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November 2011

Environmental Sustainability Report 2011

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Environmental Sustainability Report 2011

National Aeronautics and
Space Administration

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Dr. Ann Clarke

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Letter from the Center Director

"NASA Ames Leadership in Sustainability"

A Culture of Sustainability

Sustainability is an important principle of doing business in the government, as well as in industry, non-governmental organizations, and academia with whom we interact. Sustainable practices are designed to protect the resources and relationships that will enable NASA to thrive as it carries out its mission across space and time. Sustainable practices include ethics, corporate governance, workplace diversity and inclusion, community involvement (e.g., education, outreach, volunteerism), health and safety, and environmental quality. In this report we focus on Ames environmental sustainability not only as a necessary step to assuring resources are available to sustain future endeavors, but also as a means to demonstrate integrity, assure transparency, provide for inclusion, consider impacts on the larger environment, and protect health and safety of workers and the public.

Dr. S. Pete Worden
Center Director
NASA Ames Research Center

Letter from the Environmental Management Division Chief

I am pleased to present the second edition of the Ames Environmental Sustainability Report. We welcome you to continue to learn more about the Center's progress toward making Ames one of, if not the greenest Center at NASA. We also encourage you to visit the several sources of information referenced in the report to learn about the NASA Ames research and development activities that address needs for sustaining missions in the harsh environment of space and the more familiar environment of Earth. Many of these efforts have had or may result in spin-offs that contribute to a more sustainable future for all of us.

Dr. Ann Clarke
Chief, Environmental Management Division
NASA Ames Research Center

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About NASA Ames

NASA Ames Research Center at Moffett Field, California, was founded December 20, 1939 as an aircraft research laboratory by the National Advisory Committee for Aeronautics (NACA). With the passage of the Space Act in 1958, the National Aeronautics and Space Administration (NASA) was created, replacing the NACA.

NASA Ames is one of ten NASA field installations and is uniquely situated at the core of the research cluster of high-tech companies, universities, and laboratories in Silicon Valley that define the region's character. Ames' wind tunnels, office buildings, hangars, and airfield are a significant presence in the community. With more than $3.0 billion in capital equipment, 2,300 research personnel and a $600 million annual budget, Ames' economic impact is significant.

A Current Aerial image of Ames and the Research park

Currently, Ames is making history by forging ahead with its small, inexpensive satellite missions. This dynamic center is at the forefront in astrobiology, supercomputing, robotic lunar exploration, the search for habitable planets, intelligent/adaptive systems, advanced thermal protection, and airborne astronomy. Ames also develops strategic private sector partnerships to further space exploration, create innovative technologies, and foster interdisciplinary scientific discoveries in Earth and space sciences. To find out more about the exciting work being done at the NASA Ames Research Center visit http://www.arc.nasa.gov/.

In addition, Ames is redeveloping the former Naval Air Station at Moffett Field into the NASA Research Park (NRP). The NRP has been successful in bringing in over 70 on-site partners who fully occupy approximately 675,000 square feet of leasable space. This ongoing development has produced a collaborative community of government, industry, and academic leaders who are delivering innovation, powering economic growth, and advancing science, technology, engineering and math education. Over the next fifteen years, the NRP is estimated to have a positive economic impact on the area, generating an additional 21,300 local jobs and an additional $5.8 billion in annual economic output. To find out more about the NRP visit http://researchpark.arc.nasa.gov/.

Artist rendition of the future NASA Research Park.

Some of the NRP onsite partners include Carnegie Mellon University, Singularity University, and Airship Ventures.

After more than 70 years of innovation, NASA Ames looks forward to a future of new scientific advances and breakthrough technologies.

NASA Ames celebrated its 70th anniversary on December 20, 2009.

Introduction

Welcome to the NASA Ames Research Center's Environmental Sustainability Report for 2011. The following pages highlight the various environmental issues addressed at Ames, and the center's accomplishments over the past two years.

In an effort to manage its environmental resources, NASA follows Executive Order (EO) 13423 of January 24, 2007. Additionally, NASA follows EO 13514 of October 5, 2009, which strengthened many provisions detailed in EO 13514. These EOs set broad goals to strengthen environmental, energy, and transportation management across Federal agencies. They consolidate previously issued EO's and require Federal agencies to implement Environmental Management Systems (EMS) at all appropriate organizational levels. They then require the use of EMS as the primary management approach for addressing environmental aspects of internal agency operations and activities, including energy and transportation functions. EMS compliance is equivalent to ISO 14001 compliance. NASA Ames EMS is conformant with the White House Council of Environmental Quality Requirements.

EO 13514: "Sustainability" and "Sustainable" mean to Create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations.

NASA is implementing the EO goals, in large part, through the NASA Strategic Sustainability Performance Plan. To implement the plan, the NASA Ames Environmental Management Division is spearheading an internal Ames 'Green Team' which is focused on strengthening the Center's environmental management system, including outreach through websites, a variety of forums, and topical fact sheets. This Green Team participates in the Sustainable Silicon Valley, and other organizations that share information and collaborate in finding common solutions to such challenges as clean transportation, energy and water conservation, chemical management, and green purchasing.

Sustainability for NASA Ames is consistent with the Space Act of 1958, NASA policy on Environmental Quality (14 CFR subpart 1216.1) and NASA's strategic goals. The NASA 2011 Strategic Plan vision is to reach for new heights and reveal the unknown, so that what NASA does and learns will benefit all humankind and its mission is to "drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth." NASA Ames contributes to the Agency's overarching strategy of "Committing to environmental stewardship through Earth observation and science, and the development and use of green technologies and capabilities in NASA missions and facilities" in part through many of the efforts described in the following pages. Ames also celebrates the accomplishments of its personnel in furthering Center sustainability goals through annual Earth Day events, the Ames Sustainability Award Program, and other activities.

NASA Ames has received many sustainability awards. See www.environmentalmanagement.arc.nasa.gov for details.

National Aeronautics and Space Administration

AMES RESEARCH CENTER
EMS Certified

The National Environmental Policy Act of 1969

The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

Energy

EO 13514 Agency-wide Goals for Energy:

1. Increase renewable energy and renewable energy generation on agency property.
2. Align Federal policies to increase effectiveness of local planning for energy choices
3. Identify and analyze impacts from energy usage and alternative energy sources in all Environmental Impact Statements and Environmental Assessments for new or expanded Federal facilities proposals
4. Ensure all new Federal buildings planned post-2019 achieve zero-net-energy standards by 2030.
5. Manage existing buildings to reduce energy consumption.
6. Ensure 95% of all new contracts, including non-exempt contract modifications, require energy efficient products and services.

Effective energy management is crucial to Ames' sustainability due to the center's requirements for both electricity and natural gas for its power. Major energy users at Ames are the wind tunnels, arc jet, and supercomputing facilities. Base power demand is 10 to 20 megawatts, but peak demand can be up to 150 megawatts when running the wind tunnels and/or the arc jet.

Energy reliability hinges on supply, quality and price. Currently Ames purchases electricity from Western Area Power Authority (WAPA), the majority of which is supplied by large scale hydroelectric dams. WAPA power is delivered to Ames over Pacific Gas & Electric (PG&E) power lines. WAPA allots Ames 5.3 percent of the daily generating capacity of WAPA hydroelectric dams. This allotment varies day to day as well as seasonally. The price for electricity also varies based on the volume of water available to WAPA. When WAPA has abundant water, Ames' cost per kilowatt hour falls. When the volume decreases as in a drought, NASA's costs may increase. When Ames exceeds WAPA's electricity allotment, WAPA purchases power for Ames through the California Independent Systems Operators (CAISO), part of the open market for electricity. Electricity through the open market is generally more expensive than WAPA power.

Ames uses natural gas to power boilers for heating water and air, and running air conditioning and ventilation systems. Natural gas is provided to NASA Ames by PG&E via the Defense Energy Support Center. The Ames Facilities Engineering Branch has a number of energy-related projects, a few are discussed below.

