ANNUAL

INTEGRATED PEST MANAGEMENT REPORT

2016

EAST BAY REGIONAL PARK DISTRICT

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East Bay
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Figure 1. A great blue heron performs mechanical control of gophers at the Brazil building lawn in Tilden Regional Park.

Introduction

This annual report provides the Board of Directors of the East Bay Regional Park District (EBRPD or the District), Ecology Committee (advisory to the Board), and the interested public with a summary, analysis, and evaluation of integrated pest management practices and a descriptive review of Integrated Pest Management (IPM) techniques utilized to provide more sustainable and effective pest control. For reference, this report also includes a brief description of the District's Integrated Pest Management (IPM) program.

IPM Program Goals

IPM is an adaptive management approach for preventing and suppressing pests before they reach unacceptable levels. The goal of the IPM program to manage pests in the most effective and safest manner for the public, staff and the environment in order to optimize recreational experiences and ecosystem functioning. Our IPM approach includes: monitoring and research, cultural, mechanical, chemical, and biological strategies that, when integrated together, create sustainable land management practices. Site characteristics, biological timing, pest species, environmental considerations, level of desired control and efficacy factors dictate the strategies selected. Before implementing management actions, possible strategies are evaluated to develop an adaptable management strategy that maximizes pest control, ecological functioning, and public and staff safety.

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What is a pest?

A pest is any organism that is injurious to recreational activities, economic commodities, public health and / or ecological functioning. In the EBRPD, the bulk of our pests are nuisance weeds that degrade recreational enjoyment and noxious plants that decrease diversity and ecological functioning. Additional pest management activities include the control of commensal organisms, or animals that thrive in and adjacent to human activity like mice, rats and certain insects. Public health threats like harmful algal blooms, E. coli outbreaks, vector borne diseases are additional pests that IPM staff have spent much more time and resources on in recent years.

Implementation of the IPM program involves eight major components:

1. Consultation & Recommendation: IPM staff perform site visits to offer: assessment, prescription development and implementation guidance on a variety of pest management activities and restorative actions throughout the District.
2. Annual Integrated Methods & Safety Training (formerly Pesticide Application Safety Training): IPM staff train all pesticide handlers in the District. This mandatory training has been broadened to include a curriculum on the ecology and biology of pests, ecosystem approaches to pest problems and best science updates as it pertains to pest and vegetation management.
3. Sustainable Practices Training: IPM staff offer supplemental training on alternative pest control strategies that focus on mechanical and cultural techniques. These include alternate years of training on vertebrate trapping techniques, developing volunteer programs and Bay Friendly Landscape Maintenance training, among others.
4. Pest Control Request: IPM staff require park staff to submit a detailed description of the problem, history, and desired objective of pest problems
5. Pest Control Recommendation (PCR): If a chemical pesticide application is required, the IPM specialist, Pest Control Advisor, provides a prescription. The PCR is a legal document that ensures safe, effective and environmentally sensitive application of pesticides.
6. Pesticide Use Report (PUR): Park staff (and their contractors) report all pesticide use to the IPM department; detailing the amount and type of pesticide applied. This allows IPM staff to track, report, analyze and manage the IPM program.
7. Pest Control Contracts: IPM staff manage various pest management contracts to control or eradicate invertebrate, plant, and vertebrate pests of a high priority. Contractors also utilize mechanical and chemical methods of control.
8. Annual IPM Report: IPM staff compiles, analyzes and presents in an annual report form a summary of pest management projects, narrative and analysis of mechanical/cultural methods and pesticide use and trends within District parklands.

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NEW - IPM Program Improvements

IPM staff has introduced a more comprehensive IPM training that combines the Annual Pesticide Safety Training with additional topics that incorporate concepts of plant and vertebrate biology, weed ecology, best management strategies to prevent spread and introduction of pest species, and integrated vegetation management strategies. An additional training on Bay Friendly Landscaping & Maintenance, was specially formulated for the District and is offered in 2017.

IPM staff continue to grow its volunteer program with a total of 9,700 volunteer hours. Individual volunteers, school and corporate groups work on a variety of invasive plant species and habitat enhancement projects in a variety of parks.

IPM staff has been training and conducting site visits and advising on structural pest control contracts to increase the awareness and practice of rodent exclusion in District buildings and residences and to increase the efficacy of trapping efforts by operations staff.

IPM staff developed an organic and slow release fertilizer list for operations staff to utilize in turf maintenance. Additionally, IPM staff has trained and are working with selected park staff to continue to test and incorporate the OMRI (Organic Material Review Institute) registered non-selective herbicide, Suppress. Staff continue to report that this burn down herbicide can be effective when application is timed correctly on young annual plants.

IPM program has phased out nonylphenol ethoxolate (NPE) based surfactants and replaced them with the non-NPE aquatically registered Competitor (some Hasten oil and Target Pro-spreader/Activator remain in stock).

IPM program phased out the pre-emergent herbicide Surflan AS (signal word CAUTION) with the safer and more effective Spect(i)cle Flo (no signal word).

IPM staff worked with Design and Construction for the Oyster Bay recreational development utilizing mechanical weed control and local volunteers to plant native trees and shrubs.

IPM staff continue to work with the USDA-ARS (United States Department of Agriculture-Agriculture Research Service) and their biocontrol programs. Most notably, USDA entomologists received federal approval for a cape ivy biocontrol that was released in two District parks.

IPM staff worked with Park operations to research, install and maintain turf alternatives that are more drought tolerant and pest resistant.

