

# Benefits of Employing New Technology in Human Genome Sciences Vivarium

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## Vivarium Services

### Abstract

The Human Genome Sciences' new vivarium employed a new animal housing system that uses disposable caging. The new disposable caging system enabled HGS to decrease cost, labor and time while simultaneously maximizing space efficiency. As a general rule, vivaria built with disposable caging systems can cost 2/3rd less to build compared to the ones with traditional housing systems; and our experience matches that cost savings. Additionally, disposable caging reduces per diem cost. Current estimated per diem rates for HGS vivarium are approximately 1/2 the per diem charged by contract research facilities. Traditional cage washing and autoclaving facilities and equipment are not needed with disposable caging, which represents a significant cost and space savings. The HGS vivarium requires approximately 25% less space than traditional vivarium because the area dedicated to equipment sanitation is greatly reduced, and space allocated for clean cage storage is eliminated. Also, disposable caging reduces the risk of cross contamination within the animal colony as each cage replacement comes with a new sterile cage. In traditional systems, errors during cage sanitation procedures and residual moisture in cages, often lead to contamination in the colony. This new system is also more environmentally friendly: 1) cages and cage supplies are recycled by the manufacturer; 2) due to complete absence of washing, no water and chemicals are used. Disposable caging usage for housing animals in biomedical research is growing rapidly. Human Genome Sciences' vivarium is one of the few facilities in our area utilizing 100% disposable caging.

### Introduction

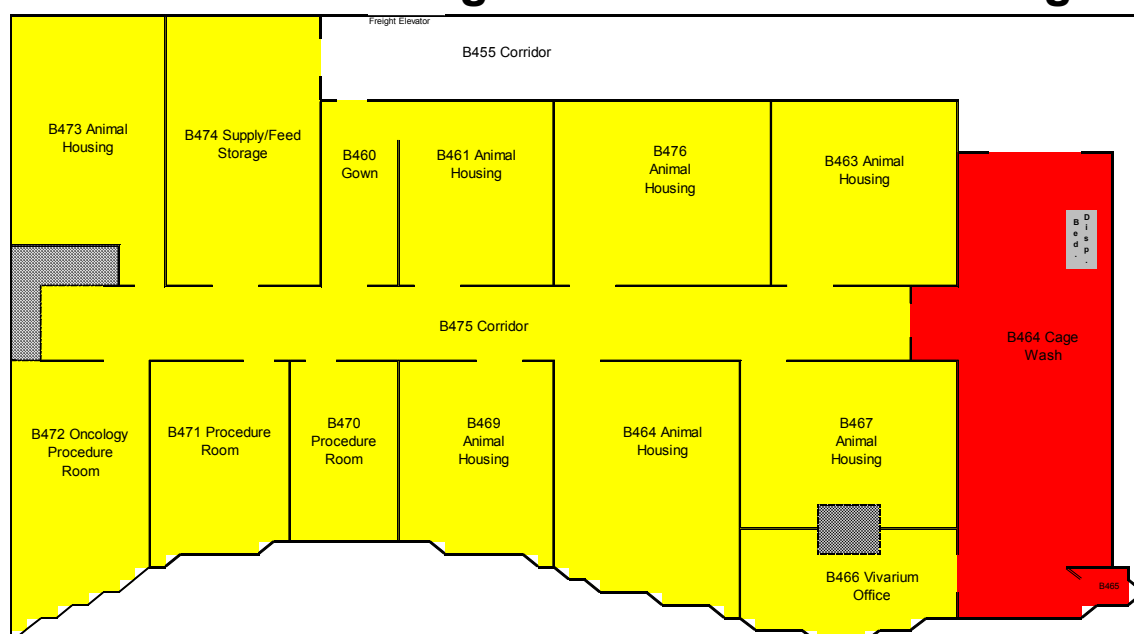
There were several key factors to determine the feasibility of creating an on-site vivarium to serve the needs of HGS researchers. The initial cost was certainly one of these factors. Additionally, economy of space, maintenance, annual expense and environmental concerns were among the remaining factors. While the basic design of vivaria have not changed greatly over the last 20 years, the options for housing rodents have changed. One of the latest options for housing research rodents is the disposable cage system. The disposable cage systems have a great effect on facility design, equipment cost and labor required to maintain a vivarium.

