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March 1990

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Colvin, Bruce A.; Ashton, A. Daniel; McCartney, Wellard G.; and Jackson, William B., "PLANNING RODENT CONTROL FOR BOSTON'S CENTRAL ARTERY/TUNNEL PROJECT" (1990). *Proceedings of the Fourteenth Vertebrate Pest Conference 1990*. 14.

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# PLANNING RODENT CONTROL FOR BOSTON'S CENTRAL ARTERY/TUNNEL PROJECT

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**ABSTRACT:** A comprehensive rodent control program is being planned for a \$4.4 billion highway-construction project in Boston, MA. This IPM program will include broad participation by project personnel, city and state agencies, and community groups. Surveys, public education, and sanitation improvements will begin more than a year before construction; baiting will begin approximately 3 months before construction. All control activities will be maintained until construction is complete. Mitigation of community impacts during construction projects is a growing concern, and improved approaches to construction-related rodent control are needed.

Proc. 14th Vertebr. Pest Conf. (L.R. Davis and R.E. Marsh, Eds.)  
Published at Univ. of Calif., Davis. 1990.

## INTRODUCTION

The Massachusetts Department of Public Works is undertaking a 10-year and \$4.4 billion highway-construction project in Boston. This Central Artery/Tunnel Project (CA/T) is 90% federally funded and includes expansion of two interstate highways. An existing elevated section of I-93 will be replaced by an 8 to 10 lane underground highway, and I-90 will be extended to provide access to Logan Airport via a new 4-lane harbor tunnel (Fig. 1). In all, there will be 12 km of mainline highway constructed, 7.3 km of which will be underground. Approximately 10.3 million m<sup>3</sup> of dirt will be excavated, numerous utilities will be relocated, and the existing highway will be maintained until the underground system is completed.

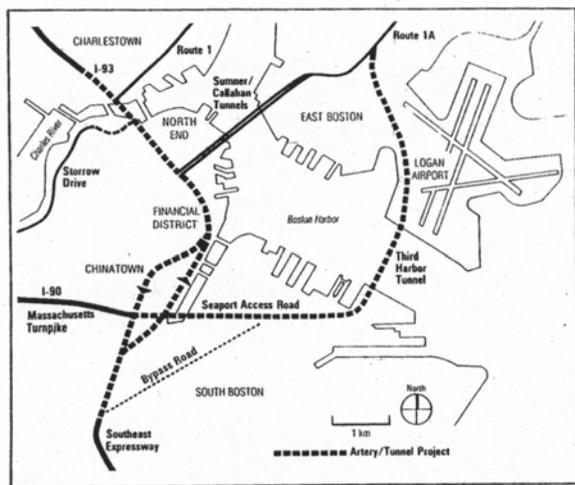


Figure 1. The proposed alignment for the Central Artery/Third Harbor Tunnel Project, Boston, Massachusetts.

Construction will pass through downtown Boston and waterfront areas; it also will border some residential

neighborhoods. Environmental conditions range from the asphalt surroundings of the downtown Financial District to the extreme congestion of Chinatown and the outdoor market of the North End residential community. Underground environments include intersecting subway tunnels, current and historic utility systems, and filled wetlands upon which much of downtown Boston is built.

As part of construction planning, public concerns have been solicited through numerous public meetings. Mitigation of community impacts has been a major focus, and the foremost public concern has been the potential for rodents to disperse from construction sites to bordering neighborhoods once utility relocation and underground construction begins. Given this concern, and also the well-established Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*) populations in Boston, a comprehensive rodent control program was included in project planning.

Historically, rodent control during construction in Boston (and elsewhere in the United States) has been largely reactionary rather than preventive. General contractors have subcontracted pest control operators (PCOs) and, if rodent problems occurred, PCOs responded. Thus, control efforts have been linked almost exclusively to the actual construction period. Contract specifications typically have been vaguely written and provided for minimal rodent control services.