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IPM staff purchased and is training staff on the use of the GopherX machine. This machine that generates carbon monoxide and is used as an alternative to rodenticides. This tool is a promising complement to the IPM tool box. This machine will not completely replace rodenticides due to possible non-target asphyxiation of listed species that may use burrows in critical habitat.

IPM staff assisted with the Master's Thesis study of the origins and fate of phosphorous loading in Lake Temescal. Understanding the nutrient fluxes and physical cycles of this urban lake will help inform treatment to control harmful algal blooms in 2017. Staff continues to work with other departments and industry experts to better understand the dynamics of algal blooms and refine plans for an aeration system for Lake Anza that will mitigate harmful algal blooms in the future. IPM, in partnership with the Water department, continues to employ watershed interns to assist in the monitoring of waterbodies for water quality issues and algal bloom occurrences

IPM continues to consult with and advise other District departments to prevent invasive plants and pest issues during design and implementation phases. Additionally, more site visits have been incorporated into IPM staff scheduling to address structural pests and implement exclusion practices.

Working with multiple departments and partnering agencies, IPM staff assisted with the development of an action plan to reduce and respond to future bed bug outbreaks at Camp Arroyo and developed a monitoring plan to detect future infestations.

IPM is finishing Best Management Practice (BMP) protocols for that will assist the District and its staff in reducing the spread of weed propagules and pathogens like *Phytophthora ssp*. that cause Sudden Oak Death, plant root rot and other pathogens.

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Integrated Pest Control by Park or Program

The bulk of pest control consists of an adaptive management approach to vegetation management. Mechanical and Cultural methods are difficult to quantify but comprise the majority of district vegetation management activities. Mechanical methods used in the district include: propane torching of seedlings, mechanical brush removal (pulling and grubbing), mechanical mowing, line trimmers, scythes and weed whips. Most fire roads and trails are rough mowed or line trimmed and much of the District's fencing is line trimmed, as are most if not all group camps and other recreational areas. Often vegetative growth is sufficient to warrant two or more mowings.

Chemical control around critical infrastructure like pumps stations, overflow preventers and fencing is used when it is difficult or excessive to treat with other methods. Figure 2 illustrates a common strategy of trailside vegetation management: integrating rough mowing and line trimming with herbicide application around more difficult to maintain structures. Herbicide treatment of difficult to mow areas allows for park staff to perform more frequent trail side mowing and mow more trails while protecting wood and metal fencing from incidental trimming that reduces its life and requires more maintenance. Warmer and drier parks often require wider vegetative buffers from park infrastructure due to higher incidence of wildfire ignitions and wildlife conflicts. Figure 3 illustrates this.

The following narrative includes descriptions of mechanical, cultural and chemical methods reported by staff. Products and amounts are listed by park in table 6.

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Figure 2. Integrated right of way trail management that includes rough mowing trail side and herbicide treatment of fence line posts. Vegetation management along trails limits accidental wildfire ignitions as well as mitigates tick bite incidents.

Anthony Chabot

- Staff continued to use gas cartridges to control gophers in campground turf.
- Poison oak was successfully controlled along single track trails and the campground using a combination of herbicide, hand tools and the woods mower.
- Several hazardous eucalyptus trees were removed from the campgrounds. Stumps and resprouts were treated chemically.
- Yellow star thistle and other thistles were successfully treated with pre-emergent herbicide along trails and roads to control the spread of the noxious wildland weeds.
- Staff reported that chemical treatment of *Euphorbia oblongata* was up to 90% successful in 2015, though they were unable to follow up in 2016 to control, seedlings that were flushed by treatment. Crews are planning for follow-up in 2017.
- Park staff contracted with Alameda County Department of Agriculture to continue to control the spread of Stinkwort (*Dittrichia graveolens*) along roads and the campground chemically. Park staff followed up with hand pulling.
- IPM investigated the efficacy of pre-emergent herbicide on Stinkwort in the log deck utilized for fuels in previous years.

- Staff line trimmed and rough mowed around gates, sign posts, tables, barbeques and fence lines throughout the park and campground.
- The USDA-ARS released biocontrols for cape ivy and are optimistic that overwintering insects will reduce the biomass of this invasive.
- The seed heads of pampas grass were removed from plants that were easily accessible from the trailside of Soaring Hawk.
- Rangers tested three different treatments on poison hemlock at Bort Meadow in spring. One plot was burned with a propane torch, one spot was line trimmed and one spot was left as a control. All the plots were then seeded with a native sedge mixture. The plot that was line trimmed and then seeded showed the most reduction in poison hemlock. Crews will survey and report for the 2017 report.

Alameda Creek Trails

- Park staff uses an integrated approach to control nuisance weeds along more than 26 miles of regional trails in right of way applications that includes pre and post emergent herbicide.
- Rangers removed several hazardous eucalyptus and treated stumps chemically.
- Staff targeted puncture vine in several spots using herbicide.
- Staff line trimmed and rough mowed around gates, sign posts, tables, fence lines and along trails throughout the park.

Ardenwood Farm

- Park staff continued their annual treatment of gophers, moles and ground squirrels using gas cartridges and traps throughout the park and staff gardens.
- Staff hired a contractor to control weeds in the picnic areas, parking lots and railways with pre and post-emergent herbicides.
- Park staff worked with volunteers pulling privet seedlings throughout the grounds.
- Park staff used diphacinone treated oats in bait stations for ground squirrel control around key infrastructure.
- Rangers experimented with organic burn down herbicide, Suppress, on poison oak.
- Staff line trimmed and rough mowed around gates, sign posts, tables, fence lines and along trails throughout the park.