Fuel Cells - Fuel cells generate "clean" electric power through a highly efficient electrochemical process that all but eliminates air pollutants and drastically reduces greenhouse gases. Fuel cells are currently under development at two sites, one near the Sustainability Base and the other at the 12ft Wind Tunnel Facility. At the Wind Tunnel, a 12 kW fuel cell from Logan Energy will serve as a backup power source to the DCS Data Systems and Emergency Lighting. The fuel cell is part of the promotional backup power fuel cell deployment project of the U.S. Department of Energy. Site analysis at Ames has been approved and the Department of the Army will be responsible for procurement of the fuel cell, its installation, and five years of operations and maintenance. At the site of Sustainability Base N-232, a solid oxide fuel cell produced by Bloom Energy will be installed generating electric power for use throughout the center.

Fuel Cell near Building. 232

Utility Energy Services Contract - Using PG&E's Utility Energy Services Contract program, Ames has initiated a design-build plan to implement a variety of energy efficiency and renewable energy conservation measures including installation of a 100 kW photovoltaic system, installation of new high-efficiency Heating, Ventilation, and Air Conditioning (HVAC) equipment to replace aging and energy-inefficient systems, expansion of the energy management control system, installation of a small fuel cell, and implementation of a center-wide retro-commissioning program.

Street and Parking Lot Lights - In cooperation with Relume Technologies, in 2010, Ames installed prototype LED streetlights around our administration building. These streetlights have a life of 10,000 hours and will use 90 percent less power than the existing streetlights. Plans are also underway to install LED lighting in the parking lot and along the pathways of the East Side. Additionally, Ames installed five SolarOne LED photovoltaic parking lot lights at the Automation Sciences Research building.

Solar Panels - Two of Ames' buildings have rooftop photovoltaic solar panels, which provide over 10 kW of power, and the solar panels at the Sustainabiliy Base will provide and additional 90 kW, once complete. The sign at the front gate raises awareness of energy use by posting the center's monthly usage.

Cloud Computing - The Nebula project moves Ames toward the use of 'Cloud Computing.' It uses a containerized data center to house servers on the NASA Ames campus. These containers are the "greenest" form of data center due to their inherent density. Nebula also makes Cloud Computing more efficient by turning physical hardware off when not needed. Estimates show Nebula to be 50% more energy efficient than traditional data centers.

Nebula Data Center

Major accomplishments and awards:

3 Ames Sustainability Awards:

- N-232 Sustainability Base Energy Efficient IT Infrastructure - Data from a network of sensors that react to changing environmental and usage conditions.
- Supercomputer expansion which increased computing power 8-fold, while avoiding the need for 11MW of power.
- Facility Monitoring and Control System enabled more than 140K MHh of savings at no cost.

Water

EO 13514 Agency-wide Goals to Improve Water Use Efficiency and Management:

1. Reduce potable water consumption intensity by 2 percent annually through fiscal year 2020, or 26 percent by the end of fiscal year 2020, relative to a baseline of the Agency's water consumption in fiscal year 2007, by implementing water management strategies including water-efficient and low-flow fixtures and efficient cooling towers.
2. Reduce agency industrial, landscaping, and agricultural water consumption by 2 percent annually or 20 percent by the end of fiscal year 2020 relative to a baseline of the agency's industrial, landscaping, and agricultural water consumption in fiscal year 2010.
3. Consistent with State law, identify, promote, and implement water reuse strategies that reduce potable water consumption.
4. Implement and achieve objectives identified in the USEPA storm water management guidance.
5. Manage existing buildings to reduce water consumption.
6. Ensure 95% of all new contracts, including non-exempt contract modifications, require products and services that are water-efficient.

Ames continues to reduce its use of potable water in the years to come in order to meet the requirements of Executive Orders 13423 and 13514 by reducing water use intensity in its processes and using reclaimed water instead of potable water where feasible.

Large water uses at Ames include irrigation, cooling towers, interior building use, vehicle and aircraft washing, and food service. Ames has established a Water Community of Practice and is undertaking the following initiatives to protect water quality and reduce potable water consumption.

East Side Irrigation System - In 2009 a portion of the east side was converted to using reclaimed water from the Sunnyvale Wastewater Treatment Plant. Potable water was saved by the use of this reclaimed water for golf course irrigation, in the amounts of 53 million gallons in FY 2009 and 31 million gallons in FY 2010.

Ames used 218 million gallons of potable water in FY 2009 and 178 million gallons in FY 2010, costing $985,000 and $863,000, respectively. Additional decreases are considered anomalous based on temporary decreased facility uses, decreased aircraft washings, and less irrigation during mild summers, and cannot necessarily be counted on in the future.

Moffett Field East Side irrigation

Major accomplishments and awards:

- Successful 2010 Water Summit held in coordination with Sustainable Silicon Valley.
- Awarded a White House Award for East Side Irrigation System project.
- Blue Marble Award given to Dr. Leslie Prufert-Bebout for her research utilizing algae to produce carbon-neutral renewable energy.
- Dr. Richard Luthy (Stanford University) spoke at the 2010 Earth Day Directors Colloquium discussing California's urban water challenges.

Ground Water Reuse Project - Significant decreases in potable water use are anticipated when the Ground Water Reuse project is completed and put into operation, either late 2011 or 2012. This project converts the currently mothballed Industrial Wastewater Pretreatment Plant into a reverse osmosis plant to produce industrial feed water for Ames' Arc Jet and Unitary Wind Tunnel facilities. The process will use available treated (for environmental cleanup purposes) groundwater sources that discharge to the environment, such as to Stevens Creek, without any reuse. When implemented, this new groundwater reuse facility is expected to save approximately 29 million gallons of potable water per year without impacting the steelhead in Stevens Creek.

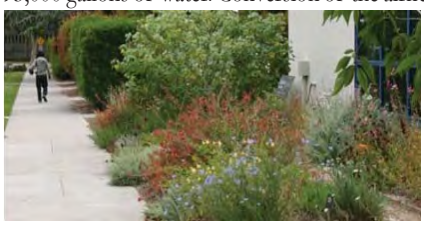
Steelhead trout in Stevens Creek; photo by Chris Alderete

Storm Water Management - In 2010, after the Navy cleaned up the PCB contaminated soils and restored the vegetation and hydrologic flow, NASA acquired the Northern Channel (a.k.a. The Moffett Channel) from Cargill. The Northern Channel provides flexibility for managing flood water from upstream sources, major spills, and overflow from the Bay.

Utility Energy Service Contract (UESC) - A UESC is currently being implemented at Ames, which includes water saving upgrades, such as low flow toilets, urinals, and faucets.

Emergency Water Tank - Ames receives water from the San Francisco Public Utilities Commission whose sources are the Hetch Hetchy Reservoir in the Sierra Nevada and a local watershed in Alameda County. A 400,000 gallon emergency water tank ihas been installed at Ames for the potable water system.

Native Landscaping - Each year Ames' native landscaping saves approximately 93,000 gallons of water. Conversion of the airfield turf to native plants is being studied. Additionally, Earth scientists are comparing water usage and the carbon footprint of conventional vs. native landscaping to find additional water savings.



Native landscaping; photo by Chris Alderete

Air

EO 13514 Agency-wide Goals for Air Quality:

1. Pursue opportunities with vendors and contractors to reduce greenhouse gas (GHG) emissions (e.g., transportation options and supply chain activities).
2. Develop and implement innovative, Agency-specific policies and practices to reduce GHG emissions from commuting during Agency operations.
3. Decrease use of chemicals directly associated with GHG emissions.

As an active research center, Ames requires clean air in its operations, yet under various regulations these operations are permitted to generate air pollution. The table below lists major pollution sources and the control systems.

Air Pollution Source	Pollution Control System
Vehicular traffic	Federal and state emission controls
Aircraft operations	Aircraft emission controls
Boilers-natural gas combustion	Bay Area Air District emission controls
Paint and resin spray booths	Filter/water wash spray, low volatile organic compound coatings
Solvent cleaning & operations	Tightly closed tanks & containers, high boiling point (low volatility) solvents
Fuel dispensers	Vapor recovery systems
Thermal Protection Labs - Arc Jets	2-stage scrubber: vacuum-holding sphere and tower
Wind tunnel testing of powered models	Bay Area Air District emission controls, air credits

Ames has one of the most comprehensive air quality monitoring programs in the Federal government. The data is used to make informed decisions on how to demolish or retrofit older buildings and design and operate new buildings to assure a healthy work environment. Additionally, carbon dioxide (CO_2) is emitted into the atmosphere as a result of Ames' energy usage. To assure air quality, Ames has undertaken several initiatives - some are highlighted here.

