

**City of San Francisco
Integrated Pest Management Guidelines**

Norway Rats and Roof Rats

Updated February, 2006

Prepared By _____ Phone _____ Pager _____

Date Prepared _____ Email Address _____

Sites/Facilities Addressed by this Plan _____
(names and locations)

Pest Species	<u>Norway Rat (aka brown, wharf or sewer rat)</u> (common name)	<u><i>Rattus norvegicus</i></u> (scientific name)
	<u>Roof Rat (aka black, ship, or house rat)</u> (common name)	<u><i>Rattus rattus</i></u> (scientific name)

How To Use This Form: This document provides a wide range of information about IPM options for monitoring and managing rats. Each method is listed under a management category such as "monitoring" or "biological controls." The format is designed to assist City staff in rapid development of an IPM plan for key pests. Non-chemical methods are emphasized.

- Use the check-off boxes to indicate which individual methods you plan to integrate into your plan.
- If a method you plan to use is not included on the form, use the "other" category to describe it.
- Modify the form as needed.
- Post the accompanying Summary Sheet in your work area as a convenient summary of activities.

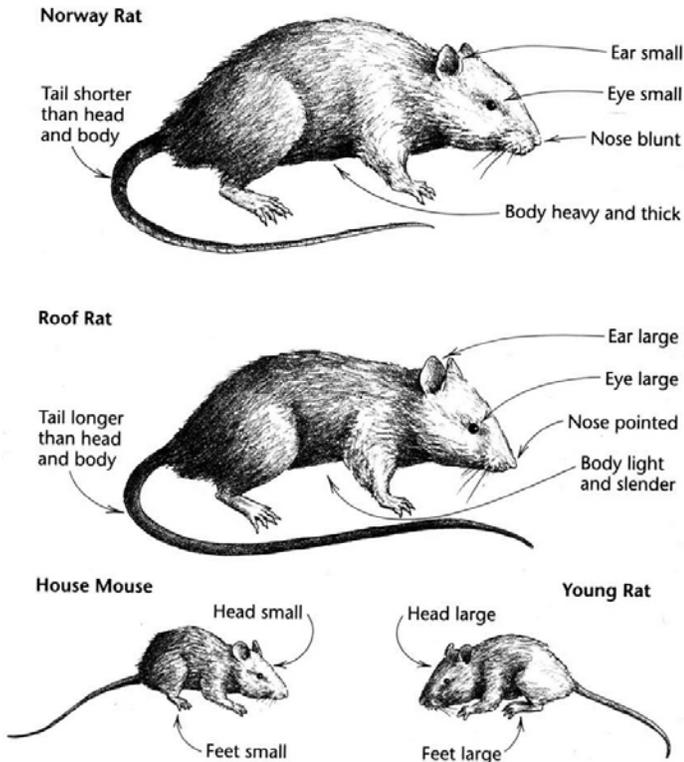
For further information, contact Chris Geiger, Dept. of the Environment. Telephone: 415/355-3759; Fax: 415/554-6393; Email address: chris.geiger@sfgov.org

1.0 General Management Objectives

List your IPM objectives for solving rat problems. It is useful to read this entire document before listing your management objectives. Solving rat problems requires a sustained commitment to reducing or removing the conditions that cause rat problems in addition to removing the rats themselves. Familiarity with the available rat management methods listed below will help you define realistic management objectives and select appropriate management components of your IPM plan.

2.0 Pest Identification

.Graphic from Timm (1994)



The Norway rat is larger and stockier than the roof rat. It weighs an average of 12 ounces, but can reach over 20 ounces. It has small eyes, a blunt nose, and small ears with short hairs. Its shaggy fur is brown with some black and its scaly tail is darker above and pale underneath. It commonly grows to a length of 16 inches overall with a tail 7-1/2 inches long, which is always shorter than its combined head and body length.

The smaller roof rat averages 7 ounces. Its overall length is 15 inches; its 8-1/2 inch-long tail is longer than its combined head and body length. Its nose is pointed, ears large and hairless, the smooth fur is grey to black, its tail uniformly dark.

Which Rat? The easiest way to tell these rats apart is to examine the tail. If it is shorter than the head plus the body and is dark on top and light on the bottom, it is a **Norway rat**. If the tail is longer than the head plus the body, and dark on both sides, it is a **roof rat**.

Traits that differentiate Norway rats, roof rats, and the house mouse are described in Table 1.

Table 1. Differences Between Norway Rats, Roof Rats, and the Common House Mouse

Characteristic	Norway Rat	Roof Rat	House Mouse
Scientific name:	<i>Rattus norvegicus</i>	<i>Rattus rattus</i>	<i>Mus musculus</i>
Other common names:	Brown, wharf or sewer rat	Black, ship or house rat	None
Adult size:	12 ounces	7 ounces	1/2 ounce
Snout:	blunt	pointed	pointed
Ears:	small, short hairs	large, hairless	large, some hair
Tail Coloration:	dark above, pale underneath	all dark	all dark
Fur:	brown with black, shaggy	grey to black, smooth	light brown to grey
Droppings:	capsule-shaped (round ends)	spindle-shaped, pointed ends	rod-shaped
Food requirement:	1 ounce/day	1 ounce/ day	1/10 ounce/day
Water source:	free water	free water	water from food
Climbing ability:	can climb	active climber	good climber
Nest locations:	mainly in burrows	walls, attics, trees, ivy	near or in stored material
Swimming ability:	excellent	can swim	can swim
Litter size:	8 to 12	6 to 8	6 to 7
Litters per year:	7	6	8 to 10

Source: Olkowski, Daar, Olkowski (1991)

