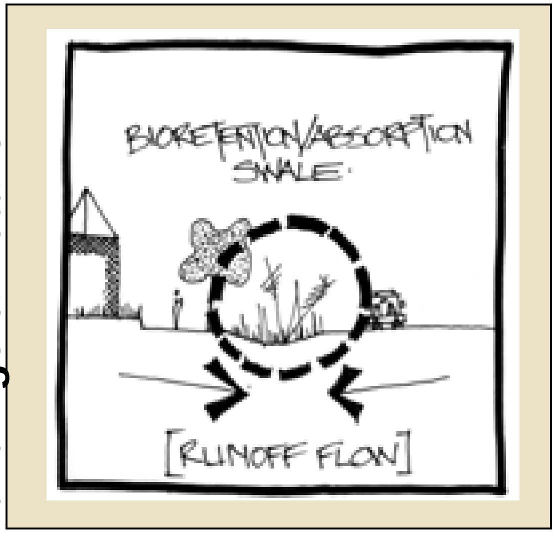
Block / Neighborhood



Clustering buildings & surrounding them with green space allows runoff to be filtered and absorbed.

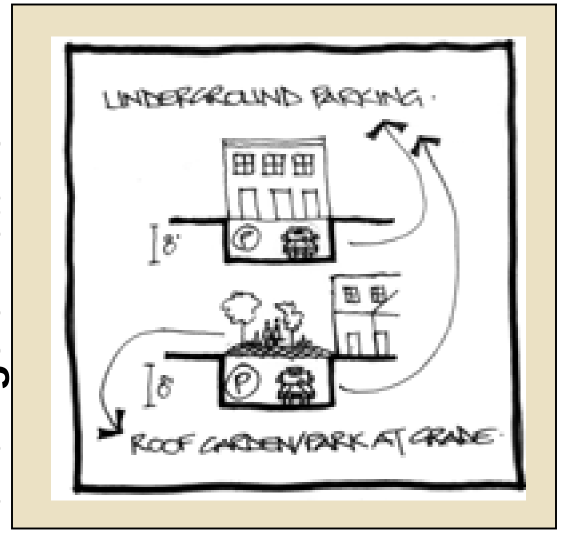
STORMWATER

Buildings & Details



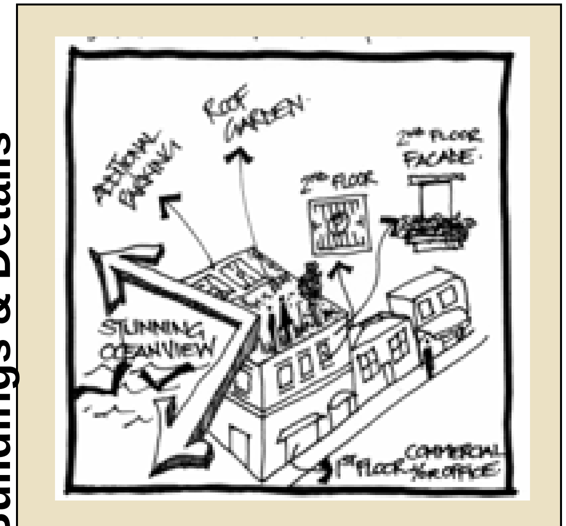
Swales can filter runoff as it travels through plants & flowers.

Buildings & Details



To reduce pavement, cars can be parked under buildings or parks.

Buildings & Details



Cars can also be parked next to roof gardens, or within a 2nd story façade.

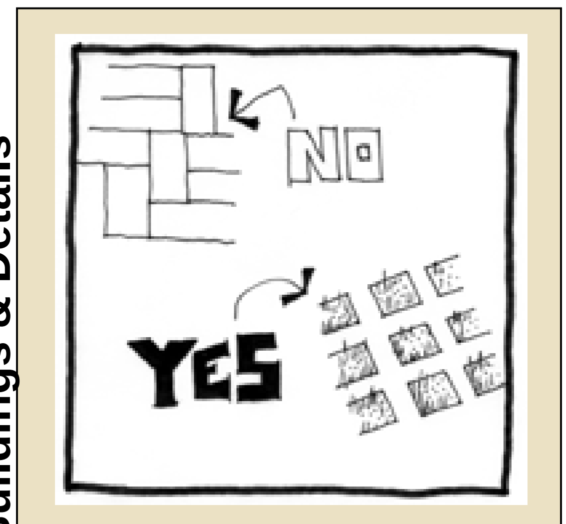
Buildings & Details

Rooftop gardens catch water, use some water for plant growth, and evaporate the rest.