Renewable Energy Purchases - Besides the above requirements, EO 13514 also requires renewable energy purchases under the 2005 Energy Policy Act (EPAct) to increase carbon-neutral energy use and lower GHG emissions.

The Toxics Release Inventory (TRI) - This annual report to the Environmental Protection Agency (EPA) tracks pollutants and has thresholds for air, waste, and water releases. Ames is required to report releases and emissions for certain chemicals above certain thresholds. Of the 650 TRI listed chemicals and compounds, Ames has 123 TRI chemicals and 21 TRI compounds known to be used or present on site. None of these chemicals or compounds used at Ames exceeded any activity (manufacturing, processing, or other use) thresholds for the 2010 reporting year.

Fleet Management - The Ames Transportation office manages the Motor Pool, which is a fleet of flex-fuel vehicles from the General Services Administration. This fleet includes vehicles that can use either ethanol or gasoline. In addition, compressed natural gas (CNG) vehicles and Global Electric Motorcars (GEM) are in use, and green products are used to maintain them. Additionally, in 2010, The Environmental Management Division purchased a hybrid truck for use in handling hazardous waste, and the facilities maintenance contractor converted its fleet to hybrid utility trucks.

Gem Motorcar

Synthetic Minor Operating Permit - In June 2011, the Bay Area Air Quality District approved the Synthetic Minor Operating Permit under the Federal Clean Air Act. This saves NASA Ames more than $1,000,000 over the next decade, compared to the higher level CAA Title V permit otherwise required. This permit addresses new requirements which take into account greenhouse gas emissions.

Boilers - Ames is replacing 28 boilers under the UESC contract to improve energy efficiency. The remaining boilers will be upgraded, replaced, or retired to comply with the new BAAQMD regulations. This project is ongoing and will take several years to complete.

Ames Renovated Boiler System

NOX Scrubber - Ames is upgrading the Arc-Jet NOX scrubber, after 30 years of use, to meet new regulations for air emissions.

Ozone Depleting Substances (ODS) - NASA has been managing its stockpile of Halon for use in aircraft and space vehicle fire-fighting while looking for non-ODS alternatives. Additionally, Ames collects old refrigerators and air-conditioning units prior to disposal and drains the refrigerants.

Left: Halon containing fire extinguisher.
Right: Discarded refrigerators and air conditioners awaiting recycling after ODS removal.

Major accomplishments and awards:

- Logistics transportation team installed vapor recovery systems on fueling stations - 2011.
- Synthetic Minor Operating Permit was submitted in June 2011 for approval.

Climate Change

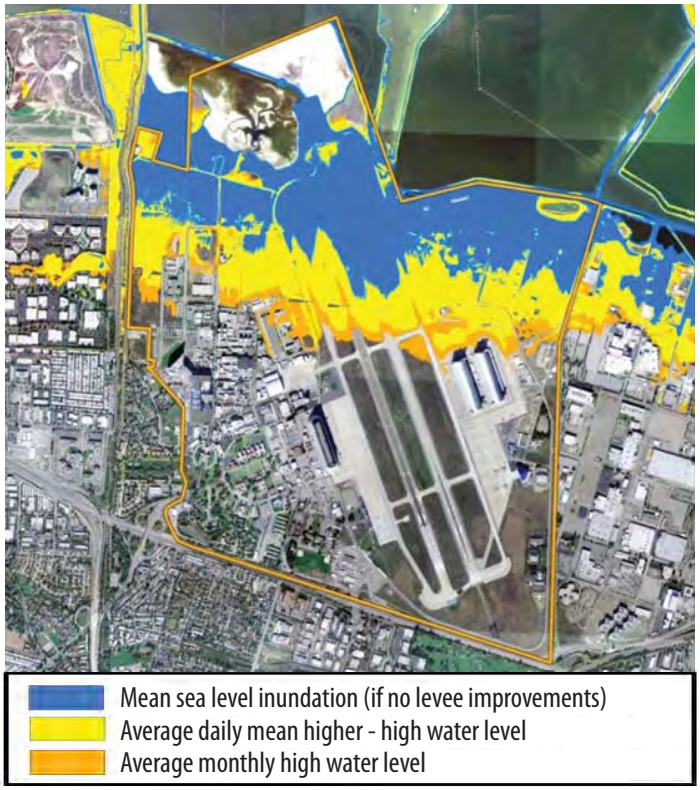
EO 13514 Agency-wide Goal for Climate Change:

1. Develop an Agency-wide goal for greenhouse gas reduction and obtain White House, Office of Management and Budget, approval.
2. Develop an Agency-wide Adaptation Strategy.

Climate change is a long-term change in the statistical distribution of weather patterns over periods from decades to millions of years. Climate change reflects a change in the energy balance of the climate system. The following highlights the projected consequences over multiple time horizons (20, 50, 80 years) that may effect life and work at Ames and the surrounding community.

In February 2011 Ames hosted the Resilience and Adaptation to Climate Change Risks Workshop and Symposium, where the major causes and effects of climate change were discussed, and adaptation steps were outlined. The workshop and symposium represent major steps toward meeting NASA's goals under the Executive Order.

Potential Water Inundation - The image below shows the potential inundation due to rising sea levels in the San Francisco Bay, assuming no improvement in the levee system, no subsidence, and no increase in tidal amplitude. This image also assumes a year 2000 baseline water level.



Potential Inundation Due to Rising Sea Levels in the San Francisco Bay Region. San Francisco Estuary and Watershed Science, 8:1. Available at http://escholarship.org/uc/search?entity=jmie_sfews;volume=8;issue=1. Data from website: http://cascade.wr.usgs.gov. Image by : Knowles, Noah. 2010.

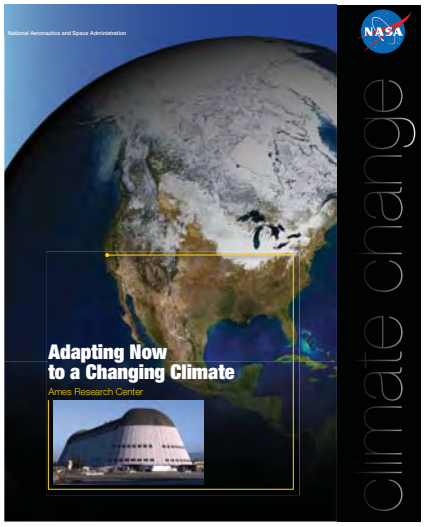
Major accomplishments and awards:

- 2011 NASA Honor Award for Resilience and Adaptation to Climate Change Workshop and Symposium.

Emerging Recommendations - Climate change in the near future is sure to cause a change in habitats for many plant and animal species. Additionally, climate change will alter the frequency, duration or severity of weather systems. The following are the mitigation recommendations discussed at the 'Resilience and Adaptation to Climate Change Risks Workshop and Symposium,' held in February 2011.

- Reduce current stresses on habitats, e.g. invasive species.
- Reduce current contamination.
- Maintain corridors for plants and animals to move.
- Monitor change of species at Ames, e.g. rattlesnakes.
- Manage stormwater.
- Plan for extreme events, e.g., work schedules, safety plans and emergency response.
- Coordinate with the Army Corps of Engineers in planning levee upgrades.
- Use the Ames Master Plan process to address flood and salt water intrusion risk to infrastructure.

Shoreline Study - Ames slopes from grassy uplands to marsh. Northern areas are below mean sea level due to past agricultural pumping. The center is protected from flooding by levees and is a cooperating Agency with the U.S. Army Corps of Engineers in its Shoreline Feasibility Study to determine whether and how to upgrade the levees to protect against sea level rise.



Left: NASA Ames is committed to Adapting Now to a Changing Climate. See http://environment.arc.nasa.gov/symposium2011/agenda/NASA_AmesPDFforweb.pdf for more information.