3.0 Damage or Nuisance Activity

Rats do damage by gnawing, eating, urinating and defecating on food, and as vectors of human diseases. Rats damage structures by gnawing and have been known to cause electrical fires by chewing on wiring. Their abundant droppings destroy insulation materials and foul foods. Burrows of Norway rats often undermine concrete slabs, foundations, and asphalt paving. They eat human and animal food and contaminate foods with urine and droppings. Rats also eat the bark off of young trees and shrubs, especially new transplants. Rats shed hair, scales, dander, partially consumed food and pheromone-laden dust—all of which are allergenic. Although infection of humans in the U.S. are rare, rats are vectors (carriers) of human plague, infectious jaundice, salmonellosis, rat-bite fever, murine typhus, reckettsial pox and other pathogens. Rats transmit diseases via bites, fleas, mites, as well as urine and feces contamination of water and food. Between 14,000 and 24,000 rat bites are reported each year in the United States.

List the problems rats are causing at your facilities: _____

4.0 Special Conditions

Describe any regulatory or other special conditions or activities that impact pest management at the sites with rat infestations (e.g., regulatory issues, community concerns, multi-agency responsibilities, etc.).

Inter-departmental Collaboration on Rat Management: Rats are distributed citywide, and several city agencies and contractors have direct responsibilities for citywide rat abatement. Three prominent departments involved in these efforts are the Public Health Department's Environmental Health Section vector control program; the Department of Public Works; and the SFPUC's CDD-Water Pollution Control branch. These agencies together with the city's IPM structural pest control contractor work collaboratively to reduce rats and other rodents in and around city-owned structures including sewers and storm drains. Currently, the Environmental Health Section is working collaboratively in a pilot area of San Francisco with six other City and County agencies toward the reduction of rodents. It is this type of collaboration that is necessary to reduce the food, water, and harborage for rats that is essential to achieve sustained rat reduction. Any city departments with rat problems are encouraged to contact the Vector Control staff in the Environmental Health Section.

Other: _____

5.0 Biology/Behavior of Rats

Rats are nocturnal, with their peak activity at dusk or before dawn. When the population is large and/or they are disturbed or hungry, they can be seen during the day. Rats have poor eyesight, but have keen senses of hearing and smell, and taste. They are wary of new things in their environment, which affects how trapping and other management activities are carried out. Both Norway and roof rats have similar reproduction cycles and share certain behaviors, but their food and harborage preferences can differ significantly within the same habitat, and this necessitates somewhat different strategies for managing these two species.

The Norway Rat

Harborage: Rats live in colonies, although they are territorial and have a pecking order. These factors lead rats to maintain some distance from one another within the same burrow system. The Norway rat generally prefers to live outdoors in underground burrows. Their outdoor nesting burrows are often located along the foundation of exterior walls, under wood piles or other debris, in vegetation near dumpsters, etc. Typically, outdoor burrows are about 3-feet long and about half as deep. Burrows have two or more entrances with openings 2 to 4-inches in diameter. At least one opening is a well-hidden escape route. As their population increases, the network of underground tunnels becomes extensive. The Norway rat is also known to live inside buildings, commonly building surface nests on the ground floor or basement level. If the population becomes too large, they are capable of climbing interior or exterior walls and relocating to ceiling voids and attic areas.

Food and Water: Norway rats require about 1 ounce of food per day, preferring meat, fish, and cereal grains, with pet food a favorite choice. However these rats will eat most foods, including human garbage, when favorite foods are not available. When food is scarce, they may be attracted to unusual foods such as the fat in bars of soap. Norway rats also nest and forage in sewers. Norway rats will forage 100 to 150 feet from their nests in search of food. Outdoor-dwelling Norway rats will seek food outside, but will also enter a structure at night to forage for food, then return to their outdoor burrows. Indoor-dwelling rats that are able to obtain sufficient food and water inside the structure may not forage outdoors. The Norway rat is usually the primary species around dumpsters and garbage cans, fishing areas and shorelines, shopping malls, restaurants, and at ground or basement level in warehouses and residential buildings. This species is an excellent swimmer and can obtain water from toilets, sinks, rain puddles, ponds, or condensation from utility pipes. Its ability to travel sewers and drains and enter buildings through these passageways makes it a citywide problem.

The Roof Rat

Harborage: Roof rats are active climbers and prefer elevated harborage in trees (especially date palms) and dense vine-covered fences and walls. In buildings, they harbor in the upper levels inside voids in walls, ceilings, attics, or along the roofline. When populations are very high, they are sometimes forced to burrow in dense groundcover (Algerian and English ivy are favorites), overgrown landscapes, and woodpiles. Roof rats will forage up to 300 feet from their burrows in a three-dimensional range.

Food and Water: The roof rat consumes about 1 ounce of food per day, preferring fruits, nuts, grains, and invertebrates (e.g., snails and insects). This species forages in family groups of up to 10 rats, but could expand to several hundred if food is abundant. The roof rat can swim when needed, and obtains drinking water from toilets, sinks, rain puddles, ponds, or condensation from utility pipes.

General Rat Behavior

Reproduction: Rats build their nests from soft material such as shredded paper or chewed grass, or other fibrous material. Mating is followed by a gestation period of about 21 to 23 days and produces litters of 8 to 12 offspring (Norway rats) and 6 to 8 (roof rats). Females can mate within 1 or 2 days following a litter. During a rat's normal life expectancy of 1 year in the wild, a female can produce from 4 to 9 litters, with 8-12 pups per litter. Litter size is determined by environmental factors, especially food supply. Young rats develop quickly, eating solid food at 3 weeks of age and reaching sexual maturity in 2-5 months. Female rats produce approximately 80 live young per year.

