

# **Operations & Maintenance Cost Study for NASA Facilities**

## **Final Report for Administration Buildings**

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## **Operations & Maintenance Cost Study for NASA Facilities: Final Report for Administration Buildings**

### **Overview**

National Aeronautics and Space Administration (NASA) requires a credible method for estimating the operations and maintenance (O&M) requirements of its facilities.<sup>1</sup> The failure to anticipate future costs can lead to under-funding and diminished service life.

NASA has over 450 buildings totaling 12.6 million GSFT distributed at 24 sites in the selected inventory for this project. It is not cost effective to inspect all facilities, yet NASA needs detailed sustainment and operations estimates to support its budget planning. This project developed cost models for a sample of NASA assets with inventory details collected through site surveys. Estimates were extrapolated by facility type and size and adjusted for location to generate requirements for the selected NASA inventory.

The project employed the MARS Facility Cost Forecast System to provide cost information. Now in its eighth version, MARS is a facility cost modeling tool developed by CBRE | Whitestone and used by many federal and commercial agencies.

Phases 1 and 2 of this project called for inspections of four facility types: Administration Buildings, Propulsion Buildings, Communications Buildings, and Space Science (R&D and Test) Buildings. Eight sample buildings were chosen at two sites: the Goddard Space Flight Center (GSFC) and the Marshall Space Flight Center (MSFC).

Site inspections were conducted by Jacobs Facilities, a long-time CBRE | Whitestone partner experienced in inspecting federal facilities and creating MARS component inventories. A team of three, consisting of an architect, and electrical and mechanical engineers, carried out the facility inspections.

The project scope called for individual reports on two facility types, Administration and Propulsion Buildings. This report describes the project methodology and presents final estimates for the Administration Buildings in the NASA inventory.

### **Project Methodology**

#### **Parametric Estimates for Buildings**

The project methodology entailed estimating O&M requirements for the selected NASA inventory based on the inspection and modeling of a sample of facilities. The project included four key steps:

1. Validate the existing NASA inventory and develop a sample
2. Perform on-site inspections of the sample buildings
3. Develop and calibrate MARS models

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<sup>1</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mowing, and snow removal), security, telecommunications, and management. Maintenance (also known as sustainment) includes preventative maintenance, minor repair, unscheduled maintenance, and renewal and replacement.

4. Generate per square foot estimates of sustainment and operations costs for the sample and extrapolate to the project inventory

## Study Sample

NASA has over 450 buildings at 24 sites globally in the selected inventory. Complete inspection of each site to estimate O&M requirements is impractical and costly. This project generated sustainment and operations estimates for a sample of buildings and extrapolated the costs to a selected NASA inventory.

The Statement of Work called for a sample that included one small building (approximately 10,000 square feet) and one large building (approximately 100,000 square feet) from four Classification types. The sample included two buildings from Administration Buildings, Propulsion Buildings, Communications Buildings, and Space Science (R&D and Test) Buildings. The project inventory excluded other Classification types in the NASA inventory, such as Warehouses and Wind Tunnels. CBRE | Whitestone proposed buildings at the Goddard Space Flight Center and the Marshall Space Flight Center to minimize travel costs.

Table 1 shows the building detail for the inspected Administration Buildings.

<b>Table 1. Administration Buildings Inspection Sample</b>						
<b>Site</b>	<b>Classification</b>	<b>Property ID</b>	<b>Property Name</b>	<b>Year Built</b>	<b>Size</b>	<b>CRV</b>
Marshall Space Flight Center	Administration Buildings	1045/62/212	OFFICE BUILDING	1943	11,050	\$3,332,663
	Administration Buildings	1045/62/178	OFFICE BUILDING	1964	110,929	\$20,520,846
<b>Total</b>					<b>121,979</b>	<b>\$23,853,509</b>

There are a number of variables that drive O&M costs. The project sampling plan only controls for size and Classification type. An alternative sample may control for current replacement value (CRV), age, and location.

The inspected sample was mapped to the remaining inventory by size and type. The 11k gross square foot (GSFT) building was mapped to the smaller half of the inventory, while the 111k GSFT building was mapped to the larger half. Square foot estimates were generated by MARS and then extrapolated to the inventory. All costs were indexed for location.

Administration Buildings represent the largest Classification type (67.6 percent) in the selected NASA inventory, totaling 8.5 million GSFT and 198 buildings with a \$2.2 billion CRV. Table 2 shows the Administration Buildings inventory by Site.

<b>Table 2. NASA Administration Buildings by Site</b>			
<b>Site</b>	<b>Count</b>	<b>Size</b>	<b>CRV</b>
AMES Research Center	10	302,101	\$321,088,766
CAPE	3	42,369	\$9,512,716
Dryden Flight Research Center	10	59,741	\$12,756,692
Ellington Field (JSC)	2	18,535	\$2,379,585
Glenn Research Center	2	119,003	\$26,375,803
Goddard Space Flight Center	6	479,804	\$148,913,686
Jet Propulsion Laboratory	33	1,370,645	\$411,155,281
Johnson Space Center	16	947,871	\$192,137,133
JPL/Table Mtn Observatory	1	6,954	\$2,332,116
Kennedy Space Center	28	1,214,905	\$222,579,596
Langley Research Center	13	473,920	\$157,119,882
Marshall Space Flight Center	18	1,312,798	\$254,344,864
Michoud Assembly Facility	3	740,110	\$133,768,613
Moffett Federal Airfield	12	297,292	\$108,443,659
NASA/JSC/White Sands Test Facility	9	85,820	\$10,969,492
Palestine, TX - Form 1018-Ledger 1621/1631	2	13,660	\$1,374,281
Plum Brook Station	1	57,625	\$12,719,276
Stennis Space Center	13	453,553	\$90,051,838
Stennis Space Center (MSAAP)	4	244,292	\$17,164,735
Stennis Space Center (Tenants)	11	237,537	\$37,020,080
Wallops Flight Facility	1	14,613	\$3,551,579
<b>Total</b>	<b>198</b>	<b>8,493,148</b>	<b>\$2,175,759,673</b>

Detailed cost models were developed for the two buildings using CBRE | Whitestone's MARS Facility Cost Forecast System.

### Description of the MARS Model

CBRE | Whitestone used MARS to estimate preventative maintenance, unscheduled maintenance, repair, and renewal/replacement costs for this project. MARS is an asset management system that estimates both deferred maintenance and future requirements on the basis of asset components and their scheduled maintenance and repair. It also estimates costs for ten operations types in the typical commercial chart of accounts. MARS was originally developed in 1996, and is currently in its eighth version. It is used by many government agencies and commercial concerns.

<b>Sustainment</b>	Preventive Maintenance & Minor Repair Unscheduled Maintenance Renewal & Replacement
<b>Operations</b>	Custodial Energy Grounds Management Pest Control Refuse Road Clearance Security Telecom Water/Sewer

Note that the definition of future M&R requirements is the same as the “sustainment” requirements used for programming by DoD and an approach endorsed in a National Research Council (NRC) study of Department of Energy facility practices.<sup>2</sup> Among other agencies, the MARS Facility Cost Forecast System has been used to forecast budgets for the IRS, FAA, USDA, and CDC. It was recently used to benchmark costs for the Department of State Overseas Embassies. MARS is also the basis for the DoD Sustainment Model and a study for NNSA validating total life-cycle facility costs at eight nuclear weapons production and research sites.<sup>3</sup> The model is used continuously to simulate alternative facility costs for the U.S. nuclear complex.

The MARS process begins with a component inventory of a building or structure. Derived from building plans, equipment inventory data, and on-site inspections, these components are organized into UNIFORMAT category level three elements and are identified specifically in terms of product characteristics, quantity, and output level; e.g. “Single-Ply Modified Bituminous/Thermoplastic Roof,” “Condenser, Air-Cooled, 60 Ton,” or “Pipe & Fittings, ¾” Copper.”

Once the component inventory is completed, the MARS system relates maintenance tasks from a pre-defined task library to each selected component. New components and related tasks are defined as necessary. The frequency of each task determines the forecast of future required maintenance. MARS estimates four types of maintenance: preventative maintenance, unscheduled maintenance (service calls), repair, and renewal/replacement tasks. Tasks and their labor and material requirements are pre-defined by CBRE | Whitestone, but are also editable.

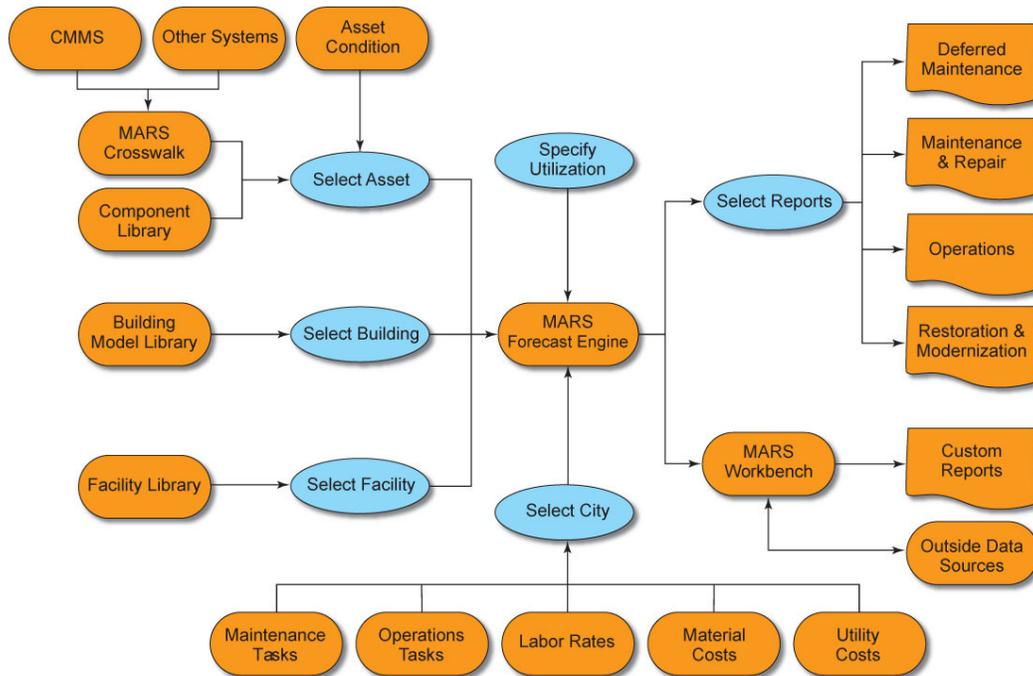
<sup>2</sup> National Research Council, *Intelligent Sustainment and Renewal of Department of Energy Facilities and Infrastructure*, 2004. P. 44.

<sup>3</sup> Jacobs Facilities and Whitestone Research, *Implementation of the Department of Defense Sustainment Model, Final Report*, May 2002.

Other calibration steps include modifying default values for contract and in-house labor rates, specifying site-typical mark-up for contract expenditures, and identifying the utilization characteristics for each asset.

The sources for local wage rates and benefits are primarily the U.S. Department of Labor and Davis-Bacon Act labor agreements, and private sector employers. Both union and non-union wages are considered in determining prevailing rates by locality. State and local wage surveys are also used when available.

### MARS Facility Cost Forecast System



MARS is also used to estimate operations costs other than maintenance and repair. These are based on the Facilities Operation Model developed jointly by the Department of Defense (DOD) and CBRE | Whitestone. This model provides costs for ten services, including those mentioned in the Federal Real Property Council (FRPC) guidance—utilities, cleaning and janitorial, and roads and grounds.<sup>4</sup> Each operation type for an asset can be calibrated for a level of service (low, medium, high) to reflect the level of demand or frequency at which certain operations task are performed.

The CBRE | Whitestone operations cost models provides estimates for the following services:

**Custodial.** The custodial function represents the expense of cleaning offices, work areas, restrooms and common areas. Costs include local wage rates and benefits, task productivity, mark-ups for equipment, materials, supervision, and assumptions concerning the level of service. Trash removal costs are not included. Custodial service levels are defined by altering the combination and frequency of common tasks.

<sup>4</sup> Federal Real Property Council. *Guidance for Real Property Inventory Reporting*. Washington, D.C. August, 2012.

**Energy.** Energy includes all expenses related to the purchase, generation, distribution, and conservation of energy and source fuels necessary to operate an asset. The main energy sources considered are electricity and natural gas. Not included are utilities maintenance and supervision, and utility tax rates. Service levels vary according to estimated commodity demand by asset use type.

**Grounds.** The grounds function includes any expense related to the maintenance of exterior landscaping. It does not include sweeping or the maintenance of signage, parking lots and roadways. Costs are estimated using local wage rates and benefits, task productivity, mark-ups for equipment, materials and supervision, and assumptions concerning the level of service. Service levels are defined by altering the combination and frequency of common tasks.

**Management.** The real property management function describes all costs associated with facility management, including: public works, contracts, material procurement, facility data, furnishings, real estate, and engineering services. Costs are expressed as a fixed percentage of Plant Replacement Value. Service levels are based on the distribution of costs found in institutional and commercial settings. For this project, the level of service for all NASA buildings was set to low to reflect economies of scale in a campus environment.

**Pest Control.** Pest control expenses cover indoor and outdoor pest control programs, separate from the grounds function. Costs are based on the frequency of common tasks for rodent and insect abatement and inspections. Costs include prevailing labor and material rates. Service levels are defined by altering the combination and frequency of common tasks.

**Refuse.** Refuse costs include all expenses related to trash collection and disposal, pick-up services, fees, recycling operations and administration, composting, etc. Costs exclude handling and disposal of HAZMAT materials. Service levels vary according to estimated demand by asset use type.

**Road Clearance.** The road clearance function includes all expenses related to sweeping paved areas including sidewalks, walkways, and parking lots. Costs include prevailing labor and material rates, and climatic variables. Service levels are defined by altering the combination and frequency of common tasks.

**Security.** Security expenses relate to the physical security of assets and occupants, and include personnel, operating and monitoring security equipment. Costs include relevant prevailing labor and material rates. Service levels are defined by altering the combination and frequency of common tasks and services.

**Telecommunications.** Telecommunication expenses cover the purchase of all the services ordinarily associated with commercial activities, such as voice and data equipment and service subscription. The level of telecommunications is defined by the combination of services selected.

**Water and Sewer.** Water and Sewer expenses include all costs related to providing the asset with potable water, irrigation water, and sewage service. Estimates include local commodity costs. Service levels vary according to estimated commodity demand by asset use type.

## Data Collection and Calibration

### MARS Model Development

The technical work for this task involved the definition of the component inventory for the two sample Administration Buildings. Marshall Space Flight Center staff supplied existing equipment inventories and construction design documents before the inspection. Jacobs Facilities inspected the buildings and created draft models in MARS. In total, 314 MARS components were defined for the two facilities.

Jacobs submitted the MARS database to CBRE | Whitestone for a detailed component-by-component review. Three areas of focus included:

- 1) Check for completeness. Review the wall finishes (exterior and interior), roofing, plumbing, HVAC, fire protection, and electrical data to ensure the building model contains the appropriate components in each category.
- 2) Check for consistency. Review the building gross square feet for accuracy. Ensure the square footage of structural components (exterior walls, roofing system, interior finishes) are reasonable compared to building GSFT. Verify the capacity of the following is consistent with the building type and size:
  - Heating, cooling, and air distribution
  - Electrical service, distribution, and lighting
  - Plumbing fixtures and water distribution
  - Fire protection
- 3) Forecast review. Run the following building-level MARS reports and look for extraordinary costs (high or low) illustrating an error in the building model:
  - Average M&R Costs
  - Most Costly M&R Tasks
  - Deferred Maintenance Detail
  - Operation Cost Summary

We also compared the costs with known resources (*The Whitestone Facility Maintenance and Repair* and *Operations Cost References*, comparable CBRE | Whitestone project work with federal agencies, and third party sources).

Attachment A and B provide detailed MARS component lists for the two inspected Administration Buildings at MSFC. CBRE | Whitestone also collected information to calibrate the models for local site values.

## Local Calibration of MARS

While the MARS system has pre-defined building models, labor and material costs, utility rates, and an extensive component library, all of these values can be changed or supplemented to reflect the actual site practices.

Calibration data was gathered to adjust MARS factors at both the site and the building level. Site-level information, such as labor and utility rates, was directly used to estimate O&M costs for the remaining non-inspected buildings at GSFC and MSFC.

Building-level calibration data was applied to the sample models and then extrapolated to the remaining NASA inventory by Classification type and size.

The following data was collected to calibrate the building models:

Maintenance and Repair. The sites provided contract labor rates and labor rate mark-ups. A default assumption in MARS assigns in-house labor to preventative maintenance, minor repair, and unscheduled maintenance, while contract labor performs major repair and replacement tasks. Goddard Space Flight Center and the Marshall Space Flight Center staff indicated all maintenance was performed by contract laborers. CBRE | Whitestone adjusted the MARS database accordingly.

NASA personnel specified laborers must be paid prevailing wages for the area. We used the default MARS wage rates for this study, and included a 30 percent mark-up for contract overhead.

Table 3 shows the source of the maintenance and repair factors for each site.

Table 3. Data Sources by Site, Maintenance & Repair					
Site	In-house Shop Rates	In-house Markup Rates	Contract Labor Rates	Contract Overhead Rates	Utilization
Goddard Space Flight Center	N/A	N/A	WST	WST	Site
Marshall Space Flight Center	N/A	N/A	WST	WST	Site
WST=Whitestone, Site = Respective NASA Site					

MARS estimates also can be adjusted to reflect utilization factors that impact M&R. For example, many NASA facilities have special safety requirements which increase costs relative to conventional commercial practice. Other special requirements include high or low hours of operation and security. The two sites defined utilization factors for the eight buildings.

Table 4 displays the average utilization multipliers by site used to adjust for these requirements.

<b>Table 4. Average Utilization Adjustment by Site<sup>A</sup></b>				
<b>Site</b>	<b>Hours of Operation<sup>B</sup></b>	<b>Security<sup>C</sup></b>	<b>Safety &amp; Permitting<sup>D</sup></b>	<b>Sum<sup>E</sup></b>
Goddard Space Flight Center	1.37	1.05	1.04	1.45
Marshall Space Flight Center	1.07	1.01	1.03	1.11

<sup>A</sup> Calculated from individual asset multipliers assigned by the sites.  
<sup>B</sup> Hours of Operation rates building use on a weekly basis and is defined as follow s: 0.80 = 40 hours, 1.00 = 41 to 80 hours, 1.37 = 80+ hours.  
<sup>C</sup> Security is defined as follow s: 1.00 = free access, 1.01 = contractor training & daily check-in, 1.15 = full contractor accompaniment.  
<sup>D</sup> Safety & Permitting is defined as follow s: 1.00 = typical commercial & service activity, 1.07 = non-specific laboratory, 1.75 = radiological or life science research, 3.00 = nuclear facility.  
<sup>E</sup> In combination the multipliers are additive such that the total multiplier =  $1 + \sum (\beta - 1)$  w here  $\beta$  = the multiplier value.

**Operations.** MARS also estimates operations costs for ten services including: custodial, energy, grounds, management, pest control, refuse, road clearance, security, telecommunications, and water & sewer. We requested utility rates, operations labor rates, and mark-ups. In addition, individual building models are calibrated in terms of level of service (low, medium, high, or none).

Each site defined levels of service for all operation types and provided several utility rates. As with M&R, CBRE | Whitestone used the default MARS wage rates and a 30 percent mark-up for contract overhead.

The utility rates provided by the two sites were significantly lower than the default MARS commercial rates. These discounts are often provided to large federal property holders like NASA. CBRE | Whitestone applied the average discounts for the calibrated sites (GSFC and MSFC) to the remaining sites in the inventory.

Table 5 shows the source of the operations calibration data.

<b>Table 5. Data Sources by Site, Operations</b>											
<b>Site</b>	<b>Level of Service</b>	<b>Custodial Wage</b>	<b>Refuse Rates</b>	<b>Energy Rates</b>	<b>Water/Sewer Rates</b>	<b>Groundskeeper Wage</b>	<b>Pest Control Wage</b>	<b>Road Clearance Wage</b>	<b>Security Rates</b>	<b>Property Management</b>	<b>Telecom Rates</b>
Goddard Space Flight Center	Site	WST	Site	Site	Site	WST	WST	WST	WST	Site	WST
Marshall Space Flight Center	Site	WST	WST	Site	Site	WST	WST	WST	WST	Site	WST

WST=Whitestone, Site = Respective NASA Site

## Cost Estimates for Administration Buildings

### Sustainment Costs

The final sustainment estimate for the smaller MSFC Administration Building (Property ID 1045/62/212) is an average of \$7.45 per GSFT over a 50-year period. The larger building (Property ID 1045/62/178) is \$4.77 per GSFT over the same period.

The sample estimates were extrapolated to the population. Table 6 shows sustainment costs by site for all Administration Buildings. Sustainment estimates are expressed as 30, 40, and 50-year averages. While Whitestone computes annual requirements, average costs are presented to smooth the annual oscillations. Overall, the sustainment requirements are an average of \$46.9 million per year over 50 years, or \$5.52 per GSFT. Expressed another way, this amounts to 2.2 percent of the \$2.2 billion replacement value.

Table 6. Average Annual Estimates of Sustainment Requirements by Site, Administration Buildings											
Site	GSFT	CRV	Sustainment <sup>A</sup>								
			30-Year Estimates			40-Year Estimates			50-Year Estimates		
			Avg. Annual Estimate	Per GSFT	Percent CRV	Avg. Annual Estimate	Per GSFT	Percent CRV	Avg. Annual Estimate	Per GSFT	Percent CRV
AMES Research Center	302,101	\$321,088,766	\$2,368,882	\$7.84	0.7%	\$2,377,371	\$7.87	0.7%	\$2,387,862	\$7.90	0.7%
CAPE	42,369	\$9,512,716	\$260,226	\$6.14	2.7%	\$278,150	\$6.56	2.9%	\$269,610	\$6.36	2.8%
Dryden Flight Research Center	59,741	\$12,756,692	\$495,545	\$8.29	3.9%	\$529,677	\$8.87	4.2%	\$513,414	\$8.59	4.0%
Ellington Field (JSC)	18,535	\$2,379,585	\$128,816	\$6.95	5.4%	\$137,688	\$7.43	5.8%	\$133,461	\$7.20	5.6%
Glenn Research Center	119,003	\$26,375,803	\$746,024	\$6.27	2.8%	\$739,591	\$6.21	2.8%	\$748,090	\$6.29	2.8%
Goddard Space Flight Center	479,804	\$148,913,686	\$2,683,396	\$5.59	1.8%	\$2,557,789	\$5.33	1.7%	\$2,646,811	\$5.52	1.8%
Jet Propulsion Laboratory	1,370,645	\$411,155,281	\$8,946,282	\$6.53	2.2%	\$8,793,967	\$6.42	2.1%	\$8,938,764	\$6.52	2.2%
Johnson Space Center	947,871	\$192,137,133	\$4,718,570	\$4.98	2.5%	\$4,450,789	\$4.70	2.3%	\$4,634,088	\$4.89	2.4%
JPL/Table Mtn Observatory	6,954	\$2,332,116	\$52,441	\$7.54	2.2%	\$56,053	\$8.06	2.4%	\$54,332	\$7.81	2.3%
Kennedy Space Center	1,214,905	\$222,579,596	\$5,450,619	\$4.49	2.4%	\$5,188,160	\$4.27	2.3%	\$5,373,162	\$4.42	2.4%
Langley Research Center	473,920	\$157,119,882	\$2,770,306	\$5.85	1.8%	\$2,842,952	\$6.00	1.8%	\$2,819,443	\$5.95	1.8%
Marshall Space Flight Center	1,312,798	\$254,344,864	\$6,785,948	\$5.17	2.7%	\$6,409,752	\$4.88	2.5%	\$6,668,280	\$5.08	2.6%
Michoud Assembly Facility	740,110	\$133,768,613	\$3,441,791	\$4.65	2.6%	\$3,169,937	\$4.28	2.4%	\$3,347,296	\$4.52	2.5%
Moffett Federal Airfield	297,292	\$108,443,659	\$2,355,733	\$7.92	2.2%	\$2,373,569	\$7.98	2.2%	\$2,378,643	\$8.00	2.2%
NASA/JSC/White Sands Test Facility	85,820	\$10,969,492	\$561,156	\$6.54	5.1%	\$599,807	\$6.99	5.5%	\$581,391	\$6.77	5.3%
Palestine, TX - Form 1018-Ledger 1621/1631	13,660	\$1,374,281	\$91,873	\$6.73	6.7%	\$98,201	\$7.19	7.1%	\$95,186	\$6.97	6.9%
Plum Brook Station	57,625	\$12,719,276	\$449,519	\$7.80	3.5%	\$480,481	\$8.34	3.8%	\$465,728	\$8.08	3.7%
Stennis Space Center	453,553	\$90,051,838	\$2,365,730	\$5.22	2.6%	\$2,343,668	\$5.17	2.6%	\$2,371,566	\$5.23	2.6%
Stennis Space Center (MSAAP)	244,292	\$17,164,735	\$1,094,229	\$4.48	6.4%	\$1,012,860	\$4.15	5.9%	\$1,066,360	\$4.37	6.2%
Stennis Space Center (Tenants)	237,537	\$37,020,080	\$1,277,869	\$5.38	3.5%	\$1,281,324	\$5.39	3.5%	\$1,287,625	\$5.42	3.5%
Wallops Flight Facility	14,613	\$3,551,579	\$96,908	\$6.63	2.7%	\$103,583	\$7.09	2.9%	\$100,403	\$6.87	2.8%
<b>Total<sup>B</sup></b>	<b>8,493,148</b>	<b>\$2,175,759,673</b>	<b>\$47,141,862</b>	<b>\$5.55</b>	<b>2.2%</b>	<b>\$45,825,370</b>	<b>\$5.40</b>	<b>2.1%</b>	<b>\$46,881,512</b>	<b>\$5.52</b>	<b>2.2%</b>

<sup>A</sup> Sustainment is the average annual sum of preventative maintenance, unscheduled maintenance, and major repair and replacement tasks.