Right: Outside speakers provided context for developing a NASA Ames-specific adaptation strategy. Mark Bierman (Craig Conner not shown), Army Corps of Engineers, San Francisco District, presenting the Corps levee program to workshop participants.

Material

EO 13514 Agency-wide Goals for Materials:

1. Promote pollution prevention, recycling, and sustainable acquisition: 1) Ensure 95% of all new contracts require products and services to be energy-efficient, water-efficient, biobased, environmentally preferable, non-ozone depleting, contain recycled-content, non-toxic or less-toxic alternatives; 2) Minimize generation of waste and pollutants through source reduction; 3) Divert at least 50% of non-hazardous solid waste, construction and demolition debris, by the end of FY 2015; 4) Reduce printing paper use and acquiring uncoated printing and writing paper containing at least 30% post-consumer fiber; 5) Reduce and minimize the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of; 6) Increase diversion of compostable and organic material from the waste stream; 7) Implement integrated pest management and other appropriate landscape management practices; 8) Increase agency use of acceptable alternative chemicals and processes in keeping with the Agency's procurement policies; 9) Decrease Agency use of chemicals when this will assist in achieving greenhouse gas emission reduction targets; 10) Report under sections 301 through 313 of the Emergency Planning & Community Right-to-Know Act of 1986.
2. Promote electronics stewardship, in particular: 1) Ensure procurement preference for EPEAT-registered electronic products; 2) Establish and implement policies to enable energy-efficient or environmentally preferable features on all eligible electronic products; 3) Employ environmentally sound practices with respect to the disposition of excess or surplus products; 4) Procure Energy Star and FEMP designated electronic equipment; 5) Implement best practices for energy-efficient management of servers and Federal data centers.

Consistent with Federal policy, Ames strives to procure recycled content, bio-based, energy-efficient, and environmentally preferable products (EPP) to meet the EPA Comprehensive Procurement Guidelines (CPG) and the U.S. Department of Agriculture's bio-based product requirements. Buying EPPs has many benefits, including supporting a market for recycled and energy efficient products, protecting employee health, and protecting the environment. Table 1 shows the EPPs with recycled or bio-based content purchased in FY 2010.

Bio-based or Recycled Product Purchased	% Content	Bio-based or Recycled Product Purchased	% Content
Toner Cartridges	100%	Office Furniture	95.3%
Sanitary Tissue	100%	Motor Vehicle Tires	11.6%
Roofing Materials	100%	Hydraulic Fluid	94.1%
Plastic Trash Bags	100%	Engine Coolants	100%
Plastic File Folders	100%	Engine Coolants	0%
Plastic Desk Accessories	100%	Engine Oil	90.4%
Plastic Clipboards	100%	Disposable Cutlery	100%
Paper & Paper Products	99.4%	Disposable Tableware	100%
Bathroom Cleaners	100%	Disposable Containers	80.4%
Biobased Fuel	82.8%	Binders	100%

Table 1: Products purchased in FY10 with bio-based or recycled content.

As a member of the Federal Electronics Challenge (FEC), Ames works to improve electronic product stewardship. For Example, Ames specifies computers that meet the Electronic Product Environmental Assessment Tool (EPEAT) standards. Table 2 shows (for fiscal year 2010) all the computers and monitors reported as purchased were rated as EPEAT Gold. Ames is currently planning to implement additional actions that will improve electronic product stewardship, including increasing the use of lower standby power functions and duplex printing.

Knowledge Sharing - The Environmental Management Division works with the Acquisition Division and the Chief Information Officer to share information with the Ames community about environmentally preferable products and EPEAT computers. Recently, the Environmental Management Division published a Green Purchasing brochure and a Green Meetings brochure.

Electronic Product Purchased in FY10	Number	Percent EPEAT Gold
Desktop Computers	1231	100%
Liquid Crystal Display (LCD) Monitors	2150	100%
Laptop/notebook computers	1174	100%

Table 2: Electronic Product Purchases FY10

Hazardous Material Information Management System- The Environmental Management Division is upgrading its system to reduce the time that researchers and other Ames staff spend on inventory tracking and reporting. The upgrade is also expected to reduce errors, and may allow researchers to reduce their chemical inventory.

Green Packaging Materials - A special machine in the shipping office is using a 'green' packing material for shipments. The system converts 2-ply paper into a multi-ply pad for cushioning, wrapping and blocking contents of a shipment. The is 60% recycled paper and 40% saw dust. No virgin materials are used and it is 100% recyclable material. The machine is easy to operate, compact, and durable. The only cost is for the paper actually used.

The 'green' packing material Machine

Major accomplishments and awards:

- Removed toxic plastics from use in cafeteria by converting to compostable materials (corn based packaging materials and utensils).
- Personnel, in partnership with Apple Computer, recycled 400 cubic yards of styrofoam.
- Ames Safetu Award (2011).

Waste

EO 13423 and 13514 Agency-wide Goals for Waste Reduction:

1. Increase source reduction of pollutants and waste.
2. Divert at least 50% non-hazardous solid waste (including C&D materials) by FY 2015.
3. Reduce printing paper use.
4. Increase use of uncoated printing and writing paper containing at least 30% post-consumer fiber.
5. Reduce and minimize the acquisition, use, and disposal of hazardous chemicals and materials.
6. Increase diversion of compostable and organic materials from the waste stream.
7. Implement integrated pest management and landscape management practices to reduce and eliminate the use of toxic and hazardous chemicals and materials.
8. Increase Agency use of acceptable alternative chemicals and processes.
9. Decrease Agency use of chemicals to assist Agency in achieving FY 2020 GHG reduction targets.
10. Report in accordance with Sections 301 and 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986.

Waste generated at Ames in FY 2010 was from ongoing research operations and construction and demolition (C&D) activities. Ames has programs that recycle various hazardous and non-hazardous solid waste streams, and is doing well with C&D recycling, achieving a 99% recycling rate; well above the required 50%. However, non-C&D solid waste has a 22% recycling rate. The challenge will be in meeting the 50% recycling rate required by the end of FY 2015.

Hazardous Waste: NASA is subject to the Resources Conservation and Recovery Act (RCRA), a cradle-to-grave requirement, and other Federal, State, and local hazardous material and waste requirements. In FY 2010, Ames shipped 330,595 lbs of hazardous waste offsite for proper disposal or recycling. Almost half (47%) was sent to landfill. 37 percent was recycled or reclaimed. The rest was disposed via incineration (6%), fuel blending (4%), neutralization (3%), stabilization (2%), and metals recovery (0.3%).

Most of the hazardous waste at Ames is from clean up and maintenance operations. Contaminated soil accounted for over a third of the hazardous waste shipped. Adding oil and oily water accounts for 60% of hazardous waste shipped. The top 10 waste types account for 85% of hazardous waste shipments (see table 1).

The Ames Chemical Exchange (ACE) accepts donations of Ames's hazardous materials that have been purchased but not opened, and makes them available to other members of the NASA Ames community. ACE saves the Center money by avoiding unnecessary purchases, avoiding disposal costs, and returning unused materials to suppliers.

Solid Waste: Ames diverts concrete, demolition debris, cardboard scrap metal and paper for recycling (see Table 2).

Hazardous Waste Type	Quantity Shipped (lbs.)
Contaminated Soil	113,517
Oil	52,238
Oily Water	33,435
Debris, Non-RCRA	18,895
Batteries	14,523
Asbestos Debris	12,242
Empty Drums	12,087
Fuel	10,847
PCB Materials	7,077
Fluorescent Light Tubes	6,000

Table 1: Top 10 Hazardous Waste Types, NASA Ames FY 2010

Major accomplishments and awards:

- NASA Ames is on track to win Gold Federal Electronics Challenge in 2012.