Black Diamond Mines

- Staff applied pre and post-emergent herbicides to parking lots, the corporation yard, residences and trail sides for right of way to control nuisance weeds and grasses.
- Rangers continued to use herbicide to control invasive tree of heaven.
- Staff targeted yellow star thistle in areas and along trails where this noxious weed with herbicide spot treatment.
- Staff line trimmed and rough mowed around gates, sign posts, tables, fence lines and along trails throughout the park.

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- The Contra Costa County Department of Agriculture (CCCDA) continued its spot treatment with herbicide of noxious rangeland weeds to artichoke and purple star thistles as well as Russian knapweed throughout the wildlands of Black Diamond Mines.
- Environmental Programs continued its mitigation projects to chemically treat perennial pepperweed and various noxious thistles.

Botanical Garden

- The Botanical Garden continues to rely heavily on hand pulling and mulching to control weeds.
- Staff gardeners used very small amounts of herbicide to control woody perennial weeds and tree sprouts such as Himalayan black berry, poison oak, etc.
- Gardeners used pheromone treatments to control light brown apple moth and metaldehyde product to control slugs and snails.

Figure 3. Typical integrated vegetation management in drier parks: Rough mowing around structures with a wider band of herbicide treatment to keep vegetation off wood fencing

and away from structures. This protects structures from fire damage and helps control burrowing by mammals and subsequent incidence of rattlesnake encounters.

Briones

- Staff controlled broadleaf weeds and annual grasses in gravel parking lots, fire trails edges and staging areas chemically with pre and post emergent herbicides.
- Rangers line trimmed and rough mowed around gates, sign posts, tables, fence lines and along trails throughout the park.
- Fire roads and group campsites were mowed and line trimmed.
- The Contra Costa County Department of Agriculture (CCCDA) continued its spot treatment with herbicide of noxious rangeland weeds to artichoke and purple star thistles throughout Briones wildlands.
- Park staff used diphacinone treated oats in bait stations for ground squirrel control around key infrastructure.

Camp Arroyo

- Rangers at Camp Arroyo used pre and post-emergent herbicides to control vegetation in order to discourage ground squirrel and consequent rattlesnake activity around camp cabins, recreational areas and offices.
- Staff line trimmed and rough mowed around gates, sign posts, tables, fence lines and along trails throughout the park.
- IPM staff and management services engaged in a protracted season of bedbug treatment in one cabin. Mechanical heat treatments and less toxic insecticides were initially used but the well-insulated construction made these treatments ineffective. Staff opted for the most effective treatment, fumigation, for the third and final treatment. No reoccurrence of bed bugs have been reported since.

Carquinez Martinez Shoreline

- Rangers line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Park staff maintained their fire roads through rough mowing and line trimming.
- CCCDA continued its spot treatment with herbicide of noxious rangeland weeds that include artichoke and purple star thistles with herbicide.

Contra Costa Trails

- Park staff uses an integrated approach to control nuisance weeds along more than 91 miles of regional trails and fences in right of way applications that includes pre and post emergent herbicide as well as line trimming and rough mowing.

Contra Loma

- Staff applied pre and post-emergent herbicides for park maintenance and right of way around buildings, along trails and in picnic areas.

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- Rangers rough mowed approximately 20 acres several times this season.
- Park staff box scraped to augment weed control in 2 acres of overflow, gravel parking lots.
- Park staff line trimmed around gates, sign posts, tables and fence lines throughout the park for a total of 5 acres, several times for the growing season.

Coyote Hills

- Staff applied a small amount of herbicide to woody nuisance weeds.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park and rough mowed fire roads, group campsites and other recreational areas.

Crown Beach

- Park staff targeted yellow star thistle along shoreline trails with mowing and spot herbicide treatment.
- Rangers converted 2 acres of turf into a native garden/pathway and used mechanical grubbing, scarping and selective herbicide to control aggressive perennial grasses.
- Chemical control was used to control problem weeds around picnic areas, tables, parking lots and curbs so that mechanical follow up would be effective.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park and rough mowed trails and other recreational areas.

Cull Canyon

- Park Staff used chemical control to treat nuisance weeds around picnic tables, in overflow parking lots, around buildings, fences, etc.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park and rough mowed trails and other recreational areas.
- Poison oak was controlled through a combination of chemical and mechanical methods along single track trails.

Del Valle

- Rangers rough mowed approximately 20 acres in the campground, 11 miles of fire road and 1.5 miles of line trimming narrow track trail.
- Staff also line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Park staff used chemical control with pre and post emergent herbicide to spot treat in picnic areas, recreational areas and campgrounds. Spot spraying occurred around table posts, fire pits, curb stops, overflow and gravel parking lots, maintenance structures, roadsides, fence lines, etc.
- Park staff manual pulled and grubbed *Dittrichia* (stinkwort), purple and yellow star thistles by hand throughout the campground, removing approximately 1500 plants.