Little information exists in the literature concerning rodent control for construction projects, and it appears that only some basic and small-scale principles have been described (Peterson 1978). As with any situation involving the control of commensal rodents, public health and damage to structures and equipment are a concern in construction areas and also in bordering blocks where rodent dispersal potentially could occur.

Incorporation of a comprehensive and centrally coordinated rodent control program as part of a major construction project in the U.S. is unique, and we believe that the program planned for the CA/T Project represents the first of its kind in the world. The purpose of this paper is to describe key aspects of the CA/T control program and an

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Integrated Pest Management (IPM) strategy for construction-related rodent control.

## IPM STRATEGIES

Effective mitigation requires action prior to the start of construction. The overall strategy is to create a rodent-free construction corridor that lasts for the duration of construction. The central objective is to control existing rodent populations prior to construction (thereby preventing dispersal) and to keep work areas rodent-free during construction.

In Boston, basic principles of urban rodent control can be applied (Davis and Jackson 1981). However, control activities must be timed and shifted according to construction scheduling. Additionally, constant environmental change and disruption associated with construction dictate that the control program be flexible, closely managed, and responsive.

The idea of rat-free towns was developed by Telle (1969) and also described by Myllymaki (1969) and Drummond (1970); urban rodent control has been successfully implemented based on that concept (Gacs et al. 1977). For the CA/T Project, that concept will be applied within a strip that bisects downtown Boston. A rodent-free window of time will be created, allowing each phase of construction to be successfully staged without community impact from rodents.

The CA/T rodent control program will involve standard IPM techniques of surveys, public education, sanitation, rodent proofing, and baiting. These actions will be distributed collectively among three control zones (Impact, Management, Buffer) adequate to match environmental conditions and proposed construction activities (Fig. 2).

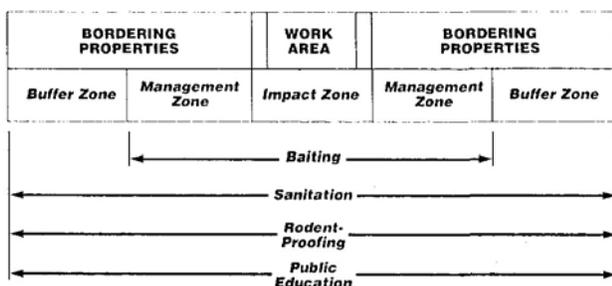


Figure 2. A cross section of the CA/T construction alignment showing control zones and IPM actions.

The work area and abutting streets or properties will be called the Impact Zone, and this area will require intensive elimination of rodents. The Management Zone will extend outward from the Impact Zone. It will range about one to three blocks wide, include intensive baiting initially and then maintenance baiting directed at interception points used by rodents dispersing from or towards the Impact Zone. By clearing bordering blocks of rodents prior to construction, the intent is to provide adequate space (vacated territories) into which any dispersing rodents would go, to maintain baiting in those areas, and thus to prevent any further dispersal or reinfestation.

The Buffer Zone will extend approximately one block beyond the Management Zone. This outermost zone will not include baiting but will include other IPM efforts (particularly sanitation) to reduce potential recolonization of Impact and

Management Zones.

Standardized surveys, using Center for Disease Control (CDC) procedures (Davis et al. 1974), will be initiated at least a year before major construction. These surveys will identify sanitation deficiencies (exposed garbage, unapproved refuse storage) and signs of rodent activity on premises within the construction corridor and in bordering neighborhoods. Survey data will be used to tailor the control program to the needs of each neighborhood and to evaluate the effectiveness of the program (Drummond et al. 1972). Furthermore, comparisons of survey data collected before and during construction will be used to evaluate any claim of community impact during construction. Surface surveys will be conducted every 6 months until each section of construction is complete.

In addition to premises surveys, utility manholes (sewer, electric, phone, subway) and catch basins will be surveyed for rodent activity 6 to 10 months prior to each phase of construction. Test baiting will include representative utility systems and the use of paraffin-block census baits, suspended by wire in manholes, for approximately 3 to 5 days. Additionally, all manholes, catch basins, and utility networks will be mapped in a similar manner as done by Bentley (1960) and Greaves et al. (1968). An identifying number will be assigned to each manhole and catch basin so that rodent activity levels and future bait placements can be tracked.