<sup>B</sup> All costs expressed in \$2012.

### Operation Costs

Final estimates of ten operation costs are shown in Table 7. In total, the operation requirements for the selected Administration Buildings are an annual average of \$50.5 million, or \$5.94 per GSFT and 2.3 percent of replacement value. Note that in commercial accounting M&R (sustainment) is often included as an operating cost, but is reported separately above.

Table 7. Annual Estimates of Operations Costs by Site, Administration Buildings															
Site	GSFT	CRV	Operations Type <sup>A</sup>										Total Costs	Per GSFT	Percent CRV
			Custodial	Energy	Grounds	Management	Pest Control	Refuse	Road Clearance	Security	Telecom	Water/Sewer			
AMES Research Center	302,101	\$321,088,766	\$291,061	\$281,845	\$52,808	\$802,722	\$45,010	\$10,972	\$0	\$267,516	\$718,562	\$51,793	\$2,522,288	\$8.35	0.8%
CAPE	42,369	\$9,512,716	\$28,550	\$39,743	\$5,250	\$23,782	\$4,293	\$1,337	\$0	\$45,441	\$93,216	\$10,016	\$251,628	\$5.94	2.6%
Dryden Flight Research Center	59,741	\$12,756,692	\$54,048	\$55,836	\$11,027	\$31,892	\$5,770	\$2,016	\$0	\$69,708	\$131,436	\$11,461	\$373,193	\$6.25	2.9%
Ellington Field (JSC)	18,535	\$2,379,585	\$12,727	\$21,019	\$2,255	\$5,949	\$1,750	\$1,758	\$0	\$20,057	\$40,779	\$5,130	\$111,425	\$6.01	4.7%
Glenn Research Center	119,003	\$26,375,803	\$100,098	\$98,972	\$12,658	\$65,940	\$9,376	\$1,056	\$9,531	\$90,825	\$286,245	\$26,519	\$701,219	\$5.89	2.7%
Goddard Space Flight Center	479,804	\$148,913,686	\$507,526	\$477,928	\$60,365	\$372,284	\$65,435	\$15,792	\$7,419	\$350,408	\$1,189,659	\$145,956	\$3,192,773	\$6.65	2.1%
Jet Propulsion Laboratory	1,370,645	\$411,155,281	\$1,248,074	\$1,281,057	\$252,940	\$1,027,888	\$132,425	\$46,262	\$0	\$981,317	\$3,320,897	\$262,959	\$8,553,818	\$6.24	2.1%
Johnson Space Center	947,871	\$192,137,133	\$656,494	\$762,427	\$115,302	\$480,343	\$89,558	\$28,704	\$0	\$498,073	\$2,366,516	\$181,141	\$5,178,559	\$5.46	2.7%
JPL/Table Mtn Observatory	6,954	\$2,332,116	\$4,792	\$10,397	\$945	\$5,830	\$547	\$559	\$0	\$7,926	\$15,299	\$1,381	\$47,677	\$6.86	2.0%
Kennedy Space Center	1,214,905	\$222,579,596	\$825,371	\$1,139,604	\$150,493	\$556,449	\$123,147	\$38,350	\$0	\$666,235	\$3,015,197	\$287,216	\$6,802,061	\$5.60	3.1%
Langley Research Center	473,920	\$157,119,882	\$347,482	\$350,577	\$52,092	\$392,800	\$49,041	\$14,795	\$2,877	\$419,126	\$1,101,393	\$67,607	\$2,797,788	\$5.90	1.8%
Marshall Space Flight Center	1,312,798	\$254,344,864	\$964,701	\$1,373,197	\$164,624	\$635,862	\$87,842	\$43,571	\$2,998	\$798,569	\$3,274,693	\$108,132	\$7,454,190	\$5.68	2.9%
Michoud Assembly Facility	740,110	\$133,768,613	\$596,808	\$804,476	\$97,049	\$334,422	\$71,408	\$68,558	\$0	\$362,712	\$1,874,304	\$162,380	\$4,372,116	\$5.91	3.3%
Moffett Federal Airfield	297,292	\$108,443,659	\$286,352	\$277,358	\$51,967	\$271,109	\$44,293	\$10,797	\$0	\$269,297	\$704,408	\$50,968	\$1,966,551	\$6.61	1.8%
NASA/JSC/White Sands Test Facility	85,820	\$10,969,492	\$62,401	\$66,885	\$8,241	\$27,424	\$8,537	\$1,351	\$614	\$94,222	\$188,812	\$4,328	\$462,815	\$5.39	4.2%
Palestine, TX - Form 1018-Ledger 1621/1631	13,660	\$1,374,281	\$9,191	\$15,470	\$1,451	\$3,436	\$1,211	\$1,313	\$0	\$14,820	\$30,053	\$2,446	\$79,391	\$5.81	5.8%
Plum Brook Station	57,625	\$12,719,276	\$48,182	\$47,926	\$6,131	\$31,798	\$4,538	\$511	\$4,615	\$68,296	\$126,780	\$12,841	\$351,619	\$6.10	2.8%
Stennis Space Center	453,553	\$90,051,838	\$369,136	\$391,375	\$53,632	\$225,130	\$37,371	\$13,217	\$0	\$339,241	\$1,091,635	\$39,467	\$2,560,204	\$5.64	2.8%
Stennis Space Center (MSAAP)	244,292	\$17,164,735	\$199,505	\$210,802	\$28,884	\$42,912	\$20,133	\$7,119	\$0	\$124,188	\$616,912	\$21,258	\$1,271,713	\$5.21	7.4%
Stennis Space Center (Tenants)	237,537	\$37,020,080	\$193,179	\$204,973	\$28,089	\$92,550	\$19,571	\$6,922	\$0	\$190,312	\$565,466	\$20,670	\$1,321,732	\$5.56	3.6%
Wallops Flight Facility	14,613	\$3,551,579	\$10,676	\$15,324	\$1,606	\$8,879	\$1,512	\$1,429	\$89	\$16,462	\$32,150	\$4,427	\$92,553	\$6.33	2.6%
<b>Total<sup>B</sup></b>	<b>8,493,148</b>	<b>\$2,175,759,673</b>	<b>\$6,816,354</b>	<b>\$7,927,191</b>	<b>\$1,157,808</b>	<b>\$5,439,399</b>	<b>\$822,767</b>	<b>\$316,388</b>	<b>\$28,143</b>	<b>\$5,694,751</b>	<b>\$20,784,412</b>	<b>\$1,478,099</b>	<b>\$50,465,313</b>	<b>\$5.94</b>	<b>2.3%</b>

<sup>A</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mowing, and snow removal), security, telecommunications, and management.

<sup>B</sup> All costs expressed in \$2012.

## Total O&M Costs

Estimated total annual Administration Building costs are shown in Table 8. A combination of maintenance and repair (sustainment) and operations, these costs represent an annual average for the next 50 years. Total costs are an estimated \$97.3 million per year, or can also be expressed as \$11.46 per GSFT and 4.5 percent of CRV.

<b>Table 8. Total Annual Costs by Site, Administration Buildings</b>							
<b>Site</b>	<b>GSFT</b>	<b>CRV</b>	<b>O&amp;M Estimates</b>		<b>Total Costs</b>	<b>Per GSFT</b>	<b>Percent CRV</b>
			<b>50-Year Avg. Sustainment<sup>A</sup></b>	<b>Annual Operations<sup>B</sup></b>			
AMES Research Center	302,101	\$321,088,766	\$2,387,862	\$2,522,288	\$4,910,149	\$16.25	1.5%
CAPE	42,369	\$9,512,716	\$269,610	\$251,628	\$521,237	\$12.30	5.5%
Dryden Flight Research Center	59,741	\$12,756,692	\$513,414	\$373,193	\$886,607	\$14.84	7.0%
Ellington Field (JSC)	18,535	\$2,379,585	\$133,461	\$111,425	\$244,885	\$13.21	10.3%
Glenn Research Center	119,003	\$26,375,803	\$748,090	\$701,219	\$1,449,309	\$12.18	5.5%
Goddard Space Flight Center	479,804	\$148,913,686	\$2,646,811	\$3,192,773	\$5,839,584	\$12.17	3.9%
Jet Propulsion Laboratory	1,370,645	\$411,155,281	\$8,938,764	\$8,553,818	\$17,492,582	\$12.76	4.3%
Johnson Space Center	947,871	\$192,137,133	\$4,634,088	\$5,178,559	\$9,812,648	\$10.35	5.1%
JPL/Table Mtn Observatory	6,954	\$2,332,116	\$54,332	\$47,677	\$102,008	\$14.67	4.4%
Kennedy Space Center	1,214,905	\$222,579,596	\$5,373,162	\$6,802,061	\$12,175,224	\$10.02	5.5%
Langley Research Center	473,920	\$157,119,882	\$2,819,443	\$2,797,788	\$5,617,231	\$11.85	3.6%
Marshall Space Flight Center	1,312,798	\$254,344,864	\$6,668,280	\$7,454,190	\$14,122,470	\$10.76	5.6%
Michoud Assembly Facility	740,110	\$133,768,613	\$3,347,296	\$4,372,116	\$7,719,412	\$10.43	5.8%
Moffett Federal Airfield	297,292	\$108,443,659	\$2,378,643	\$1,966,551	\$4,345,193	\$14.62	4.0%
NASA/JSC/White Sands Test Facility	85,820	\$10,969,492	\$581,391	\$462,815	\$1,044,206	\$12.17	9.5%
Palestine, TX - Form 1018-Ledger 1621/1631	13,660	\$1,374,281	\$95,186	\$79,391	\$174,577	\$12.78	12.7%
Plum Brook Station	57,625	\$12,719,276	\$465,728	\$351,619	\$817,348	\$14.18	6.4%
Stennis Space Center	453,553	\$90,051,838	\$2,371,566	\$2,560,204	\$4,931,770	\$10.87	5.5%
Stennis Space Center (MSAAP)	244,292	\$17,164,735	\$1,066,360	\$1,271,713	\$2,338,073	\$9.57	13.6%
Stennis Space Center (Tenants)	237,537	\$37,020,080	\$1,287,625	\$1,321,732	\$2,609,357	\$10.99	7.0%
Wallops Flight Facility	14,613	\$3,551,579	\$100,403	\$92,553	\$192,956	\$13.20	5.4%
<b>Total<sup>C</sup></b>	<b>8,493,148</b>	<b>\$2,175,759,673</b>	<b>\$46,881,512</b>	<b>\$50,465,313</b>	<b>\$97,346,825</b>	<b>\$11.46</b>	<b>4.5%</b>

<sup>A</sup> Sustainment is the average annual sum of preventative maintenance, unscheduled maintenance, and major repair and replacement tasks.  
<sup>B</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mow ing, and snow removal), security, telecommunications, and management.  
<sup>C</sup> All costs expressed in \$2012.

Included in Attachment A and B are detailed MARS reports for the two sample Marshall Space Flight Center Administration Buildings.

**Attachment A: Detailed MARS Reports for MSFC Property ID  
1045/62/212**

# Building Component List

Whitestone Research

**Building:** Office Building

**Year Built:** 1943

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/212

**City:** Huntsville, AL

**Replacement Value:** \$3,332,663 **per SF:** \$302

**Building Gsft:** 11,050

Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
B1010		Concrete Ramp	2011	250 Sq Ft		
B1020		Steel Roof Access Ladder	1995	20 Ln Ft		
B2010		Aluminum Louver, 1st Floor	1995	2 Each		
B2010		Aluminum Louver, 2nd Floor	2011	1 Each		
B2010		Clay Brick, Painted, Exterior, 1st Floor	1943	215 Sq Ft		
B2010		Concrete Block, Painted, Exterior, 1st Floor	1943	7700 Sq Ft		
B2010		Concrete Block, Painted, Exterior, 2nd Floor	1943	700 Sq Ft		
B2020		Aluminum Fixed Window w/ Thermal Break, Double Glaze	2011	7 Each		
B2020		Aluminum Fixed Window w/ Thermal Break, Double Glaze	2011	2 Each		
B2020		Glass Curtain Wall	1989	85 Sq Ft		
B2030		Aluminum Frame, Fully Glazed, Exterior Door	1989	2 Each		
B2030		Steel w/ Safety Glass, Painted, Exterior Door	1943	2 Each		
B2030		Wood, Solid Core, Painted, Exterior Door	1970	2 Each		
B3010		Aluminum Gutter, Downspouts, Fittings	2011	0.61 K Ln Ft		
B3010		Concrete Roof	1943	40 Sq Ft		
B3010		Metal Canopy	2011	80 Sq Ft		
B3010		Metal Roof	2011	12680 Sq Ft		
C1010		Movable Partitions, Office, Fabric, 6'	2011	390 Ln Ft		
C1010		Toilet Partitions, Painted Metal, Overhead Braced	2011	3 Each		
C1020		Steel, Painted, Interior Door	2011	1 Each		
C1020		Wood, Solid Core, Painted, Interior Door	1989	2 Each		
C1020		Wood, Solid Core, Painted, Interior Door	2011	17 Each		
C2010		Concrete, Exterior Stairs	2011	200 Sq Ft		
C2010		Metal, Painted, Exterior Railing	1989	135 Ln Ft		
C2010		Metal, Painted, Interior Railing	2011	32 Ln Ft		
C2010		Metal, Painted, Interior Stairs	2011	42 Sq Ft		
C3010		Ceramic Tile, 4"x4", Interior Wall Finish	1995	1600 Sq Ft		
C3010		Clay Brick, Painted, Interior Wall Finish	1943	360 Sq Ft		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
C3010		Concrete Block, Painted, Interior Wall Finish	1943	3660 Sq Ft		
C3010		Gypsum Board, Interior Wall Finish	2011	9290 Sq Ft		
C3010		Plate Glass Interior Wall	2011	45 Sq Ft		
C3010		Vinyl, Interior Wall Finish	2011	290 Sq Ft		
C3020		Carpet, Nylon 20 oz., Low Traffic	2011	8323 Sq Ft		
C3020		Ceramic Tile Flooring	1943	712 Sq Ft		
C3020		Concrete Flooring	1943	571 Sq Ft		
C3020		Concrete, Painted Flooring	1943	1000 Sq Ft		
C3020		Vinyl Tile Flooring	2011	444 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	2011	8355 Sq Ft		
C3030		Concrete, Painted Ceiling	1943	1190 Sq Ft		
C3030		Gypsum Board, Finished Ceiling	1989	200 Sq Ft		
C3030		Metal, Painted Ceiling	2011	305 Sq Ft		
D2010		Drinking Fountain, Refrigerated	2011	2 Each		
D2010		Lavatory, Vitreous China	2011	6 Each		
D2010		Service Sink, Iron, Enamel	2011	1 Each		
D2010		Sink, Stainless Steel	2011	1 Each		
D2010		Tankless Water Closet	2011	5 Each		
D2010		Urinal, Vitreous China	2011	2 Each		
D2020		Hose Bib	2011	1 Each		
D2020		Pipe & Fittings, 2" Copper, Cold Water	1990	0.1 K Ln Ft		
D2020		Pipe & Fittings, 2" Copper, Hot Water	1990	0.1 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Cold Water	1990	0.175 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Cold Water	2011	0.05 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Hot Water	1990	0.175 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Hot Water	2011	0.05 K Ln Ft		
D2020		Pipe Insulation, Fiberglass, Cold Water	2011	0.2 K Ln Ft		
D2020		Pipe Insulation, Fiberglass, Hot Water	2011	0.2 K Ln Ft		
D2020		Water Heater, Electric, 80 Gal.	2011	1 Each		
D2030		Backflow Preventer, 1"	2011	1 Each		
D2030		Floor Drain	2011	4 Each		
D2030		Pipe & Fittings, 2" PVC	2011	0.05 K Ln Ft		
D2030		Pipe & Fittings, 3" Cast Iron	1943	0.1 K Ln Ft		
D2030		Pipe & Fittings, 3" Cast Iron	2011	0.15 K Ln Ft		
D2030		Pipe & Fittings, 4" Cast Iron	1943	0.1 K Ln Ft		
D2030		Pipe & Fittings, 4" Cast Iron	2011	0.05 K Ln Ft		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D2030		Pipe & Fittings, 4" PVC	2011	0.05 K Ln Ft		
D2030		Pipe & Fittings, 6" Cast Iron	1943	0.05 K Ln Ft		
D3020		Pipe & Fittings, 2" Steel	2011	0.3 K Ln Ft		
D3020		Pipe Insulation, Fiberglass, Heating Water/Steam	2011	0.45 K Ln Ft		
D3020		Steam Trap, F&T, 2"	2011	8 Each		
D3030		Ball Valve, 4"	2011	4 Each		3"
D3030		Circulator Pump, 1/6 HP, Chilled Water	2011	2 Each		
D3030		Flow Control Valve, Motorized, 4"	2011	2 Each		3"
D3030		Pipe & Fittings, 2" Steel	2011	0.3 K Ln Ft		
D3030		Pipe & Fittings, 4" Steel	2011	0.15 K Ln Ft		
D3030		Pipe Insulation, Fiberglass, Chilled Water	2011	0.45 K Ln Ft		
D3040	AHU-1	Air Handler, Single Zone, 15,000 Cfm	2011	1 Each		~12,000cfm
D3040		Duct Insulation, Fiberglass Blanket	1989	1000 Sq Ft		
D3040		Duct Insulation, Fiberglass Blanket	2011	2000 Sq Ft		
D3040		Ductwork	1989	2000 Lbs		
D3040		Ductwork	2011	2500 Lbs		
D3040		Exhaust Fan, Ceiling, 200-500 Cfm	2011	3 Each		
D3040		Exhaust Fan, Centrifugal, 800 Cfm	2011	3 Each		
D3040		Variable Air Volume Box, 1,300 Cfm	2011	4 Each		
D3040		Variable Air Volume Box, 2,500 Cfm	2011	2 Each		
D3040		Variable Air Volume Box, 400 Cfm	2011	1 Each		
D3040		Variable Air Volume Box, 800 Cfm	2011	2 Each		
D3050		Fan Coil Unit, 2 Ton	2011	1 Each		
D3050		Fan Coil Unit, 5 Ton	1989	1 Each		
D3050		Unit Heater, 480v, 5kW	2011	2 Each		
D3060		Direct Digital Controls, System Points	2011	112 Each		
D3060		Thermostat	2011	25 Each		
D4010		Fire Alarm Control Panel	2011	1 Each		
D4010		Fire Department Connection, Siamese, 3"	2011	1 Each		
D4010		Fire Sprinkler Head	2011	60 Each		
D4010		Fire Sprinkler System	2011	1 Each		
D4010		Pipe & Fittings, 2" Steel	1989	0.5 K Ln Ft		
D4010		Pipe & Fittings, 3" Steel	1989	0.15 K Ln Ft		
D5010		Disconnect Switch, 30 Amp.	2011	1 Each		
D5010		Motor Starter, <5HP, <600V	2011	1 Each		
D5010		Power Panel Board, 208 Y/120 V, 100 Amp.	2011	1 Each		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D5010		Power Panel Board, 208 Y/120 V, 200 Amp.	2011	4 Each		
D5010		Power Panel Board, 208 Y/120 V, 225 Amp	2011	1 Each		
D5010		Power Panel Board, 208 Y/120 V, 400 Amp.	2011	1 Each		
D5010		Power Panel Board, 480 V, 100 Amp.	2011	1 Each		
D5010		Power Panel Board, 480 V, 200 Amp.	2011	1 Each		
D5010		Power Panel Board, 480 V, 400 Amp.	2011	1 Each		600 A
D5010		Secondary Transformer, Dry, 30 kVA	2011	1 Each		
D5010		Secondary Transformer, Dry, 45 kVA	2011	1 Each		
D5010		Variable Frequency Drive, <600 V	2011	3 Each		
D5020		Compact Fluorescent Lighting Fixture, 32 w	2011	6 Each		
D5020		Emergency Lighting Pack, 2 Light w/ Battery	2011	2 Each		
D5020		Fluorescent Lighting Fixture, T8, 2-32w	2011	36 Each		
D5020		Fluorescent Lighting Fixture, T8, 4-32 w	2011	205 Each		
D5020		Grounded Fault Circuit Interruptor, 15 Amp.	2011	2 Each		
D5020		High Pressure Sodium Lighting Fixture, 250 w	2002	12 Each		
D5020		Lighting Control Panel	2011	1 Each		
D5020		Occupancy Sensors, Indoor Lighting	2011	29 Each		
D5020		Receptacle, 120 V, 20 Amp.	2011	180 Each		
D5020		Wiring Device, Switch	2011	45 Each		
D5030		Camera, Exterior, Closed Circuit, PTZ Color	2011	5 Each		
D5030		Camera, Interior, Closed Circuit, PTZ Color	2011	9 Each		
D5030		Card Reader	2011	5 Each		
D5030		Electric Lock	2011	9 Each		
D5030		Fire Alarm Horn & Strobe	2011	13 Each		
D5030		Handicap Door Access Interface	2011	3 Each		
D5030		Headend Panel, Closed Circuit	2011	1 Each		
D5030		Heat Detector	2011	8 Each		
D5030		Intrusion Detection Motion Detector, Interior	2011	5 Each		
D5030		Keypad	2011	4 Each		
D5030		Manual Pull Station	2011	5 Each		
D5030		Monitor, Medium, Closed Circuit	2011	3 Each		
D5030		Public Address Speaker	2011	2 Each		
D5030		Security System Panel	2011	1 Each		
D5030		Smoke Detector	2011	27 Each		
D5030		Smoke Detector, Duct	2011	1 Each		
D5090		Grounding System	2011	0.625 K Ln Ft		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D5090		Meter, Electrical, 208 Volt, 600 Amp.	2011	1 Each		
E1010		Icemaker, Commercial	2011	1 Each		
E1010		Kitchen Exhaust Hood, Commercial	2011	1 Each		