Reproduction generally peaks in spring and fall, with lessened activity in summer and winter. Rat populations increase when food and shelter are abundant. If food and shelter are not reduced as part of the IPM strategy, rat numbers can rebound quickly following lethal control measures by increasing breeding frequency and producing larger litter sizes. Rats can rapidly develop very high populations; rats seen during daytime hours indicate a very high density.

Feeding behavior: Rats cache food in or near their harborage. Initial feeding and aversion preferences are learned from the mother. Rats develop individual feeding and aversion habits based on population density, ranking in the social hierarchy (pecking order), experience with traps and baits, and food availability. Even though rats have food preferences, they tend to be omnivorous. They will travel 100-150 feet from their nests for food and water sources, using established runways. Rats can develop "bait shyness" when they become wary of food that doesn't "taste right" or when they ingest sublethal doses of bait. Rats are wary of new objects in their surroundings, so it is often prudent to pre-bait traps with

non-toxic baits or foods in unset snap traps.

Physical Abilities:

- Pass through openings as small as 1/2 inch square. Rule of thumb: adult rats can enter through an opening the size of a quarter (coin).
- Walk along horizontal wires and climb vertical wires (roof rats)
- Scale up and down the inside of vertical pipes from 1-1/2" to 4" in diameter
- Climb the outside of pipes up to 3" in diameter
- Climb pipes and conduits of any size if within 3" of a wall surface
- Crawl horizontally on any size pipe or conduit
- Climb walls with textured surfaces such as brick, stucco, and wood
- Jump vertically at least 3 feet from a flat surface
- Reach 13" above a flat surface
- Dive and swim underwater for up to 30 seconds
- Swim through drain traps such as toilets and floor drains
- Gnaw through or leave marks on nearly anything, including wood, particle board, lead and plastic pipes, cinder blocks, asbestos, aluminum, sheet metal, glass, and sun-dried adobe

Inspection, Monitoring and Management Methods

The following sections contain a comprehensive menu of available IPM monitoring and management methods for solving rat problems in a wide variety of sites and conditions. The most effective management programs involve use of several methods within an integrated program of prevention and direct suppression of unwanted rats. **To permanently reduce rat presence and damage at a site, 80% to 95% of the rats and substantial sources of rat food and harborage must be removed in order to prevent recovery of the rat population within 1 year.** Recovery occurs from a combination of (1) larger litter sizes; (2) increased number of litters; (3) lower death rates due to reduced competition for resources; and (4) immigration of new rats. To achieve this high level of management requires use of a wide range of methods.

[x] Place a mark in the boxes below to indicate which methods you plan to use at the facilities under your management. If these methods are not listed, please describe them in the "Other" section under the appropriate category.

6.0 Inspection, Monitoring, Record-keeping

Inspecting and monitoring for rats is essential in urban areas, especially where food services of any kind are located. In the IPM process, an initial inspection is made in the area where rats are suspected or reported in order to gain background information on location and degree of rat activity and damage or nuisance occurring. Following the inspection, an IPM program is implemented and monitored in order to evaluate success and fine-tune the program elements as needed (see Section 8.0). Monitoring for signs of rats can be performed at any time of day or night. To see rats, it is best to monitor between sunset and sunrise. Monitoring activities are most effective when performed at suspected food sources and habitat sites.

Tools for monitoring include a strong flashlight, a portable ultra-violet light, various non-toxic baits, or non-toxic tracking powder (such as talc), lockable bait stations, a drill with concrete bit to secure bait stations, snap traps, gloves, binoculars and night vision goggles (if affordable). Table 2 describes a method for using visual monitoring information to estimate the size of a rat population.

Inspection is generally a one-time event. The primary purpose of inspections is to:

- identify the pest
- locate food, water, and sources of harborage sustaining the pest
- identify factors conducive to the presence of rats and make recommendations for reducing or removing them

- identify human behaviors contributing to the presence of rats

Monitoring is an ongoing activity. The purpose of monitoring is to:

- track pest activity
- properly time pest management actions
- document methods and products used
- evaluate the effectiveness of pest management programs
- communicate with and educate the client and others involved with solving the problem

The purpose of record-keeping is to:

- provide a paper trail of pest problem assessment, recommendations, actions taken, and results
- display monitoring information such as efficacy of non-chemical methods, increase or decrease of rodenticide use, etc.
- provide evidence of compliance with laws and regulations
- develop an institutional memory about the rat IPM program

Information gained from monitoring is used to fine-tune pest management methods and plan future actions.

The monitoring methods described below are generally used when:

- rat presence or damage is likely to rise to levels of concern (reach the treatment threshold)
- damage or nuisance is occurring inside city structures where health and safety issues and building damage can arise
- damage is occurring outdoors where rat burrowing can undermine structures, damage vegetation, and cause nuisance issues.

[] **Mapping Estimates:** Obtain a copy of an existing map of the site or sketch one out on grid paper. Mark, count, map and loosely plug burrow entrances with soil or paper on a weekly basis. Burrows that are reopened the following week are active. This provides a relative abundance in a limited area, and can be adapted to quickly show where the priority areas are located, and to track decreases or increases of burrows over time.

[] **Non-toxic Bait Estimates:** Estimates of rats present can also be made by placing pre-measured nontoxic cereal bait in various locations to determine how much is eaten each night. Double the amount each night until the amount taken in one night levels off. Divide the amount by 1/2 oz. This will provide a very rough estimate of the minimum number of rats present.