## EDUCATION PROGRAM

Community education and participation is a critical component of urban rodent control and will receive major emphasis as part of the CA/T program. Education activities are scheduled to begin as early as 2 years before major construction in some areas. The first step will be to involve and inform community leaders and key community organizations. Subsequently, broad outreach efforts will be mobilized in each neighborhood. Educational approaches will be diverse, include multiple languages, and present clear messages of community involvement.

Educational materials will include literature, slide shows, videos, and neighborhood displays. "How To" brochures on sanitation and rodent-proofing have been developed and will be distributed door-to-door in each neighborhood. Public presentations on rodent control will be made to community groups, schools, and professional associations. The importance of community sanitation and the fact that rodent control can be successful, if people work together, will be stressed.

The education program will be coordinated from the CA/T Project and involve the community relations, mitigation, public information, and technical staffs. The City of Boston will be contracted to assist with door-to-door dissemination of information and neighborhood organizing. Neighborhood organizations will also assist in disseminating information.

## SANITATION

The importance of sanitation in urban rodent control has been well documented (Davis 1953), and heightened emphasis on sanitation will occur more than a year before any construction and throughout construction. Sanitation deficiencies will be resolved through a balanced approach of education and sanitary code enforcement. Two city agencies with legal jurisdiction (Inspectional Services, Code Enforcement Police) will be contracted to resolve sanitation problems on private properties. Additionally, the City's Water and Sewer Commission will assist with heightened cleaning of catch basins. The intent is to reduce the ability of the

proposed construction corridor to support rodent populations prior to initiation of baiting programs, thus reducing the dependency on baiting and providing a long-term IPM solution to existing rodent infestations.

In addition to neighborhood sanitation efforts, sanitation will be strictly enforced by resident engineers in construction areas. Specifications for construction contractors will require that all work areas be cleared of vegetation and debris prior to construction and be maintained free of weeds and excessive debris during construction. Furthermore, construction contractors must submit and implement a sanitation plan prior to construction mobilization that includes rodent-proof refuse containers, designation of lunch areas, and emptying of refuse containers daily.

## RODENT-PROOFING

The old infrastructure of many buildings, streets, subway tunnels, and utility systems in Boston provides a labyrinth of avenues for rodent movement. Openings in basement walls and cracks in building foundations are not unusual, and utility conduit (for example, electric service) provides secure routes for rats and mice to move between building basements and manholes under the street. Sewer laterals also can provide routes into basement drains and through plumbing fixtures.

Use of proper construction and repair materials and rodent-proofing methods will be included in the public education effort (Holsendorf 1937, Scott 1976, Jenson et al. 1979, Timm 1986). Building owners and managers, in consort with their own staff and PCOs, will be encouraged to secure building foundations and perimeters. The CA/T Project, in cooperation with utility companies, will seal utility conduit ducts inside manholes where survey and baiting data indicate chronic movement and reinfestation routes used by rodents. This primarily will involve a series of utility manholes that parallel the construction corridor. Sealing of utility conduit at the manhole end will be initiated after poison baiting and during the month preceding construction in any one area. This sequence is being used because, if such rodent-proofing were to precede baiting, rodents might be confined in utility systems and damage cabling while attempting to escape.

In addition to construction-period mitigation efforts, rodent-proofing principles will be integrated into final design. This will include sealing of new utility ducts, landscape design for surface areas once the existing elevated highway is demolished and structural design for administration and maintenance buildings where operational personnel will be based. IPM maintenance activities for the completed system will include appropriate use of refuse containers, litter control, street cleaning, regular inspections for structural repairs, and monthly pest control inspections and service.