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- Staff mulched with approximately 64 yards of wood chips around various structures in group camps, campground infrastructure and parking lots to reduce weeds.
- Staff provided mechanical control with hand pulling of late season yellow star thistle seedlings after early herbicide treatment. Additionally, staff hand pulled various thistles throughout the park and campground, including purple star, bull, and Italian and milk thistles.
- Staff contracted with Alameda County Department of Agriculture (ACDA) to control noxious weeds with herbicide on a critical fire road that connects the north and south areas of the park.
- Staff contracted to control noxious star thistle in various areas around the campground.
- Park staff continued the use of diphacinone-treated grain in bait stations to control ground squirrel burrowing in an effort to protect valuable campground infrastructure and limit rattle snake habitat.

Design & Construction

- Design and Construction contracted with a licensed operator to control weeds in and around the Atlas Bridge construction project at Point Pinole and to provide pre-emergent weed control under new asphalt.

Diablo Foothills

- CCCDA continued its spot treatment of noxious rangeland weeds that include artichoke and purple star thistles with herbicide.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers also rough mowed fire roads and other recreational areas.
- Park staff used pre and post-emergent herbicides to control broadleaf and grass weeds in recreation areas, gravel parking lots and around buildings and infrastructure.
- Staff continued its integrated program of mowing and chemical treatment of yellow star thistle.
- Rangers trapped for gophers in turf areas logging over 30 hours of staff time.
- Structural rodent control in offices and buildings is accomplished entirely with snap traps for approximately 4 staff hours.
- Staff used diphacinone-treated grain bait to control ground squirrels in bait stations around valuable infrastructure with approximately 12 staff hours.
- Noxious weed mechanical control included the following:
    - Hoeing mustard for 3.5 staff hours
    - Mowing and hoeing horehound for 1.5 staff hours
    - Mowing & line trimming various thistles for 16.5 staff hours

- Yellow star thistle was line trimmed and hand pulled with a total of 25 staff hours and 27 volunteer hours; 32 hours of staff time for herbicide application.
- Stinkwort was grubbed and hand pulled with 14 staff hours and 31 volunteer hours
- Staff line trimmed medusahead grass at flowering stage for a total of 69 staff hours.

Don Castro

- Don Castro utilizes an integrated approach that include hand pulling, torching, mowing and mulching of nuisance weeds.
- Staff utilized herbicide to control stinkwort in parking lots and median planting. Staff followed up with hand pulling late in the season.
- Rangers line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Park staff continued vegetation management of fire roads using rough mowing and line trimming.
- Park staff trapped all of its gophers and utilized yellow jacket traps to control wasps early in the season.

East Contra Costa Trails

- Staff used consistent amounts of pre- and post-emergent herbicide for right of way and recreational use on over 36 miles trails, and vegetation control along fence lines and gravel parking lots.
- Staff focused on nuisance and noxious trail side weeds like yellow star thistle, stinkwort and puncture vine among others.
- Park staff line trimmed around gates, sign posts, tables and fence lines throughout the park. Rangers combine chemical treatment with many hours of rough mowing along regional trails.

Fuels Management

- Fuels management program contracted for fuel reduction in Tilden, Anthony Chabot and Sibley Parks in 2016.
- Herbicide use consisted of triclopyr product applications to eucalyptus stumps, sprouts and other hardwood resprouting species along the Wildland Urban Interface.

Garin/Dry Creek

- Rangers used diphacinone treated bait grain to control ground squirrels in and around the heritage apple orchard.
- IPM staff treated Jordan pond with aquatic herbicide to decrease cat tails and tules in order to increase flushing and fishing access.

- ACDA continued its spot herbicide treatment of noxious rangeland weeds like artichoke and purple starthistle in Garin's back county.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Staff also rough mowed many fire roads and other recreational areas.

Golf Courses

Tables 5 and 6 list the all fungicides, herbicides, plant growth regulators and rodenticides reported by both golf courses from 2011-2016.

- *Redwood Canyon Golf Course*

Redwood Canyon Golf Course (RCGC) utilized very low amounts of pesticide for course management. RCGC reported chemical control for the months of February, April and May. Relatively low volumes of fungicides and herbicides and no rodenticides were reported. RCGC treated its irrigation pond/driving range for aquatic vegetation in order to facilitate the retrieval of balls.

- *Tilden Park Golf Course (TGC)*

It has been one year under the new management team of American Golf, the Tilden Golf Course superintendent has changed its fungicide regime and removed several higher impact pesticides and fertilizers. Golf Course management has eliminated fertilizers that contain phosphorous and converted 10 acres of turf to a naturalized buffer zone for Wildcat Creek, saving water and intercepting nutrients. Insecticides have been removed from the approved product list, herbicide applications have been limited to spot spraying and many Prop 65 fungicides have been removed from the approved list. TGC only treats its greens with fungicide and has instituted several no spray zones. TGC exclusively trapped gophers and moles rather than utilizing rodenticides. TGC staff also work diligently to control invasive species like French broom, attacking new areas each year.

Hayward Shoreline

- Rangers applied post emergent herbicide to control nuisance weeds along levee trails and problem areas of pampas grass and stinkwort.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers rough mowed levee trails, gravel parking lots and around infrastructure.
- IPM and Wildlife Departments continued their annual chemical treatment of the Least Tern Island in order to control nuisance weeds to maintain breeding habitat for this endangered species.
- IPM and the Invasive Spartina Project continued to treat this invasive wetland grass throughout District properties and stopped encroachment of spartina from no-treat zones or rail refugia.