### Vivarium Design: Traditional Caging vs. Disposable Caging

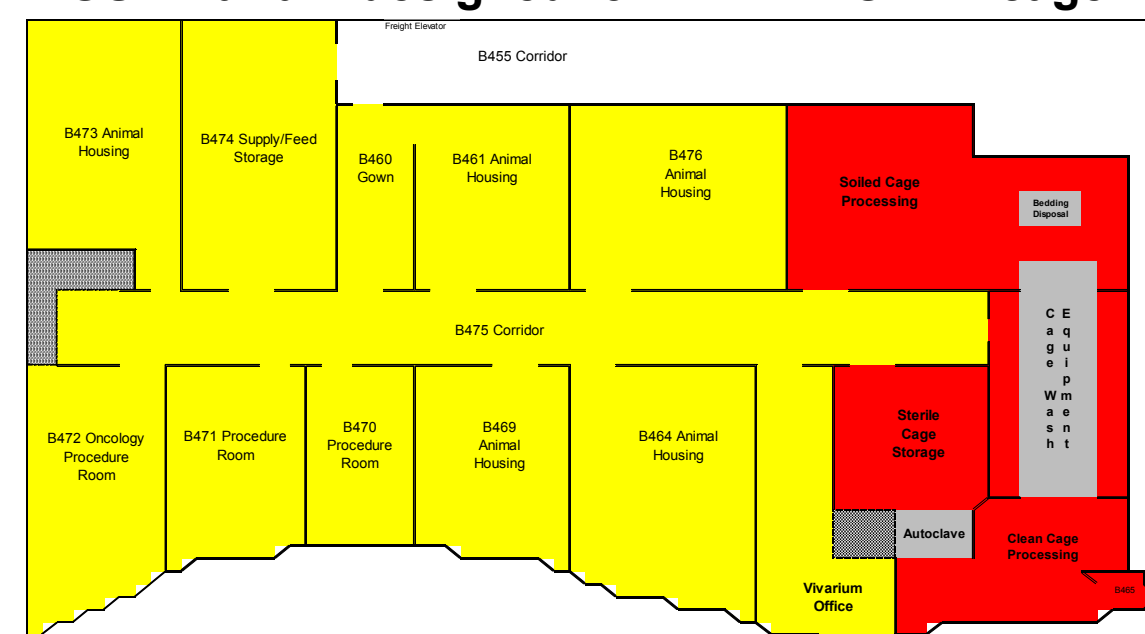
Vivarium designed to house traditional rodent housing systems require equipment for washing and sterilizing rodent cages. The equipment used to clean and sterilize rodent cages is very large, expensive and requires unique facility design. Additional space, such as clean sterile cage storage, clean cage processing and soiled cage processing, must be allocated to support this standard cage wash for traditional rodent housing systems. On average 25% or more of the total space allocated for a vivarium is dedicated to cage cleaning and storage when using traditional rodent housing systems.

Vivarium designed to house disposable caging systems does not require specialized cage cleaning equipment. These cages are pre-sterilized by the manufacturer, so there is no need to have a large autoclave dedicated to animal housing on site. Cages arrive at HGS in pre-sterilized, efficiently packed packages and take up approximately just 10% of the space required to store traditional sterile cages. Less space dedicated to cage cleaning translates into more space for housing animals and procedure rooms. The total area of the new HGS vivarium is approximately 3200 square feet. Because the vivarium was designed for the use of disposable caging, only 12.3% of the total vivarium space is dedicated to cage cleaning and processing. If the HGS vivarium had been designed to use a traditional caging system, 22.4% of the total vivarium space would have been dedicated to cage cleaning, processing and storage. This translated into adding two additional animal holding rooms ie. increase in animal holding capacity by 40%.

#### HGS vivarium designed for DISPOSABLE cage



#### HGS vivarium designed for TRADITIONAL cage



### Construction and Equipment Cost Reduction

Incorporating disposable caging into the vivarium design eliminated the need for cage sanitation and sterilization equipment, required for traditional caging systems. This represented a reduction in cost, approximately \$300,000.00 for equipment alone, and time. Because cage sanitation and sterilization equipment require significant volumes of water, steam and electricity, the design, construction and installation requirements are complicated and time consuming.

#### TRADITIONAL CAGING EXPENDITURES

	Year 1	Year 2	Year 3
<b>Equipment:</b>			
Cost of racks	\$280,000	\$0	\$0
Cost of additional cages	\$48,400	\$0	\$0
Annual cage replacement cost	\$12,100	\$12,403	\$12,713
Annual cage breakage cost	\$726	\$744	\$763
<b>Total rack and cage cost</b>	<b>\$341,226</b>	<b>\$13,147</b>	<b>\$13,475</b>

<b>Washroom:</b>			
Washroom build out and equipment	\$300,000	\$0	\$0
Lost revenue and/or time during renovation			
Washroom maintenance and supplies	\$95,000	\$97,375	\$99,809
Annual washroom utilities	\$100,000	\$102,500	\$105,063
<b>Total washroom cost</b>	<b>\$495,000</b>	<b>\$199,875</b>	<b>\$204,872</b>

<b>Labor:</b>			
Vivarium technicians	1.9	1.9	1.9
Washroom labor	2.0	2.0	2.0
<b>Total labor costs</b>	<b>\$153,653</b>	<b>\$157,494</b>	<b>\$161,431</b>
<b>Annual costs</b>	<b>\$989,879</b>	<b>\$370,516</b>	<b>\$379,779</b>

**Total cost (over 10 years)** **\$ 4,678,184**

#### DISPOSABLE CAGING EXPENDITURES

	Year 1	Year 2	Year 3
<b>Equipment</b>			
Cost of racks	\$128,651	\$0	\$0
Annual cage costs	\$57,075	\$58,502	\$59,964
<b>Total rack and cage cost</b>	<b>\$185,725</b>	<b>\$58,502</b>	<b>\$59,964</b>