Buildings & Details

Stormwater can be caught in cisterns and used later.

Buildings & Details



Permeable paving stones allow water to percolate into soil.

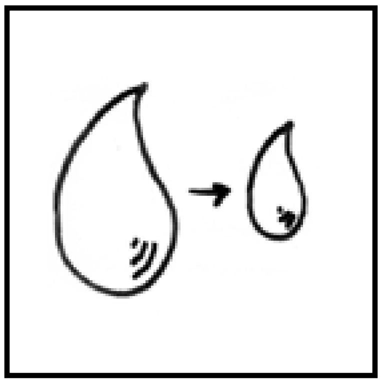
Goals

- Minimize water use.
- Recover any increase in water use by increasing efficiency throughout the already-efficient Fort Bragg system.

Rewards

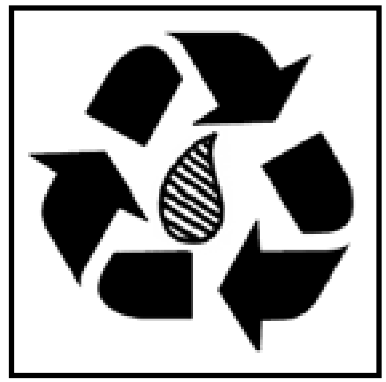
- The need to find new water storage and supplies may be delayed or prevented.
- More water will be left in the ecosystem for other species.
- The costs of pumping and water treatment may be lower.

The Fundamentals



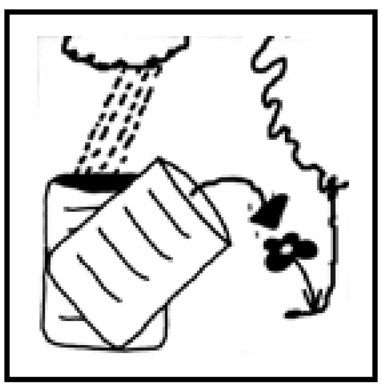
Use Less

Conservation strategies are essential in a water strategy. Often, water can be saved without sacrifice, by using more efficient appliances.



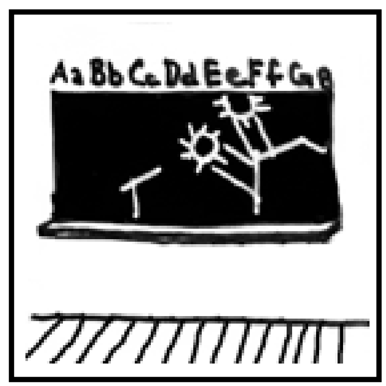
Recycle Greywater

Greywater can be recycled and used for non-drinking uses. This will keep drinking water from being used for toilet flushing, plant watering, & car washing.



Catch & Reuse

Rainwater barrels can catch water for irrigation, toilet flushing, or other non-drinking uses.



Educate

Water is very easy to conserve when people are aware of common ways water is wasted and know simple strategies they can use to save water.

WATER

City or Master Plan

Building guidelines / incentives can promote water efficiency.

City or Master Plan

Landscaping guidelines control the lawn, the largest water user.

City or Master Plan

Public education can teach easy ways to save water.

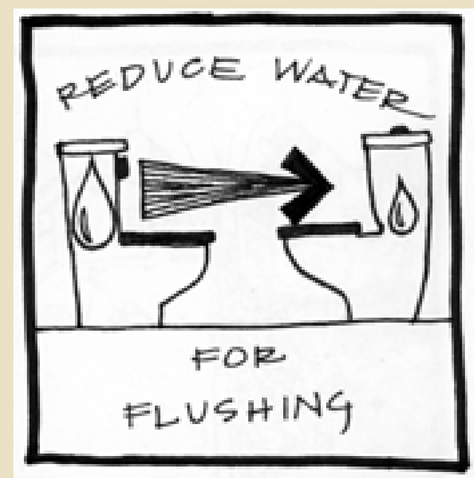
City or Master Plan

A large-scale water recyling plant could be reconsidered.