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Kennedy Grove

- CCCDA continued its spot treatment with herbicide of noxious rangeland weeds that include artichoke and purple star thistles with herbicide.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park for over 120 staff hours.
- Rangers maintained over 3 miles of fire roads, infrastructure and other recreational areas with rough mowing.
- Staff used a small amount of post emergent herbicide to control thistles and poison hemlock.
- Staff augmented milk and hemlock control with grubbing and hand pulling over 1,000 sq. feet.
- Rangers pulled yellow starthistle for a total of 12 staff hours.
- Staff hand pulled over 200 sq. ft. of stinkwort and are beginning to see great reduction and progress towards local elimination.
- Staff removed several large hazardous eucalyptus, chipped the branches and used this mulch over 2 acres to control recreational weeds.

Lake Chabot

- Park staff line trim around gates, sign posts, tables and fence lines throughout the park.
- Staff maintained right of way along trails and roads by rough mowing throughout the park.
- Park staff utilized pre- and post-emergent herbicides to overflow gravel parking lots, around infrastructure and buildings.
- Park staff used timed mowing to treat a 2 acre medusahead grass infestation along Nike road.
- Rangers continued timed mowing of the perennial invasive harding grass throughout the Nike hills.
- IPM and park staff continued treatment of pampas grass and stinkwort with chemical application and targeted hand pulling in sensitive areas and follow up after treatments.
- Rangers continue reduce the number and density of teasel infestations throughout the park with spot herbicide.
- IPM staff treated blue green algae outbreaks throughout the marina during the worst of the blooms.

Las Trampas

- Staff line trim around gates, sign posts, tables and fence lines throughout the park.
- Staff maintains right of way along trails, roads and other recreational areas with rough mowing.
- Park staff utilized pre- and post-emergent herbicides to overflow gravel parking lots, around infrastructure and buildings.
- Rangers targeted large patches of stinkwort with spot herbicide treatment along trails and in wildland areas.

- Staff continued their treatment of tree of heaven sprouts with basal bark herbicide treatment.

Martin Luther King, Jr. Shoreline/Oyster Bay

- IPM and the Invasive Spartina Project continued to treat this invasive wetland grass throughout District properties and stopped encroachment of spartina from no-treat zones or rail refugia.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Staff maintained roads and trails with rough mowing.
- IPM continued treatment of noxious weeds like pampas grass, Russian thistle, yellow starthistle and castor bean at Oyster Bay in collaboration with the Design and Construction department for the development of new recreational opportunities.
- IPM staff used contractors to masticate other noxious and woody weeds that impede development. Minimal to no chemical retreatment was required due to opportunity fill utilized to finish grading and development.
- Staff continued removal and stump treatment of the diseased *Myoporum* species throughout the park in order to replace with more pest resistant natives.

Martin Luther King Jr. Shoreline hosts a robust volunteer program led by Save the Bay and the Golden Gate Audubon Society that includes transplanting natives in the nursery, pulling invasive species, spreading mulch, competitive planting, and removing trash detailed here:

Total Hours	# Volunteers	#Native plants planted	Pounds invasives removed	Gallons of invasives removed
3890	1666	1668	2535	356

Miller Knox

- IPM and the Invasive Spartina Project continued to treat this invasive wetland grass in the East Shore State Park.
- Rangers applied pre- and post-emergent herbicides to control nuisance weeds along trail sides, fence lines and parking lots.
- Staff targeted yellow starthistle, stinkwort and other noxious wildland weeds with timed mowing and spot herbicide treatment.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Staff maintained roads and trails with rough mowing.
- Staff used diphacinone-treated grain bait in bait stations to control ground squirrels around infrastructures and roads.

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Pleasanton Ridge

- Environmental Programs continued mitigation treatments of noxious invasive wildland weeds involving a number of thistle species.
- ACDA continued spot treatment of artichoke and purple star thistles throughout Pleasanton Ridge wildlands.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites by rough mowing and line trimming.

Point Pinole

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails by rough mowing and line trimming.
- Rangers continued a robust eucalyptus control program: removing hazardous trees, pulling 500+ eucalyptus seedlings and treating resprouting eucalyptus with herbicide.
- All rodent control in turf utilized gas cartridges and trapping.
- IPM staff and the Invasive Spartina Project continued to treat this invasive wetland grass in the Giant Marsh.
- Environmental Programs continued treatment of noxious invasive wetland and upland weeds in the Breuner Marsh restoration project including a number of thistle species, perennial pepperweed and stinkwort.
- Staff worked with Civicorps to hand pull 20 yards of stinkwort.
- Staff used integrated treatment of Teasel, with over 200 plants pulled by hand in the spring and spot herbicide treatment of older plants.
- Staff and volunteers hand grubbed 200+ individuals of harding grass.

Quarry Lakes

- Biologists from the ACDA continued control of vertebrate pests in high use turf areas (see table 2).
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails as well as group campsites by rough mowing and line trimming.
- Gardeners continued use of organically registered insecticides to control pests in the rare fruit orchard.
- Rangers applied pre and post-emergent herbicides to control nuisance weeds along trail sides, fence lines, other recreational areas and parking lots.
- IPM assisted park staff in controlling invasive woody shrubs in and around the native and botanical tree plantings with targeted herbicide treatment.

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Redwood

- IPM staff continued spot herbicide treatment of stump sprouting invasive woody species, including cotoneaster and acacia in and around the serpentine prairie.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites with rough mowing and line trimming.
- Staff continued to lead a robust volunteer program removing invasive broom along and adjacent to fire and single track trails throughout the park.

Roberts

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites by rough mowing and line trimming.
- Staff initiated control of pampas grass and acacia along high use trails and fence lines with spot herbicide treatment.