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## Average M&R Costs

Whitestone Research

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<b>Building:</b>	Office Building	<b>GSFT:</b>	11,050
<b>Building Number:</b>	1045/62/212	<b>PRV:</b>	\$3,332,663
<b>Facility:</b>	Marshall Space Flight Center	<b>Built Date:</b>	1943
<b>City:</b>	Huntsville, AL		

### M&R Average Annual Cost Forecasts

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	Current Year	5 Year	20 Year	50 Year
<b>PM &amp; Minor Repair:</b>	\$17,458	\$17,508	\$16,791	\$16,567
<b>Unscheduled Maintenance:</b>	\$12,276	\$12,301	\$11,673	\$11,534
<b>Renewal &amp; Replacement:</b>	\$16,730	\$6,376	\$47,639	\$54,271
<b>Total M&amp;R Costs:</b>	\$46,464	\$36,185	\$76,103	\$82,372
<b>Per GSFT:</b>	\$4.20	\$3.27	\$6.89	\$7.45
<b>As % of PRV:</b>	1.39%	1.09%	2.28%	2.47%

# M&R Costs by System per Year Chart

**Building:** Office Building

**Facility:** Marshall Space Flight Center

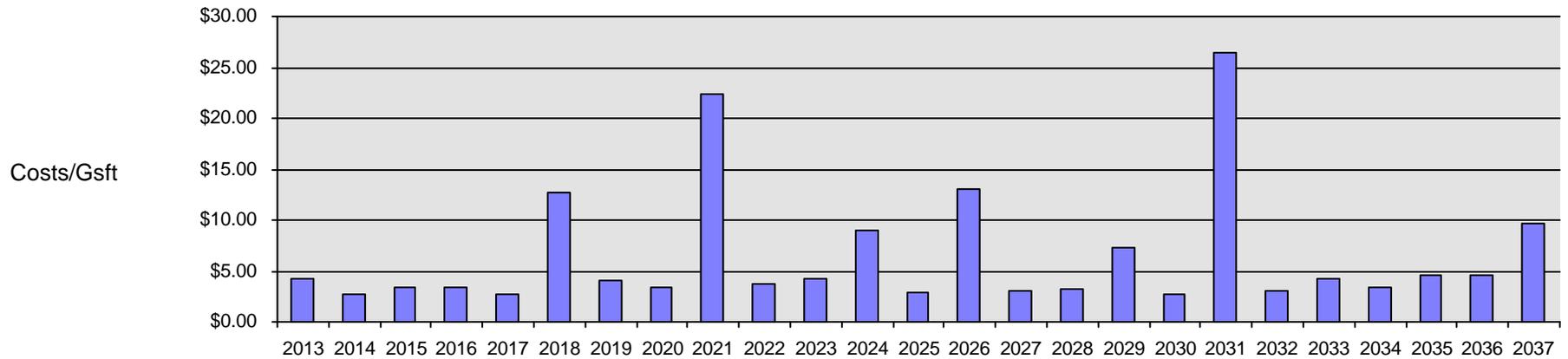
**City:** Huntsville, AL

**Building Num:** 1045/62/212

**GSFT:** 11050

Forecast Year: 2013 4 5 6 7 2018 9 0 1 2 2023 4 5 6 7 2028 9 0 1 2 2033 4 5 6 7

	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
A10 Foundations																									
A20 Basement Construction																									
B10 Super Structure									0.02				0.04	0.01					0.02					0.14	
B20 Exterior Enclosure	1.01	0.02	0.02			2.45	0.40	0.10	0.01		0.89	0.02	0.05	0.00		0.10	0.08	0.10	0.02		0.93	0.02	0.02		0.03
B30 Roofing	0.29	0.29	0.30	0.53	0.29	0.29	0.29	0.29	0.54	0.29	0.29	0.29	0.29	0.53	0.30	0.29	0.29	0.29	1.05	0.29	0.30	0.29	0.29	0.53	0.29
C10 Interior Construction	0.00	0.01	0.04	0.10	0.00		0.11		0.61		0.04	0.01	0.00	0.10	0.04		0.24	0.86		0.00	0.01	0.04	0.80	0.00	
C20 Stairs			0.01				0.56				0.01		0.05	0.01		0.01		0.01			0.02	0.01			
C30 Interior Finishes	0.50	0.00	0.03	0.11		7.28	0.02	0.04	0.85			0.03	5.47		0.50	0.23		0.89		0.04		0.03	0.13		
D10 Conveying																									
D20 Plumbing	0.08	0.04	0.37	0.04	0.09	0.33	0.09	0.04	0.44	0.03	0.09	0.03	0.16	0.53	0.09	0.03	0.09	0.04	0.44	0.08	0.10	0.03	0.14	0.10	0.08
D30 HVAC	1.23	1.23	1.51	1.26	1.23	1.23	1.56	1.86	7.89	1.23	1.82	7.63	1.23	1.34	1.51	1.23	1.59	1.23	8.50	1.23	1.86	1.89	2.87	1.33	8.09
D40 Fire Protection	0.22	0.21	0.21	0.22	0.21	0.21	0.21	0.21	0.43	0.21	0.21	0.21	0.22	0.47	0.21	0.21	0.21	0.21	0.43	0.21	0.21	0.21	0.21	0.22	0.22
D50 Electrical	0.71	0.71	0.72	1.00	0.73	0.70	0.72	0.71	10.09	1.78	0.73	0.70	0.72	3.66	0.71	0.70	4.45	0.70	12.74	1.10	0.71	0.73	0.74	1.39	0.71
E10 Equipment	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	1.52	0.16	0.16	0.16	0.16	0.84	0.16	0.16	0.16	0.16	1.52	0.16	0.16	0.16	0.16	0.16	0.16
E20 Furnishings																									
F10 Special Construction																									
F20 Selective Bldg Demolition																									
G10 Site Preparation																									
G20 Site Improvements																									
G30 Site Mechanical Utilities																									
G40 Site Electrical Utilities																									
G90 Other Site Construction																									
<b>Total</b>	<b>4.20</b>	<b>2.68</b>	<b>3.37</b>	<b>3.42</b>	<b>2.71</b>	<b>12.64</b>	<b>4.14</b>	<b>3.42</b>	<b>22.41</b>	<b>3.70</b>	<b>4.24</b>	<b>9.04</b>	<b>2.91</b>	<b>13.00</b>	<b>3.03</b>	<b>3.21</b>	<b>7.35</b>	<b>2.73</b>	<b>26.49</b>	<b>3.06</b>	<b>4.32</b>	<b>3.36</b>	<b>4.64</b>	<b>4.65</b>	<b>9.59</b>



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft. Based on a 50-Year Forecast.

# M&R Costs by System per Year Chart

**Building:** Office Building

**Facility:** Marshall Space Flight Center

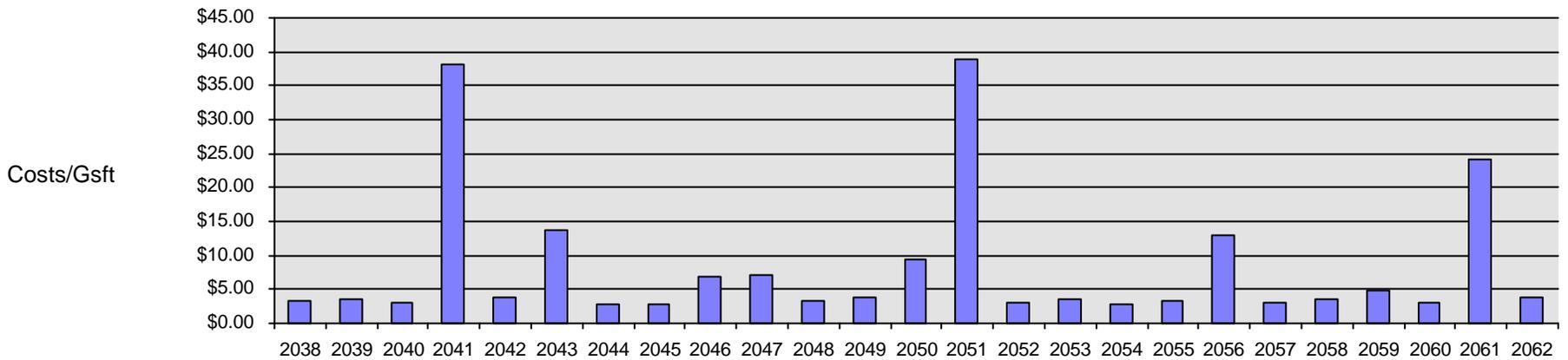
**City:** Huntsville, AL

**Building Num:** 1045/62/212

**GSFT:** 11050

Forecast Year: 2038 9 0 1 2 2043 4 5 6 7 2048 9 0 1 2 2053 4 5 6 7 2058 9 0 1 2 **Total**

	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2	Total	
A10 Foundations																										0.00	
A20 Basement Construction																											0.00
B10 Super Structure				0.03									0.04	0.02					0.01					0.02			0.35
B20 Exterior Enclosure	0.10	0.23	0.11	0.01		9.03	0.02	0.02		0.00	0.13	0.40	0.23	0.05		0.89	0.02	0.10		0.00	0.10	0.08	0.10	0.01		17.86	
B30 Roofing	0.29	0.30	0.29	0.79	0.29	0.35	0.29	0.29	0.53	0.29	0.29	0.30	0.29	11.25	0.29	0.29	0.29	0.30	0.53	0.29	0.29	0.29	0.29	0.55	0.29	28.54	
C10 Interior Construction		0.11		0.61		0.04	0.01	0.00	0.10	0.04		0.07		2.32		0.00	0.01	0.04	0.10	0.00		0.11		1.31		7.95	
C20 Stairs		0.02		0.05		0.01				0.01		0.56		0.01				0.01	0.05			0.02		0.61		2.00	
C30 Interior Finishes	0.54	0.02		6.21		1.66		0.03	2.10	0.17	0.52	0.02		0.89				0.07	5.47		0.52	0.02		1.26	35.69		
D10 Conveying																										0.00	
D20 Plumbing	0.04	0.12	0.34	0.97	0.04	0.10	0.04	0.08	0.78	0.06	0.09	0.05	0.09	0.47	0.07	0.10	0.08	0.07	0.66	0.05	0.07	0.07	0.14	0.37	0.08	8.62	
D30 HVAC	1.23	1.51	1.23	7.89	1.23	1.51	1.23	1.23	1.90	1.82	1.28	1.30	7.63	9.02	1.23	1.23	1.23	1.51	1.26	1.54	1.49	3.24	1.53	7.95	1.23	126.96	
D40 Fire Protection	0.21	0.21	0.21	0.68	0.21	0.21	0.21	0.21	0.22	0.21	0.21	0.22	0.21	0.43	0.21	0.21	0.21	0.21	0.47	0.21	0.21	0.21	0.21	0.67	0.21	12.60	
D50 Electrical	0.71	0.76	0.70	18.66	1.78	0.71	0.75	0.72	0.97	4.44	0.70	0.72	0.71	13.02	1.12	0.73	0.70	0.72	3.63	0.75	0.70	0.74	0.70	9.94	1.83	115.27	
E10 Equipment	0.16	0.16	0.16	2.20	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	1.52	0.16	0.16	0.16	0.16	0.84	0.16	0.16	0.16	0.16	1.52	0.16	16.89	
E20 Furnishings																										0.00	
F10 Special Construction																										0.00	
F20 Selective Bldg Demolition																										0.00	
G10 Site Preparation																										0.00	
G20 Site Improvements																										0.00	
G30 Site Mechanical Utilities																										0.00	
G40 Site Electrical Utilities																										0.00	
G90 Other Site Construction																										0.00	
<b>Total</b>	<b>3.28</b>	<b>3.45</b>	<b>3.02</b>	<b>38.10</b>	<b>3.71</b>	<b>13.78</b>	<b>2.70</b>	<b>2.74</b>	<b>6.75</b>	<b>7.20</b>	<b>3.37</b>	<b>3.80</b>	<b>9.37</b>	<b>38.99</b>	<b>3.07</b>	<b>3.61</b>	<b>2.70</b>	<b>3.19</b>	<b>13.01</b>	<b>3.00</b>	<b>3.53</b>	<b>4.93</b>	<b>3.12</b>	<b>24.21</b>	<b>3.80</b>	<b>372.73</b>	



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft. Year 26-50 Based on a 50-Year Forecast.







# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Finish Replaced Clay Brick, Painted, Exterior, 1st Floor																									
Finish Replaced Concrete Block, Painted, Exterior, 2nd Floor						1,167																			
Repair Concrete Block, Painted, Exterior, 1st Floor (2% of Wa																									
Repoint (50% surface) Concrete Block, Painted, Exterior, 1st																									
Finish Repaired Concrete Block, Painted, Exterior, 1st Floor																									
Replace Concrete Block, Painted, Exterior, 1st Floor						81,078																			
Finish Replaced Concrete Block, Painted, Exterior, 1st Floor						8,552																			
Refinish Concrete Block, Painted, Exterior, 2nd Floor																1,167									
Repair Concrete Block, Painted, Exterior, 2nd Floor (2% of W																									
Repoint (50% surface) Concrete Block, Painted, Exterior, 2nd																									
Finish Repaired Concrete Block, Painted, Exterior, 2nd Floor																									
Replace Clay Brick, Painted, Exterior, 1st Floor																									

## B30 Roofing

Repair Metal Canopy																										126
Replace Metal Canopy						2,895																				
Replace Metal Roof																120,666										
Minor Replacement, Metal Roof (2% of Roof)																										
Repair Metal Roof						2,593					2,593															2,593
Maintain Aluminum Gutter, Downspouts, Fittings	201	201	201	201	201	201	201	201	201	201	201	201	201			201	201	201	201	201	201	201	201	201	201	201
Replace Concrete Roof						684																				
Refinish Metal Canopy																126										126
Repair Concrete Roof																										
Clean & Seal Concrete Roof						37										37										37
Replace Aluminum Gutter, Downspouts, Fittings																3,512										
Maintain Metal Roof	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352			1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352

## C10 Interior Construction

Maintain Steel, Painted, Interior Door Locks						22										22										22
Finish Replaced Wood, Solid Core, Painted, Interior Door																395										
Replace Wood, Solid Core, Painted, Interior Door																22,430										
Replace Wood, Solid Core, Painted, Interior Door Locks						627										627										627
Maintain Wood, Solid Core, Painted, Interior Door Locks						44																				44
Replace Steel, Painted, Interior Door Locks																313										313
Refinish Steel, Painted, Interior Door						23																				23
Replace Toilet Partitions, Painted Metal, Overhead Braced																2,372										
Refinish Toilet Partitions, Painted Metal, Overhead Braced						70																				70
Replace Movable Partitions, Office, Fabric, 6'																										7,742

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7		
Refinish Wood, Solid Core, Painted, Interior Door	46		395		46		395		46		395		46		395						395		46		395		46

## C20 Stairs

Refinish Metal, Painted, Interior Railing			27				27				27				27						27				27	
Finish Repaired Metal, Painted, Interior Railing														1												
Repair Metal, Painted, Interior Stairs													96													
Refinish Metal, Painted, Interior Stairs			35				35				35				35						35				35	
Replace Metal, Painted, Interior Railing																										
Finish Repaired Metal, Painted, Interior Stairs														1												
Repair Metal, Painted, Interior Railing														39												
Replace Metal, Painted, Exterior Railing							6,043																			
Finish Repaired Metal, Painted, Exterior Railing																									3	
Repair Metal, Painted, Exterior Railing																									168	
Refinish Metal, Painted, Exterior Railing																										126
Replace Concrete, Exterior Stairs																										
Repair Concrete, Exterior Stairs														437												
Finish Replaced Metal, Painted, Interior Railing																										
Finish Replaced Metal, Painted, Exterior Railing																										114

## C30 Interior Finishes

Refinish Concrete, Painted Flooring	688																									688
Repair Acoustic Tile, Dropped Ceiling (2% of Ceiling)																										439
Replace Vinyl Tile Flooring																										1,881
Repair Vinyl Tile Flooring (2% of Floors)																										27
Finish Replaced Concrete, Painted Flooring																										688
Replace Concrete, Painted Flooring																										6,537
Replace Acoustical Tile, Dropped Ceiling																										
Repair Concrete, Painted Flooring (2% of Floors)																										130
Refinish Gypsum Board, Finished Ceiling																										226
Replace Concrete Flooring																										3,733
Finish Repaired Concrete, Painted Flooring																										14
Refinish Concrete, Painted Ceiling	1,374																									1,374
Repair Concrete, Painted Ceiling (2% of Ceiling)																										
Finish Repaired Concrete, Painted Ceiling																										
Finish Replaced Concrete, Painted Ceiling																										1,374
Repair Gypsum Board, Finished Ceiling (2% of Ceiling)																										16
Finish Repaired Gypsum Board, Finished Ceiling																										4
Refinish Metal, Painted Ceiling																										344

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2	
Refinish Wood, Solid Core, Painted, Interior Door	395			46		395			46		395			46		46			395		46			395		46

## C20 Stairs

Refinish Metal, Painted, Interior Railing	27					27					27								27							27	
Finish Repaired Metal, Painted, Interior Railing				1															1								1
Repair Metal, Painted, Interior Stairs				96															96								96
Refinish Metal, Painted, Interior Stairs	35					35					35								35							35	
Replace Metal, Painted, Interior Railing																										831	
Finish Repaired Metal, Painted, Interior Stairs				1															1								1
Repair Metal, Painted, Interior Railing				39															39								39
Replace Metal, Painted, Exterior Railing																6,043											6,043
Finish Repaired Metal, Painted, Exterior Railing																											
Repair Metal, Painted, Exterior Railing																											
Refinish Metal, Painted, Exterior Railing	126																									126	
Replace Concrete, Exterior Stairs																										5,872	
Repair Concrete, Exterior Stairs				437															437								437
Finish Replaced Metal, Painted, Interior Railing																										27	
Finish Replaced Metal, Painted, Exterior Railing																114											114

## C30 Interior Finishes

Refinish Concrete, Painted Flooring	688										688															688	
Repair Acoustic Tile, Dropped Ceiling (2% of Ceiling)	439																		439								439
Replace Vinyl Tile Flooring											1,881																1,881
Repair Vinyl Tile Flooring (2% of Floors)	27																									27	
Finish Replaced Concrete, Painted Flooring																											
Replace Concrete, Painted Flooring																											
Replace Acoustical Tile, Dropped Ceiling											21,996																21,996
Repair Concrete, Painted Flooring (2% of Floors)																										130	
Refinish Gypsum Board, Finished Ceiling	226															226										226	
Replace Concrete Flooring																											
Finish Repaired Concrete, Painted Flooring																										14	
Refinish Concrete, Painted Ceiling	1,374															1,374										1,374	
Repair Concrete, Painted Ceiling (2% of Ceiling)						485																				485	
Finish Repaired Concrete, Painted Ceiling						27																				27	
Finish Replaced Concrete, Painted Ceiling																											
Repair Gypsum Board, Finished Ceiling (2% of Ceiling)						16																				16	
Finish Repaired Gypsum Board, Finished Ceiling						4																				4	
Refinish Metal, Painted Ceiling																										344	

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Repair Metal, Painted Ceiling (2% of Ceiling)																									137
Finish Repaired Metal, Painted Ceiling																									7
Repoint (50% of surface) Clay Brick, Interior Wall Finish																									
Repair Concrete Flooring (2% of Floors)																						75			
Replace Concrete, Painted Ceiling						24,600																			
Repair Clay Brick, Interior Wall Finish (2% of Walls)																									
Replace Clay Brick, Interior Wall Finish						5,527																			
Replace Ceramic Tile Flooring																									
Refinish Clay Brick, Painted, Interior Wall Finish	311															311									
Finish Repaired Clay Brick, Painted, Interior Wall Finish																									
Repair Ceramic Tile, 4"x4", Interior Wall Finish (2% of Walls)			321										321										321		
Finish Replaced Clay Brick, Painted, Interior Wall Finish						311																			
Refinish Concrete Block, Painted, Interior Wall Finish	3,167															3,167									
Repair Concrete Block, Painted, Interior Wall Finish (2% of Wal																									
Repoint (50% surface) Concrete Block, Painted, Interior Wall Fi																									
Finish Repaired Concrete Block, Painted, Interior Wall Finish																									
Replace Concrete Block, Painted, Interior Wall Finish						34,310																			
Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)			1,199						1,199									1,199						1,199	
Refinish Gypsum Board, Interior Wall Finish									7,816											7,816					
Repair Gypsum Board, Interior Wall Finish (2% of Walls)																					362				
Finish Repaired Gypsum Board, Interior Wall Finish																					157				
Repair Plate Glass Interior Wall																								75	
Replace Plate Glass Interior Wall																									
Repair Vinyl, Interior Wall Finish (2% of Walls)				10					10										10					10	
Replace Vinyl, Interior Wall Finish														516											
Repair Ceramic Tile Flooring (2% of Floors)						253															253				
Replace Carpet, Nylon 20 oz., Low Traffic														59,952											
Finish Replaced Concrete Block, Painted, Interior Wall Finish						3,167																			

## D20 Plumbing

Replace Pipe Insulation, Fiberglass, Cold Water (20% of Insula																									157
Re-tape Pipe Insulation, Fiberglass, Cold Water				52					52					52					52						
Replace Pipe & Fittings, 2" Copper, Hot Water (20% of Pipe)			888																						
Replace 10' Section, Pipe & Fittings, 2" Copper, Hot Water																								44	
Resolder Joint, Pipe & Fittings, 2" Copper, Hot Water													35											35	
Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe)			888																						
Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water													35											35	
Maintain Backflow Preventer, 1"	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2		
Repair Metal, Painted Ceiling (2% of Ceiling)																										137	
Finish Repaired Metal, Painted Ceiling																											7
Repoint (50% of surface) Clay Brick, Interior Wall Finish						1,233																					
Repair Concrete Flooring (2% of Floors)											75																
Replace Concrete, Painted Ceiling																											
Repair Clay Brick, Interior Wall Finish (2% of Walls)						110																					
Replace Clay Brick, Interior Wall Finish																											
Replace Ceramic Tile Flooring						8,515																					
Refinish Clay Brick, Painted, Interior Wall Finish	311										311										311						
Finish Repaired Clay Brick, Painted, Interior Wall Finish						6																					
Repair Ceramic Tile, 4"x4", Interior Wall Finish (2% of Walls)									321										321								
Finish Replaced Clay Brick, Painted, Interior Wall Finish																											
Refinish Concrete Block, Painted, Interior Wall Finish	3,167										3,167										3,167						
Repair Concrete Block, Painted, Interior Wall Finish (2% of W						686																					
Repoint (50% surface) Concrete Block, Painted, Interior Wall						7,251																					
Finish Repaired Concrete Block, Painted, Interior Wall Finish						64																					
Replace Concrete Block, Painted, Interior Wall Finish																											
Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)									1,199							1,199										1,199	
Refinish Gypsum Board, Interior Wall Finish						7,816										7,816										7,816	
Repair Gypsum Board, Interior Wall Finish (2% of Walls)																362											
Finish Repaired Gypsum Board, Interior Wall Finish																157											
Repair Plate Glass Interior Wall																											
Replace Plate Glass Interior Wall																											4,414
Repair Vinyl, Interior Wall Finish (2% of Walls)									10						10												10
Replace Vinyl, Interior Wall Finish						516													516								
Repair Ceramic Tile Flooring (2% of Floors)																						253					
Replace Carpet, Nylon 20 oz., Low Traffic						59,952													59,952								
Finish Replaced Concrete Block, Painted, Interior Wall Finish																											