## BAITING

The baiting program for the CA/T Project will be the first comprehensive baiting program, involving both surface and underground environments such as sewers, in the history of the city. Baiting activities in Boston during past construction projects, and for community rodent control, essentially have been limited to surface applications and almost exclusively burrow baiting. Subsurface rodent infestations generally have been considered insignificant. Furthermore, baiting has almost exclusively been directed at control of rat populations rather than inclusive of mice. Because rodent control during construction has previously only involved surface environments, rodent displacement from

sewer and utility systems apparently has occurred and contributed to current public apprehension.

For the CA/T Project, several pest control companies will be contracted to perform the baiting, and each will be assigned a geographical area. Pest control companies will be contracted directly by the Project to allow central coordination by Project management over the entire construction route. Baiting will be initiated approximately 3 months before construction in most areas, timed with each phase of construction, and tailored to environmental conditions in each neighborhood.

Initial baiting will be an intensive process and include burrow baiting, installation of tamper-resistant bait boxes, and baiting of all catch basins and accessible manholes within the construction corridor. These efforts will be distributed to each side of the construction corridor according to the type of construction activities (anticipated environmental disruption) and the distribution and abundance of rodent populations. In all cases, the objective will be to eliminate rodent populations within the construction corridor prior to construction and to bait an adequate perimeter to prevent reinvansion of cleared zones. Specifications for construction contractors will require written notification from the CA/T Project that construction areas are rodent-free before construction mobilization is initiated.

During the month prior to construction, a maintenance baiting program will be established and maintained until all construction is completed and all construction materials and equipment are removed. The distribution of bait points will be decided based upon the history and locations of bait consumption, regular checks of manhole and catch basin baits, and results of surveys and weekly inspections of work areas and bordering blocks.

The maintenance baiting program will include interception baiting to prevent reinfestation. The public is most concerned about rodents being displaced from the construction corridor; however, critical to the long-term success of the control program is prevention of rodents from moving into cleared zones from nearby areas. For that reason, once utility and sewerage systems are cleared of rats, bait points will be maintained, especially at perimeters of control zones.

North of the CA/T Project, there is an adjoining highway construction project (CANA) where sewer baiting has begun, and that work is serving as a model for future CA/T rodent control. Prior to excavation for two tunnels, 427 m and 244 m long, sewerage systems were baited in the work area and bordering blocks. Bait consumption was monitored monthly for each manhole. The number of active manholes decreased 91% after 1 month while bait consumption decreased 85%. Activity was greatest in sanitary sewers (Table 1), and rats appeared most often in sewer lines with moderate or low-flow volume and within or bordering residential areas. The number of bait points was reduced during the maintenance phase, and the area has been effectively maintained free of activity for 7 months. These results have demonstrated the existence of subsurface populations and also that a rodent-free construction zone can be created.

## DATA AND PROGRAM MANAGEMENT

The size of this construction project and dimensions of the control program will require detailed data management, supervision, and ongoing evaluations and planning. Results of community and utility surveys; records and evaluations of any complaint calls from the public; and the locations, types, and

Table 1. Bait consumption and rodent activity in CANA sanitary and storm sewers during Spring-Summer 1989. Data were grouped into month intervals for each manhole baited.<sup>a</sup>

	Month 1		Month 2		Month 3	
	Sanitary	Storm	Sanitary	Storm	Sanitary	Storm
No. manholes baited	43	22	39	22	30	15
Avg. bait blocks/manhole <sup>b</sup>	3.0	2.7	2.5	2.4	2.7	2.4
% Manholes active	41.8	23.0	4.9	0	0	0
% Bait consumed	31.9	11.9	5.9	0	0	0

<sup>a</sup>Data provided by D. Dudley, Envirsan Pest Control, Somerville, MA.

<sup>b</sup>20-g block; brodifacoum.

amounts of bait placed will be recorded in the field on standardized data sheets and subsequently transferred to computer file. PCOs will be required to submit data sheets weekly that detail their baiting activities, inspections for rodent activity and sanitation deficiencies, and any complaint calls investigated. Similarly, city personnel contracted by the project will be required to submit monthly progress reports regarding neighborhood education, surveys, and sanitation conditions.