Block / Neighborhood

To use recycled water, a separate pipe network is required.

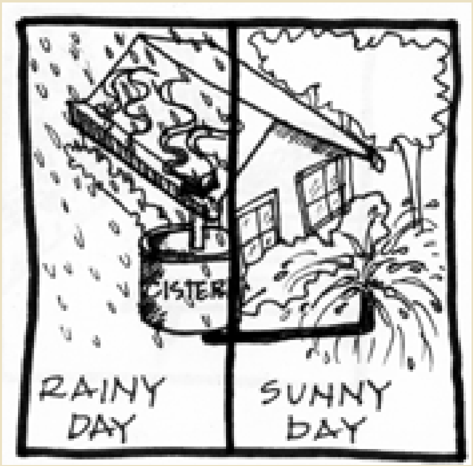
Buildings & Details



Water used for flushing toilets should be minimized.

WATER

Buildings & Details



Rainwwater can be harvested and reused.

Buildings & Details

Landscaping with native plants means plants need less water.

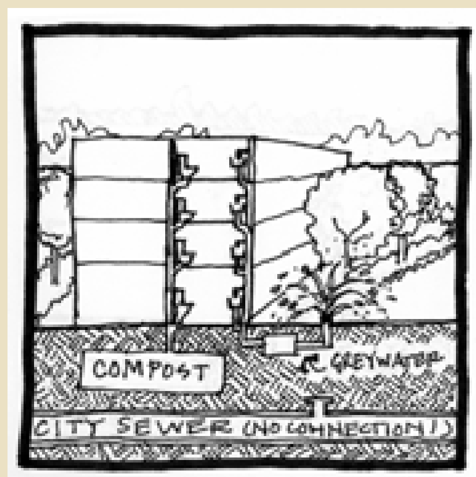
Buildings & Details

This list is only a beginning…

Buildings & Details

Smart watering practices, such as watering with drip lines at night, can greatly reduce water use.

Buildings & Details



Buildings that compost sewage and reuse greywater require much less water than average.

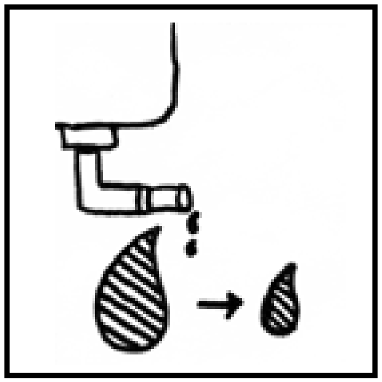
Goals

- Have developments treat their own waste, to model alternatives to the sewage plant.
- Reuse nutrients in waste as fertilizer.
- Reclaim and reuse greywater.

Rewards

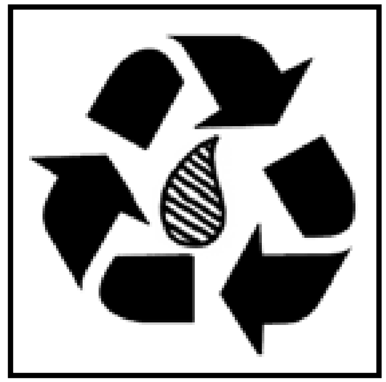
- Diverting water from sewage plant lowers costs.
- Reclaiming nutrients and water may save money on fertilizer and water costs.
- Eliminating sewage pipes may cut building costs.
- Water treated onsite will not leak from pipes to pollute groundwater.
- Solutions create more parks & wildlife habitat.

The Fundamentals



Treat Less

The easiest way to "treat" wastewater sustainably is simply to avoid creating it in the first place.