## D20 Plumbing

Replace Pipe Insulation, Fiberglass, Cold Water (20% of Insul																											157
Re-tape Pipe Insulation, Fiberglass, Cold Water						52					52					52					52						
Replace Pipe & Fittings, 2" Copper, Hot Water (20% of Pipe)						888																					
Replace 10' Section, Pipe & Fittings, 2" Copper, Hot Water																											44
Resolder Joint, Pipe & Fittings, 2" Copper, Hot Water																35											35
Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe)						888																					
Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water																35											35
Maintain Backflow Preventer, 1"	46	46	46			46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

	Forecast Year:																								
	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe)			663																						190
Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water																								44	
Re-tape Pipe Insulation, Fiberglass, Hot Water				52					52					52									52		
Replace Pipe Insulation, Fiberglass, Hot Water (20% of Insulat)																									157
Check Operation, Water Heater, Electric, 80 Gal.		19			19			19			19						19			19			19		
Replace 10' Section, Pipe & Fittings, 3" Cast Iron			33								51								33				51		
Replace Water Heater, Electric, 80 Gal.														5,405											
Replace Backflow Preventer, 1"									992											992					
Maintain Floor Drain	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
Replace Floor Drain																									
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water																								9	33
Replace Faucet Washer & Clean Trap, Sink, Stainless Steel	20		20		20		20		20		20		20		20		20		20		20		20	20	20
Install New Gasket & Bolts, Pipe & Fittings, 3" Cast Iron																									18
Drain & Flush Water Heater, Electric, 80 Gal.						236							236								236				
Replace Service Sink, Iron, Enamel																									
Replace 10' Section, Pipe & Fittings, 4" Cast Iron			57								28							57					28		
Install New Gasket & Bolts, Pipe & Fittings, 4" Cast Iron																									8
Replace Coolant & Adjust Drinking Fountain, Refrigerated	48		48		48		48				48		48		48		48				48		48	48	48
Replace Drinking Fountain, Refrigerated									1,893											1,893					
Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chin	119		119		119		119		119		119		119		119		119		119		119		119	119	119
Replace Washer & Spud Connection, Lavatory, Vitreous China						218							218								218				
Replace Valve Set, Lavatory, Vitreous China									742												742				
Replace Lavatory, Vitreous China																									
Replace Faucet Washer & Clean Trap, Sink, Iron, Enamel	20		20		20		20		20		20		20		20		20		20		20		20	20	20
Replace Valve Set, Sink, Stainless Steel									124												124				
Replace Valve Set, Service Sink, Iron, Enamel									124												124				
Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water									17				62								17			62	
Repair Strainer, Sink, Stainless Steel							58								58								58		
Replace Sink, Stainless Steel																									
Replace Flush Valve, Tankless Water Closet									97												97				
Replace Tankless Water Closet																									
Replace Flush Valve, Urinal, Vitreous China						260							260								260				
Replace Urinal, Vitreous China																									
Replace Valve, Hose Bib									53												53				
Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water									17				62								17			62	
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water																					9			33	
Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pipe)			663																						190

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe			663																						190
Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water																									44
Re-tape Pipe Insulation, Fiberglass, Hot Water				52					52					52					52						
Replace Pipe Insulation, Fiberglass, Hot Water (20% of Insula																									157
Check Operation, Water Heater, Electric, 80 Gal.	19						19			19			19			19					19				19
Replace 10' Section, Pipe & Fittings, 3" Cast Iron					33						51						33					51			
Replace Water Heater, Electric, 80 Gal.			5,405															5,405							
Replace Backflow Preventer, 1"			992											992											992
Maintain Floor Drain	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
Replace Floor Drain														1,134											
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water																			9						33
Replace Faucet Washer & Clean Trap, Sink, Stainless Steel	20			20		20		20		20		20				20		20		20		20			20
Install New Gasket & Bolts, Pipe & Fittings, 3" Cast Iron						12																			18
Drain & Flush Water Heater, Electric, 80 Gal.			236									236						236							
Replace Service Sink, Iron, Enamel									964																
Replace 10' Section, Pipe & Fittings, 4" Cast Iron				57						28						57						28			
Install New Gasket & Bolts, Pipe & Fittings, 4" Cast Iron						17																			8
Replace Coolant & Adjust Drinking Fountain, Refrigerated	48					48		48		48		48				48		48		48		48			48
Replace Drinking Fountain, Refrigerated			1,893											1,893											1,893
Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chi	119		119		119		119				119		119			119		119		119		119		119	119
Replace Washer & Spud Connection, Lavatory, Vitreous Chin	218															218									218
Replace Valve Set, Lavatory, Vitreous China						742													742						
Replace Lavatory, Vitreous China									2,607																
Replace Faucet Washer & Clean Trap, Sink, Iron, Enamel	20		20		20		20				20		20			20		20		20		20			20
Replace Valve Set, Sink, Stainless Steel						124																			124
Replace Valve Set, Service Sink, Iron, Enamel						124													124						
Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water									17				62						17						62
Repair Strainer, Sink, Stainless Steel						58																58			
Replace Sink, Stainless Steel														942											
Replace Flush Valve, Tankless Water Closet				97															97						
Replace Tankless Water Closet									3,054																
Replace Flush Valve, Urinal, Vitreous China	260															260									260
Replace Urinal, Vitreous China									1,469																
Replace Valve, Hose Bib				53										53											53
Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water									17				62						17						62
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water																			9						33
Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pip			663																						190





# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7	
Repair Fan Coil Unit, 2 Ton														563												
Replace Valve Actuator, 4"																							3,295			
Replace Fan & Motor, Exhaust Fan, Ceiling 200-500 Cfm																								2,152		
Replace Thermostat										8,866										8,866						
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																									31	
Replace 10' Section, Pipe & Fittings, 2" Steel											57														57	
Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam				116					116					116						116						
Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20																									493	
Maintain Steam Trap, F&T, 2"	237	237	237	237	237	237	237	237	237	237		237	237	237	237	237	237	237	237	237	237	237	237	237	237	
Repair Steam Trap, F&T, 2"			3,098				3,098								3,098				3,098							
Replace Steam Trap, F&T, 2"										6,809															6,809	
Lubricate, Repack Gland, Ball Valve, 4"	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	
Maintain Flow Control Valve & Actuator, 4"	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	
Replace Flow Control Valve, Motorized, 4"																									5,905	
Inspect & Lubricate Circulator Pump, 1/6 HP, Chilled Water	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	
Maintain Air Handler, Single Zone, 15,000 Cfm	844	844	844	844	844	844	844	844	844	844	844		844	844	844	844	844	844	844	844	844	844	844	844	844	
Maintain Fan & Motor, Exhaust Fan, Ceiling 200-500 Cfm	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	
Replace Existing Ductwork (20% of Ductwork)																				3,210						
Replace Duct Insulation (20% of Insulation)																				825						
Replace Ball Valve, 4"																									3,841	
Repair Air Handler, Single Zone, 15,000 Cfm										2,033												2,033				
Overhaul Circulator Pump, 1/6 HP, Chilled Water				92						92					92										92	
Replace Pipe Insulation, Fiberglass, Chilled Water (20% of Ins																									354	
Re-tape Pipe Insulation, Fiberglass, Chilled Water				116						116					116										116	
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel																									25	
Replace 10' Section, Pipe & Fittings, 4" Steel											60														60	
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																									31	
Replace 10' Section, Pipe & Fittings, 2" Steel											57														57	
Replace Circulator Pump, 1/6 HP, Chilled Water																									3,938	
Replace Air Handler, Single Zone, 20,000 Cfm																									31,592	

## D40 Fire Protection

Maintain Fire Sprinkler System	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768
Repair Fire Alarm Control Panel				114						114															114
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel			18																						
Replace 10' Section, Pipe & Fittings, 3" Steel		43												43											43
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel			53																						
Replace 10' Section, Pipe & Fittings, 2" Steel		93												93											93

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2		
Repair Fan Coil Unit, 2 Ton												563															
Replace Valve Actuator, 4"																										3,295	
Replace Fan & Motor, Exhaust Fan, Ceiling 200-500 Cfm																										2,152	
Replace Thermostat						8,866										8,866										8,866	
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																										31	
Replace 10' Section, Pipe & Fittings, 2" Steel																										57	
Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam						116										116										116	
Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20																										493	
Maintain Steam Trap, F&T, 2"	237	237	237	237	237	237	237	237	237		237	237	237	237	237	237	237	237	237	237	237	237	237	237	237	237	237
Repair Steam Trap, F&T, 2"						3,098										3,098										3,098	
Replace Steam Trap, F&T, 2"																6,809										6,809	
Lubricate, Repack Gland, Ball Valve, 4"	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	
Maintain Flow Control Valve & Actuator, 4"	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	
Replace Flow Control Valve, Motorized, 4"																											
Inspect & Lubricate Circulator Pump, 1/6 HP, Chilled Water	46	46	46	46	46	46	46	46	46	46	46	46	46			46	46	46	46	46	46	46	46	46	46	46	
Maintain Air Handler, Single Zone, 15,000 Cfm	844	844	844	844	844	844	844	844	844	844	844	844				844	844	844	844	844	844	844	844	844	844	844	
Maintain Fan & Motor, Exhaust Fan, Ceiling 200-500 Cfm	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	
Replace Existing Ductwork (20% of Ductwork)																										4,013	
Replace Duct Insulation (20% of Insulation)																										1,650	
Replace Ball Valve, 4"																										3,841	
Repair Air Handler, Single Zone, 15,000 Cfm																										2,033	
Overhaul Circulator Pump, 1/6 HP, Chilled Water																										92	
Replace Pipe Insulation, Fiberglass, Chilled Water (20% of In																										354	
Re-tape Pipe Insulation, Fiberglass, Chilled Water																										116	
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel																										25	
Replace 10' Section, Pipe & Fittings, 4" Steel																										60	
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																										31	
Replace 10' Section, Pipe & Fittings, 2" Steel																										57	
Replace Circulator Pump, 1/6 HP, Chilled Water																										3,938	
Replace Air Handler, Single Zone, 20,000 Cfm																										31,592	

## D40 Fire Protection

Maintain Fire Sprinkler System	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768
Repair Fire Alarm Control Panel																										114
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel																										18
Replace 10' Section, Pipe & Fittings, 3" Steel																										43
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																										53
Replace 10' Section, Pipe & Fittings, 2" Steel																										93

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Test Gages & Valves, Fire Sprinkler System	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708
Replace Fire Department Connection, Siamese, 3"																									
Test Fire Sprinkler Head									1,770										1,770						
Inspect Fire Sprinkler Head	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
Replace Fire Alarm Control Panel														3,011											
Inspect & Test Fire Alarm Control Panel	122	122	122	122	122	122	122	122	122	122	122	122	122		122	122	122	122	122	122	122	122	122	122	122
Inspect & Maintain Fire Department Connection, Siamese, 3"	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
Replace Fire Sprinkler Head																									

## D50 Electrical

Maintain Card Reader	286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286		286	286	286	286	286	286
Replace Card Reader									4,346														4,346	
Replace Electric Lock									2,257														2,257	
Replace Fire Alarm Horn & Strobe																							1,800	
Replace Camera, Interior, Closed Circuit, PTZ Color									26,321														26,321	
Replace Handicap Door Access Interface									698														698	
Replace Wiring Device, Switch													1,486											
Maintain Headend Panel, Closed Circuit	19	19	19	19	19	19	19	19		19	19	19	19	19	19	19	19	19		19	19	19	19	19
Replace Headend Panel, Closed Circuit									2,215														2,215	
Check Operation, Heat Detector	150	150	150	150	150	150	150	150	150	150	150	150	150		150	150	150	150	150	150	150	150	150	150
Maintain Handicap Door Access Interface	86	86	86	86	86	86	86	86		86	86	86	86	86	86	86	86	86		86	86	86	86	86
Maintain Camera, Interior, Closed Circuit, PTZ Color	514	514	514	514	514	514	514	514		514	514	514	514	514	514	514	514	514		514	514	514	514	514
Inspect & Maintain Lighting Control Panel	30	30	30	30	30	30	30	30	30	30	30	30	30		30	30	30	30	30	30	30	30	30	30
Maintain Camera, Exterior, Closed Circuit, PTZ Color	286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286		286	286	286	286	286
Repair Wiring Device, Switch									1,412															1,412
Replace Receptacle, 120 V, 20 Amp.																							13,992	
Replace Occupancy Sensors, Indoor Lighting													25,937											
Replace Lighting Control Panel													1,028											
Replace Control Unit, Occupancy Sensors, Indoor Lighting				2,966					2,966														2,966	2,966
Inspect & Maintain Occupancy Sensor, Indoor Lighting	879	879	879	879	879	879	879	879	879	879	879	879	879		879	879	879	879	879	879	879	879	879	879
Replace Lightning Protection General Wiring																								1,761
Repair Heat Detector									332															332
Replace Camera, Exterior, Closed Circuit, PTZ Color									22,862														22,862	
Replace Security System Panel									433														433	
Replace Power Panel Board, 208 Y/120 V, 100 Amp.																								
Replace HP Sodium Lighting Fixture, 250 w									11,962															
Annual PM, Grounding System	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
Maintain & Repair, Grounding System	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Test Gages & Valves, Fire Sprinkler System	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708
Replace Fire Department Connection, Siamese, 3"																									1,131
Test Fire Sprinkler Head				1,770										1,770											
Inspect Fire Sprinkler Head	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
Replace Fire Alarm Control Panel				3,011																					3,011
Inspect & Test Fire Alarm Control Panel	122	122	122		122	122	122	122	122	122	122	122	122	122	122	122	122	122			122	122	122	122	122
Inspect & Maintain Fire Department Connection, Siamese, 3"	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
Replace Fire Sprinkler Head																									3,861

## D50 Electrical

Maintain Card Reader	286	286	286		286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286	286	286	286
Replace Card Reader				4,346										4,346											4,346
Replace Electric Lock				2,257										2,257											2,257
Replace Fire Alarm Horn & Strobe														1,800											1,800
Replace Camera, Interior, Closed Circuit, PTZ Color				26,321										26,321											26,321
Replace Handicap Door Access Interface				698										698											698
Replace Wiring Device, Switch				1,486																					1,486
Maintain Headend Panel, Closed Circuit	19	19	19		19	19	19	19	19	19	19	19		19	19	19	19	19	19	19	19	19	19	19	19
Replace Headend Panel, Closed Circuit				2,215										2,215											2,215
Check Operation, Heat Detector	150	150	150		150	150	150	150	150	150	150	150	150	150	150	150	150	150			150	150	150	150	150
Maintain Handicap Door Access Interface	86	86	86		86	86	86	86	86	86	86	86		86	86	86	86	86	86	86	86	86	86	86	86
Maintain Camera, Interior, Closed Circuit, PTZ Color	514	514	514		514	514	514	514	514	514	514	514		514	514	514	514	514	514	514	514	514	514	514	514
Inspect & Maintain Lighting Control Panel	30	30	30		30	30	30	30	30	30	30	30	30	30	30	30	30	30			30	30	30	30	30
Maintain Camera, Exterior, Closed Circuit, PTZ Color	286	286	286		286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286	286	286	286
Repair Wiring Device, Switch														1,412											1,412
Replace Receptacle, 120 V, 20 Amp.														13,992											13,992
Replace Occupancy Sensors, Indoor Lighting				25,937																					25,937
Replace Lighting Control Panel				1,028																					1,028
Replace Control Unit, Occupancy Sensors, Indoor Lighting									2,966					2,966											2,966
Inspect & Maintain Occupancy Sensor, Indoor Lighting	879	879	879		879	879	879	879	879	879	879	879	879	879	879	879	879	879	879			879	879	879	879
Replace Lightning Protection General Wiring																									1,761
Repair Heat Detector														332											332
Replace Camera, Exterior, Closed Circuit, PTZ Color				22,862										22,862											22,862
Replace Security System Panel				433										433											433
Replace Power Panel Board, 208 Y/120 V, 100 Amp.				3,899																					3,899
Replace HP Sodium Lighting Fixture, 250 w									11,962																11,962
Annual PM, Grounding System	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
Maintain & Repair, Grounding System	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7	
Replace Meter, Electrical, 208 Volt, 600 Amp.																										
Replace Smoke Detector, Duct														479												
Replace Smoke Detector														3,963												
Repair Smoke Detector, Duct									39																39	
Repair Smoke Detector									1,069																	1,069
Inspect and Test Meter, Electrical, 208 Volt, 600 Amp.	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
Replace Batteries & Check Operation, Smoke Detector	485	485	485	485	485	485	485	485	485	485	485	485	485			485	485	485	485	485	485	485	485	485	485	
Replace Heat Detector																1,005										
Maintain Security System Panel				58				58						58				58							58	
Replace Public Address Speaker																547										
Maintain Public Address Speaker	37	37	37	37	37	37	37	37	37	37	37	37	37			37	37	37	37	37	37	37	37	37	37	
Replace Monitor, Medium, Closed Circuit									8,906											8,906						
Replace Manual Pull Station																567										
Check & Repair Manual Pull Station									245																245	
Replace Access Keypad									1,970											1,970						
Maintain Keypad	228	228	228	228	228	228	228	228			228	228	228	228	228	228	228	228			228	228	228	228	228	
Replace Intrusion Detection Motion Detector, Interior									3,051											3,051						
Maintain Intrusion Detection Motion Detector, Interior	142	142	142	142	142	142	142	142			142	142	142	142	142	142	142	142			142	142	142	142	142	
Replace Batteries & Check Operation, Smoke Detector, Duct	18	18	18	18	18	18	18	18	18	18	18	18	18			18	18	18	18	18	18	18	18	18	18	
Replace Power Panel Board, 208 Y/120 V, 200 Amp.																										
Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w																									4,223	
Maintain Power Panel Board, 480 V, 200 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
Repair Power Panel Board, 208 Y/120 V, 200 Amp.										367															367	
Repair Power Panel Board, 480 V, 100 Amp.										92															92	
Maintain Power Panel Board, 480 V, 100 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
Replace Power Panel Board, 208 Y/120 V, 400 Amp.																										
Repair Power Panel Board, 208 Y/120 V, 400 Amp.										92															92	
Maintain Power Panel Board, 208 Y/120 V, 400 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
Replace Power Panel Board, 208 Y/120 V, 225 Amp.																										
Replace Power Panel Board, 480 V, 200 Amp.																										
Maintain Power Panel Board, 208 Y/120 V, 225 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
Repair Power Panel Board, 480 V, 200 Amp.										92															92	
Maintain Power Panel Board, 208 Y/120 V, 200 Amp.	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	
Repair Power Panel Board, 208 Y/120 V, 100 Amp.										92															92	
Maintain Power Panel Board, 208 Y/120 V, 100 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
Replace Motor Starter, <5HP, <600V																									532	
Replace Coil, Motor Starter, <5HP, <600V		188				188																			188	

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Meter, Electrical, 208 Volt, 600 Amp.						441																			
Replace Smoke Detector, Duct						479													479						
Replace Smoke Detector						3,963													3,963						
Repair Smoke Detector, Duct																			39						
Repair Smoke Detector																			1,069						
Inspect and Test Meter, Electrical, 208 Volt, 600 Amp.	19	19	19			19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Replace Batteries & Check Operation, Smoke Detector	485	485	485			485	485	485	485	485	485	485	485	485	485	485	485	485			485	485	485	485	485
Replace Heat Detector						1,005																			
Maintain Security System Panel						58													58						
Replace Public Address Speaker						547																			
Maintain Public Address Speaker	37	37	37			37	37	37	37	37	37	37	37	37	37	37	37	37			37	37	37	37	37
Replace Monitor, Medium, Closed Circuit						8,906																			
Replace Manual Pull Station						567																			
Check & Repair Manual Pull Station																			245						
Replace Access Keypad						1,970																			
Maintain Keypad	228	228	228			228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228
Replace Intrusion Detection Motion Detector, Interior						3,051																			
Maintain Intrusion Detection Motion Detector, Interior	142	142	142			142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142
Replace Batteries & Check Operation, Smoke Detector, Duct	18	18	18			18	18	18	18	18	18	18	18	18	18	18	18	18			18	18	18	18	18
Replace Power Panel Board, 208 Y/120 V, 200 Amp.						22,445																			
Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w																									
Maintain Power Panel Board, 480 V, 200 Amp.	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Repair Power Panel Board, 208 Y/120 V, 200 Amp.																									
Repair Power Panel Board, 480 V, 100 Amp.																									
Maintain Power Panel Board, 480 V, 100 Amp.	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 208 Y/120 V, 400 Amp.						7,099																			
Repair Power Panel Board, 208 Y/120 V, 400 Amp.																									
Maintain Power Panel Board, 208 Y/120 V, 400 Amp.	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 208 Y/120 V, 225 Amp.						5,971																			
Replace Power Panel Board, 480 V, 200 Amp.						7,632																			
Maintain Power Panel Board, 208 Y/120 V, 225 Amp.	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Repair Power Panel Board, 480 V, 200 Amp.																									
Maintain Power Panel Board, 208 Y/120 V, 200 Amp.	228	228	228			228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228	228
Repair Power Panel Board, 208 Y/120 V, 100 Amp.																									
Maintain Power Panel Board, 208 Y/120 V, 100 Amp.	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Motor Starter, <5HP, <600V																									
Replace Coil, Motor Starter, <5HP, <600V	188					188																			

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Inspect & Clean Motor Starter, <5HP, <600V	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
Replace Disconnect Switch, 30 Amp.																									
Repair Disconnect Switch, 30 Amp.									119											119					
Maintain Disconnect Switch, 30 Amp.	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Repair Power Panel Board, 208 Y/120 V, 225 Amp.									92											92					
Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtur									469																
Replace Grounded Fault Circuit Interruptor, 15 Amp.																				118					
Replace Fluorescent Lighting Fixture, T8, 4-32 w																				33,982					
Replace Fluorescent Lighting Fixture, T8, 2-32 w																				5,968					
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4-3									21,254																
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2-3									3,732																
Replace Emergency Lighting Pack, 2 Light w/ Battery																				2,011					
Replace Lens, Replace Emergency Lighting Pack, 2 Light w/ Ba									63																
Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/ B	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
Replace Power Panel Board, 480 V, 100 Amp.																									
Replace Compact Fluorescent Lighting Fixture, 32 w																				529					
Maintain Power Panel Board, 480 V, 400 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Variable Frequency Drive, <600V																				41,054					
Replace Coil, Variable Frequency Drive, <600V				399					399					399								399			
Inspect & Clean Variable Frequency Drive, <600 V	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172
Replace Secondary Transformer, Dry, 45 kVA																									
Repair Secondary Transformer, Dry, 45 kVA									265											265					
Maintain Secondary Transformer, Dry, 45 kVA	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Secondary Transformer, Dry, 30 kVA																									
Repair Secondary Transformer, Dry, 30 kVA									265											265					
Maintain Secondary Transformer, Dry, 30 kVA	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 480 V, 400 Amp.																									
Repair Power Panel Board, 480 V, 400 Amp.									127											127					

## E10 Equipment

Maintain Icemaker, Commercial	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826
Replace Icemaker, Commercial									16,699											16,699					
Maintain Kitchen Exhaust Hood, Commercial	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Replace Kitchen Exhaust Hood, Commercial																									7,628