[] **"Tracking Patch":** A non-toxic tracking patch can help determine the location and extent of rat activity. Place a light dusting of unscented baby powder, talc, or powdered limestone in suspected runways and near rat signs. Typical patch sizes range from 12"x4" to 6"x18". When active rats walk through the powder, they leave behind their characteristic 3/4" footprints with a "drag line" (from their tail) in the middle of their tracks. Examine the patch for tracks at regular intervals.

[] **Trapping or Non-toxic Baiting Counts:** An estimate of rat populations and areas of activity can be obtained by placing baited snap traps or bait boxes containing non-toxic food baits in area suspected of rat activity (e.g. around dumpsters or other food sources). A sample monitoring form for recording catch data is provided as Appendix A.

[] **Photo Points.** Standing in the same position each time, take pre-and post-treatment photos of priority rat-infested sites. Store them in a photo binder along with a written log of the date, technician's name, site location(s) shown in the photos, IPM treatment methods used, results of the treatments, and any other relevant information. Update the information periodically until the problem is solved.

[] **Other Monitoring Methods To Be Used:** _____

Table 2. How To Estimate the Size of a Rat Population Using Information From Visual Monitoring

Population Size	Visual Observation
Rats not present, or in very low numbers; any infestation is probably recent	None of the signs listed below, have been observed
Medium Population	Old droppings present. Signs of gnawing seen. One or more rodents seen at night by flashlight. No rats seen during the day. Each rat seen at night usually represents 10 or more elsewhere.
High Population	Fresh droppings. Signs of recent gnawing. Tracks observed in dust. Three or more rats seen at night by flashlight or one or more seen in daylight.

Source: Timm (1994)

7.0 Treatment Threshold

Be aware that rats occur in locations throughout the city and that elimination of rats from all locations is not possible. A comprehensive IPM program focused on reducing or eliminating the conditions that rats need to survive (i.e. sources of food, water, harborage) combined with population reduction through careful, trapping or baiting and sustained monitoring, can keep rat numbers at very low levels where they are rarely seen.

The "treatment threshold" (also known as the "tolerance level") is the maximum number of rats that can be tolerated in an area without causing unacceptable damage or nuisance. Once the number of rats approaches the threshold, treatments are applied to prevent an increase in rat numbers that will produce unacceptable damage. Treatment thresholds are site specific, and may differ from one site to the next, and may change from year to year.

One rat in a restaurant, office, hospital, or jail, etc. is the treatment threshold for these and similar sites. Sewer workers and buildings connected to the sewers are at risk from large sewer rat populations. Regular monitoring can help establish subterranean tolerances for rats. When rats are seen living in a date palm on a right-of-way they can be more easily tolerated, but the area should be monitored regularly for population density. Remember as you set your treatment threshold that it is not possible to eliminate all of the rats in San Francisco. However, it is possible to manage them at acceptable population levels.

Describe the treatment thresholds for rats established at the facilities listed at the top of this form.

Indoors: _____

Outdoors: _____

8.0 Rat Inspection & Monitoring Guidelines

The following information describes general guidelines for establishing an IPM inspection and monitoring program for rats in indoor and outdoor areas on City of San Francisco property.

1. Determine the location(s) or area(s) to be inspected. Base this on "trouble calls" regarding visual sighting of rats, signs of their presence (discussed below), or locations with conditions conducive to rats. Talk to building managers, custodians, and other workers in city buildings, city crews that work in the area, local business persons, and others familiar with the area on a daily basis. Ask if rats have been sighted in the last few days, or if there was a prior history of rat presence.

If rats are reported present in the area, ask what **time of day or night** they have been observed. Use this information to help you decide where and when to focus your initial inspections.

2. Inspect areas suspected of harboring rats. Visit areas both in daylight and at night using a flashlight or spotlight with a red filter. Look for the following signs of rat presence:

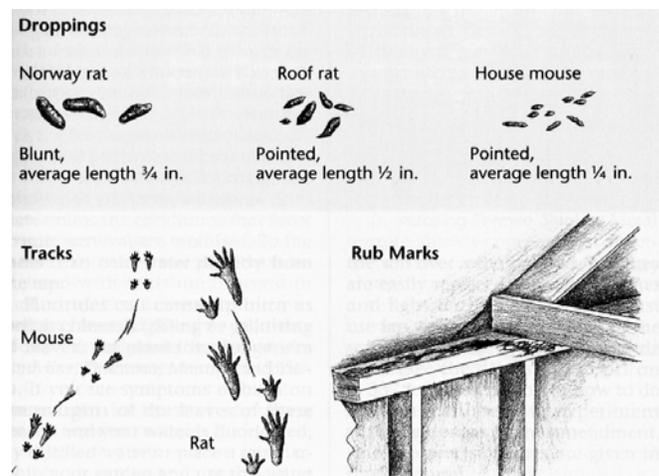
- **Visual sightings.** Seeing rats in daylight usually indicates a high population. Notice what type of food the rats are eating (or contents of garbage cans), and place the same type of food in bait boxes or traps used for monitoring.
- **Droppings.** A single rat may produce 50 droppings daily. They are usually found along rat runways, in feeding areas, and near rat holes and nests. Identify currently infested areas by sweeping up old droppings then re-inspect after one week. Fresh droppings have putty-like texture; old droppings crumble easily. See the illustration of rat droppings above to distinguish Norway rats from roof rats.
- **Urine stains.** These deposits occur along traveled pathways or in feeding areas. Both wet and dry rat urine glows blue-white under any ultraviolet light. Use portable UV flashlights made for rat inspections.
- **Burrows.** These occur next to walls, along fences, next to buildings, or under shrubs or debris.