<b>Labor:</b>			
Vivarium technicians	1.0	1.0	1.0
Labor costs	\$38,012	\$38,962	\$39,936
<b>Total costs</b>	<b>\$223,737</b>	<b>\$97,464</b>	<b>\$99,900</b>

**Total cost (over 10 years)** **\$ 1,193,942**

### Operational and Maintenance Costs

Vivaria designed around the use of traditional caging systems cost significantly more to operate and maintain, as compared to vivaria designed around the use of disposable caging systems. Cage sanitation and sterilization equipment require significant amounts of chemicals, water and power to operate. The estimated annual cost for supplies, water and electricity are estimated to be \$195,000.00 for the first year and increase over time. (the estimated cost includes equipment maintenance expense) Also, a minimum of 2 technicians are required to operate equipment and process traditional caging.

Vivaria designed around the use of disposable caging systems have no requirements for cage sanitation or sterilization. The soiled bedding from each cage is removed and the cage is returned to the manufacturer where it is recycled. A single technician can process the soiled caging, reducing the labor by at least 1/2 (depending on animal population). At current population level, disposable caging saves HGS approximately \$100,000.00 annually. The use of disposable caging at HGS has resulted in a reduction in research cost. Previously HGS research animals were housed off-site at a cost of approximately \$2.08 per cage. The average daily cost of housing research animals at the HGS vivarium is approximately \$0.97 per cage. This represents a savings of more than 60% for HGS.

### Disposable Rodent Housing System



#### Disposable Rodent Cage



### HGS Vivarium Cage Wash Area



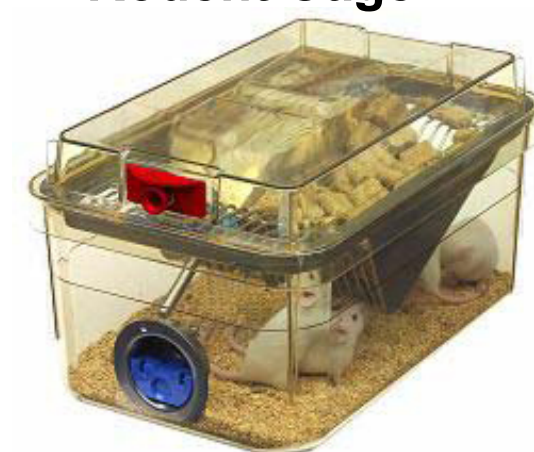
### Providing a Safe Healthy Environment for Research Animals

Protecting the research animals is a primary consideration when choosing a caging system for any vivarium. To prevent bacterial and/or viral contamination of the animal colony, traditional caging systems require caging to be cleaned and sterilized between usages. Constant sanitation and sterilization caused the plastic in the cages to deteriorate leaving defects in the plastic surfaces of each cage. Cracks and scratches in the surface of the plastic make it more difficult to properly sanitize cages. Errors in the sanitation/sterilization procedures may allow disease to spread through the animal colony. In addition, the majority of traditional rodent caging is made of polycarbonate plastic, which contains bisphenol A (BPA). Because traditional caging is often sterilized after feed, bedding and water are placed inside, BPA (released due to the high temperatures of the sterilization process) may contaminate the cage environment (air, bedding, feed and water) each time a cage is sterilized. BPA may pose health risks to the animals and effect the research outcome. Disposable caging systems help to avoid the spread of diseases by eliminating the reuse of cages. Animals receive a new sterile cage at 2 week intervals (on average). The disposable cages used here at HGS do not contain BPA. These factors help to ensure a safe, healthy environment for the animals.

### Traditional Rodent Housing System



#### Traditional Rodent Cage



### Traditional Cage Wash Facility



### Environmental Impact

A traditional animal housing system uses tens of thousands of gallons of water each year in the cage sanitation process. Additionally large volumes of acids and detergents are used to clean traditional caging. The equipment used to sanitize traditional caging heats water and air to a minimum of 180° F requiring significant amounts of fuel and electricity. All waste water generated in the cage sanitation process must be neutralized before entering the waste stream. Disposable caging has allowed HGS vivarium to greatly reduce water and energy usage as compared to a traditional vivarium. Chemicals used for cage sanitation are eliminated completely. All of the disposable caging used at HGS is recycled by the manufacturer (Innovive), greatly reducing the amount of waste generated by the vivarium.

### Conclusions

The decision to use a disposable caging system in the HGS vivarium has allowed HGS to:

- 1) Increase the capacity of the limited space
- 2) Reduce the initial build-up expense and time
- 3) Reduce the ongoing operational expenses
- 4) Reduce the expected impact on our environment
- 5) All of this was done while providing as safe and healthy environment for the research animals and scientists.
- 6) HGS can expect to save an estimated \$3,484,242.00 in the first 10 years of operation as compared to the expected cost of building, operating and maintaining a traditional vivarium.