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/212

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Inspect & Clean Motor Starter, <5HP, <600V	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
Replace Disconnect Switch, 30 Amp.																									326
Repair Disconnect Switch, 30 Amp.				119																	119				
Maintain Disconnect Switch, 30 Amp.	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Repair Power Panel Board, 208 Y/120 V, 225 Amp.																					92				92
Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtu				469																					469
Replace Grounded Fault Circuit Interruptor, 15 Amp.																					118				118
Replace Fluorescent Lighting Fixture, T8, 4-32 w																					33,982				33,982
Replace Fluorescent Lighting Fixture, T8, 2-32 w																					5,968				5,968
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4-				21,254																					21,254
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2-				3,732																					3,732
Replace Emergency Lighting Pack, 2 Light w/ Battery																					2,011				2,011
Replace Lens, Replace Emergency Lighting Pack, 2 Light w/				63																					63
Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/		126				126		126		126		126		126		126		126		126		126		126	126
Replace Power Panel Board, 480 V, 100 Amp.				5,500																					5,500
Replace Compact Fluorescent Lighting Fixture, 32 w																					529				529
Maintain Power Panel Board, 480 V, 400 Amp.	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Variable Frequency Drive, <600V																					41,054				41,054
Replace Coil, Variable Frequency Drive, <600V		399				399										399					399				399
Inspect & Clean Variable Frequency Drive, <600 V	172	172	172	172	172	172	172	172	172		172	172	172	172	172	172	172	172	172	172	172	172	172	172	172
Replace Secondary Transformer, Dry, 45 kVA				5,165																					5,165
Repair Secondary Transformer, Dry, 45 kVA																					265				265
Maintain Secondary Transformer, Dry, 45 kVA	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Secondary Transformer, Dry, 30 kVA				4,456																					4,456
Repair Secondary Transformer, Dry, 30 kVA																					265				265
Maintain Secondary Transformer, Dry, 30 kVA	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 480 V, 400 Amp.				8,911																					8,911
Repair Power Panel Board, 480 V, 400 Amp.																					127				127

## E10 Equipment

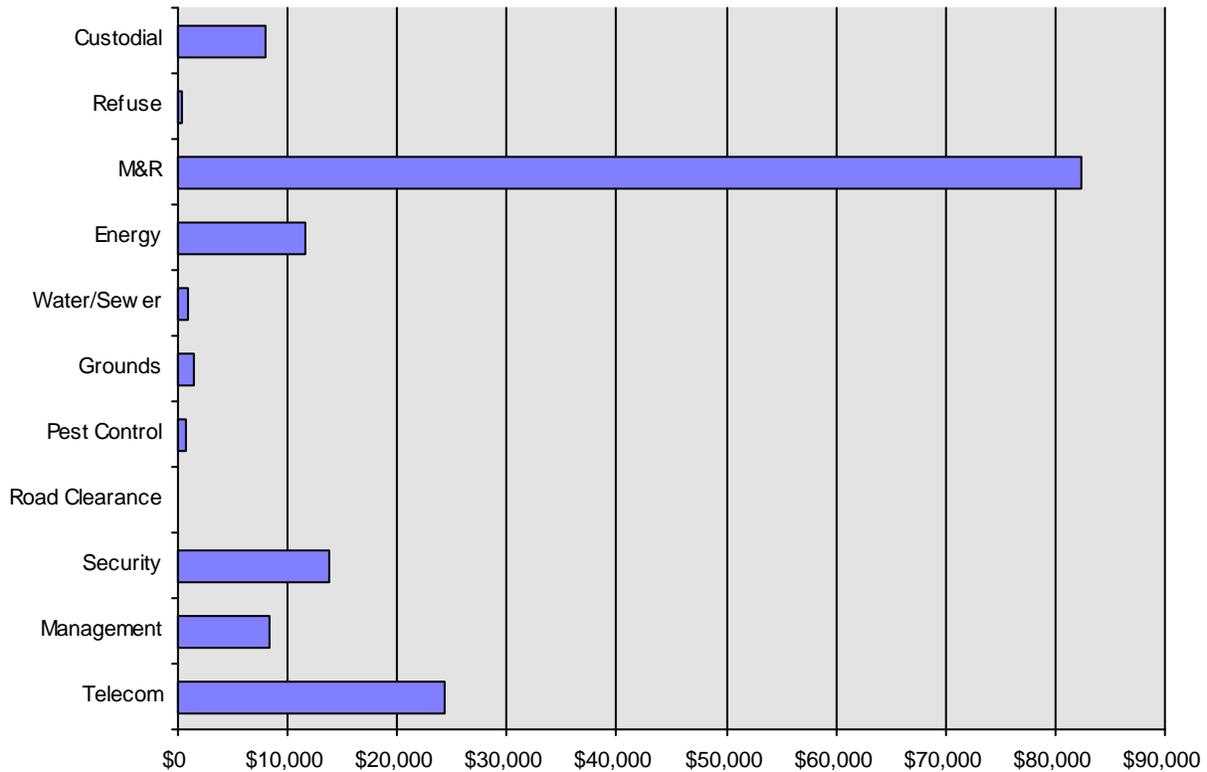
Maintain Icemaker, Commercial	826	826	826		826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826
Replace Icemaker, Commercial				16,699												16,699									16,699
Maintain Kitchen Exhaust Hood, Commercial	68	68	68		68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Replace Kitchen Exhaust Hood, Commercial				7,628																					7,628

# Operation Costs Summary

Whitestone Research

**Building:** Office Building **GSFT:** 11,050  
**Building Number:** 1045/62/212 **Replacement Value:** \$3,332,663  
**Facility:** Marshall Space Flight Center **Building Use:** Office  
**City:** Huntsville, AL **Building Type:** Engineering Office  
**Built Date:** 1943

Operation	Annual Cost/GSFT	Annual Total	Percent
Custodial	\$0.729	\$8,051	5.3%
Energy	\$1.046	\$11,558	7.6%
Grounds	\$0.125	\$1,386	0.9%
M&R	\$7.455	\$82,372	54.3%
Management	\$0.754	\$8,332	5.5%
Pest Control	\$0.067	\$739	0.5%
Refuse	\$0.033	\$367	0.2%
Road Clearance	\$0.002	\$25	0.0%
Security	\$1.243	\$13,733	9.0%
Telecom	\$2.200	\$24,311	16.0%
Water/Sewer	\$0.082	\$910	0.6%
<b>Building Total</b>	<b>\$13.74</b>	<b>\$151,784</b>	<b>100.0%</b>



# Building Operations Task Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1943

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/212

**City:** Huntsville, AL

**Replacement Value:** \$3,332,663 **per SF:** \$302

**Building Gsft:** 11,050

Functional Area	FA GSFT	Task	Labor Cost	Material Cost	Task Cost
<b>Operation: Custodial</b>		<b>Level of Service: Low</b>			
Office	6630	Vacuum Carpet with 14" Upright Vacuum	\$2,317	\$376	\$2,693
Office	6630	Empty Trash; Wipe Clean & Re-line Basket	\$662	\$108	\$770
Office	6630	Clean and Wipe Furniture with Trigger Sprayer & Cloth	\$406	\$66	\$472
Office	6630	Dust Surfaces with Duster	\$306	\$50	\$355
Office	6630	Vacuum Upholstered Furniture with Tank or Canister Vacuum	\$254	\$41	\$296
Office	6630	Dust Window Blinds	\$147	\$24	\$170
Storage	1878	Sweep Hard Floor with 48" Push Broom	\$34	\$5	\$39
Storage	1878	Empty Trash; Wipe Clean & Re-line Basket	\$22	\$4	\$25
Common/Circulation Are	552	Vacuum Carpet with 14" Upright Vacuum	\$386	\$63	\$448
Conference Room	552	Vacuum Carpet with 14" Upright Vacuum	\$193	\$31	\$224
Conference Room	552	Clean and Wipe Furniture with Trigger Sprayer & Cloth	\$73	\$12	\$85
Common/Circulation Are	552	Empty Trash; Wipe Clean & Re-line Basket	\$55	\$9	\$64
Common/Circulation Are	552	Vacuum Upholstered Furniture with Tank or Canister Vacuum	\$42	\$7	\$49
Conference Room	552	Empty Trash; Wipe Clean & Re-line Basket	\$28	\$4	\$32
Restroom	442	Service Restroom: Empty Trash, Clean & Disinfect Fixtures, Wipe Mirrors, Replace Supplies, Wet	\$927	\$151	\$1,077
Restroom	442	Service Restroom: Empty Trash, Replace Supplies & Touch Up as Needed	\$142	\$23	\$165
Mechanical/Equipment	442	Sweep Hard Floor with 48" Push Broom	\$8	\$1	\$9
Mechanical/Equipment	442	Empty Trash; Wipe Clean & Re-line Basket	\$5	\$1	\$6
Laboratory	331	Wet Mop & Rinse Hard Floor with 32 oz. Mop Using Single Bucket & Wringer	\$99	\$16	\$115
Laboratory	331	Empty Trash; Wipe Clean & Re-line Basket	\$33	\$5	\$38
Laboratory	331	Clean and Wipe Furniture with Trigger Sprayer & Cloth	\$20	\$3	\$24
Laboratory	331	Dust Surfaces with Duster	\$15	\$2	\$18
Laboratory	331	Dust Window Blinds	\$7	\$1	\$9
Kitchen	221	Scrub and Damp Wipe Sinks	\$177	\$29	\$205
Kitchen	221	Wet Mop & Rinse Hard Floor with 32 oz. Mop Using Double Bucket & Wringer	\$165	\$27	\$192
Kitchen	221	Clean and Polish Metal Surfaces with Trigger Sprayer & Cloth	\$132	\$22	\$154
Kitchen	221	Wash Fatigue Mats with Pressure Washer	\$88	\$14	\$103

Functional Area	FA GSFT	Task	Labor Cost	Material Cost	Task Cost
Kitchen	221	Clean Oven	\$42	\$7	\$49
Kitchen	221	Empty, Clean and Disinfect Refrigerator	\$42	\$7	\$49
Kitchen	221	Clean Stovetop	\$37	\$6	\$43
Kitchen	221	Empty Trash; Wipe Clean & Re-line Basket	\$33	\$5	\$38
Kitchen	221	Damp Wipe Interior and Exterior Cupboard	\$27	\$4	\$32
<b>Total:</b>			<b>\$6,926</b>	<b>\$1,125</b>	<b>\$8,051</b>
<b>Operation: Grounds</b>		<b>Level of Service: Low</b>			
Grounds, Improved	6630	Mow Turfgrass with 21" Power Mower	\$245	\$102	\$347
Grounds, Improved	6630	Aerate Improved Grounds	\$190	\$79	\$269
Grounds, Improved	6630	Clear Shrubs	\$159	\$66	\$225
Grounds, Improved	6630	Edge Clean & Trim Walks with Gas Powered Edger	\$102	\$42	\$144
Grounds, Improved	6630	Overseed, Improved Grounds	\$95	\$40	\$134
Grounds, Improved	6630	Vacuum with 30" Billy Goat	\$63	\$26	\$90
Grounds, Improved	6630	Clear Crabgrass	\$47	\$20	\$67
Grounds, Improved	6630	Clear Weeds with 15" Boom, Improved Grounds	\$25	\$11	\$36
Grounds, Improved	6630	Trim Around Raised Objects with String Edger	\$21	\$9	\$29
Grounds, Improved	6630	Fertilize Improved Grounds	\$19	\$8	\$27
Grounds, Improved	6630	Sweep with 30" Power Rake	\$13	\$5	\$18
Grounds, Improved	6630	Fertilize Using Power Take Off Broadcast	\$0	\$0	\$0
<b>Total:</b>			<b>\$979</b>	<b>\$407</b>	<b>\$1,386</b>
<b>Operation: Pest Control</b>		<b>Level of Service: Medium</b>			
Pest Controlled	11050	Install, or Check and Re-Bait 5 Rodent Boxes	\$255	\$106	\$362
Pest Controlled	11050	Perform Crawling Insect Abatement	\$192	\$80	\$271
Pest Controlled	11050	Inspect Building for Pests	\$107	\$0	\$107
<b>Total:</b>			<b>\$554</b>	<b>\$186</b>	<b>\$739</b>
<b>Operation: Road Clearance</b>		<b>Level of Service: Medium</b>			
Pavement NASA	8840	Plow Paved Area	\$19	\$6	\$25
<b>Total:</b>			<b>\$19</b>	<b>\$6</b>	<b>\$25</b>
<b>Operation: Security</b>		<b>Level of Service: Medium</b>			
Secured Area	11050	Patrol Building Perimeter	\$2,100	\$341	\$2,442
Secured Area	11050	Guard Lobby/Parking	\$0	\$0	\$0
<b>Total:</b>			<b>\$2,100</b>	<b>\$341</b>	<b>\$2,442</b>

# Building Operations Utility Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1943

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/212

**City:** Huntsville, AL

**Replacement Value:** \$3,332,663 **per SF:** \$302

**Building Gsft:** 11,050

		Utility	GSFT	Demand	UM	Rate	Cost
<b>Operation:</b>	<b>Energy</b>	<b>Level of Service: Medium</b>					
		Electricity	11050	11.027	kWh	\$0.0833	\$10,150
		Natural Gas	11050	0.161	Thm	\$0.7900	\$1,408
		Diesel	11050	0.000	Gal	\$3.2100	\$0
		<b>Total:</b>		<b>11.189</b>			<b>\$11,558</b>
<b>Operation:</b>	<b>Refuse</b>	<b>Level of Service: Medium</b>					
		Municipal Solid Waste	11050	0.370	Lbs	\$0.0717	\$293
		Recycling	11050	0.180	Lbs	\$0.0370	\$74
		<b>Total:</b>		<b>0.550</b>			<b>\$367</b>
<b>Operation:</b>	<b>Water/Sewer</b>	<b>Level of Service: Medium</b>					
		Sewer	11050	17.160	Gal	\$0.0034	\$645
		Water	11050	21.840	Gal	\$0.0011	\$265
		<b>Total:</b>		<b>39.000</b>			<b>\$910</b>

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# Building Operations Management Details

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Whitestone Research

**Building:** Office Building

**Year Built:** 1943

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/212

**City:** Huntsville, AL

**Replacement Value:** \$3,332,663

**per SF:** \$302

**Building Gsft:** 11,050

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	Service	Demand	UM	PRV	Cost
<b>Operation:</b> Management	<b>Level of Service:</b> Low				
	Management	0.3%	PRV	\$3,332,663	\$8,332
	<b>Total:</b>				<b>\$8,332</b>

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# Building Operations Service Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1943

**FTEs:** 27

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/212

**City:** Huntsville, AL

**Replacement Value:** \$3,332,663

**per SF:** \$302

**Building Gsft:** 11,050

		Service*	Quantity	Rate	Cost
<b>Operation:</b>	<b>Security</b>	<b>Level of Service: Medium</b>			
		Intrusion Detection Systems	1	\$4,986	\$4,986
		System Monitoring	1	\$3,615	\$3,615
		Access Control	1	\$2,690	\$2,690
		<b>Total:</b>			<b>\$11,291</b>
<b>Operation:</b>	<b>Telecom</b>	<b>Level of Service: High</b>			
		Local Telephone	27	\$468	\$12,636
		Data	27	\$3,588	\$6,491
		Long Distance Telephone	27	\$192	\$5,184
		<b>Total:</b>			<b>\$24,311</b>

**Attachment B: Detailed MARS Reports for MSFC Property ID  
1045/62/178**

# Building Component List

Whitestone Research

**Building:** Office Building

**Year Built:** 1964

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/178

**City:** Huntsville, AL

**Replacement Value:** \$20,520,846 **per SF:** \$185

**Building Gsft:** 110,929

Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
B1020		Steel Roof Access Ladder	1964	15 Ln Ft		
B2010		Aluminum Louver, 3rd Floor	1964	1 Each		
B2010		Concrete, Exterior, 1st Floor	1964	600 Sq Ft		
B2010		Concrete, Exterior, 2nd Floor	1964	600 Sq Ft		
B2010		Concrete, Painted, Exterior, 3rd+ Floor	1964	3200 Sq Ft		
B2010		Steel, Painted, Exterior, 3rd+ Floor	1964	1920 Sq Ft		
B2020		Glass Curtain Wall	1964	45320 Sq Ft		
B2030		Aluminum Frame, Fully Glazed, Sliding Exterior Door	1990	3 Each		
B2030		Steel, Painted, Exterior Door	1964	1 Each		
B2030		Vault Door	1964	1 Each		
B3010		Metal Canopy	1964	2640 Sq Ft		
B3010		Single-Ply Roof w/ Thermoplastic Olefin (TPO) Membrane	2008	15620 Sq Ft		
C1010		Toilet Partitions, Painted Metal, Overhead Braced	2000	50 Each		
C1020		Aluminum Frame, Fully Glazed, Sliding Interior Door	1990	2 Each		
C1020		Aluminum, Fully Glazed, Interior Door	1964	2 Each		
C1020		Aluminum, Fully Glazed, Interior Door	1990	1 Each		
C1020		Aluminum, Fully Glazed, Interior Door	2005	1 Each		
C1020		Aluminum, Fully Glazed, Interior Door	1964	2 Each		Double door
C1020		Steel, Painted, Interior Door	1964	13 Each		
C1020		Steel, Painted, Interior Double Door	1964	1 Each		
C1020		Wood, Hollow Core, Painted, Interior Door	1964	80 Each		
C1020		Wood, Hollow Core, Painted, Interior Door	1995	345 Each		
C1020		Wood, Hollow Core, Painted, Interior Door	1964	6 Each		Double Door
C1020		Wood, Painted, Fully Glazed, Interior Door	1990	5 Each		
C1020		Wood, Painted, Fully Glazed, Interior Door	1964	4 Each		
C1020		Wood, Painted, Fully Glazed, Interior Door	2000	6 Each		
C1020		Wood, Painted, Fully Glazed, Interior Door	2005	3 Each		
C2010		Metal, Painted, Interior Railing	1964	650 Ln Ft		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

05-Mar-13

Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
C2010		Metal, Painted, Interior Stairs	1964	2592 Sq Ft		
C3010		Ceramic Tile, 4"x4", Interior Wall Finish	1990	1782 Sq Ft		
C3010		Ceramic Tile, 4"x4", Interior Wall Finish	1990	2160 Sq Ft		
C3010		Concrete, Painted, Interior Wall Finish	1964	9990 Sq Ft		
C3010		Fabric, Interior Wall Finish	1995	1300 Sq Ft		
C3010		Gypsum Board, Interior Wall Finish	1964	103950 Sq Ft		
C3010		Gypsum Board, Interior Wall Finish	1995	93100 Sq Ft		
C3010		Steel, Interior Wall Finish	1964	504 Sq Ft		
C3010		Wallpaper, Interior Wall Finish	2000	3330 Sq Ft		
C3010		Wallpaper, Interior Wall Finish	1995	864 Sq Ft		
C3010		Wallpaper, Interior Wall Finish	2005	1080 Sq Ft		
C3020		Carpet, Nylon 20 oz., Low Traffic	2000	38408 Sq Ft		
C3020		Carpet, Nylon 20 oz., Low Traffic	1995	50585 Sq Ft		
C3020		Carpet, Nylon 20 oz., Low Traffic	2010	4060 Sq Ft		
C3020		Carpet, Nylon 20 oz., Low Traffic	2005	5135 Sq Ft		
C3020		Ceramic Tile Flooring	1964	3500 Sq Ft		
C3020		Ceramic Tile Flooring	2000	1000 Sq Ft		
C3020		Concrete Flooring	1964	6556 Sq Ft		
C3020		Vinyl Tile Flooring	1995	1685 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	2000	40854 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	1995	45750 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	2010	760 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	1964	10700 Sq Ft		
C3030		Acoustical Tile, Dropped Ceiling	2005	500 Sq Ft		
C3030		Concrete Ceiling	1964	72 Sq Ft		
C3030		Gypsum Board, Finished Ceiling	2000	3841 Sq Ft		
C3030		Metal Ceiling	1964	183 Sq Ft		
D1010		Elevator, Geared, 3,500 lbs, 6-15 Floor, 350 fpm	1964	3 Each		
D1010		Elevator, Hydraulic, 2,500 lbs, 3-5 Floor, 200 fpm	1964	1 Each		
D2010		Drinking Fountain, Refrigerated	2000	12 Each		
D2010		Lavatory, Vitreous China	2000	38 Each		
D2010		Service Sink, Floor	1964	5 Each		
D2010		Tankless Water Closet	2000	56 Each		
D2010		Urinal, Vitreous China	2000	19 Each		
D2020		Ball Valve, 4"	1990	4 Each		
D2020	PMP-005	Booster Pump, 1 1/2 HP	2000	1 Each		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D2020		Circulator Pump, 1/2 HP, Hot Water	1990	1 Each		
D2020		Circulator Pump, 3 HP, Cold Water	2010	2 Each		
D2020		Circulator Pump, 3 HP, Hot Water	1990	1 Each		
D2020		Pipe & Fittings, 2" Copper, Cold Water	1964	0.244 K Ln Ft		
D2020		Pipe & Fittings, 2" Copper, Hot Water	1964	0.168 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Cold Water	1964	0.072 K Ln Ft		
D2020		Pipe & Fittings, 3/4" Copper, Hot Water	1964	0.216 K Ln Ft		
D2020		Pipe & Fittings, 4" Copper, Cold Water	1964	0.288 K Ln Ft		
D2020		Pipe Insulation, Fiberglass, Cold Water	1964	0.604 K Ln Ft		
D2020		Pipe Insulation, Fiberglass, Hot Water	1964	0.384 K Ln Ft		
D2020		Water Heater, Electric, 120 Gal.	2010	1 Each		
D2020		Water Storage Tank, 500 Gal.	1964	1 Each		
D2030		Backflow Preventer, 2"	1964	2 Each		
D2030		Floor Drain	1964	20 Each		
D2030		Pipe & Fittings, 4" Cast Iron	1964	0.288 K Ln Ft		
D2030		Pipe & Fittings, 6" Cast Iron	1964	0.12 K Ln Ft		
D2030		Pipe & Fittings, 8" PVC	1964	0.192 K Ln Ft		
D2040		Pipe & Fittings, 4" PVC	1964	0.12 K Ln Ft		
D2040		Pipe & Fittings, 6" PVC	1964	0.168 K Ln Ft		
D2040		Roof Drain, 4-6"	1964	6 Each		
D2040		Sump Pump, 3 HP	1995	2 Each		2 HP
D2040		Sump Pump, 3 HP	2010	2 Each		2 HP
D2090	AC-1, 2	Air Compressor, 5 HP	2010	2 Each		
D2090		Compressed Air Dryer	2005	2 Each		
D3020		Expansion Tank, 10 Gal.	2000	1 Each		DHW
D3020		Pipe & Fittings, 2" Steel	1964	0.55 K Ln Ft		
D3020		Pipe & Fittings, 3" Steel	1964	0.25 K Ln Ft		
D3020		Pipe & Fittings, 6" Steel	1964	0.25 K Ln Ft		
D3020		Pipe Insulation, Fiberglass, Heating Water/Steam	1964	1 K Ln Ft		
D3030		Ball Valve, 4"	1990	4 Each		
D3030	CHWP-1, 2	Circulation Pump, 10 HP, Chiller & Condenser Water	2010	2 Each		
D3030		Pipe & Fittings, 2" Steel	1964	0.75 K Ln Ft		
D3030		Pipe & Fittings, 4" Steel	1964	0.25 K Ln Ft		
D3030		Pipe & Fittings, 6" Steel	1964	0.1 K Ln Ft		
D3030		Pipe & Fittings, 8" Steel	1964	0.05 K Ln Ft		
D3030		Pipe Insulation, Fiberglass, Chilled Water	1964	1.15 K Ln Ft		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D3040	AHU-1, 2	Air Handler, Multizone, 100,000 Cfm	1964	2 Each	Basement	Includes SAF-1, 2
D3040		Duct Insulation, Fiberglass Blanket	1964	49950 Sq Ft		
D3040		Ductwork	1964	66600 Lbs		
D3040	EF-6	Exhaust Fan, Centrifugal, 10,000 Cfm	1964	1 Each		
D3040	EF-1	Exhaust Fan, Centrifugal, 5,000 Cfm	1964	1 Each		
D3040	EF-3, 4, 5, 8	Exhaust Fan, Roof Mounted, 1,500 Cfm	1964	4 Each		
D3040	EF-2	Exhaust Fan, Roof Mounted, 8,500 Cfm	1964	1 Each		
D3040	EF-7	Exhaust Fan, Roof Mounted, 800 Cfm	1964	1 Each		
D3040	RAF-1, 2	Supply Fan, Centrifugal, 60,000 Cfm	1964	2 Each		
D3040		Variable Air Volume Control Box	1964	177 Each		
D3060		Direct Digital Controls, System Points	1999	114 Each		
D3060		HVAC Control Panel	1964	1 Each		
D3060		Thermostat	1964	150 Each		
D3060		Thermostat	2005	95 Each		
D4010		Fire Alarm Control Panel	2000	1 Each		
D4010		Fire Department Connection, Siamese, 3"	1995	12 Each		Interior
D4010		Fire Sprinkler Head	1995	640 Each		
D4010		Fire Sprinkler System	1995	1 Each		
D4010		Fire Suppression System Water Pump, 10 HP	2000	1 Each		15 hp
D4010		Pipe & Fittings, 2" Steel	1995	5.1 K Ln Ft		
D4010		Pipe & Fittings, 3" Steel	1995	1.2 K Ln Ft		
D4010		Pipe & Fittings, 4" Steel	1995	0.15 K Ln Ft		
D4010		Valves & Components, Sprinkler System, 3"	1995	4 Each		
D5010		Bus Duct & Fittings, AL, 800-4,000 Amp.	1964	84 Ln Ft		
D5010		Disconnect Switch, 100 Amp.	1990	4 Each		
D5010		Disconnect Switch, 30 Amp.	1964	3 Each		
D5010		Disconnect Switch, 30 Amp.	1990	3 Each		
D5010		Disconnect Switch, 400 Amp.	1964	1 Each		
D5010		Disconnect Switch, 60 Amp.	1964	3 Each		
D5010		Motor Starter, <5HP, <600V	1995	3 Each		
D5010		Motor Starter, 5-20 HP, <600 V	1995	2 Each		
D5010		Power Panel Board, 208 Y/120 V, 100 Amp.	1990	5 Each		
D5010		Power Panel Board, 208 Y/120 V, 100 Amp.	2000	2 Each		
D5010		Power Panel Board, 208 Y/120 V, 100 Amp.	1964	1 Each		
D5010		Power Panel Board, 208 Y/120 V, 100 Amp.	2000	1 Each		125A
D5010		Power Panel Board, 208 Y/120 V, 200 Amp.	1990	1 Each		150A