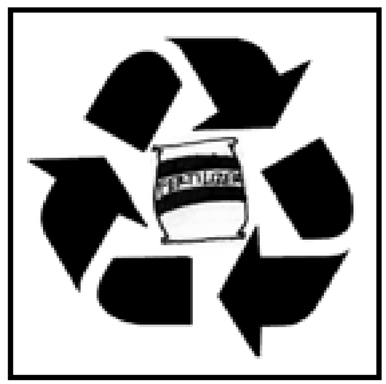


Reuse Greywater

Greywater can be recycled and used whenever drinking water is not needed. It can even be reused directly, with some caution.

Reduce Contaminants

Keeping chemicals, grease, and organic matter out of wastewater whenever possible makes treatment processes more efficient.



Reclaim Nutrients

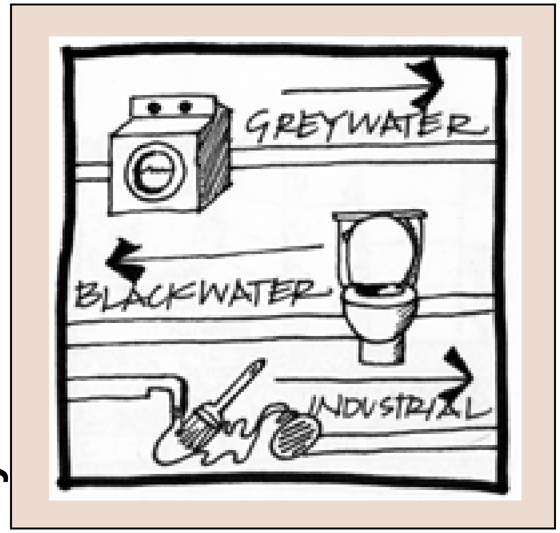
Human waste could replace around 25% of fertilizers if carefully composted and sterilized.

WASTEWATER & SEWAGE

City or Master Plan

Nutrients from sewage should be safely reused.

City or Master Plan



Greywater, sewage, & industrial waste should be kept separate.

City or Master Plan

Biological approaches should be continued & expanded.

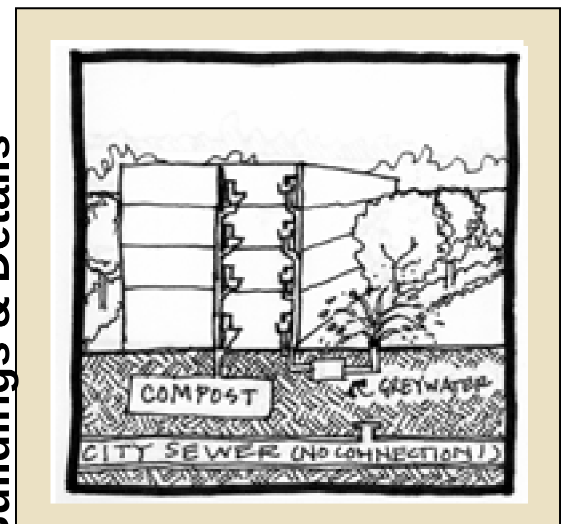
City or Master Plan

A large-scale water recyling plant could be reconsidered.

Block / Neighborhood

Wastewater and sewage could be treated in individual neighborhood clusters.

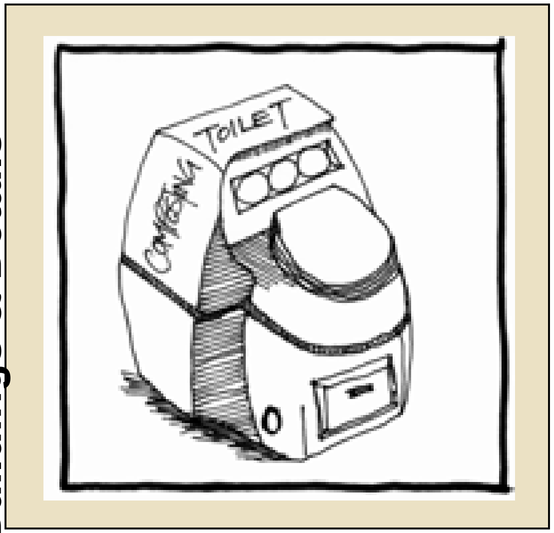
Buildings & Details



Buildings that compost sewage and reuse greywater add no burden to city sewers.