Shadow Cliffs

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites by rough mowing and line trimming.
- Rangers applied pre -and post-emergent herbicides to control nuisance weeds along trail sides, fence lines, other recreational areas and gravel parking lots.
- IPM staff contracted to control widespread yellow starthistle infestations using spot herbicide treatment.
- IPM staff treated swim areas for *E. coli* outbreaks attributed to excess goose populations foraging in shallow water.

Sibley/Huckleberry

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites by rough mowing and line trimming.
- Fuels management continued to thin Eucalyptus plantations in Sibley with mechanical removal and herbicide treatment of stumps.
- CCCDA continued spot treatment of noxious rangeland weeds that include artichoke and purple star thistles with herbicide.

Sunol/Mission Peak

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and group campsites by rough mowing and line trimming.

- ACDA continued spot herbicide treatment of noxious rangeland weeds like artichoke and purple starthistle throughout the back county.
- Staff treated dense milk thistle and stinkwort in and around Mission Peak recreational areas and infrastructure.
- IPM and park staff worked with USDA-ARS to release the cape ivy biocontrol.

Temescal

- Rangers treated parking lots, medians, and other recreational areas with broad spectrum herbicide spot treatment.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails as well as group campsites by rough mowing and line trimming.
- IPM staff treated blue green algae outbreaks throughout the lake with long term phosphorous management products and hydrogen peroxide products to treat acute algae blooms.

Tilden

- Fuels management continued the thinning and maintenance of Eucalyptus plantations in Sibley with mechanical removal and herbicide treatment of stumps.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained all right of way along roads and trails and group campsites by rough mowing and line trimming and hand pruning.
- Staff continued is treatment of oblong spurge by hand pulling seedlings and spot treating adults with herbicide.
- Rangers continued removal of hazardous eucalyptus by mechanical removal and herbicide stump treatment.
- Staff experimented with stinkwort treatment using the organic burn down herbicide and selective herbicide spot treatment. Crews report that burn down appears moderately effective at large doses with thorough coverage due to the late phenology at time of treatment. Broadleaf herbicide requires less product and less application coverage to provide effective control.
- Tilden rangers utilized a variety of mechanical methods including hand pulling, grubbing, torching, hoeing, line trimming, weed wrenches, etc. in landscaping areas as well as noxious weeds in wildlands.
- Rangers assisted monthly volunteers in Tilden targeting broom, cape ivy, among other harmful invasives.

Vasco Hills Parks

- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails as well as group campsites by rough mowing and line trimming.

- Rangers applied pre- and post-emergent herbicides to control nuisance weeds along trail sides, fence lines, other recreational areas and gravel parking lots
- Staff targeted various populations of stinkwort by hand pulling and spot herbicide treatments.
- CCCDA and ACDA continued the spot treatment with herbicide of noxious rangeland weeds that include artichoke and purple star thistles.

Wildcat Canyon

- CCCDA continued the spot treatment of noxious rangeland weeds that include artichoke and purple star thistles with herbicide.
- IPM staff and its contractors continued backcountry treatment of dense infestations of artichoke thistle using spot herbicide treatment.
- Staff tackled a number of hazardous eucalyptus trees, mechanically removing and stump treating with herbicide.
- Staff line trimmed around gates, sign posts, tables and fence lines throughout the park.
- Rangers maintained right of way along roads and trails and other recreational areas by rough mowing and line trimming.

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LONG-TERM AND DISTRICT WIDE TRENDS

General Park Use Pesticides

IPM staff track all pesticide use in the District. For management purposes, comprehensive analysis is performed on the most common products utilized in park operations on a regular basis. Adjuvants, like surfactants and penetrants, are recorded but not included in more comprehensive analysis but are tabulated in Table 7. General park use products comprise the bulk (84% in 2016) of herbicide products used on District lands and are described in the general park use herbicide list in Appendix A. Rodenticides are analyzed in figure 6 following herbicide trends.

The remaining 14% of pesticide use (primarily herbicide) for 2016 was for public health response, resource projects (noxious weed control and endangered species recovery), and mitigation and restoration projects. The amount of these special use products vary according to annual conditions and circumstances that include blue green algae blooms, landscape scale restoration projects and capital asset development projects, such as the Atlas Bridge construction in 2016. Special use products are reported in table 2.

Reporting Statistics

In 2016, 36 out of 65 parks used chemical treatments that require the submission of a Pesticide Use Reports (PURs). Approximately 212 PURs were submitted by operations staff and 52 PURs were submitted by IPM staff for resource projects capturing approximately 264 application events. Several programs in the District contract out pest control services and contingent to their contracts must submit their PUR to IPM for annual reporting. In 2016, the fuels program submitted a total of 7 PURs for contractor applied herbicide in Tilden Park, Sibley and Anthony Chabot. Environmental Programs submitted 8 PURs for resource projects at Point Pinole, Pleasanton Ridge, and Black Diamond Mines. Design and Construction submitted 2 PURs for work at Point Pinole's Atlas Bridge project. Contractors hired by operations submitted 8 PURs for projects that include right of way (2), park maintenance (5) and habitat enhancement (1).