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D5010		Power Panel Board, 208 Y/120 V, 225 Amp	1964	15 Each		
D5010		Power Panel Board, 480 V, 100 Amp.	1964	1 Each		
D5010		Power Panel Board, 480 V, 200 Amp.	1964	5 Each		225A
D5010		Power Panel Board, 480 V, 400 Amp.	1964	3 Each		300A
D5010		Secondary Transformer, Dry, 2 kVA	1964	1 Each		
D5010		Secondary Transformer, Dry, 30 kVA	1964	1 Each		
D5010		Secondary Transformer, Dry, 75 kVA	1964	3 Each		
D5010		Switchgear, Indoor, 600 V	1964	1 Each		
D5010		Variable Frequency Drive, <600 V	1995	5 Each		
D5020		Compact Fluorescent Lighting Fixture, 32 w	2000	146 Each		
D5020		Emergency Lighting Pack, 2 Light w/ Battery	1995	20 Each		
D5020		Exit Lighting Fixture, w/ Battery	2000	3 Each		
D5020		Fluorescent Lighting Fixture, T8, 2-32w	1964	12 Each		
D5020		Fluorescent Lighting Fixture, T8, 2-32w	1990	348 Each		
D5020		Fluorescent Lighting Fixture, T8, 4-32 w	1990	1410 Each		
D5020		Incandescent Lighting Fixture, Basic, 100 w	1964	13 Each		
D5020		Incandescent Lighting Fixture, Basic, 100 w	1995	30 Each		
D5020		Metal Halide Lighting Fixture, Wall Mount, 150 w	1990	4 Each		
D5020		Receptacle, 120 V, 15 Amp.	2005	200 Each		
D5020		Receptacle, 120 V, 15 Amp.	1995	1200 Each		
D5020		Receptacle, 120 V, 15 Amp.	1964	200 Each		
D5020		Receptacle, 120 V, 15 Amp.	2005	350 Each		
D5020		Wiring Device, Switch	1964	250 Each		
D5020		Wiring Device, Switch	1995	350 Each		
D5030		Camera, Exterior, Closed Circuit, PTZ B/W	2006	2 Each		
D5030		Camera, Interior, Closed Circuit, Fixed B/W	2006	9 Each		
D5030		Camera, Interior, Closed Circuit, PTZ B/W	2006	7 Each		
D5030		Card Reader	2006	4 Each		
D5030		Electric Lock	2006	4 Each		
D5030		Fire Alarm Horn & Strobe	2000	46 Each		
D5030		Heat Detector	2000	2 Each		
D5030		Manual Pull Station	2000	26 Each		
D5030		Motion Detector	2000	40 Each		
D5030		Public Address Speaker	1964	10 Each		
D5030		Public Address Speaker	1995	21 Each		
D5030		Smoke Detector	2000	315 Each		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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Uniformat	Asset Description	Component	Date	Quantity	Location	Notes
D5090		Grounding System	1964	1 K Ln Ft		
D5090		Lightning Protection System	2006	1.18 K Ln Ft		
E1010		Icemaker, Commercial	2000	1 Each		

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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**Average M&R Costs**Whitestone Research

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<b>Building:</b>	Office Building	<b>GSFT:</b>	110,929
<b>Building Number:</b>	1045/62/178	<b>PRV:</b>	\$20,520,846
<b>Facility:</b>	Marshall Space Flight Center	<b>Built Date:</b>	1964
<b>City:</b>	Huntsville, AL		

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**M&R Average Annual Cost Forecasts**

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	<b>Current Year</b>	<b>5 Year</b>	<b>20 Year</b>	<b>50 Year</b>
<b>PM &amp; Minor Repair:</b>	\$106,648	\$96,610	\$105,176	\$105,687
<b>Unscheduled Maintenance:</b>	\$40,810	\$41,943	\$43,153	\$43,375
<b>Renewal &amp; Replacement:</b>	\$82,714	\$461,066	\$398,144	\$380,355
<b>Total M&amp;R Costs:</b>	\$230,172	\$599,619	\$546,473	\$529,417
<b>Per GSFT:</b>	\$2.07	\$5.41	\$4.93	\$4.77
<b>As % of PRV:</b>	1.12%	2.92%	2.66%	2.58%



# M&R Costs by System per Year Chart

**Building:** Office Building

**Facility:** Marshall Space Flight Center

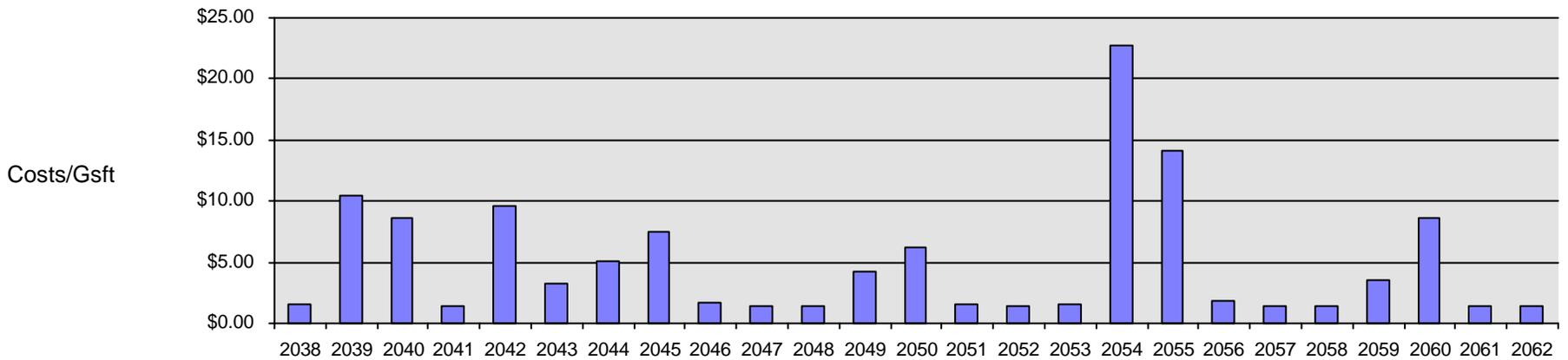
**City:** Huntsville, AL

**Building Num:** 1045/62/178

**GSFT:** 110929

Forecast Year: 2038 9 0 1 2 2043 4 5 6 7 2048 9 0 1 2 2053 4 5 6 7 2058 9 0 1 2 **Total**

	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2	Total	
A10 Foundations																										0.00	
A20 Basement Construction																											0.00
B10 Super Structure		0.00					0.01														0.00						0.02
B20 Exterior Enclosure	0.01	1.12	0.05	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.43	0.01	0.00	0.01	0.00	17.63	0.00	0.00	0.00	0.00	0.43	0.01	0.00	0.00	39.84	
B30 Roofing	0.06	0.02	0.02	0.02	0.02	1.85	0.10	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.06	0.88	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	5.11	
C10 Interior Construction	0.01	0.17	0.72	0.07	0.00	0.00	0.36	1.26	0.00	0.00	0.03	0.17	0.32	0.00	0.03	0.07	0.45	1.75	0.01		0.02	0.17	0.59		0.02	13.20	
C20 Stairs	0.00	0.72			0.00	0.02	0.01		0.00	0.02			0.00	0.02			0.06	0.02			0.00	0.03			0.00	1.29	
C30 Interior Finishes		4.96	3.71	0.00		0.01	0.03	3.31		0.00	0.02	0.93	0.61	0.00	0.01	0.02	0.01	4.39	0.00	0.02	0.00	0.93	2.66	0.01	0.02	39.35	
D10 Conveying	0.75	1.77	0.75	0.75	4.16	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	46.56	
D20 Plumbing	0.04	0.23	0.29	0.08	0.08	0.06	0.17	0.14	0.04	0.07	0.04	0.09	0.48	0.07	0.04	0.05	0.11	0.24	0.08	0.05	0.08	0.07	0.36	0.05	0.04	6.49	
D30 HVAC	0.47	1.04	0.28	0.28	5.13	0.28	2.72	0.56	0.28	0.28	0.28	0.92	0.29	0.45	0.28	0.28	0.75	5.40	0.36	0.28	0.28	0.89	1.17	0.28	0.31	45.61	
D40 Fire Protection	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.59	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.40	0.05	0.05	0.05	0.05	0.11	0.05	0.05	4.33	
D50 Electrical	0.17	0.30	2.55	0.19	0.17	0.19	0.35	0.77	0.52	0.18	0.17	0.89	3.46	0.18	0.17	0.18	1.97	1.12	0.60	0.18	0.17	0.19	2.70	0.19	0.17	35.41	
E10 Equipment	0.01	0.01	0.15	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15	0.01	0.01	1.42	
E20 Furnishings																										0.00	
F10 Special Construction																										0.00	
F20 Selective Bldg Demolition																										0.00	
G10 Site Preparation																										0.00	
G20 Site Improvements																										0.00	
G30 Site Mechanical Utilities																										0.00	
G40 Site Electrical Utilities																										0.00	
G90 Other Site Construction																										0.00	
<b>Total</b>	<b>1.58</b>	<b>10.39</b>	<b>8.59</b>	<b>1.47</b>	<b>9.62</b>	<b>3.25</b>	<b>5.04</b>	<b>7.43</b>	<b>1.69</b>	<b>1.39</b>	<b>1.40</b>	<b>4.28</b>	<b>6.15</b>	<b>1.56</b>	<b>1.38</b>	<b>1.49</b>	<b>22.68</b>	<b>14.10</b>	<b>1.89</b>	<b>1.38</b>	<b>1.41</b>	<b>3.55</b>	<b>8.55</b>	<b>1.37</b>	<b>1.41</b>	<b>238.63</b>	



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft. Year 26-50 Based on a 50-Year Forecast.





# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Replace Membrane, Single-Ply Roof w/ TPO Membrane																									
Minor Replacement, Single-Ply Roof w/ TPO (2% of Roof)						2,793					2,793														
Repair Metal Canopy																									
Refinish Metal Canopy		4,160																				4,160			
Maintain Single-Ply Roof w/ TPO Membrane	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	
Non-Destructive Moisture Inspection	1,689					1,689					1,689					1,689					1,689				

## C10 Interior Construction

Refinish Wood, Hollow Core, Painted, Interior Door			8,023	2,000			8,023	2,000			8,023					2,000	8,023			2,000	8,023			2,000	8,023
Replace Steel, Painted, Interior Double Door Locks		313										313										313			
Replace Steel, Painted, Interior Double Door																									
Finish Replaced Steel, Painted, Interior Double Doors																									
Refinish Wood, Painted, Fully Glazed, Interior Door	70	116		139	70	209		139	70	209		139	70	209		139	70	209		139	70	209		139	70
Replace Aluminum, Fully Glazed, Interior Door Locks			313					313				1,254	313				313				1,254	313			
Maintain Wood, Painted, Fully Glazed, Interior Door Locks			311				89	311				89	311			89	311				89	311			
Replace Wood, Painted, Fully Glazed, Interior Door Locks			940					3,449				1,254	940				3,449				1,254	940			
Finish Replaced Wood, Painted, Fully Glazed, Interior Door			93																						
Maintain Wood, Hollow Core, Painted, Interior Door Locks		1,915	7,685				1,915	7,685								1,915	7,685				1,915	7,685			
Replace Wood, Hollow Core, Painted, Interior Door Locks		26,966	108,175																		26,966	108,175			
Replace Wood, Hollow Core, Painted, Interior Door												44,113	176,965												
Finish Replaced Wood, Hollow Core, Painted, Interior Door												2,000	8,023												
Maintain Steel, Painted, Interior Double Door Locks		22					22					22				22					22				
Replace Wood, Painted, Fully Glazed, Interior Door		7,430																							
Replace Aluminum Frame, Fully Glazed, Sliding Interior Door																									
Refinish Steel, Painted, Interior Door				302				302				302				302					302				302
Refinish Toilet Partitions, Painted Metal, Overhead Braced				1,163								1,163				1,163					1,163				1,163
Replace Toilet Partitions, Painted Metal, Overhead Braced								39,535																	
Maintain Aluminum Frame, Fully Glazed, Sliding Interior Door			44					44				44				44					44				44
Refinish Steel, Painted, Interior Double Door				45				45				45				45					45				45
Repair Aluminum Frame, Fully Glazed, Sliding Interior Door		459											459												
Maintain Aluminum, Fully Glazed, Interior Door Locks			44				89	44				89	44			89	44				89	44			89
Replace Aluminum, Fully Glazed, Interior Door		7,947																							
Maintain Steel, Painted, Interior Door Locks		290					290					290				290					290				290
Replace Steel, Painted, Interior Door Locks		4,076										4,076										4,076			
Replace Steel, Painted, Interior Door																									
Finish Replaced Steel, Painted, Interior Door																									
Replace Door Locks Aluminum Frame, Fully Glazed, Sliding Int								651													651				651

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Membrane, Single-Ply Roof w/ TPO Membrane						205,685																			
Minor Replacement, Single-Ply Roof w/ TPO (2% of Roof)	2,793															2,793									
Repair Metal Canopy							4,171																		
Refinish Metal Canopy							4,160																		
Maintain Single-Ply Roof w/ TPO Membrane	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733	1,733
Non-Destructive Moisture Inspection	1,689										1,689					1,689					1,689				

## C10 Interior Construction

Refinish Wood, Hollow Core, Painted, Interior Door		2,000	8,023			2,000	8,023				2,000	8,023			2,000	8,023					2,000	8,023			2,000
Replace Steel, Painted, Interior Double Door Locks												313										313			
Replace Steel, Painted, Interior Double Door		1,801																							
Finish Replaced Steel, Painted, Interior Double Doors		45																							
Refinish Wood, Painted, Fully Glazed, Interior Door	209	139	70	93		256	70	93		256	70	93		116	70	232		116		232	70	116		232	
Replace Aluminum, Fully Glazed, Interior Door Locks						1,254	313									1,254									313
Maintain Wood, Painted, Fully Glazed, Interior Door Locks		89	200			89	311				89	178				89	244				89	311			
Replace Wood, Painted, Fully Glazed, Interior Door Locks		1,882				1,254	940				1,568					1,254									3,449
Finish Replaced Wood, Painted, Fully Glazed, Interior Door			116									139						70							
Maintain Wood, Hollow Core, Painted, Interior Door Locks		1,915	7,685			1,915	7,685				1,915	7,685									1,915	7,685			
Replace Wood, Hollow Core, Painted, Interior Door Locks						26,966	108,175																		
Replace Wood, Hollow Core, Painted, Interior Door																44,113	176,965								
Finish Replaced Wood, Hollow Core, Painted, Interior Door																2,000	8,023								
Maintain Steel, Painted, Interior Double Door Locks						22					22					22					22				
Replace Wood, Painted, Fully Glazed, Interior Door		9,288									11,145						5,572								
Replace Aluminum Frame, Fully Glazed, Sliding Interior Door		4,037																							
Refinish Steel, Painted, Interior Door						302					302					302					302				
Refinish Toilet Partitions, Painted Metal, Overhead Braced						1,163					1,163					1,163					1,163				
Replace Toilet Partitions, Painted Metal, Overhead Braced		39,535																							39,535
Maintain Aluminum Frame, Fully Glazed, Sliding Interior Door							44					44					44								44
Refinish Steel, Painted, Interior Double Door						45					45					45					45				
Repair Aluminum Frame, Fully Glazed, Sliding Interior Door		459														459									
Maintain Aluminum, Fully Glazed, Interior Door Locks		89	22			89	44				89	44				89	22				89	44			
Replace Aluminum, Fully Glazed, Interior Door		1,987															1,987								
Maintain Steel, Painted, Interior Door Locks						290					290					290					290				
Replace Steel, Painted, Interior Door Locks											4,076											4,076			
Replace Steel, Painted, Interior Door		10,772																							
Finish Replaced Steel, Painted, Interior Door		302																							
Replace Door Locks Aluminum Frame, Fully Glazed, Sliding I																651									651





# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7	
Finish Replaced Concrete, Painted, Interior Wall Finish																										
Replace Fabric, Interior Wall Finish													1,822													
Repair Gypsum Board, Interior Wall Finish (2% of Walls)			3,621									4,043											3,621			
Finish Repaired Gypsum Board, Interior Wall Finish			1,566									1,748											1,566			
Replace Gypsum Board, Interior Wall Finish																										
Finish Replaced Gypsum Board, Interior Wall Finish																										
Repair Steel, Interior Wall Finish (2% of Walls)		290																								
Replace Steel, Interior Wall Finish																										
Replace Wallpaper, Interior Wall Finish			1,342					5,174					1,679										1,342			
Repair Fabric, Interior Wall Finish (2% of Walls)			38																				38			

## D10 Conveying

Renovate Elevator, Geared, 3,500 lbs, 6-15 Floor, 350 fpm																										
Maintain Elevator, Hydraulic, 2,500 lbs, 3-5 Floor, 200 fpm	9,202		9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	9,202	
Maintain Elevator, Geared, 3,500 lbs, 6-15 Floor, 350 fpm	58,541	58,541	58,541	58,541		58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	58,541	
Renovate Elevator, Hydraulic, 2,500 lbs, 3-5 Floor, 200 fpm	123,352																									

## D20 Plumbing

Maintain Backflow Preventer, 2"	211		211	211	211	211	211	211	211	211		211	211	211	211	211	211	211	211	211	211		211	211	211	
Replace Water Storage Tank, 500 Gal.												3,808														
Maintain Water Storage Tank, 500 Gal.	87	87	87	87	87	87	87	87	87	87	87		87	87	87	87	87	87	87	87	87	87	87	87	87	
Replace Water Heater, Electric, 120 Gal.													9,775													
Drain & Flush Water Heater, Electric, 120 Gal.					236							236										236				
Check Operation, Water Heater, Electric, 120 Gal.	19		19			19			19						19			19				19			19	
Replace Pipe Insulation, Fiberglass, Hot Water (20% of Insulation)		302																								
Re-tape Pipe Insulation, Fiberglass, Hot Water						100						100					100					100				
Replace 10' Section, Pipe & Fittings, 4" DWV PVC		39																				39				
Replace Pipe Insulation, Fiberglass, Cold Water (20% of Insulation)		475																								
Re-tape Pipe Insulation, Fiberglass, Cold Water						157						157					157					157				
Replace Pipe & Fittings, 4" Copper, Cold Water (20% of Pipe)		7,569																								
Replace 10' Section, Pipe & Fittings, 4" Copper, Cold Water																							379			
Resolder Joint, Pipe & Fittings, 4" Copper, Cold Water												101										101				
Replace Pipe & Fittings, 2" Copper, Hot Water (20% of Pipe)		1,492																								
Replace Backflow Preventer, 2"		3,560										3,560										3,560				
Replace 10' Section, Pipe & Fittings, 2" Copper, Hot Water																							75			
Resolder Joint, Pipe & Fittings, 2" Copper, Hot Water												59										59				
Overhaul Sump Pump, 3 HP			93				186						186					93					93			
Inspect & Lubricate Sump Pump, 3 HP	93	93	46	93	93	93	93	93	93	93	93	93	93	93	93	93	93	46	93	93	93	93	46	93	93	



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Replace Roof Drain, 4-6"																									
Maintain Roof Drain, 4-6"	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)												1,364													
Replace 10' Section, Pipe & Fittings, 6" DWV PVC		73																				73			
Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)												746													
Replace 10' Section, Pipe & Fittings, 8" DWV PVC		103																				103			
Replace Pipe & Fittings, 8" DWV PVC (20% of Pipe)												2,069													
Maintain Floor Drain	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460
Replace Pipe & Fittings, 6" Cast Iron (20% of Pipe)																									
Install New Gasket & Bolts, Pipe & Fittings, 6" Cast Iron		21																							
Replace 10' Section, Pipe & Fittings, 6" Cast Iron												88											88		
Replace Pipe & Fittings, 4" Cast Iron (20% of Pipe)																									
Install New Gasket & Bolts, Pipe & Fittings, 4" Cast Iron		48																							
Replace 10' Section, Pipe & Fittings, 4" Cast Iron												164											164		
Replace Floor Drain																									
Inspect & Lubricate Circulator Pump, 3 HP, Hot Water	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Replace Faucet Washer & Clean Trap, Sink, Floor		56		56		56		56		56		56		56		56		56		56		56		56	
Lubricate, Repack Gland, Ball Valve, 4"	112	112	112	112	112	112	112	112	112	112	112		112	112	112	112	112	112	112	112	112	112	112	112	112
Replace Urinal, Vitreous China																								13,952	
Replace Flush Valve, Urinal, Vitreous China		2,466							2,466							2,466									
Replace Tankless Water Closet																							34,211		
Replace Flush Valve, Tankless Water Closet								1,090									1,090								
Replace Sink, Enameled Steel																						6,026			
Replace Circulator Pump, 3 HP, Hot Water																			7,880						
Repair Strainer, Sink, Floor									278							278									
Overhaul Booster Pump, 1 1/2 HP			109															109					109		
Replace Lavatory, Vitreous China																							16,509		
Replace Valve Set, Lavatory, Vitreous China									4,703									4,703							
Replace Washer & Spud Connection, Lavatory, Vitreous China		1,384								1,384						1,384									
Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chin		756		756		756		756		756		756		756		756		756		756		756		756	
Replace Drinking Fountain, Refrigerated																							11,355		
Replace Coolant & Adjust Drinking Fountain, Refrigerated		294		294		294				294		294		294		294				294		294		294	
Repair Air Compressor, 5 HP		1,318				1,318				1,318				1,318				1,318				1,318		1,318	
Replace Valve Set, Sink, Enameled Steel		492										492													
Replace Circulator Pump, 3 HP, Cold Water																							15,760		
Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water																							108		
Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water												85											85		