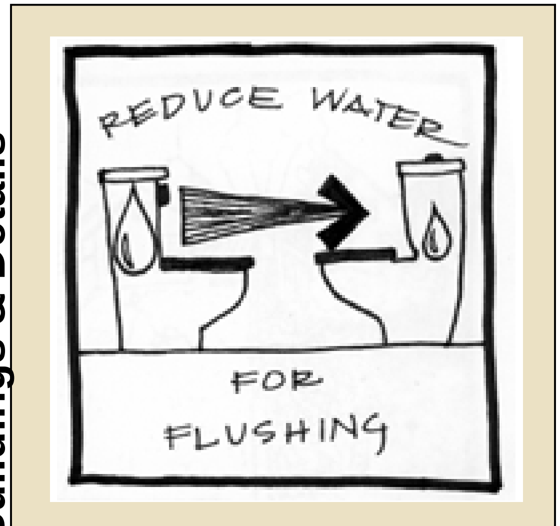
WASTEWATER & SEWAGE

Buildings & Details



Composting toilets recapture nutrients & create no wastewater.

Buildings & Details



Reducing flush water reduces the sewage that needs treated.

Buildings & Details

Reducing water use reduces the wastewater that needs treated.

Buildings & Details

Simple methods allow greywater in homes to be reused.

Buildings & Details

This list is only a beginning…

Appendix C: Glossary

Asborption basins: A gently-sloped depression in the ground designed to fill during rainstorms. They catch stormwater and have it absorb in the ground, so that stormwater will not carry pollutants to the ocean. Both swales and absorption basins are designed to hold or convey stormwater. The difference is that during storms, swales are like creeks, while absorption basins are like ponds. Both quickly dry out between rains.

Bio-accumulation: The process by which chemicals become more concentrated as they are continually taken in by a living organism from its air, food, or water. This process is particularly important when an animal near the top of the food chain eats many smaller organisms and accumulates the contaminants each one has in its body.

Biodiversity: Variability of life. Biodiversity is the number of different species, the variation in the genetic code between different members of one species, and the multitude of different ecosystems and ecological communities they form. Often considered important in allowing an ecosystem to adapt to or recover from disturbances like climate change.

Biofiltration: Using plants to filter pollutants. In this report, it particularly refers to using plants to slow stormwater, so that pollutants settle out or are trapped on plant leaves.

Biointensive gardening: A method for maximizing food production in a small area that is sustainable indefinitely. It is an integrated system that includes deeply-digging soil, adding compost to replenish nutrients, spacing plants closely, growing crops that replenish soil organic matter, growing high calorie foods like potatoes, and using open-pollinated seeds instead of hybrids.

Bioremediation: Using microorganisms, plants, or other living organisms to remove contaminants from polluted water and soil.

Blackwater: Wastewater from the toilet, also known as sewage.

Brownfields: Property whose expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. (Source: U.S. Environmental Protection Agency).

Community Advisory Group: A group of citizens from a local community organized to work cooperatively with industries or governmental agencies during the process of brownfield assessment and remediation.

Compaction: The compression of soil particles. Compression removes the gaps and spaces between particles that allow water and air to travel through the soil.

Detection limits: The lowest concentration of a particular chemical that a particular laboratory procedure can detect.

Drip irrigation: An efficient form of irrigation in which water is delivered directly to plant roots by tubes with small holes.

Eco-industrial park: A type of industrial park in which businesses cooperate with each other and with the local community in an attempt to reduce waste, efficiently share resources (such as information, materials, water, energy, infrastructure, and natural resources), and produce sustainable development, with the intention of increasing economic gains and improving environmental quality. (Source: Wikipedia).

Ecological community: A collection of plants, animals, etc., usually found together. These species create a food web, provide habitat for one another, and interact somewhat independently of other ecological communities.