Institutional Solid Waste	Amount Recycled (lbs.)
Cardboard	483,300
Scrap Metal	476,888
Mixed Paper	201,000
Wood Waste	174,150
Green Waste	62,000
Drums	13,367
Cooking Oil/ Grease	8,448
Styrofoam	1,447
Tires	500

C&D Solid Waste	Amount Recycled (lbs.)
Concrete	2,602,917
Debris	611,180
Scrap Metal	317,106

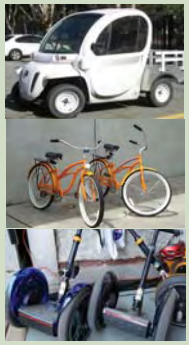
Table 2: *Non-Hazardous Solid Waste Recycling - Ames, FY 2010*

Electronic Waste Reduction - NASA Ames has an established program for managing electronics recycling. Computers, LCDs, CRTs and other electronics are reused, sold, donated or recycled (see Table 3). NASA Ames also participates in the Federal Electronics Challenge (FEC), which encourages Federal agencies to improve their electronic product stewardship. In the past, Ames has won FEC Silver and Bronze awards and efforts are underway to win the Gold award. As part of these efforts, Ames is undertaking multiple projects including: procuring the most energy efficient computers and surveying duplex printer setting to reduce printing paper use. Additionally, The Ames Child Care Center sponsors household electronic waste recycling events, collecting 3593 lbs of waste in 2010.

E-Waste FY 2010	Reused	Do-nated	Re-cycled	Sold	Land-filled
Desktop Computers	52	445	0	312	0
Cathode Ray Tube (CRT) Monitors	41	13	476	0	0
Liquid Crystal Displays (LCD)	215	77	46	0	0
Laptop Computers	197	0	0	93	0
Televisions	0	0	57		0

Table 3: *Electronics Disposition, NASA Ames 2010*

Transportation



EO 13514 Goals Transportation

1. Reduce petroleum consumption by 2% per year through FY 2020 (applies to agencies with fleets of more than 20 vehicles) (Baseline FY 2005).
2. Use low greenhouse gas emitting vehicles, including Alternative-Fuel Vehicles (AFV), and optimize the number of vehicles in agency fleets.
3. Participate in regional transportation planning & recognizing existing community transportation infrastructure.
4. Ensure that planning for new Federal facilities or new leases includes consideration of sites that are pedestrian friendly, near existing employment centers, and accessible to public transit, and emphasizes existing central cities and, in rural communities, existing or planned town centers.
5. Develop and implement innovative, Agency-specific policies and practices to reduce GHG emissions (e.g., from commuting) in Agency operations.

Green transportation revolutionizes the way people get around and is critical to mitigating the effects of climate change. Transporting people and goods encompasses ~30% of the total energy used in the United States.

Alternative Commute Programs - Ames has promoted programs such as ride sharing, telecommuting, offering subsidized employee public transportation passes, and Bike-to-Work-Day.

Ames Motor Pool - NASA Headquarters identified Ames with the oldest fleet and therefore, requested vehicles to be replaced by U.S. General Services Administration under the American Recovery and Reinvestment Act of 2009. As a result, the Ames Motor Pool received nine (9) new vehicles (3 hybrids, 1 minivan (E85) and 5 flex fuel trucks (E10).

One of the hybrid vehicles in the Ames Motor Pool.

Solar GEM and Retro-fit Project – GEM batteries were retrofitted from lead to gel and in cooperation with the National Hispanic University a solar charging system for the GEMs was designed.

Free Range Bicycle Program - Ames purchased 100 orange-colored bicycles that can be used by anyone for transportation between onsite buildings.

Environmentally Responsible Aviation - Ames has been working on projects that strive to reduce the impact of aviation on the environment. These projects are aimed at improving aircraft fuel efficiency, developing the next generation of efficient air traffic control, and creating new technologies and systems engineering processes to advance the future of carbon-neutral air transportation.

Future Air-Traffic-Management Concepts Evaluation Tool (FACET) - FACET is an Ames developed flexible software tool that provides powerful simulation capabilities and can rapidly generate thousands of aircraft trajectories to enable efficient planning of air traffic flows. It equips service providers with a way to explore, develop and evaluate advanced air transportation concepts before they are field-tested and eventually deployed.

In addition to modeling the airspace system for NASA research, FACET has also transitioned into a valuable tool for operational use. FAA traffic flow managers and commercial airline dispatchers have used FACET technology for real-time operations planning. FACET integrates live air traffic data from FAA radar systems and weather data from the National Weather Service to summarize NAS performance. This information allows system operators to reroute flights around congested airspace and severe weather to maintain safety and minimize delay.

KleenSpeed - KleenSpeed Technologies, Inc. (NRP tenant), is a designer of electric power systems and components for high-performance cars and other vehicles. In July of 2009, their 'Thruxar' electric race car won the "Refuel - the First Alternative Vehicle Demonstration and Electric Time Trial" overall competition and secured the four wheel vehicle trophy with a lap time of 1:43, or an average speed of 90 mph.

Clockwise from top left: Tim Collins, President, KleenSpeed; Andrew Gillis, driver with trophy, COO KleenSpeed; Morgan Gillis, VP Production, KleenSpeed; Paul Gillis, Gillis Motorsports

EGT Airship Bullet - In 2011, the world's largest and greenest operating airship, Bullet 580, based its West Coast operations at NASA Ames. The 235-foot long, 65-foot diameter lighter-than-air vehicle, which can fly at speeds up to 74 mph, is newly designed and manufactured by E-Green Technologies, Inc., and is considered radically different in design, moving beyond the performance limitations of traditional blimps. It combines advanced technology with simple construction, and the ability to fuel with algae-based bio-fuel, protecting our environment. Missions for the 'Bullet' include communications relay, airspace and maritime surveillance, and weather and environmental monitoring, as well as providing long endurance platforms for geophysical surveys, and monitoring of oil spills and forest fires, among other civilian and military uses.

EGT Airship Bullet™ Class 580 after inflation in Garrett Coliseum, Alabama (2010)

Major accomplishments and awards:

- FACET received the AIAA Aerospace Software Engineering Award in 2009 for its significant breakthrough in simulation capabilities.

Natural Resources

EO 13514 Agency-wide Goal for Advancing Regional and Local Integrated Planning by:

1. Coordinating with regional programs for Federal, State, tribal, and local ecosystem, watershed, and environmental management.

In addition to efforts highlighted in previous sections, Ames is responsible for stewardship of natural resources.

Wildlife Habitat Protection - The saltwater marshes, wetlands, and grasslands at Ames are home to several protected species, including the Western burrowing owl, gray fox, salt marsh harvest mouse, salt marsh common yellowthroat, clapper rail, snowy plover, loggerhead shrike, white-tailed kit, Northern harrier, golden eagle, horned lark, American peregrine falcon, and the Western pond turtle. Mitigation measures have been taken to reduce human impact and protect these species. For example, currently 81 acres are protected burrowing owl habitat. The number of owls varies from year to year, but generally 15 to 25 pairs are present during the breeding season. The number of salt marsh harvest mice at Ames is unclear since the U.S. Fish and Wildlife Services grants few permits to survey these animals due to the concern their delicate habitat would be damaged by surveying. Instead, pickleweed sites are cordoned off during activities that could impact the species. A survey of Western pond turtles has been completed.

Western Burrowing Owl (Left) and Gray Fox (right) living at Moffett Field.

Ames is a member of Partners-in-Flight, an international partnership sponsored by the Federal government to conserve migratory birds in the Western Hemisphere under several treaties. Ames is responsible for one of the few remaining populations of burrowing owls in the San Francisco Bay area and is implementing a management plan consistent with the Migratory Bird Treaty Act and in support of Partners-in-Flight goals.

Native Plants - Ames participates in the federally led Plant Conservation Alliance. In furtherance of Federal goals to restore native plants and mitigate invasive species, Ames has converted several areas to California drought resistant native plants.

Native Garden at Bush Circle

Major accomplishments and awards:

- Opening of the Moffett Gap portion of the San Francisco Bay Trail - September 2010.

Urban Wildlife - Ames also hosts common species such as skunks, gophers, tree squirrels, pigeons, and rats. Ames implements an Integrated Pest Management Program in collaboration with the U.S. Fish and Wildlife Service, California Department of Fish and Game, and local entities. Ames is working to eliminate food sources such as from open dumpsters, artificial feeding, and landfills to avoid these species becoming wildlife pests.