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Roof Drain, 4-6"	2,836																								
Maintain Roof Drain, 4-6"	141	141	141	141	141	141		141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)	1,364																								
Replace 10' Section, Pipe & Fittings, 6" DWV PVC	73																								
Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)	746																								
Replace 10' Section, Pipe & Fittings, 8" DWV PVC	103																								
Replace Pipe & Fittings, 8" DWV PVC (20% of Pipe)	2,069																								
Maintain Floor Drain	460	460	460	460	460	460		460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460
Replace Pipe & Fittings, 6" Cast Iron (20% of Pipe)	1,761																								
Install New Gasket & Bolts, Pipe & Fittings, 6" Cast Iron																									
Replace 10' Section, Pipe & Fittings, 6" Cast Iron	88																								
Replace Pipe & Fittings, 4" Cast Iron (20% of Pipe)	3,265																								
Install New Gasket & Bolts, Pipe & Fittings, 4" Cast Iron																									
Replace 10' Section, Pipe & Fittings, 4" Cast Iron	164																								
Replace Floor Drain	5,670																								
Inspect & Lubricate Circulator Pump, 3 HP, Hot Water	23	23	23	23	23	23		23	23	23	23	23		23	23	23	23	23	23	23	23	23	23	23	23
Replace Faucet Washer & Clean Trap, Sink, Floor	56		56		56		56		56		56		56		56		56		56		56		56		56
Lubricate, Repack Gland, Ball Valve, 4"	112	112	112		112	112		112	112	112	112	112		112	112	112	112	112	112	112		112	112	112	112
Replace Urinal, Vitreous China																									
Replace Flush Valve, Urinal, Vitreous China	2,466					2,466					2,466														
Replace Tankless Water Closet																									
Replace Flush Valve, Tankless Water Closet	1,090										1,090														
Replace Sink, Enameled Steel																									
Replace Circulator Pump, 3 HP, Hot Water													7,880												
Repair Strainer, Sink, Floor	278					278					278														
Overhaul Booster Pump, 1 1/2 HP						109					109					109									
Replace Lavatory, Vitreous China																									
Replace Valve Set, Lavatory, Vitreous China	4,703										4,703														
Replace Washer & Spud Connection, Lavatory, Vitreous Chin	1,384					1,384					1,384					1,384									
Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chi	756		756		756		756		756		756		756		756		756		756		756		756		756
Replace Drinking Fountain, Refrigerated	11,355										11,355										11,355				
Replace Coolant & Adjust Drinking Fountain, Refrigerated	294				294		294		294		294		294		294		294		294		294		294		294
Repair Air Compressor, 5 HP	1,318					1,318					1,318					1,318									
Replace Valve Set, Sink, Enameled Steel	492										492														
Replace Circulator Pump, 3 HP, Cold Water													15,760												
Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water																					108				
Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water													85												

# M&R Costs by Task

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

	Forecast Year:																									
	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7	
Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe)	818																									
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water																						40				
Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water												76										76				
Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pipe)	273																									
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water																						13				
Replace Ball Valve, 4"												3,839														
Overhaul Circulator Pump, 3 HP, Hot Water			46					46					46										46			
Inspect & Lubricate Booster Pump, 1 1/2 HP	23	23	23	23	23	23	23		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
Overhaul Circulator Pump, 3 HP, Cold Water			92					92					92										92			
Inspect & Lubricate Circulator Pump, 3 HP, Cold Water	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	
Replace Circulator Pump, 1/2 HP, Hot Water																						2,863				
Overhaul Circulator Pump, 1/2 HP, Hot Water			46					46					46										46			
Inspect & Lubricate Circulator Pump, 1/2 HP, Hot Water	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
Replace Assembly, Booster Pump, 1 1/2 HP								6,131																		
Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe)	2,166																									
Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water												25										25				
Replace Pump & Motor Assembly, Sump Pump, 3 HP			2,819																		2,819		2,819			
Replace Air Compressor, 5 HP																							15,279			
Check & Adjust Compressed Air Dryer	59	59	59	59	59	59	59		59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	
Recharge Compressed Air Dryer			117										117									117				
Replace Compressor, Compressed Air Dryer			2,868																			2,868				
Replace Compressed Air Dryer								8,485															8,485			
Check & Adjust, Air Compressor, 5 HP	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	

## D30 HVAC

Replace Duct Insulation (20% of Insulation)																										
Maintain Exhaust Fan, Roof Mounted, 800 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	
Replace Supply Fan, Centrifugal, 60,000 Cfm																							83,147			
Repair Supply Fan, Centrifugal, 60,000 Cfm				2,221																		2,221				
Maintain Supply Fan, Centrifugal, 60,000 Cfm	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	
Replace Exhaust Fan, Centrifugal, 10,000 Cfm																								5,186		
Repair Exhaust Fan, Centrifugal, 10,000 Cfm				192																		192				
Maintain Exhaust Fan, Centrifugal, 10,000 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	
Replace Exhaust Fan, Centrifugal, 5,000 Cfm																								3,186		
Repair Exhaust Fan, Centrifugal, 5,000 Cfm				192																		192				
Repair Exhaust Fan, Roof Mounted, 800 Cfm				192																		192				
Replace Existing Ductwork (20% of Ductwork)																										
Maintain Exhaust Fan, Roof Mounted, 8,500 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe		818																							
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water																						40			
Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water													76									76			
Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pip		273																							
Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water																						13			
Replace Ball Valve, 4"						3,839																3,839			
Overhaul Circulator Pump, 3 HP, Hot Water			46						46										46				46		
Inspect & Lubricate Booster Pump, 1 1/2 HP	23	23		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Overhaul Circulator Pump, 3 HP, Cold Water			92						92										92				92		
Inspect & Lubricate Circulator Pump, 3 HP, Cold Water	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Replace Circulator Pump, 1/2 HP, Hot Water																2,863									
Overhaul Circulator Pump, 1/2 HP, Hot Water			46						46										46				46		
Inspect & Lubricate Circulator Pump, 1/2 HP, Hot Water	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Replace Assembly, Booster Pump, 1 1/2 HP			6,131																				6,131		
Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe)		2,166																							
Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water													25									25			
Replace Pump & Motor Assembly, Sump Pump, 3 HP													2,819					2,819							
Replace Air Compressor, 5 HP																							15,279		
Check & Adjust Compressed Air Dryer	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Recharge Compressed Air Dryer			117						117										117				117		
Replace Compressor, Compressed Air Dryer									2,868														2,868		
Replace Compressed Air Dryer																8,485									
Check & Adjust, Air Compressor, 5 HP	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131

## D30 HVAC

Replace Duct Insulation (20% of Insulation)						41,207																			
Maintain Exhaust Fan, Roof Mounted, 800 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
Replace Supply Fan, Centrifugal, 60,000 Cfm																							83,147		
Repair Supply Fan, Centrifugal, 60,000 Cfm																2,221									
Maintain Supply Fan, Centrifugal, 60,000 Cfm	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440
Replace Exhaust Fan, Centrifugal, 10,000 Cfm																							5,186		
Repair Exhaust Fan, Centrifugal, 10,000 Cfm																192									
Maintain Exhaust Fan, Centrifugal, 10,000 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
Replace Exhaust Fan, Centrifugal, 5,000 Cfm																							3,186		
Repair Exhaust Fan, Centrifugal, 5,000 Cfm																192									
Repair Exhaust Fan, Roof Mounted, 800 Cfm																192									
Replace Existing Ductwork (20% of Ductwork)						106,895																			
Maintain Exhaust Fan, Roof Mounted, 8,500 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Replace Air Handler, Multizone, 100,000 Cfm				539,986													539,986								
Repair Air Handler, Multizone, 100,000 Cfm													17,824												
Maintain Exhaust Fan, Centrifugal, 5,000 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
Maintain Variable Air Volume Control Box	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411		8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411
Replace Thermostat		53,197	33,691									53,197	33,691								53,197	33,691			
Replace HVAC Control Panel												3,354													
Minor Repair, HVAC Control Panel		213					213										213				213				
Inspect & Maintain HVAC Control Panel	47	47	47	47	47	47	47	47	47	47	47		47	47	47	47	47	47	47	47	47	47	47	47	47
Replace Direct Digital Controls, System Points																	70,327				70,327				
Repair Exhaust Fan, Roof Mounted, 1,500 Cfm				777													777				777				
Replace Variable Air Volume Control Box													87,454												
Replace Exhaust Fan, Roof Mounted, 800 Cfm																								1,080	
Replace Exhaust Fan, Roof Mounted, 8,500 Cfm																								3,237	
Repair Exhaust Fan, Roof Mounted, 8,500 Cfm				287													287								
Maintain Thermostat	4,788	1,856	2,932	4,788	4,788	4,788	4,788	4,788	4,788	4,788	4,788	1,856	2,932	4,788	4,788	4,788	4,788	4,788	4,788	4,788	4,788	1,856	2,932	4,788	4,788
Replace Exhaust Fan, Roof Mounted, 1,500 Cfm																								4,866	
Maintain Air Handler, Multizone, 100,000 Cfm	1,943	1,943	1,943		1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943		1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943
Maintain Exhaust Fan, Roof Mounted, 1,500 Cfm	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356
Monitor Direct Digital Controls, System Points	2,228	2,228	2,228	2,228	2,228	2,228		2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228		2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228
Replace 10' Section, Pipe & Fittings, 3" Steel													73												73
Replace Ball Valve, 4"		3,841																							
Lubricate, Repack Gland, Ball Valve, 4"	279		279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279
Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20		1,096																							
Replace Pipe & Fittings, 6" Steel (20% of Pipe)																									
Replace 10' Section, Pipe & Fittings, 6" Steel													126												126
Maintain Circulation Pump, 10 HP, Chiller & Condenser Water	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel		29																							
Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam								260					260				260				260				
Replace Pipe & Fittings, 2" Steel (20% of Pipe)																									
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel		58																							
Replace 10' Section, Pipe & Fittings, 2" Steel													103												103
Maintain Expansion Tank, 10 Gal.	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Replace Expansion Tank, 10 Gal.																									
Replace Pipe Insulation, Fiberglass, Chilled Water (20% of Ins		904																							
Replace Pipe & Fittings, 3" Steel (20% of Pipe)																									
Replace Pipe & Fittings, 6" Steel (20% of Pipe)																									
Re-tape Pipe Insulation, Fiberglass, Chilled Water								298					298				298				298				

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Air Handler, Multizone, 100,000 Cfm						539,986										539,986									
Repair Air Handler, Multizone, 100,000 Cfm	17,824															17,824									
Maintain Exhaust Fan, Centrifugal, 5,000 Cfm	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
Maintain Variable Air Volume Control Box	8,411	8,411	8,411	8,411	8,411	8,411		8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411
Replace Thermostat							53,197	33,691								53,197	33,691								
Replace HVAC Control Panel		3,354														3,354									
Minor Repair, HVAC Control Panel							213					213										213			
Inspect & Maintain HVAC Control Panel	47		47	47	47	47	47	47	47	47	47	47	47	47	47	47		47	47	47	47	47	47	47	47
Replace Direct Digital Controls, System Points		70,327														70,327						70,327			
Repair Exhaust Fan, Roof Mounted, 1,500 Cfm																777									
Replace Variable Air Volume Control Box							87,454																		
Replace Exhaust Fan, Roof Mounted, 800 Cfm																								1,080	
Replace Exhaust Fan, Roof Mounted, 8,500 Cfm																								3,237	
Repair Exhaust Fan, Roof Mounted, 8,500 Cfm																287									
Maintain Thermostat	4,788	4,788	4,788	4,788	4,788	4,788	1,856	2,932	4,788	4,788	4,788	4,788	4,788	4,788	4,788	1,856	2,932	4,788	4,788	4,788	4,788	4,788	4,788	4,788	4,788
Replace Exhaust Fan, Roof Mounted, 1,500 Cfm																								4,866	
Maintain Air Handler, Multizone, 100,000 Cfm	1,943	1,943	1,943	1,943		1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943		1,943	1,943	1,943	1,943	1,943	1,943	1,943	1,943
Maintain Exhaust Fan, Roof Mounted, 1,500 Cfm	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356	356		356	356
Monitor Direct Digital Controls, System Points	2,228		2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228		2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228		2,228	2,228
Replace 10' Section, Pipe & Fittings, 3" Steel																73									
Replace Ball Valve, 4"	3,841																							3,841	
Lubricate, Repack Gland, Ball Valve, 4"		279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279
Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20		1,096																							
Replace Pipe & Fittings, 6" Steel (20% of Pipe)		2,549																							
Replace 10' Section, Pipe & Fittings, 6" Steel																126									
Maintain Circulation Pump, 10 HP, Chiller & Condenser Water	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84		84	84	84	84	84	84
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel																									
Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam							260					260				260					260				
Replace Pipe & Fittings, 2" Steel (20% of Pipe)		2,058																							
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																									
Replace 10' Section, Pipe & Fittings, 2" Steel																103									
Maintain Expansion Tank, 10 Gal.	19	19	19	19	19	19	19	19	19	19	19	19		19	19	19	19	19	19	19	19	19	19	19	19
Replace Expansion Tank, 10 Gal.																758									
Replace Pipe Insulation, Fiberglass, Chilled Water (20% of In		904																							
Replace Pipe & Fittings, 3" Steel (20% of Pipe)		1,456																							
Replace Pipe & Fittings, 6" Steel (20% of Pipe)		1,020																							
Re-tape Pipe Insulation, Fiberglass, Chilled Water							298					298				298					298				

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Replace Pipe & Fittings, 8" Steel (20% of Pipe)																									
Install New Gasket & Bolts, Pipe & Fittings, 6" Steel		57																							
Replace 10' Section, Pipe & Fittings, 8" Steel												32												32	
Repair Circulation Pump, 10 HP, Chiller & Condenser Water						264								264											
Install New Gasket & Bolts, Pipe & Fittings, 6" Steel		22																							
Replace 10' Section, Pipe & Fittings, 6" Steel												51												51	
Replace Pipe & Fittings, 4" Steel (20% of Pipe)																									
Replace Circulation Pump, 10 HP, Chiller & Condenser Water																					9,252				
Replace 10' Section, Pipe & Fittings, 4" Steel												99												99	
Replace Pipe & Fittings, 2" Steel (20% of Pipe)																									
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel		79																							
Replace 10' Section, Pipe & Fittings, 2" Steel												140												140	
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel		42																							
Install New Gasket & Bolts, Pipe & Fittings, 8" Steel		11																							

## D40 Fire Protection

Inspect & Test Fire Suppression System Water Pump, 10 HP	177	177		177	177	177	177	177	177	177	177	177	177	177	177	177		177	177	177	177	177	177	177	177
Maintain Fire Suppression System Water Pump, 10 HP	404	404		404	404	404	404	404	404	404	404	404	404	404	404	404		404	404	404	404	404	404	404	404
Replace Fire Suppression System Water Pump, 10 HP			5,476																		5,476				
Replace 10' Section, Pipe & Fittings, 2" Steel							951																951		
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel								535																	
Replace 10' Section, Pipe & Fittings, 3" Steel								348															348		
Replace Fire Department Connection, Siamese, 3"																									
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel								142																	
Test Gages & Valves, Fire Sprinkler System	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708
Replace 10' Section, Pipe & Fittings, 4" Steel								60															60		
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel									25																
Replace Fire Sprinkler Head																									
Test Fire Sprinkler Head			18,874										18,874											18,874	
Inspect Fire Sprinkler Head	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378
Replace Fire Alarm Control Panel			3,011																				3,011		
Repair Fire Alarm Control Panel								114						114										114	
Inspect & Test Fire Alarm Control Panel	122	122		122	122	122	122	122	122	122	122	122	122	122	122	122					122	122	122	122	122
Inspect & Maintain Fire Department Connection, Siamese, 3"	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377
Replace Valves & Components, Sprinkler System			12,880																					12,880	
Maintain Fire Sprinkler System	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768

## D50 Electrical

# M&R Costs by Task

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Pipe & Fittings, 8" Steel (20% of Pipe)	653																								
Install New Gasket & Bolts, Pipe & Fittings, 6" Steel																									
Replace 10' Section, Pipe & Fittings, 8" Steel														32											
Repair Circulation Pump, 10 HP, Chiller & Condenser Water				264								264													
Install New Gasket & Bolts, Pipe & Fittings, 6" Steel																									
Replace 10' Section, Pipe & Fittings, 6" Steel														51											
Replace Pipe & Fittings, 4" Steel (20% of Pipe)	1,985																								
Replace Circulation Pump, 10 HP, Chiller & Condenser Water																		9,252							
Replace 10' Section, Pipe & Fittings, 4" Steel														99											
Replace Pipe & Fittings, 2" Steel (20% of Pipe)	2,807																								
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel																									
Replace 10' Section, Pipe & Fittings, 2" Steel																				140					
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel																									
Install New Gasket & Bolts, Pipe & Fittings, 8" Steel																									

## D40 Fire Protection

Inspect & Test Fire Suppression System Water Pump, 10 HP	177	177	177	177	177	177	177		177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
Maintain Fire Suppression System Water Pump, 10 HP	404	404	404	404	404	404	404		404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
Replace Fire Suppression System Water Pump, 10 HP								5,476															5,476	
Replace 10' Section, Pipe & Fittings, 2" Steel						951												951						
Install New Gasket & Bolts, Pipe & Fittings, 2" Steel								535																
Replace 10' Section, Pipe & Fittings, 3" Steel						348												348						
Replace Fire Department Connection, Siamese, 3"								13,571																
Install New Gasket & Bolts, Pipe & Fittings, 3" Steel								142																
Test Gages & Valves, Fire Sprinkler System	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708
Replace 10' Section, Pipe & Fittings, 4" Steel						60												60						
Install New Gasket & Bolts, Pipe & Fittings, 4" Steel								25																
Replace Fire Sprinkler Head								41,186																
Test Fire Sprinkler Head																		18,874						
Inspect Fire Sprinkler Head	378	378	378	378	378	378	378		378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378
Replace Fire Alarm Control Panel								3,011															3,011	
Repair Fire Alarm Control Panel			114											114				114						
Inspect & Test Fire Alarm Control Panel	122	122	122	122	122	122	122		122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	
Inspect & Maintain Fire Department Connection, Siamese, 3"	1,377	1,377	1,377	1,377	1,377	1,377	1,377		1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	
Replace Valves & Components, Sprinkler System																		12,880						
Maintain Fire Sprinkler System	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	

## D50 Electrical

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

	Forecast Year:		2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7		
Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w			117						117	270					270				117	270					117				
Replace Incandescent Lighting Fixture, Basic, 100 w				4,082									1,770												4,082				
Replace Lamp, Metal Halide Lighting Fixture, Wall Mount, 150				382						382					382										382				
Replace Ballast, Metal Halide Lighting Fixture, Wall Mount, 150										803																			
Replace Metal Halide Lighting Fixture, Wall Mount, 150 w																													
Replace Receptacle, 120 V, 15 Amp.				49,042									8,174	22,478											49,042				
Repair Wiring Device, Switch			7,844	10,981																				7,844	10,981				
Replace Fluorescent Lighting Fixture, T8, 4-32 w																													
Annual PM, Motion Detector	228	228	228	228	228	228	228	228	228		228	228	228	228	228	228	228	228	228		228	228	228	228	228	228	228	228	228
Replace Lamp, Exit Lighting Fixture, w/ Battery				215											215						215				215				
Replace Wiring Device, Switch													8,253	11,553															
Replace Fluorescent Lighting Fixture, T8, 2-32 w																													
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4-3										146,187																			
Replace Motion Detector										23,517											23,517								
Replace Exit Lighting Fixture, w/ Battery										982																			
Maintain Card Reader	228	228	228			228	228	228	228	228	228	228	228	228	228			228	228	228	228	228	228	228	228	228	228	228	228
Replace Emergency Lighting Pack, 2 Light w/ Battery				20,114																						20,114			
Replace Lens, Replace Emergency Lighting Pack, 2 Light w/ Ba															622														
Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/ B	1,263				1,263			1,263			1,263		1,263		1,263		1,263		1,263		1,263		1,263		1,263		1,263		
Replace Compact Fluorescent Lighting Fixture, 32 w										12,876																			
Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtur																													
Replace Variable Frequency Drive, <600V	68,424																												
Replace Coil, Variable Frequency Drive, <600V								665					665					665										665	
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2-3			1,244							36,080																1,244			
Check & Repair Manual Pull Station															1,275														
Inspect & Clean Variable Frequency Drive, <600 V			286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286
Replace Lightning Protection General Wiring			2,819																										
Maintain & Repair, Grounding System	67		67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
Maintain & Repair General Wiring, Lightning Protection System	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90		90	90	90	90	90	90	90	90	
Replace Disconnect Switch, 30 Amp.			978																										
Replace Smoke Detector				46,238																									
Annual PM, Grounding System	68		68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	
Repair Smoke Detector															12,465														
Replace Batteries & Check Operation, Smoke Detector	5,654	5,654		5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654		5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	
Replace Public Address Speaker													2,737	5,749															
Maintain Camera, Interior, Closed Circuit, PTZ B/W	400	400	400		400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	
Replace Manual Pull Station			2,946																										

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w		117	270					270				117	270				117					117	270		
Replace Incandescent Lighting Fixture, Basic, 100 w						1,770											4,082								
Replace Lamp, Metal Halide Lighting Fixture, Wall Mount, 150			382					382									382						382		
Replace Ballast, Metal Halide Lighting Fixture, Wall Mount, 15			803																				803		
Replace Metal Halide Lighting Fixture, Wall Mount, 150 w																2,097									
Replace Receptacle, 120 V, 15 Amp.						8,174	22,478										49,042								
Repair Wiring Device, Switch												7,844	10,981												
Replace Fluorescent Lighting Fixture, T8, 4-32 w																233,734									
Annual PM, Motion Detector	228	228		228	228	228	228	228	228	228	228	228		228	228	228	228	228	228	228	228	228		228	228
Replace Lamp, Exit Lighting Fixture, w/ Battery								215								215							215		
Replace Wiring Device, Switch		8,253	11,553														8,253	11,553							
Replace Fluorescent Lighting Fixture, T8, 2-32 w							1,990									57,687									
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4-			146,187																					146,187	
Replace Motion Detector			23,517													23,517								23,517	
Replace Exit Lighting Fixture, w/ Battery			982																					982	
Maintain Card Reader	228	228	228	228	228	228	228			228	228	228	228	228	228	228	228	228			228	228	228	228	228
Replace Emergency Lighting Pack, 2 Light w/ Battery																	20,114								
Replace Lens, Replace Emergency Lighting Pack, 2 Light w/								622																	
Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/		1,263		1,263		1,263		1,263		1,263		1,263		1,263		1,263					1,263		1,263		1,263
Replace Compact Fluorescent Lighting Fixture, 32 w			12,876																					12,876	
Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtu																11,414									
Replace Variable Frequency Drive, <600V																68,424									
Replace Coil, Variable Frequency Drive, <600V				665					665								665						665		
Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2-			36,080														1,244						36,080		
Check & Repair Manual Pull Station			1,275																		1,275				
Inspect & Clean Variable Frequency Drive, <600 V	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286
Replace Lightning Protection General Wiring		2,819																							
Maintain & Repair, Grounding System	67		67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
Maintain & Repair General Wiring, Lightning Protection Syste	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90			90	90	90	90	90
Replace Disconnect Switch, 30 Amp.			978																						
Replace Smoke Detector							46,238																	46,238	
Annual PM, Grounding System	68		68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Repair Smoke Detector			12,465																						
Replace Batteries & Check Operation, Smoke Detector	5,654	5,654	5,654	5,654	5,654	5,654	5,654		5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654		5,654	5,654
Replace Public Address Speaker		2,737	5,749														2,737	5,749							
Maintain Camera, Interior, Closed Circuit, PTZ B/W	400	400	400	400	400	400	400			400	400	400	400	400	400	400	400	400			400	400	400	400	400
Replace Manual Pull Station							2,946																	2,946	