Precipitation

RAWS (Remote Automatic Weather Stations) stations throughout the district were analyzed for precipitation patterns. The Briones RAWS (BNE) weather station (37.934, -122.118; elevation 1450') was chosen as it most closely tracks the overall precipitation monthly averages calculated from all RAWS stations in the District. Precipitation totals for water year 2015/16 (September 2015-August 2016) at BNE was a generous 25.88 a few inches above long term average (BNE 18-year average of 22.56 inches). This report presents *water year* data in long term pesticide analysis as this more accurately reflects one of the primary control on vegetation growth. The degree and extent of this primary

production determines the amount and type of vegetation management that is required in recreational areas.

Acreage

The District has continued to grow significantly over the decades. In 2016, EBRPD increased by 1,042 acres to its current size of 120,932 acres. From 2000 to present, the District has increased by an average of 1,880 acres annually with the largest increases in the years 2009-2011. Despite this growth, per acre usage of general park use herbicides has remained between 0.1 and 0.3 ounces per acre. Figure 4 plots growth in acreage with herbicide product per acre and illustrates stable herbicide use throughout this exponential growth.

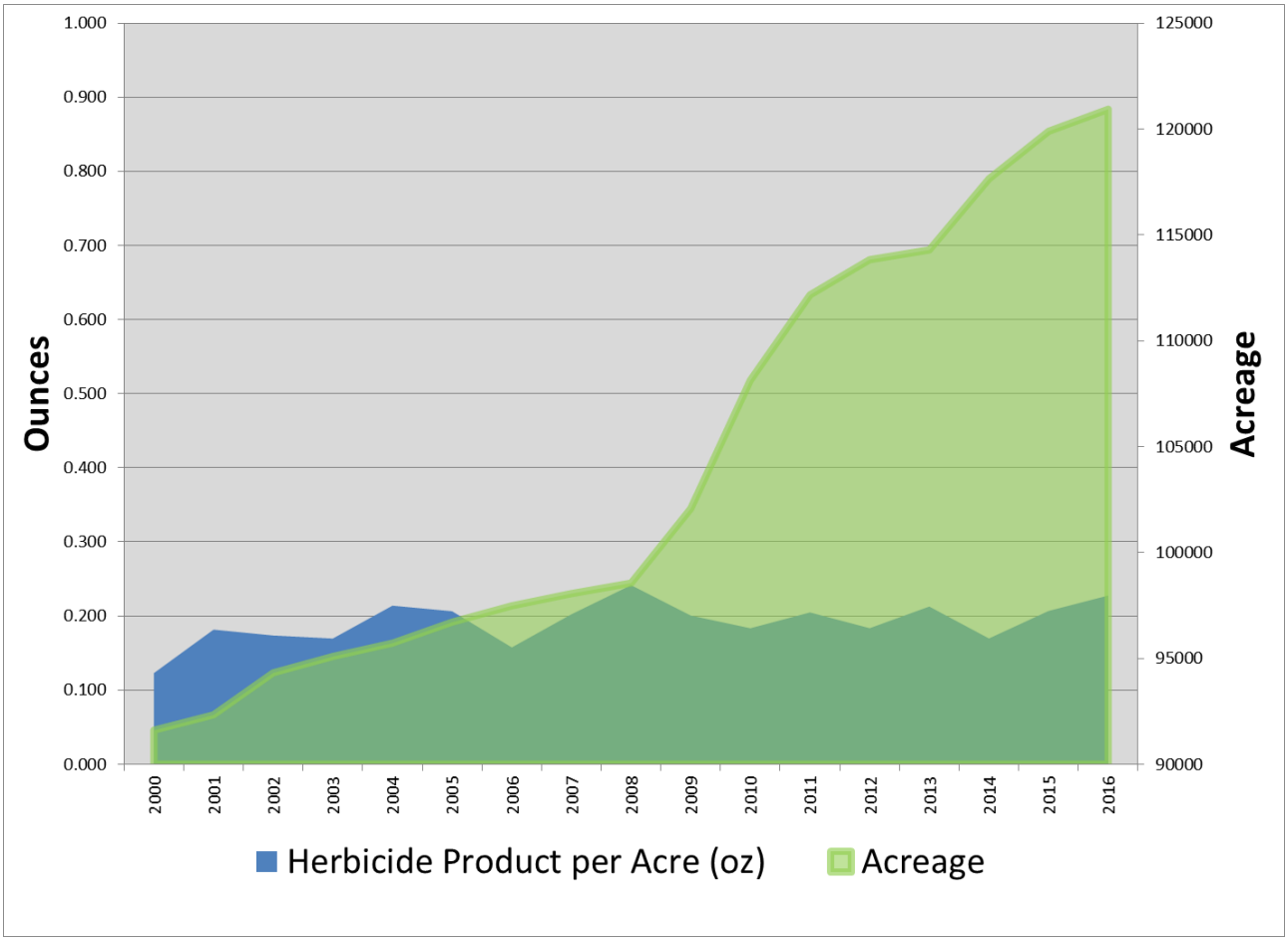

Figure 4. District acreage increase from 2000 through 2016 with respect to General Park Use herbicide usage. Charted in blue is the amount of product in ounces of product per acre plotted with the Districts growth in green.