The Environmental Management Division developed wildlife awareness training, and presented it to Center personnel including emergency responders. The training included emergency response procedures for wildlife, such as how to handle a distressed animals.

Ames Fire Department collaborated with the Marine Mammal Center to rescue a disoriented sea lion.

South San Francisco Bay Salt Pond Restoration Project - In 2010, Ames acquired the Northern Channel (or Moffett Channal) from Cargill for storm water management and spill control. Ames granted an easement to the U.S. Fish and Wildlife Service to manage the Moffett Gap portion of the 500-mile Bay Trail. In September 2010, the Moffett Gap was opened to the public, thereby contributing to the public access goals of the interagency Salt Pond Restoration Project.

Moffett Gap portion of the Bay Trail opening ceremony

The Navy, in coordination with NASA, has cleaned up contamination in the Northern Channel and restored vegetation. NASA and the Navy have worked together to conserve the Western pond turtle.

Goats - Ames utilizes a goat herd to maintain vegetation in areas of the center which are hard to reach using conventional movers. This is a low cost solution to maintaining and enhancing the burrowing owl habitat, as the goat dung attracts insects on which they prey.

Goats grazing on the East Side Fields

Land Use

EO 13514 Agency-wide Goals for Advancing Regional and Local Integrated Planning by:

1. Participating in regional transportation planning and recognizing existing community transportation infrastructure.
2. Aligning Federal policies to increase the effectiveness of local planning for energy choices.
3. Ensuring that planning for new Federal facilities or new leases includes consideration of sites that are pedestrian friendly, near existing employment centers, and accessible to public transit.
4. Identifying and analyzing impacts from energy usage and alternative energy sources in all Environmental Impact Statements and Environmental Assessments for proposals for new or expanded Federal facilities under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.).

At approximately 1,800 acres, Ames land use development areas include Bay View, Ames Campus, NASA Research Park, Eastside Airfield and Wetlands.

View looking North of NASA Ames

NASA Ames Research Center twenty-year Master Plan (ARC MP FY 2010-2032) provides a framework for real property development and identifies land use and facility requirements in support of Ames and the Agency mission, vision, and the guiding principles. The ARC master plan (MP) is a comprehensive, all-inclusive process that includes the baselines existing conditions, future mission and real property development requirements, sustainability, and collaborative partnership projects. Existing green features contribute considerably to meeting the environmental performance standards for facilities. Ames brownfield development, access to public transportation, protecting natural habitats, and maximizing open space are among many features that provide an opportunity for reducing environmental impact and approaching green building design in a broader context.

The Ames twenty-year Capital Investment Program Plan maps out future sustainment, renewal, and transition facilities and infrastructure projects. The life cycle cost analysis demonstrates the validity of replacing existing facilities beyond their life cycle with efficient, effective, and sustainable new facilities. Ames Sustainability Base, the first new building of this scope in decades, is the result and the cornerstone of the approved ARC FY 2005-2025 master plan.

FINAL
ENVIRONMENTAL ASSESSMENT

PROPOSED LONG-TERM LEASE AND INSTALLATION DEVELOPMENT PLAN FOR THE 129TH RESCUE WING

CALIFORNIA AIR NATIONAL GUARD MOFFETT FIELD, CALIFORNIA

DECEMBER 2009

NATIONAL GUARD BUREAU

CA ANG Master Plan Final Environmental Assessment 2009

The ARC FY 2010-2032 MP is structured to be a solid foundation for the future real property development decision-making process. However, as a living document, the ARC MP is flexible to accommodate changes and transformation in all areas including mission and climate.

Planning Areas from the 2002 NASA Ames Development Plan

NASA Ames is continuing to implement redevelopment of the formal Naval Air Station Moffett Field as the NASA Research Park under the 2002 NASA Ames Development Plan Environmental Impact Statement and Record of Decision. The ARC 2010-2032 MP also implements the Record of Decision.

Major accomplishments and awards

- Finalized permit for the California Air National Guard, 129th Rescue Wing, to implement its master plan.
- 2008 California Preservation Foundation, Preservation Design Award, for the report on "Evaluation of Historic Resources Associated with the Space Shuttle Program at Ames Research Center."
- ARC FY 2010-2032 Master Plan was approved.

Facilities

EO 13514 Agency-wide Goals to implement high performance sustainable Federal building design, construction, operation & management, maintenance, and deconstruction by:

1. Beginning in 2020, ensure that all new buildings that enter the planning process are designed to achieve zero-net-energy by 2030.
2. Ensure that all new construction, major renovation, or repair and alteration of Federal buildings complies with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings.
3. Ensure that at least 15% of the agency's existing buildings and building leases (> 5,000 gross sq ft) meet the Guiding Principles by fiscal year 2015 and that the Agency makes annual progress toward 100% conformance with the Guiding Principles for its building inventory.
4. Pursue cost-effective, innovative strategies to minimize consumption of energy, water, and materials.
5. Manage existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing assets' deferred maintenance costs.
6. Ensure that rehabilitation of federally owned historic buildings are retrofitted to promote long-term viability.

The investment made in a building throughout its life cycle is significant when considering the capital and architectural costs, and operating costs such as maintenance, replacement, energy, water, and disposal. Green buildings as well as green building materials for building renovations offer cost savings from a life cycle cost perspective.

Currently Ames has 127 buildings, with total interior space of more than 3 million square feet. As Ames and its partners and resident agencies renovate or implement "renovation by replacement," opportunities to incorporate green building design elements will save the Center operating costs. The Engineering and Real Property Management and the Environmental Management Divisions have focused on selecting green building materials and equipment for building renovations. Some of the green building projects include 'cool roof' buildings, that use white reflective coating to keep the building temperatures cool. Others feature installing solar panels and have carpets made from recycled bottles.

About 70% of facilities in the NASA Research Park and Eastside/Airfield are beyond their expected life cycle. In the Ames Campus, this proportion is 44%. NASA requires all new buildings and renovations to meet the Leadership in Energy and Environmental Design (LEED) Silver standard. In the near future Ames is planning several green building construction projects.

Sustainable Community for Education and Research - Ames is partnering with a consortium of local colleges and universities to establish a sustainable community for education and research at the NASA Research Park. The consortium signed a land lease with Ames in December 2008 for 75 acres of land in the NASA Research Park. Work on the site could begin as early as 2013, with initial occupancy as early as 2015.

Major accomplishments and awards:

- Began construction on "Green Building."
- Received Ames Sustainability Award for using SMART monitoring systems in the green building to optimize heating and ventilation without compromising user comfort.
- U.S. General Services Administration Real Property Award in the Green Innovation category for the Green Buildings' net-zero energy consumption.

Aerial view of NASA Ames Research Center Campus, out towards San Francisco Bay. Sustainability Base is located among the trees to the lower right of the image.

Google Green Facility - Ames has leased land to its neighbor Google to construct Google's 1 million square foot new green facility consistent with NASA sustainable design policies.

Nationally Significant Facilities - In coordination with NASA Headquarters, Ames has stewardship responsibilities for sustaining nationally significant facilities. These facilities carry out research and development work contributing to general sustainability efforts. Ames is working to "green" these facilities since they have substantial energy, water, and other resource requirements.

NASA Policy Directive 8820.2, Design and Construction of Facilities, commits NASA to the following:

"Industry-best practices of sustainable design, maintainable design, building commissioning, and safety and security shall be incorporated, to the maximum extent possible, into the planning and execution of facility projects. The use of these practices ensures that facility projects are delivered with the most economical life-cycle cost, least environmental impact, and maximum benefits in occupant's health, safety, security and productivity."

Facilities (cont.)

Ames Sustainability Base, 'Green Building'

In 2007, NASA held a "Renovation by Replacement" competition, designed to replace antiquated and inefficient buildings with new, energy-efficient buildings. Each of the agency's ten centers submitted proposals to build a new facility, and Ames Research Center was awarded funding.