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7
Maintain Camera, Exterior, Closed Circuit, PTZ B/W	114	114	114			114	114	114	114	114	114	114	114			114	114	114	114	114	114	114	114	114	114
Replace Heat Detector			251																						
Repair Heat Detector													83												
Check Operation, Heat Detector	37	37		37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
Replace Fire Alarm Horn & Strobe								6,368																	
Replace Electric Lock				1,004										1,004										1,004	
Replace Card Reader				3,476										3,476										3,476	
Replace Camera, Interior, Closed Circuit, PTZ B/W				16,875										16,875										16,875	
Replace Camera, Interior, Closed Circuit, Fixed B/W				12,834										12,834										12,834	
Maintain Camera, Interior, Closed Circuit, Fixed B/W	514	514	514			514	514	514	514	514	514	514	514			514	514	514	514	514	514	514	514	514	514
Replace Camera, Exterior, Closed Circuit, PTZ B/W				5,858										5,858										5,858	
Maintain Public Address Speaker	585	585	585	585	585	585	585	585	585	585	585	396	189	585	585	585	585	585	585	585	585	585	585	585	585
Replace Disconnect Switch, 400 Amp.		3,994																							
Repair Power Panel Board, 208 Y/120 V, 200 Amp.																									92
Repair Disconnect Switch, 60 Amp.												368												368	
Replace Power Panel Board, 208 Y/120 V, 100 Amp.							19,495				3,899							11,697							
Repair Power Panel Board, 208 Y/120 V, 100 Amp.		92					276											459					92		
Maintain Power Panel Board, 208 Y/120 V, 100 Amp.	515	515	515	515	515	515	515	229	515	515	515	458	515	515	515	515	515	343	515	515	515	515	515	515	515
Replace Motor Starter, 5-20 HP, <600 V	1,357																							1,357	
Replace Coil, Motor Starter, 5-20 HP, <600 V				376			376			376				376				376						376	376
Inspect & Clean Motor Starter, 5-20 HP, <600 V		77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Replace Motor Starter, <5HP, <600V	1,596																							1,596	
Replace Switchgear, Indoor, 600 V												4,193													
Inspect & Clean Motor Starter, <5HP, <600V		115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115		115	115	115	115	115
Replace Power Panel Board, 208 Y/120 V, 200 Amp.								5,612																	
Repair Disconnect Switch, 400 Amp.												219												219	
Maintain Disconnect Switch, 400 Amp.	54		54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Replace Disconnect Switch, 100 Amp.																									
Repair Disconnect Switch, 100 Amp.							565																	565	
Maintain Disconnect Switch, 100 Amp.	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213
Replace Disconnect Switch, 60 Amp.			2,192																						
Maintain Disconnect Switch, 60 Amp.	57		57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
Repair Disconnect Switch, 30 Amp.							359					359						359						359	
Maintain Disconnect Switch, 30 Amp.	113	57	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
Replace Bus Duct & Fittings, AL, 800-4,000 Amp.																								53,499	
Replace Coil, Motor Starter, <5HP, <600V				565			565			565				565				565						565	565
Maintain Secondary Transformer, Dry, 2 kVA	58	58	58	58	58	58	58	58	58	58	58			58	58	58	58	58	58	58	58	58	58	58	58

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2
Maintain Camera, Exterior, Closed Circuit, PTZ B/W	114	114	114	114	114	114	114	114			114	114	114	114	114	114	114	114			114	114	114	114	114
Replace Heat Detector									251																251
Repair Heat Detector			83																83						
Check Operation, Heat Detector	37	37	37	37	37	37	37		37	37	37	37	37	37	37	37	37	37	37	37	37	37		37	37
Replace Fire Alarm Horn & Strobe			6,368																						6,368
Replace Electric Lock									1,004										1,004						
Replace Card Reader									3,476										3,476						
Replace Camera, Interior, Closed Circuit, PTZ B/W									16,875										16,875						
Replace Camera, Interior, Closed Circuit, Fixed B/W									12,834										12,834						
Maintain Camera, Interior, Closed Circuit, Fixed B/W	514	514	514	514	514	514	514	514		514	514	514	514	514	514	514	514	514			514	514	514	514	514
Replace Camera, Exterior, Closed Circuit, PTZ B/W									5,858										5,858						
Maintain Public Address Speaker	585	396	189	585	585	585	585	585	585	585	585	585	585	585	585	585	396	189	585	585	585	585	585	585	585
Replace Disconnect Switch, 400 Amp.																									
Repair Power Panel Board, 208 Y/120 V, 200 Amp.			92																						92
Repair Disconnect Switch, 60 Amp.								368										368							
Replace Power Panel Board, 208 Y/120 V, 100 Amp.													19,495				3,899								11,697
Repair Power Panel Board, 208 Y/120 V, 100 Amp.			734					92						276											459
Maintain Power Panel Board, 208 Y/120 V, 100 Amp.	515	515	515	515	515	515	515	515	515	515	515	515	229	515	515	515	458	515	515	515	515	515	515	343	515
Replace Motor Starter, 5-20 HP, <600 V																1,357									
Replace Coil, Motor Starter, 5-20 HP, <600 V			376			376			376								376		376						376
Inspect & Clean Motor Starter, 5-20 HP, <600 V	77	77	77	77	77	77	77	77	77	77	77			77	77	77	77	77	77	77	77	77	77	77	77
Replace Motor Starter, <5HP, <600V																1,596									
Replace Switchgear, Indoor, 600 V								4,193																	
Inspect & Clean Motor Starter, <5HP, <600V	115	115	115	115	115	115	115	115	115	115	115		115	115	115	115	115	115	115	115	115	115	115	115	115
Replace Power Panel Board, 208 Y/120 V, 200 Amp.																									5,612
Repair Disconnect Switch, 400 Amp.									219										219						
Maintain Disconnect Switch, 400 Amp.	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Replace Disconnect Switch, 100 Amp.			4,850																						
Repair Disconnect Switch, 100 Amp.																									565
Maintain Disconnect Switch, 100 Amp.	213	213		213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213
Replace Disconnect Switch, 60 Amp.																									
Maintain Disconnect Switch, 60 Amp.	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
Repair Disconnect Switch, 30 Amp.																									359
Maintain Disconnect Switch, 30 Amp.	113	113	57	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
Replace Bus Duct & Fittings, AL, 800-4,000 Amp.																									
Replace Coil, Motor Starter, <5HP, <600V			565			565			565								565		565						565
Maintain Secondary Transformer, Dry, 2 kVA	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2013	4	5	6	7	2018	9	0	1	2	2023	4	5	6	7	2028	9	0	1	2	2033	4	5	6	7	
Repair Switchgear, Indoor, 600 V (5% of total fuses)		410																				410				
Maintain Switchgear, Indoor, 600 V			28			28			28						28		28			28			28			
Replace Secondary Transformer, Dry, 75 kVA											18,985															
Repair Secondary Transformer, Dry, 75 kVA		795																				795				
Maintain Secondary Transformer, Dry, 75 kVA	172	172	172	172	172	172	172	172	172	172	172		172	172	172	172	172	172	172	172	172	172	172	172	172	172
Replace Secondary Transformer, Dry, 30 kVA											4,456															
Repair Secondary Transformer, Dry, 30 kVA		265																				265				
Maintain Secondary Transformer, Dry, 30 kVA	58	58	58	58	58	58	58	58	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58
Maintain Power Panel Board, 208 Y/120 V, 200 Amp.	58	58	58	58	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Repair Secondary Transformer, Dry, 2 kVA		236																				236				
Maintain Power Panel Board, 208 Y/120 V, 225 Amp.	857	857	857	857	857	857	857	857	857	857	857		857	857	857	857	857	857	857	857	857	857	857	857	857	857
Replace Power Panel Board, 480 V, 400 Amp.											26,735															
Repair Power Panel Board, 480 V, 400 Amp.		381																				381				
Maintain Power Panel Board, 480 V, 400 Amp.	172	172	172	172	172	172	172	172	172	172	172		172	172	172	172	172	172	172	172	172	172	172	172	172	172
Replace Power Panel Board, 480 V, 200 Amp.											38,159															
Repair Power Panel Board, 480 V, 200 Amp.		459																				459				
Maintain Power Panel Board, 480 V, 200 Amp.	286	286	286	286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286	286	286	286	286	286
Replace Power Panel Board, 480 V, 100 Amp.											5,500															
Repair Power Panel Board, 480 V, 100 Amp.		92																				92				
Maintain Power Panel Board, 480 V, 100 Amp.	58	58	58	58	58	58	58	58	58	58	58		58	58	58	58	58	58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 208 Y/120 V, 225 Amp.											89,560															
Repair Power Panel Board, 208 Y/120 V, 225 Amp.		1,375																				1,375				
Replace Secondary Transformer, Dry, 2 kVA											2,191															

## E10 Equipment

Replace Icemaker, Commercial								16,699													16,699					
Maintain Icemaker, Commercial	826	826	826	826	826	826	826		826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Office Building

**Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/178

**City:** Huntsville, AL

Forecast Year:	2038	9	0	1	2	2043	4	5	6	7	2048	9	0	1	2	2053	4	5	6	7	2058	9	0	1	2	
Repair Switchgear, Indoor, 600 V (5% of total fuses)																	410									
Maintain Switchgear, Indoor, 600 V		28				28					28					28			28			28				28
Replace Secondary Transformer, Dry, 75 kVA																	18,985									
Repair Secondary Transformer, Dry, 75 kVA																	795									
Maintain Secondary Transformer, Dry, 75 kVA	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172		172	172	172	172	172	172	172	172	172
Replace Secondary Transformer, Dry, 30 kVA																	4,456									
Repair Secondary Transformer, Dry, 30 kVA																	265									
Maintain Secondary Transformer, Dry, 30 kVA	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58		58	58	58	58	58	58	58	58	58
Maintain Power Panel Board, 208 Y/120 V, 200 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Repair Secondary Transformer, Dry, 2 kVA																	236									
Maintain Power Panel Board, 208 Y/120 V, 225 Amp.	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857		857	857	857	857	857	857	857	857	857
Replace Power Panel Board, 480 V, 400 Amp.																	26,735									
Repair Power Panel Board, 480 V, 400 Amp.																	381									
Maintain Power Panel Board, 480 V, 400 Amp.	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172		172	172	172	172	172	172	172	172	172
Replace Power Panel Board, 480 V, 200 Amp.																	38,159									
Repair Power Panel Board, 480 V, 200 Amp.																	459									
Maintain Power Panel Board, 480 V, 200 Amp.	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286		286	286	286	286	286	286	286	286	286
Replace Power Panel Board, 480 V, 100 Amp.																	5,500									
Repair Power Panel Board, 480 V, 100 Amp.																	92									
Maintain Power Panel Board, 480 V, 100 Amp.	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58		58	58	58	58	58	58	58	58	58
Replace Power Panel Board, 208 Y/120 V, 225 Amp.																	89,560									
Repair Power Panel Board, 208 Y/120 V, 225 Amp.																	1,375									
Replace Secondary Transformer, Dry, 2 kVA																	2,191									

## E10 Equipment

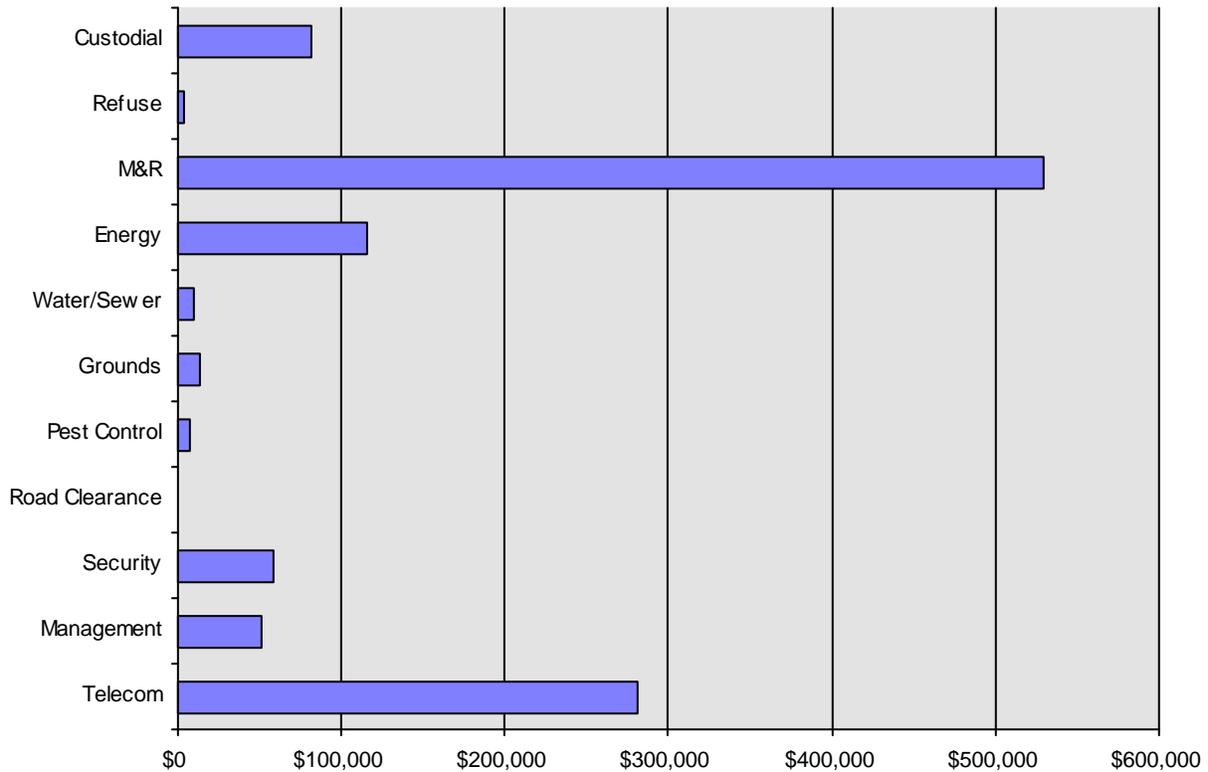
Replace Icemaker, Commercial						16,699										16,699										16,699
Maintain Icemaker, Commercial	826	826		826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826

# Operation Costs Summary

Whitestone Research

**Building:** Office Building **GSFT:** 110,929  
**Building Number:** 1045/62/178 **Replacement Value:** \$20,520,846  
**Facility:** Marshall Space Flight Center **Building Use:** Office  
**City:** Huntsville, AL **Building Type:** Engineering Office  
**Built Date:** 1964

Operation	Annual Cost/GSFT	Annual Total	Percent
Custodial	\$0.736	\$81,605	7.1%
Energy	\$1.046	\$116,033	10.1%
Grounds	\$0.125	\$13,910	1.2%
M&R	\$4.773	\$529,409	46.0%
Management	\$0.462	\$51,302	4.5%
Pest Control	\$0.067	\$7,423	0.6%
Refuse	\$0.033	\$3,682	0.3%
Road Clearance	\$0.002	\$253	0.0%
Security	\$0.526	\$58,384	5.1%
Telecom	\$2.532	\$280,923	24.4%
Water/Sewer	\$0.082	\$9,137	0.8%
<b>Building Total</b>	<b>\$10.39</b>	<b>\$1,152,060</b>	<b>100.0%</b>



# Building Operations Task Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1964

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/178

**City:** Huntsville, AL

**Replacement Value:** \$20,520,846 **per SF:** \$185

**Building Gsft:** 110,929

Functional Area	FA GSFT	Task	Labor Cost	Material Cost	Task Cost
<b>Operation: Custodial</b>		<b>Level of Service: Low</b>			
Office	87633	Vacuum Carpet with 14" Upright Vacuum	\$30,624	\$4,976	\$35,600
Office	87633	Empty Trash; Wipe Clean & Re-line Basket	\$8,750	\$1,422	\$10,172
Office	87633	Clean and Wipe Furniture with Trigger Sprayer & Cloth	\$5,371	\$873	\$6,244
Office	87633	Dust Surfaces with Duster	\$4,038	\$656	\$4,695
Office	87633	Vacuum Upholstered Furniture with Tank or Canister Vacuum	\$3,362	\$546	\$3,908
Office	87633	Dust Window Blinds	\$1,938	\$315	\$2,253
Mechanical/Equipment	8874	Sweep Hard Floor with 48" Push Broom	\$159	\$26	\$185
Mechanical/Equipment	8874	Empty Trash; Wipe Clean & Re-line Basket	\$102	\$17	\$119
Common/Circulation Are	5546	Vacuum Carpet with 14" Upright Vacuum	\$3,876	\$630	\$4,506
Conference Room	5546	Vacuum Carpet with 14" Upright Vacuum	\$1,938	\$315	\$2,253
Conference Room	5546	Clean and Wipe Furniture with Trigger Sprayer & Cloth	\$736	\$120	\$856
Common/Circulation Are	5546	Empty Trash; Wipe Clean & Re-line Basket	\$554	\$90	\$644
Common/Circulation Are	5546	Vacuum Upholstered Furniture with Tank or Canister Vacuum	\$426	\$69	\$495
Conference Room	5546	Empty Trash; Wipe Clean & Re-line Basket	\$277	\$45	\$322
Restroom	3327	Service Restroom: Empty Trash, Clean & Disinfect Fixtures, Wipe Mirrors, Replace Supplies, Wet	\$6,976	\$1,134	\$8,109
Restroom	3327	Service Restroom: Empty Trash, Replace Supplies & Touch Up as Needed	\$1,070	\$174	\$1,243
<b>Total:</b>			<b>\$70,198</b>	<b>\$11,407</b>	<b>\$81,605</b>
<b>Operation: Grounds</b>		<b>Level of Service: Low</b>			
Grounds, Improved	66557	Mow Turfgrass with 21" Power Mower	\$2,458	\$1,022	\$3,480
Grounds, Improved	66557	Aerate Improved Grounds	\$1,907	\$793	\$2,700
Grounds, Improved	66557	Clear Shrubs	\$1,592	\$662	\$2,255
Grounds, Improved	66557	Edge Clean & Trim Walks with Gas Powered Edger	\$1,020	\$424	\$1,444
Grounds, Improved	66557	Overseed, Improved Grounds	\$953	\$397	\$1,350
Grounds, Improved	66557	Vacuum with 30" Billy Goat	\$637	\$265	\$902
Grounds, Improved	66557	Clear Crabgrass	\$477	\$198	\$675
Grounds, Improved	66557	Clear Weeds with 15" Boom, Improved Grounds	\$254	\$106	\$359
Grounds, Improved	66557	Trim Around Raised Objects with String Edger	\$209	\$87	\$296

All costs expressed in (\$) 2012.

05-Mar-13

Functional Area	FA GSFT	Task	Labor Cost	Material Cost	Task Cost
Grounds, Improved	66557	Fertilize Improved Grounds	\$191	\$79	\$270
Grounds, Improved	66557	Sweep with 30" Power Rake	\$126	\$52	\$178
Grounds, Improved	66557	Fertilize Using Power Take Off Broadcast	\$0	\$0	\$0
<b>Total:</b>			<b>\$9,823</b>	<b>\$4,086</b>	<b>\$13,910</b>
<b>Operation: Pest Control</b>		<b>Level of Service: Medium</b>			
Pest Controlled	110929	Install, or Check and Re-Bait 5 Rodent Boxes	\$2,563	\$1,066	\$3,629
Pest Controlled	110929	Perform Crawling Insect Abatement	\$1,924	\$800	\$2,725
Pest Controlled	110929	Inspect Building for Pests	\$1,070	\$0	\$1,070
<b>Total:</b>			<b>\$5,557</b>	<b>\$1,867</b>	<b>\$7,423</b>
<b>Operation: Road Clearance</b>		<b>Level of Service: Medium</b>			
Pavement NASA	88743	Plow Paved Area	\$195	\$59	\$253
<b>Total:</b>			<b>\$195</b>	<b>\$59</b>	<b>\$253</b>
<b>Operation: Security</b>		<b>Level of Service: Medium</b>			
Secured Area	110929	Patrol Building Perimeter	\$21,085	\$3,426	\$24,511
Secured Area	110929	Guard Lobby/Parking	\$0	\$0	\$0
<b>Total:</b>			<b>\$21,085</b>	<b>\$3,426</b>	<b>\$24,511</b>

# Building Operations Utility Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1964

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/178

**City:** Huntsville, AL

**Replacement Value:** \$20,520,846 **per SF:** \$185

**Building Gsft:** 110,929

		Utility	GSFT	Demand	UM	Rate	Cost
<b>Operation:</b>	<b>Energy</b>	<b>Level of Service:</b>	<b>Medium</b>				
		Electricity	110929	11.027	kWh	\$0.0833	\$101,897
		Natural Gas	110929	0.161	Thm	\$0.7900	\$14,135
		Diesel	110929	0.000	Gal	\$3.2100	\$0
		<b>Total:</b>		<b>11.189</b>			<b>\$116,033</b>
<b>Operation:</b>	<b>Refuse</b>	<b>Level of Service:</b>	<b>Medium</b>				
		Municipal Solid Waste	110929	0.370	Lbs	\$0.0717	\$2,943
		Recycling	110929	0.180	Lbs	\$0.0370	\$739
		<b>Total:</b>		<b>0.550</b>			<b>\$3,682</b>
<b>Operation:</b>	<b>Water/Sewer</b>	<b>Level of Service:</b>	<b>Medium</b>				
		Sewer	110929	17.160	Gal	\$0.0034	\$6,472
		Water	110929	21.840	Gal	\$0.0011	\$2,665
		<b>Total:</b>		<b>39.000</b>			<b>\$9,137</b>

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# Building Operations Management Details

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Whitestone Research

**Building:** Office Building

**Year Built:** 1964

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/178

**City:** Huntsville, AL

**Replacement Value:** \$20,520,846    **per SF:** \$185

**Building Gsft:** 110,929

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	Service	Demand	UM	PRV	Cost
<b>Operation:</b> Management	<b>Level of Service:</b> Low				
	Management	0.3%	PRV	\$20,520,846	\$51,302
	<b>Total:</b>				<b>\$51,302</b>

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# Building Operations Service Details

Whitestone Research

**Building:** Office Building

**Year Built:** 1964

**FTEs:** 312

**Building Type:** Engineering Office

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/178

**City:** Huntsville, AL

**Replacement Value:** \$20,520,846

**per SF:** \$185

**Building Gsft:** 110,929

		Service*	Quantity	Rate	Cost
<b>Operation:</b>	<b>Security</b>	<b>Level of Service: Medium</b>			
		Intrusion Detection Systems	3	\$4,986	\$14,958
		System Monitoring	3	\$3,615	\$10,845
		Access Control	3	\$2,690	\$8,070
		<b>Total:</b>			<b>\$33,873</b>
<b>Operation:</b>	<b>Telecom</b>	<b>Level of Service: High</b>			
		Local Telephone	312	\$468	\$146,016
		Data	312	\$3,588	\$75,004
		Long Distance Telephone	312	\$192	\$59,904
		<b>Total:</b>			<b>\$280,924</b>