Indoors, **Norway rat burrows** are primarily found on ground floors or basements, although they are capable of living higher up if populations are high. Any hole or out-of-the-way location is potential harborage. On upper levels **roof rat burrows** can be found in wall, ceiling, and roof voids, under enclosed bathtubs, and other protected areas. Roof rats also nest in trees, vines, dense planting; rarely in ground-level burrows.

• **Runways.** Rats establish well-defined runways between their burrows/nests and food and water sources. Outdoor runways appear as beaten paths on the ground, or worn-down paths in the grass. Rats memorize these pathways and habitually use the same routes. Indoors runways are marked by droppings and grease marks on vertical or horizontal surfaces along walls, pipes, and wires.

• **Smudge marks or rub marks.** Marks are made when the oil and grease on rat fur rubs off and builds up on well-used runways. Check for these on walls, pipes, beams, and other fixtures in and around buildings and other structures.

• **Tracks, including footprints and tail marks.** An adult rat's footprint is about 3/4-inches long. Rats may also leave a drag line (from their tail) in the middle of their tracks. These may be found in dusty or muddy surfaces. A light sprinkling of unscented baby powder, talc, or powdered limestone in suspect areas can reveal tracks and help determine the location and extent of rat activity.



Source: redrawn from Timm (1994)

- **Odors.** Heavy infestations have a distinctive odor. Experienced pest managers can smell the difference between a rat and a mouse infestation.
- **Sounds.** Scrambling in walls, squeaks, gnawing and clawing sounds are all typical of rat presence.
- **Pet Excitement.** Cats and dogs often probe an area of floor or wall where rats are active, particularly if the rats have only recently invaded.
- **Gnawing marks.** Rats constantly gnaw on hard surfaces. Marks occur on door or window frames, ledges, moldings, in corners, etc. and on branches of trees and shrubs. Fresh wood shavings, insulation and other gnawed material indicate active infestations. Rats can also gnaw through rusty sheet metal.
- **Nests and Food Caches.** Found in large quantities in undisturbed areas such as dense shrubbery, trash piles, building foundations, attics, wall voids, etc.

9.0 Biological Controls

- [] **Predators:** Barn owls (*Tyto alba*), hawks, coyotes, feral cats, domestic dogs, foxes, and raccoons are the primary predators of rats in urban areas. All these species are present in San Francisco. Predation is probably most successful during spring and fall when rat activity peaks. Mounting specially constructed barn owl nest boxes or hawk perches might be helpful in attracting these raptors to locations with large rat infestations and with major obstacles to reducing food, shelter, and habitat for these pests. Rats and mice comprise about 1/3 of the diet of barn owls, although there is no definitive efficacy data on barn owls significantly suppressing urban rat populations. Contact SFRPD IPM Coordinator Phil Rossi (415-831-6306) for information about any plans to erect raptor perches and nest boxes for barn owls in various park locations for supplemental suppression of gophers, etc. Directions for building barn owl nesting boxes can be obtained from V.J. Ketner, 169 Via Baja, Ventura, CA. 93003 or from The Lindsay Museum, Walnut Creek, CA. Donation: \$10.00. Phone: 925/935-1978. Plans as well as pre-built owl houses are available from Rincon-Vitova Insectaries, 1-800-248-2847 and other sources.

Snakes feed on rats and other rodents. While they are not readily available for “structured work”, they should be tolerated whenever possible as a serious predator of rats and other rodents. It is illegal to capture snakes or other animals in the wild and release them in other locations.

[] **Other Biological Controls To Be Encouraged:** _____

10.0 Cultural Controls

Cultural (and horticultural) controls for rats focus on reducing/removing sources of food, water, and habitat (harborage) that rats depend on for survival.

- [] **Improve Sanitation:** Practices that reduce or eliminate rat access to food are essential to successful rat management programs. Unless sanitation measures are maintained over time, rats will return.
- **Proper garbage disposal:** This is a key issue in rodent control. Wherever there is edible garbage available there will be rats. Even the use of in-sink garbage disposals, which eliminate food waste storage problems, has the side effect of feeding rats in the sewers. When garbage is accessible to rats, it seriously hampers baiting and trapping programs that can't compete with the rats' regular food.
 - **Indoors:** dispose of food wastes promptly into rat-proof containers such as plastic bag-lined metal garbage cans with tight-fitting lids. Make sure all indoor garbage in sealed plastic bags is moved to outdoor storage each evening (no overnight garbage indoors).