Ecological design: Design which imitates or integrates itself with natural processes, so that it has a neutral or positive impact on the local environment. An example is a wastewater-treatment marsh, where wastewater is cleaned in a method very similar to the way a wetland naturally filters water. Because it imitates natural processes, this wastewater-treatment marsh then provides other benefits like bird habitat.

Ecological infrastructure: Infrastructure designed according to ecological design principles. In order to follow these principles, this infrastructure is often smaller and less centralized than typical infrastructure.

Ecological receptor: Ecological communities, populations, or individual organisms that might be exposed to toxins. "Sensitive ecological receptors" are those with exceptional environmental value, where a discharge or release could pose a greater threat than a discharge to other areas, including but not limited to: wetlands; habitat used by state or federally designated endangered or threatened species; national or state fish and wildlife refuges and fish and wildlife management areas; and state and federal designated wild and scenic rivers. (Source: Mississippi Department of Environmental Quality)

Ecotourism: Tourism, such as bird-watching, that is based on experiencing or learning about nature. Although ecotourist endeavors can be environmentally destructive (e.g., hunting safaris), for a business to qualify as "ecotourist," it now generally must also be environmentally sustainable. Ecotourism is sometimes pursued directly but may be perceived as more authentic when it results unintentionally from an area's ecological restoration efforts, such as in the Arcata wetland treatment marsh.

Environmental performance: A building or community's behavior on quantifiable environmental issues, such as energy use.

Erosion: The removal of soil particles by wind or water. Activities that clear vegetation or disturb the soil accelerate erosion.

Estuary: The area where a river or creek approaches the sea, and where freshwater and saltwater mix. This area is often wide, flat, and influenced by tides.

Geographic Information Systems, GIS: A computer software system for viewing data spatially and analyzing geographic questions. GIS helps with tasks like creating maps, layering maps on top of one another, and estimating distances.

Green building: The practice of: 1) increasing the efficiency with which buildings and their sites use and harvest energy, water, and materials, 2) reducing building impacts on human health and the environment, 3) through better siting, design, construction, operation, maintenance, and removal — the complete building life cycle. (Source: U.S. Office of the Federal Environmental Executive.)

Greywater: Wastewater from showers, sinks, dishwashers, and washing machines. Specifically excludes water from the toilet, known as sewage or blackwater.

Groundwater: Water under the earth's surface, which may be shallow or deep, that sometimes comes to the surface at springs or seeps, and from which wells draw their water.

Habitat fragmentation: The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. (Source: U.S. Geological Survey)

Habitat: The place where an animal or plant naturally occurs, where it finds food, water, shelter, and can reproduce.

Impermeable: Not permitting liquids to pass through, causing stormwater to run off rather than percolate downward into the soil. It describes both materials, such as concrete and asphalt, and areas covered by these materials.

Indicators: Quantifiable measures that can be tracked over time to determine a group's progress towards meeting its self-defined goals. Some indicators should be minimized, others maximized. Indicators might include infant mortality, hospital visits due to asthma attacks, or percentage of local graduates who remain in the area.

Invasive species: Aggressive non-native species. They spread rapidly, exclude other plants and animals, and can come to completely dominate an area. Examples include gorse, scotch broom, pampas grass, and eucalyptus.

Native species: A plant or animal that has occurred in its current location far back in history, rather than having been recently introduced. The arbitrary cutoff date for determining whether something is "native" or not is usually European settlement. Native plants are preferred because they provide food and shelter for other plants and animals, which have had time to evolve in relationship to them, unlike new arrivals. Often, but not always, native species are rare or threatened, due to the spread of aggressive invasive plant species.

Non-potable water: Water that should not be used as drinking water. Non-potable water can be used for irrigation, toilet flushing, car washing, or other uses, depending on its level of treatment.

Nutrient cycling: The circulation and transformation of nutrients in soil, such as carbon, phosphorous, and nitrogen. Nutrients are taken up by plants, decayed by micro-organisms, dissolved by water, and transformed by other chemicals, particularly acids or bases.

Passive solar energy: Using the sun's energy directly, usually for heating or cooling a house. Passive solar energy differs from "active solar energy," such as photovoltaic panels, which convert sunlight into electricity, and then use the electricity to heat or cool the house. Passive energy is generally more efficient.