Ames Sustainability base viewed from Bush Circle

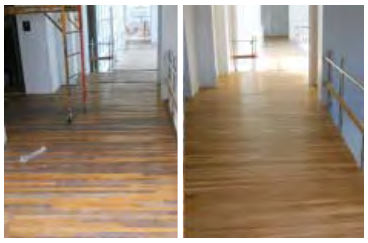
Although most people associate NASA with space, NASA is also committed to advancing technology and innovations that will help solve the critical challenges that are facing Earth. As NASA Ames Center Director Pete Worden says, "This tiny planet we share is our only home."

Sustainability Base is one of the greenest Federal buildings ever constructed. It is designed to go beyond 'not hurting' the environment to actually being beneficial to nature and humans. Through a combination of innovative design and leading-edge technology, Sustainability Base generates all the power it needs to operate. Photovoltaics (solar Panels), a highly efficient fuel cell and a small wind turbine habe been, or are being installed. The building will use 90 percent less potable (drinking) water than a traditional building of comparable size.

Solar panels on the new 'green building.'

Sustainability Base with native garden landscaping

The building and landscaping are designed 'native to place,' which means they capitalize on the natural resources of its location and blend seamlessly with their contextual environment and culture. The building's orientation takes advantage of both the sun's arc across Moffett Field and the prevailing Bay Area winds. This means that for all but approximately 40 days of the year, no artificial lighting is necessary. The landscape surrounding Sustainability Base includes plants, flowers and trees that are native to the area and draught-tolerant.



Before and after shots of the refinished reclaimed oak planks

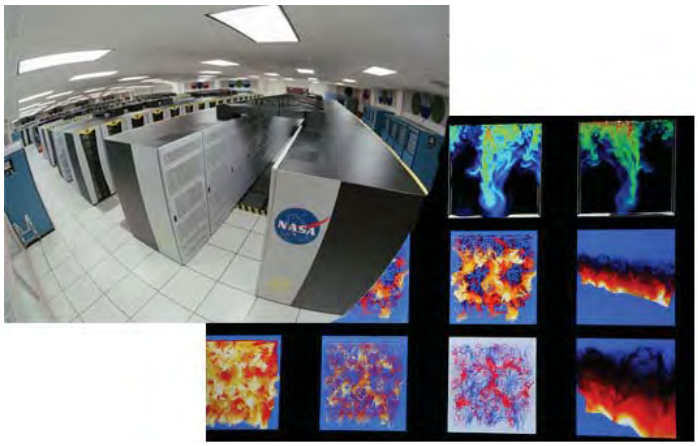
The materials used to build and furnish Sustainability Base were locally procured and include recycled elements. For example, the oak planks that line the second floor lobby were reclaimed from an old NASA wind tunnel.

Sustainability Base uses a sophisticated technology to go beyond being a 'smart building' and move in to the realm of the intuitive. The building can anticipate and react to changes in sunlight, temperature and usage, and over time, it will be able to optimize its performance automatically in response to internal and external change.

NASA Advanced Supercomputing Facility

The NASA Advanced Supercomputing Facility (NAS) was dedicated in March 1987. It was established to act as a pathfinder in advanced, large-scale computing system capabilities through the use of the latest hardware and software technology and to house NASA Ames' supercomputers. In 2004, the NAS Division co-developed, with industry partners SGI and Intel, what was initially the fastest supercomputer in the world. Named Columbia, the supercomputer is a 10,240-processor SGI Altix supercluster. Columbia remains NASA's fastest supercomputer, and it is used by scientists and engineers at almost every NASA center.

Columbia was intentionally designed using sustainability principles by creating platforms that allow continuous upgrading of systems. The new uninterruptible power supply system will use quiet and clean technology. In 2008, the NAS team cut the need for one 450-ton chiller, decreasing the need for 11 megawatts of power. It also increased the computing power eight-fold making it the third fastest computer in the world. Visit the NAS website at http://www.nas.nasa.gov/



Left: The Columbia supercomputer.
Right: Hyperwall displaying Columbia computational data.

Facilities (cont.)

Arc Jet Laboratory

The Ames Arc Jet Laboratory began in the 1950's, and a permanent facility was established in 1961. The Arc Jet is key for research in the three major areas of Thermal Protection System (TPS) development: selection, validation, and qualification. The Arc Jet data are critical for validating TPS thermal models, heat shield designs and repairs, and ultimately, for flight qualification.

An arc jet is a device in which gases are heated and expanded to very high temperatures by a continuous electrical arc between two sets of electrodes at supersonic/hypersonic speeds. The gases pass through a nozzle aimed at a test sample in vacuum, and flow over it, producing a reasonable approximation of the surface temperature, pressure, and the gas enthalpy found in a high velocity, supersonic flow of the kind experienced by a vehicle on atmospheric entry. A breakthrough patented design in 1964 by Stein, Sheppard and Watson of Ames produced a high-enthalpy constricted-arc heater, which enabled TPS studies required for development of the Mercury and Apollo missions. Currently, Ames is examining opportunities to improve the environmental impact of the Arc Jet by utilizing excess steam to power other needs at NASA Ames, reducing potable water use by recycling water, and reducing air emissions by upgrading its boiler system.

Teflon calibration test in the NASA Ames' Arc Jet Interaction Heating Facility.

Find out more about the Arc Jet at http://www.nasa.gov/centers/ames/research/technology-onepagers/arcjetcomplex.html

Wind Tunnels

The original Ames 40- by 80-Foot Wind Tunnel was constructed in 1944 as an experimental facility for researching and testing aircraft, later tests included first-generation jet engines, advanced rotor techniques, and peripheral space use testing. It has the largest wind tunnel test sections in the world, consisting of the 40- by 80-Foot test section and the 80- by 120-Foot test section.

The Unitary Plan Wind Tunnel is the most heavily used NASA wind tunnel, and was designed from the start using sustainability principles by centralizing and scheduling its power supply. Every major commercial transport and almost every fighter aircraft built in the United States during the last 50 years has been tested in this tunnel. In addition, models of the Space Shuttle and of the Mercury, Gemini, and Apollo capsules were tested here. More than 1,000 test programs have been conducted, totaling more than 60,000 hours of operation.

Visit the wind tunnel website at http://www.windtunnels.arc.nasa.gov/

Left: *National Full-Scale Aerodynamics Complex.*
Right: *Unitary Plan Wind Tunnel.*

Airfield

Moffett Federal Airfield (MFA), part of the former Naval Air Station (NAS) Moffett Field, is currently operated by NASA Ames. NASA has continued the tenant program begun by the Navy, hosting several other organizations at MFA including the Naval Reserve, the California Air National Guard, and most recently, Airship Ventures which operates a commercial Zeppelin NT airship.

NAS became a major center for the development and testing of new aviation and flight-related technology in the 1940s. After the attack on Pearl Harbor, the military decided it needed aircraft to patrol the Pacific for submarines and mines. The Navy responded by restarting the blimp project. As many as 20 blimps at a time were on duty at the base during the war years, and Moffett Field had an excellent record of ship and mine detection. During the 1950s and 1960s, NAS served as a major naval air transport base. In the 1970s, NAS returned to its original mission of long-range reconnaissance and anti-submarine patrols with the arrival of the Navy's newest anti-submarine aircraft: the P-3 "Orion." By 1973, aircraft based at Moffett Field were responsible for patrolling approximately 93 million square miles of the Pacific Ocean, an area stretching from the coast of Alaska to Hawaii. On July 1, 1994, the military base was closed and Ames assumed control of the airfield.

MFA has two fully instrumented parallel runways, four aircraft maintenance hangars, and 472,300 square yards of aircraft parking apron. Hangar 1, located on the west side of the airfield, was constructed in the 1930's and has had various uses. The Navy is currently removing the PCB contaminated siding and paint, and NASA is evaluating alternatives for preserving the structure for reuse.

Moffett Federal Airfield with Hangar 1 on the left.

Contamination Cleanup & Remediation

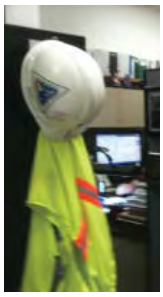
The purpose of NASA's Environmental Compliance & Restoration (ECR) Program is to clean up chemicals released to the environment from past activities. Cleanups are prioritized to ensure that the highest priority liabilities are addressed first in order to protect human health & the environment and preserve natural resources for future missions.