- **Outdoors:** collect and/or store garbage in galvanized metal garbage cans with dome-top lids and one-way swing doors, in heavy-duty plastic wheeled cans with flip-top lids, or in dumpsters. Keep dumpster and garbage can storage areas clean and free of food debris, and insure that lids on cans and dumpsters are kept tightly closed.
- Be certain that all indoor and outdoor garbage containers are emptied frequently enough to prevent overflowing, and that containers are thoroughly washed with soap and water no less than every 2 weeks.
- Never leave pet food exposed (indoors or out) before or after pets eat. Store uneaten pet food in the refrigerator overnight. Promptly clean up spilled birdseed around feeders.
- Remove food residues from recyclables before storage, and remove them weekly for pickup.
- **Good housekeeping practices:** Keep areas clean, dry, and well maintained.
 - Clean all food service and dining areas as soon as possible following use. Food residues should also be removed from all preparation and cleaning equipment including pots and pans, sponges, mops, and brooms quickly after use. Wash and hang mops and brooms to dry. Rinse off rubber floor mats daily.
 - Remove rodent droppings and urine-contaminated dust and debris (including those in attics) with a HEPA-filtering vacuum cleaner. Wash hard surfaces that have been contaminated with rodent urine and/or droppings with soap and hot water.
 - Reduce/remove clutter. Store essential non-food materials and goods neatly on racks or shelving. Keep floors clear of goods. Clutter provides harborage for rats and impedes inspection, monitoring, and management activities.
- **Proper food storage:** This denies rats access to food.
 - Inspect new deliveries of food and goods for signs of rats prior to moving containers into food storage areas.
 - Restrict food storage to food preparation areas. Storage in refrigerators or enclosed steel cabinets is preferred. Food kept in desks or lockers, on open shelves, in garages and basements is an invitation to rodents.
 - Store general food materials (snacks, groceries, etc.) in rodent proof (or rodent-resistant) containers such as glass jars with screw-on lids with rubber gaskets, or metal or hard plastic containers with tight-fitting lids. This includes pet kibble, grass seed, and birdseed.
 - Store very large containers of food on shelving beginning at least 18" above the floor and in narrow rows (6'-wide or less). Shelving should be kept at least 18" from walls to permit access for monitoring and management of rats.
 - Store large containers of dry pet food in rodent-proof containers such as metal garbage cans with lids secured with bungee cords.
 - Warehouses and storage out-buildings are favorite spots for rodents, since they have little human activity per square foot (compared to say an office) and often no people are present for up to 16 hours per day and all weekend. Keep pallets and equipment stored 18"-24" away from sidewalls to facilitate monitoring and trapping. Store grass-seed (a rat favorite) and plant bulbs in steel containers such as garbage cans with lids held tight to the can with bungee cords. Bulk foods should be stored on pallets (not on the floor) and regularly rotated "first in, first out."

[] **Other Cultural Controls To Be Used:** _____

11.0 Non-Lethal Physical/Mechanical Controls

Physical/mechanical controls include designing, constructing, and retrofitting methods that deny rats access into buildings and other structures.

[] **Exclusion/Pest-proofing:** Exclusion and pest-proofing are generally used as inter-changeable terms referring to denying pest entry into an existing structure. (Some define "exclusion" as actions to deny pest re-entry into existing

structures in contrast to "pest-proofing" which refers to design and construction details that prevent pest access into a new structure).

- **Build out pests:** When building renovation or new structures are in the design phase, it is important that pest-proofing be incorporated into the designs at an early stage in the process. Any opening roughly the size of a quarter (coin) can allow entry to a rat. A thorough inspection of existing structures is necessary to identify such openings so they can be permanently sealed. Construction documents for building renovations or new construction should contain detailed instructions regarding pest-proofing design details and finish work sealing requirements.
- **Quality Control:** Exclusion work must be competently executed so that it is both permanent and neat in appearance.
 - Use only durable materials that are properly suited to the location. Typical tools and supplies needed Include: tape measure, tin snips, hammer, screwdrivers, drill, pliers, utility knife, scissors, tin snips, small pry bar, assorted nails and screws, sheet metal, spackle, backer rod, several types of caulk, expanding foam, drywall corners, metal kick plates and door sweeps, raised metal thresholds, knitted copper wire mesh, 1/4" galvanized welded wire mesh (hardware cloth), mortar and paint for touch-ups.
 - Use mortar, 1/4-inch galvanized welded wire mesh, expanding foam, or caulk to close voids, cracks, crevices, gaps around windows and roofing ledges, holes in foundations and concrete slabs, etc. Note: copper and wire mesh must be securely stapled or nailed to surfaces or covered with galvanized sheet metal to prevent rats from pushing them out. Spaces filled with expanding foam should also be covered with galvanized sheet metal if possible.
 - Use 1/4" galvanized welded wire mesh to enclose vents in crawl spaces, attics, fan outlets, stand pipes, exhaust vents, and necessary structural openings.
 - Seal gaps where pipes, wiring or other conduits pass through exterior walls and seal interior openings that limit rodent movement to particular rooms or areas.
 - Weather-strip doors and windows, and seal gaps between the bottom of doors and floor by installing brush or vinyl door sweeps, automatic drop sweeps, and/or raised metal thresholds.
 - Weal holes in building foundations or entrances to rat burrows with a minimum of 2-inches of reinforced mortar mixed with iron filings (from machine shops) or broken glass pieces 1/8 to 1/4-inches long (place glass pieces in a thick paper bag, smash with a hammer, and shake out broken pieces of glass directly into the mortar as you mix it).
 - Repair or install window and door screens if needed.
 - Install a tight-fitting access door for the crawl space.
 - Install metal kick plates or flashing at the base of doors to prevent rat gnawing.
 - Insure that all HVAC units are well sealed from rodent access, especially those on the roof
 - Repair underground and basement sewer pipes that are broken.
 - Install threaded caps on sewer pipe clean-outs.
 - install grates with small 1/4" openings on open indoor and outdoor floor drains. Brass drains with hinges and latches work well and can be opened for drain cleaning.
 - Install plastic or metal barriers to prevent roof rats from using overhead wires and conduits to access structures.
 - Where rats are digging under foundations, excavate soil adjacent to building walls to a depth of 6" to 12" and install pea gravel which rats are unable to dig through.
 - Repair all plumbing leaks and remove other sources of water available to rats, who require up to 1 oz of available water daily to survive.
- **Inspection strip:** Remove all plants from an area 24 to 36-inches wide between exterior building walls and adjacent vegetation around the building perimeter. Install a concrete walk, paving stones, or a 6-inch depth of pebbled rock to discourage plant growth. This cleared area excludes habitat for rats to harbor in and serves as an inspection, monitoring, and management zone for rats and other pests.

[] **Horticultural Controls:** These consist of corrective actions concerned with landscape design, re-design, and maintenance that remove or reduce conditions conducive to rats.