Pedestrian-friendly: See "walkable."

Permaculture: A system for designing sustainable human habitats. Permaculture has an ethical framework, overarching guidelines, and specific design strategies. It overlaps with ecological design concepts, but places special emphasis on the integration of food growing with buildings and neighborhoods.

Permeable: Permitting liquids to pass through, allowing stormwater to percolate downward into the soil rather than to run off into streets and gutters. It describes both materials, such as vegetation or special types of paving, and areas covered by these materials, such as gardens.

Photovoltaics: Cells that convert sunlight to electricity, typically installed as flat panels on building roofs, also known as solar panels. However, innovative applications for photovoltaic cells are constantly being developed, such as photovoltaic glass which allows photovoltaic cells to be embedded in semi-transparent skylights or windows.

Phytoremediation: Using plants to remove or immobilize hazardous substances from a brownfield.

Placemaking: Techniques for turning a lifeless "space" into a well-loved "place" for social interactions and community life.

Potable water: Water that is safe to drink. It requires a higher level of filtration than non-potable water.

Preliminary remediation goals (PRGs): Generic cleanup targets used in brownfield remediation. The targets are specific to a particular contaminant, in a particular medium (water, soil, or air), and depend upon the intended future land use (residential, commercial, industrial, or open space). These are preliminary in nature and do not account for site-specific factors such as soil type or the depth to groundwater. These usually precede a thorough risk assessment.

Remediation: Taking action to reduce, isolate, or remove contamination from an environment with the goal of preventing exposure to people or animals. Also known as "cleanup." (Source: National Oceanic and Atmospheric Administration).

Riparian: Related to the banks of a creek or river.

Risk assessment: A process of measurement and calculation done to determine the risk posed by contaminants to humans or ecosystems. Risk assessment involves determining how a person or organism might be exposed, the probable duration and intensity of exposure, and the toxicity of the contaminant.

Site assessment: In brownfield cleanup, the process of determining likely contaminants' type and location through historical research, interviews with former workers, review of photographs, and visits to the site.

Site investigation: In brownfield cleanup, the process of determining whether a site is actually contaminated by the chemicals identified as possible pollutants during the site assessment stage. Samples of soil, groundwater, surface water, and air may be collected and analyzed in a laboratory.

Soil structure: The arrangement of soil particles into larger soil units of particular sizes and shapes, as well as the spaces between these units that allow water and air to pass through the soil. Well-developed soil structure encourages biodiversity in the soil. Soil structure is disturbed by compaction and tilling.

Swale: A gently-sloped, shallow, vegetated depression in the ground, like a shallow and wide ditch, that is designed to carry and clean stormwater. After water travels 9 minutes or 250 feet in a swale, almost all street pollutants picked up by the water have been filtered out by the plants. Both swales and absorption basins are designed to hold or convey stormwater. The difference is that during storms, swales are like creeks, while absorption basins are like ponds. Both quickly dry out between rains.

Topsoil: The upper layer of soil, usually the most rich in decomposing organic material, soil microorganisms, nutrients, and seeds. Topsoil is the most fertile portion of the soil.

Transit oriented development: A mixed-use community within walking distance of a transit stop, which mixes residential, retail, office, open space, and public uses in a way that makes it convenient to travel on foot or by public transportation instead of by car. (Source: Massachusetts Community Preservation Initiative.)

Transit: Public transportation that serves a group of people rather than individuals. Transit includes buses, shuttles, trains, and similar types of transportation.

Walkable: Inviting pedestrian travel. A "walkable" neighborhood generally has necessities (groceries, workplaces, and housing) within a quarter- to half-mile of each other, as well as sidewalks that allow walking. A "walkable" street is one that is a pleasant place for pedestrians – lively and interesting, with buildings and a street width of appropriate size, without intimidating traffic, and with amenities like benches, lighting, and street trees.

Water recycling: Filtering water to a safe level, and then using it again for irrigation, toilet flushing, or other non-potable use.

Wildlife corridor: A strip, such as a creek or row of trees, that connects two habitat areas and allows animals to travel safely from one to another.