NASA Ames includes both the original Ames campus and a portion of the former Naval Air Station Moffett Field. NASA is cleaning up contamination from past NASA activities and it is subject to site specific enforcement orders.

Naval Air Station Moffett Field Cleanup Site - The former Naval Air Station Moffett Field has been designated a Superfund site by the U.S. Environmental Protection Agency (EPA). The U.S. Navy has identified multiple sources of contamination at Moffett Field, and the Navy is responsible for the cleanup under a Federal Facilities Agreement with the U.S. EPA, and the State of California. A variety of contaminates are present, including solvents, polychlorinated biphenyls, oils, greases and fuels.

MEW Study Area - A large area of shallow groundwater contamination has migrated onto Ames from three superfund sites bounded by Middlefield, Ellis and Whisman Streets (MEW). These sources of contamination are associated with the prior use of solvents by semiconductor companies no longer located in the area. The contamination from these sources has combined with the Navy and NASA sources. This contamination is under the jurisdiction of the U.S. EPA and the California EPA's Water Quality Control Board. Cleanup by the MEW companies is subject to a consent order from the U.S. EPA. The status of cleanup ranges from investigation phase to treatment to clean closure.

NASA Cleanup Activities - NASA sources of contamination are also present on the Ames campus, and 13 areas of investigation have been established. The sites that overlie the MEW groundwater contamination are under the jurisdiction of the U.S. EPA, and those that do not overlie the groundwater contamination are under the jurisdiction of the CA EPA's Department of Toxic Substances Control. The status of cleanup ranges from ongoing investigation to clean closure.



Left: *Remediation Program Manager prepares many reports to regulatory agencies.*
Right: *Through interagency cooperation, the Hangar 1 time capsule has been preserved.*

These contaminated sites introduce a variety of issues that increase the complexity of Center development under the NADP. In 2001, NASA prepared an Environmental Issues Management Plan, and compiled a Record of Decision in 2002, to address these matters, including protection of construction workers, the remediation systems in contaminated areas, and the disposal of contaminated soils and groundwater encountered during construction. All partners are required to comply with the associated Environmental Issues Management Plan.

Additionally, Ames uses a variety of hazardous materials and generates hazardous waste in its operations and research. Typical hazardous materials include toxic gasses, acids, fuels and solvents. NASA Ames has a comprehensive Environmental Management System designed to ensure these materials are handled in compliance with Federal, State and local laws.

Overall, current environmental management programs at Ames Research Center ensure that past contamination is remedied. Ongoing operations prevent or minimize pollution, and reduce emissions to the environment by complying with all environmental regulations.

Major accomplishments:

- The parties have begun vapor intrusion sampling of occupied buildings located over the area groundwater contamination for the purpose of implementing U.S. EPA approved remedies.
- The Navy has initiated the removal of PCB-contaminated siding from Hangar 1.

Regional (MEW) Groundwater Contamination

TCE concentration in the groundwater aquifer due to contamination from Regional (MEW) sources.

Contamination Cleanup & Remediation (cont.)

Hangar 1

Moffett Field's Hangar 1 is a recognizable landmark in the San Francisco Bay area and a part of its early aviation history. The Navy built Hangar 1 at Moffett Field in 1932 for the USS Macon and to serve as the West Coast base for the U.S. lighter-than-air aviation program.

The Navy transferred the Hangar to NASA in 1994 after Moffett Field was decommissioned. Hangar 1 is one of the country's largest unsupported structures; in fact, the floor covers eight acres and can accommodate 10 football fields. Plans to utilize Hangar 1 were put on hold in 1997 with the discovery that the structure is releasing toxic chemicals into the sediment in wetlands bordering San Francisco Bay. The chemicals originate in the lead paint and toxic materials, including polychlorinated biphenyls (PCB), used to coat the hangar. As a result, the Hangar was closed for human use as required by the Toxic Substance Control Act.

Macon Airship in Hangar 1.

NASA remains committed to fulfilling its Federal stewardship responsibilities by pursuing various reuse options. To allow for this reuse, remediation is necessary to clean the toxic waste from the site and refurbish the hangar. The U.S. Navy, in coordination with NASA, is currently implementing a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) removal action that includes:

- Demolition or deconstruction and off-site disposal and/or recycling of all interior structures;
- Removal of the Hangar siding and roofing;
- Removal of debris to appropriate off-site disposal or recycling facilities;
- Application of a weather-resistant epoxy coating to the Hangar's steel structural frame;
- Implementation of historic mitigation measures (including the salvage of certain historical components);

The Navy's remediation project will preserve the Hangar's steel frame for potential restoration of the hangar, while protecting human health and the environment. Additionally, the Navy is photo-documenting the removal action, and the Navy and NASA have collaborated in producing a Historic American Buildings Survey and Historic American Engineering Record (HABS/HAER) for the Library of Congress. Selected artifacts have also been salvaged and, where possible, decontaminated. These artifacts were transferred to the Moffett Field Historical Museum, and a Coast Guard bell was returned to the U.S. Coast Guard. The remainder have been placed in storage.

The shell of Hangar 1 being removed, May 2011. For more information visit http://www.nasa.gov/centers/ames/home/2008/hangar_index.html

The U.S. Coast Guard bell being prepped for return.

Bioremeadiation Studies

Ames scientists have been conducting research to identify candidate microorganisms and substrates to degrade waste products. Using genes isolated from naturally occurring forest soil fungi, they are creating bio-engineered "packages" that will clean up human by-products such as petroleum-based solvents and fuels from past activities at Ames. Traditional pump and treat systems remove some contamination but over time become less efficient relative to their operational cost. Bioremediation offers a lower cost solution for removing contamination.

NASA Ames Air Sparge System

The Ames Air Sparge System is located on the west side of the N221 wind tunnel complex. The Air Sparge removes a portion of the groundwater contamination migrating from contamination sites located upgradient before it advances onto NASA. The Center is working with the U.S. EPA and Regional Water Quality Control Board (RWQCB) to identify potentially responsible parties.

Exterior (Left) and interior (Right) views of the air Sparge System

Vapor Intrusion

NASA Ames is coordinating with the US EPA, RWQCB, the Navyand MEW companies to allocate responsibility for implementing vapor intrusion sampling and remedies according to the U.S. EPA timetable.

Old Debris Piles

The Center identified and then removed concrete and other construction and demolition debris piles for recycling and reuse off site, reducing emissions that would otherwise have been generated in using raw materials. The clean-up restored the land for reuse.

One of the debris piles removed and sent for recycling.

Ames 2011 Sustainability Award Winners

Ames Celebrates the Award Winners!

The NACA Park Eco-lawn project: Recipients: Steve Frankel, Chief, Facilities Engineering Branch (right) and Keith Venter, Facilities Historic Preservation Officer. Not shown (but participated in the effort): David Yee, Tim Gafney, and Pat Jaquemet.

The award recognizes the design and implementation of the lawn features which reduces water consumption while supporting events within a wind tunnel historic district.

The N232 Sustainability Base: Recipients: James Williams, CIO, & Grace DeLeon, Deputy CIO. Not shown: Gerry Walatka, Darrell Kirk, Tim Demanty, Joshua Beining, Adam Henson, and Michael Hom.

The recipients lead a large team, over several years, whose behind the scenes efforts enabled the complex systems supporting many of the innovative sustainability features in the new Sustainability Base.

GreenGov Presidential Award

NASA won a GreenGov Presidential Award from the White House Council on Environmental Quality. This award celebrates exceptional efforts to promote sustainability in federal agency operations by honoring federal civilian and military personnel, agency teams, agency projects and facilities, and agency programs that exemplify President Obama's charge to lead by example towards a clean energy economy.

NASA is being recognized in the "Lean, Clean and Green" category for consistently moving toward sustainable and efficient operations by setting exemplary goals in agency-wide energy and water efficiency, reduced emissions, and greater renewable energy usage. Several of NASA's sustainability solutions address the communities where agency facilities are located.

Ames was recognized for the new "Sustainability Base" which used unique NASA technologies to build a 50,000- square-foot mixed-use facility intended as a sustainability technology demonstration, test-bed and dissemination tool.

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