- **Vegetation management to remove harborage and food:**

- Remove tree/shrub branches at least 3 to 6-feet away from buildings to prevent rats from gaining access to roofs; trim overhanging branches 4 to 6-feet above rooflines and prevent vines from growing on building walls.
- Install 1/4-inch welded wire barriers around the base of trees to deter rats from feeding on the bark (citrus bark is especially attractive to rats). Tree protector sleeves should be about 18-inches high and buried a few inches into the ground. The barrier needs to be about 2-inches away from the tree trunk on all sides. Wire sleeves can also be made of light weight galvanized steel or heavy gauge plastic.
- Regularly pick up fallen fruit, nuts, seeds, and similar foods from trees and shrubs and place in a hot compost, or place into and seal plastic bags before depositing bags in dumpsters. Crabapples, plums and cherries from flowering ornamentals (inedible to humans), figs, citrus, and palm fruit are especially attractive to roof rats. Netting of various types may be erected over fruiting ornamentals in landscapes to deter rats from accessing trees and shrubs.
- Thin out or replace dense trees, vines, and shrubs.
- Reduce or remove dense groundcover or replace with less dense varieties or alternative species.
- Break up dense plantings with pathways (1 or 2 in.–wide pebbled rock at least 6-inches deep and at least 36-inches wide is recommended), stretches of lawn, or very low groundcover to discourage long rodent runs.
- Regularly mow all lawns and trim shrubs up from the ground to expose lower trunks and allow sunlight to penetrate to the ground which reduces conditions favoring rat hiding places and runways.

[] **Other Horticultural Controls To Be Used:** _____

12.0 Lethal Controls

- [] **Lethal Trapping:** When lethal controls are necessary, trapping should be considered or tried before using toxic baits. The best time to trap is at dusk or later in the night.
- **Precautions:** It is highly recommended that pest control professionals always use the following safety equipment when servicing traps or baits, especially when working in attics, crawl spaces, and other enclosed environments:
 - Safety equipment includes rubber (vinyl, latex) or thick leather gloves; boots with disposable shoe covers; disposable Tyvec coveralls sealed with tape at the wrists and ankles to prevent access to the skin by fleas and mites carried on the rat; safety glasses (goggles); a dust mask or HEPA filter respirator to prevent breathing contaminated debris from rat droppings. Wash thoroughly after handling rats and traps.
 - Rat traps can be harmful to children, pets and non-target species. In sensitive areas, place traps in protected locations, use constructed barriers, or use traps modified for use in an enclosed bait station to prevent unauthorized access
 - Do not leave traps set in open areas unattended unless they are placed in locked areas or in tamper-proof trap stations. Unset and remove traps placed in populated areas when PCO staff leave the site
 - **Food bait selection:** Choose food baits that the rats are already accustomed to if that can be discerned. For example, baiting tests on Pier 39 in San Francisco showed that the rats preferred sour dough bread because it was a major part of the ambient garbage in the form of discarded sandwiches and stale loaves. Or try baits that could be highly competitive with the rats' standard diet, including the ones listed below. Once you have determined the bait preference, stick with that bait for as long as it is taken.
 - Baits for Norway rats include peanut butter, pieces of hot dog, singed bacon, nutmeats, fresh apple slices, multi-grained bread,
 - Baits for roof rats include nuts, dried fruit, fresh apple or banana slices, candy, marshmallows, raisins, peanut butter.
 - **Pre-bait traps:** This refers to placing baits on unset traps and monitoring the traps daily to see if the bait is taken, then replacing missing bait. When the take is steady, add a very small amount of fresh bait onto the underside of the trigger and set the trigger. Rats are likely to manipulate the trigger when looking for the bait that they were accustomed to finding and that they can now smell. Baits that don't stick to the trigger can be tied on with string, dental floss, or very thin wire. Once you have determined the bait preference, stick with that bait for as long as it is

taken. Where food is abundant and rat populations are large, pre-baiting may not be necessary as the rats are already accustomed to the bait and the abundance of food reduces their wariness in proximity to people.

- **Set traps:** Trapping is most effective when done at night (shortly after dusk is recommended). Spring-loaded snap traps (e.g. Victor rat traps) with expanded triggers set for a light touch are preferred for trapping rats
 - Set traps out along rat runways or where evidence of rat activity is present (see Box A). Using large numbers of traps, preferably in groups, produces greater success. Ten to 30 or more traps may be needed where populations are high. Trapping intensely for a few days is generally more effective than distributing traps sparsely over a wide area. Experiment to learn what pattern of trap placement works best in each situation.
 - Set snap traps with the trigger end facing the wall and the edge of the trap flush with the wall. Two or three traps in a row will make it difficult for rodents to jump over them without being caught.
 - Nail snap traps to walls, rafters or trees, or wire them to pipes with the trigger projecting into the runway. J.T. Eaton & Co. makes a metal Snap Trap Station that can be used to protect 2 rat traps or 3 mouse traps.
 - Move objects around to funnel rats into traps. Also use objects to protect traps from non-target species, or place traps inside large tamper-resistant bait stations or in ready-made snap trap stations, or place traps in areas or rooms inaccessible to non-target species.
 - Remember that traps must be positioned so that rats easily encounter them in their normal activity areas.
 - Pre-bait unset traps for a few hours or a day to allow rats to become accustomed to the new object in its environment. Once baits are taken regularly, bait and set traps.
 - Rats will be less wary of a trap that has “rat odors” already on it, so if possible, recycle traps when continuous trapping is underway. Otherwise clean traps with a stiff brush and detergent then lightly oil the metal parts to protect them from rust.
 - Wooden snap traps are not expensive and can be disposed of after use if preferred. Use gloves when handling traps to prevent getting human odors on them that might cause the rats to avoid the trap. Gloves are also needed for personal protection to prevent contact with rat-vectoring human parasites.
 - Set spring snap traps in tandem, with the traps side by side and the triggers facing the wall. If the rat jumps the first trap it may be captured by the second.
 - Snap traps can be nailed to vertical or horizontal boards and wired, strapped or “u-clamped” to a pipe to catch rats (especially roof rats) moving along these passageways.
 - Dispose of dead rats in closed plastic bags deposited into dumpsters or buried underground deeply enough that corpses won't be dug up by dogs or other scavengers.