Statistical analysis of surface and subsurface data will determine the most appropriate distribution of control resources, efficacy of baiting activities, maintenance baiting schedules, and overall environmental improvements. Control activities will be reevaluated regularly and shifted as necessary to ensure control.

The entire program will be centrally coordinated (Fig. 3). The CA/T Project is developing its own technical staff to supervise field operations and manage the overall program. Additionally, CA/T mitigation, public information, and community relations staffs will participate in various aspects of program operations. Coordination meetings will be held regularly with all contracted personnel and CA/T staff. A working committee that includes four city agencies, four state agencies, utility companies, community groups, university personnel, and CA/T staff has been established.

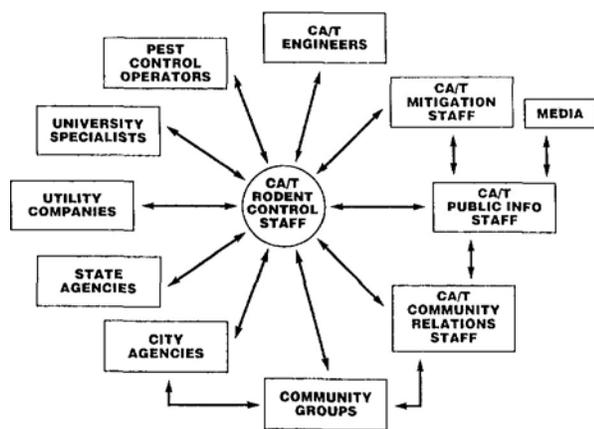


Figure 3. An organization chart showing central coordination of personnel and organizations participating in the CA/T rodent control program.

Rodent control training will be required for all participating CA/T personnel, including resident engineers responsible for supervising construction contractors. Additionally, all pest control operators and assisting city personnel will be required to attend orientation sessions on technical issues and public relations and construction sequencing.

## DISCUSSION

Construction pest control requires a proactive rather than reactive approach. For a major construction project, it also requires community participation and cooperative working relationships among city and state agencies. Only with effective planning and cooperation can IPM be a success.

The CA/T Project's rodent control program is a massive undertaking, yet an opportunity to set IPM standards for urban rodent control. Central coordination will remain the most crucial and unique element of the program, allowing previously disjointed city, state, and community efforts to be integrated for maximum effect.

Defining clear roles and work tasks for participants in the CA/T program has been complex. The control program could not simply be a replacement of city services, but rather a heightening of rodent control and sanitation as directly related to construction mitigation. Additionally, work tasks for PCOs are being defined within an IPM strategy and environmental manager role, rather than simply burrow baiting.

In general, it appears that effective use of rodent control by the construction industry is lacking in the U.S. Furthermore, it appears that the pest control industry needs to adopt more effective approaches for construction pest control and to develop the ability to implement mitigation programs. Greater use of IPM with emphasis on surveys, documentation, sanitation enforcement, and comprehensive baiting is needed.

The public is becoming more vocal about community impacts from construction projects. In Boston, public concern prompted development of the CA/T rodent control program, and the city was unwilling to allow the state to proceed with construction until the concern over rodents was effectively resolved. These facts illustrate the importance of evaluating mitigation issues as part of construction planning. Additionally, with the aging infrastructure of many U.S. cities

and existing commensal rodent populations, urban construction projects can anticipate greater emphasis on rodent control.

The CA/T Project should spur drastic upgrading of rodent control procedures in Massachusetts and construction projects in the U.S. The CA/T Project has made a commitment to address any potential problem from rodents during construction, and a positive legacy of environmental awareness and understanding of rodent control should result for Boston.

#### ACKNOWLEDGMENTS

We wish to thank the Joint Venture of Bechtel/Parsons Brinckerhoff, the Massachusetts Department of Public Works, and the City of Boston for their assistance and cooperation in the development of the CA/T rodent control program.

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