Live Trapping in Cages

Live trapping is not recommended since removing and releasing the live rat just transfers the problem to another area. In cases where lethal trapping is an unacceptable method for use (e.g., during a rat emergency in a child care center), live trapping may be an acceptable method for capturing and removing the rats to a location where they can be euthanized.

Glue Boards

City policy does not permit use of glue boards to manage rats on city property.

13.0 Reduced-risk Chemical Controls

IPM plans must comply with provisions of the city's IPM Policy and Approved Pesticide List, especially with regard to use of lethal controls such as rodenticides.

- **Compliance requirements relevant to rodenticides:**
 - Rodenticides are to be used primarily as a last resort.
 - When use is necessary, rodenticides must be incorporated within a comprehensive IPM program rather than used alone.
 - Use of chemical controls must be considered only after non-chemical methods have been evaluated and integration of a rodenticide into the treatment program found necessary.
 - Only rodenticides listed on the city's Approved Pesticide List may be used (unless a special exemption is issued by the Department of the Environment).

- Use restrictions specified in the city's Rodenticide Plan (currently under revision) must be followed, including **prohibition of rodenticide use indoors** (only trapping of rodents is permitted indoors).
 - A written recommendation from a licensed pest control advisor (PCA) must be obtained in advance of any rodenticide application made *outdoors* on city property by city staff or contractors holding a Qualified Applicator's License (QAL) or under the direct supervision of a QAL.
 - Structural pest control operators holding a Branch 2 license may apply rodenticides outdoors around the immediate perimeter of buildings on city property; such applications do not require a PCA recommendation.
 - A copy of the pesticide label and Material Safety Data Sheet (MSDS) must be available on-site during the rodenticide application and kept on file following the application.
 - All rodenticide label directions must be read and followed, including the health and safety protocols.
- **Precautions:** Rodenticides are not only toxic to rats, but are also poisonous to non-target species (including humans and domestic animals) and both avian and mammalian predators. For this reason, rodenticide treatments should be limited to affected areas (spot-treatments) and above-ground applications must be enclosed in tamper-proof bait stations to avoid killing or harming other organisms. Below-ground applications of rodenticides do not require bait stations under the conditions discussed under "Toxic Baits" below.

Rodenticide treatments should be planned to maximize the efficacy of the selected product, minimize environmental impact, and protect staff and the public from exposure to the rodenticide. It is important to:

- monitor and evaluate the rodenticide treatment regularly to determine whether it has been effective. Re-treatment of an infested area should only be done if monitoring shows the rat population is remaining the same or is increasing.
- when using rodenticides for spot-treatments, all effective non-chemical methods should be continued as scheduled unless they are in conflict with the re-entry interval for the rodenticide used. These IPM methods will continue to add their "control percentage" to the management equation.

Toxic Baits

Toxic baits should only be used under specific conditions defined in the city's Approved Pesticide List's "Site Specific Rodenticide Plan for City Facilities". Only baits listed on the "Allowed" section of the Approved List may be used (unless an exemption is approved by the citywide IPM coordinator at the Department of the Environment). No poison baiting is permitted inside structures. Above-ground baits used outdoors must be placed in a tamper-proof bait station. Monitoring with non-toxic bait blocks to determine presence of active rats should precede placement of toxic baits into bait stations. Once feeding signs are observed on the monitoring bait blocks, they should be substituted with lethal baits selected from the city's Approved Pesticide List.

Bait stations are not required for below-ground applications of rodenticide baits in sewers. In addition, placement of rodenticide baits directly into underground rat burrows is permitted in exceptional circumstances such as to prevent structural damage to buildings, sidewalks, etc. or to protect public health when conditions required for trapping are not present or trapping has been ineffective. Such burrows must not be visible to or easily accessible by the public or domestic animals.

Approved Rodenticides

As of February 2006, the only authorized rodenticide for use in city facilities is listed below. Check the Approved Pesticide List available at www.sfenvironment.com/aboutus/innovative/ipm/pest_list06/index.htm for future updates on approved rodenticides

[] Bromethalin (Topgun™ All-Weather Bait Block Rodenticide)

EPA signal word CAUTION. This product is not an anticoagulant. It is a diphenylamine product. It is approved for use to monitor and treat rats in sewers. Bait blocks are secured inside manholes and suspended on wire rings at the edge of sewer walls. Bait blocks are monitored to assess feeding acceptance by rats and replaced as needed. Rats usually consume a lethal dose in a single day's feeding and cease feeding until death occurs two or more days after consuming the bait.

14.0 Education and Training Needs

Educational methods include staff and public training, reference materials, public outreach, and similar efforts to increase awareness and knowledge about rats. Create a list of ways to provide educational information to facility users (e.g. ways to store food and garbage) or training of staff (e.g. trapping techniques) required for the IPM program.

List education of facility users or training of staff (e.g., sanitation methods) required for this IPM program:

14.0 Labor and Equipment Needs

List special labor or equipment required to implement this Plan: _____

15.0 Summary of IPM Plan

Briefly summarize your IPM plan as selected from the check-off options listed on this form: _____

16.0 References and Bibliography

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