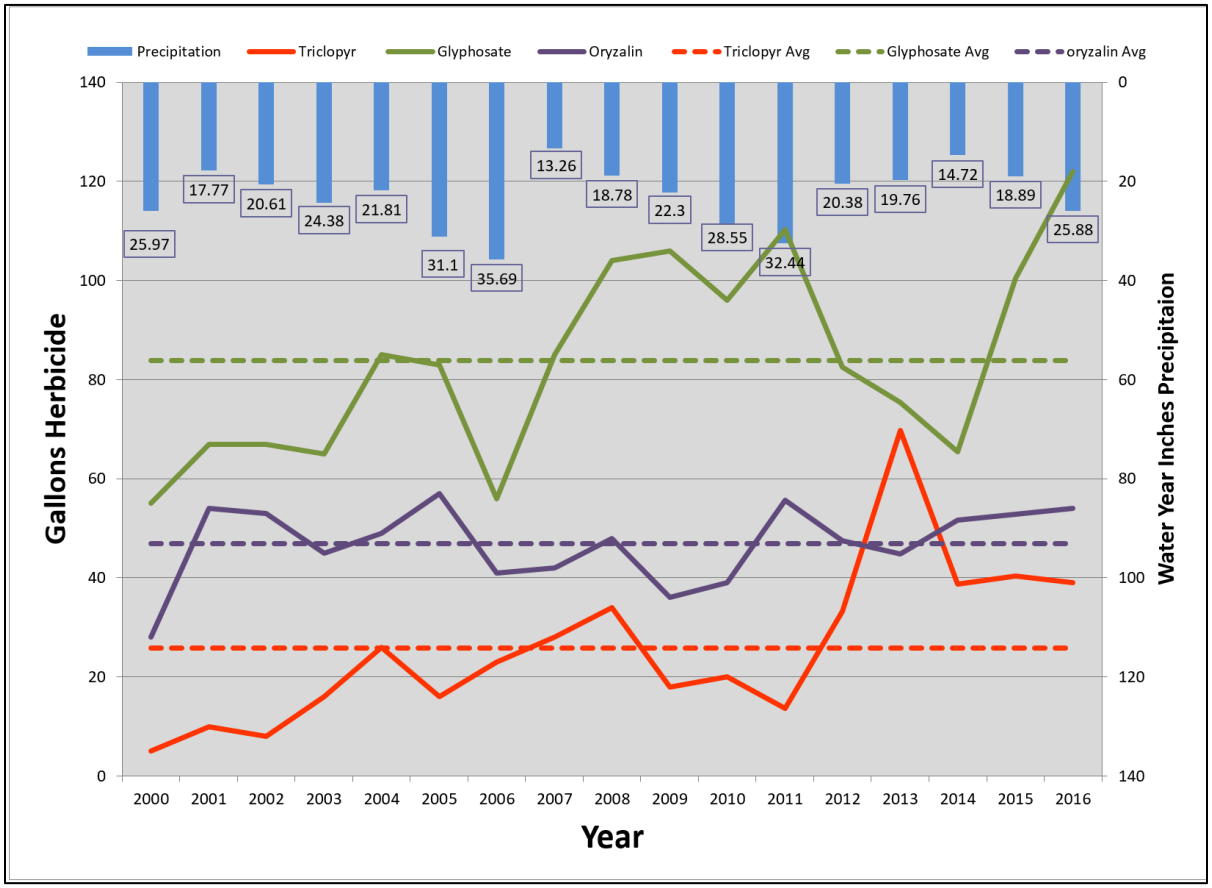

Figure 5. General park use herbicide trends and their long term averages from 2000-2016. Also, graphed is the precipitation totals for the water year, i.e., September of the previous year through August of the reporting year.

Which Pesticides Does the District Use the Most?

Table 1 describes the total volume of general park use products (see Appendix A) listed by active ingredient (glyphosate, oryzalin, triclopyr, diphacinone) that was applied to district parklands in 2016. These products comprise the bulk of pesticides that are used on District property and constitute the only products that are available to park staff for park maintenance. Long term means from 2000-2015 and their associated standard deviations (SD) are shown in table 1. Figure 5 illustrates the long term trends of general park use herbicides (2000-2016) with respect to precipitation.

Glyphosate products (non-selective, broad spectrum herbicide) constitute the bulk of herbicide use in the District with a long-term average of 57% of general herbicide use. Total use of glyphosate products for the District in 2016 was up 21% from the previous year. This increase is due in part to the large construction at Point Pinole Atlas Bridge project that required chemical control of vegetation along the railroad corridor produced by generous rains.

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Fatty Acids (Suppress EC), a contact, post-emergent, non-selective herbicide that is OMRI (Organic Materials Review Institute) registered. Use of this burn down acid product for weed control was introduced in 2015. Use of Suppress EC increased slightly in 2016 however figure 5 does not include Suppress trends as it has just begun use. 2017 trends will include Suppress use.

Oryzalin (Surflan A.S.), a pre-emergent, non-selective herbicide, is the District's second highest use product with a long term average of 25% of general herbicide use. Oryzalin use was up 2% from the previous year. Figure 4 illustrates the relatively constant use of oryzalin over long term despite the continued growth of District property. This product has been replaced with the reduced risk, pre-emergent herbicide, Spect(i)cle Flo (active ingredient indaziflam). However, oryzalin use will continue to be used as stocks are depleted and should drop drastically in 2018. Currently, approximately 30 gallons of Surflan A.S. remain in District.

Indaziflam (Spect(i)cle Flo, a pre-emergent, non-selective herbicide is replacing Surflan A.S. Its use continues to increase after its introduction to District Parks in 2015, and is reported in table 7. Figure 5 does not include indaziflam trends as it has just begun use. 2017 trends will include indaziflam use.

Triclopyr (Garlon), a post-emergent, selective herbicide, experienced a slight decrease of 3% in 2016 from 2015. It remains the third highest volume of general park use herbicide with 18% of total long term herbicide average use. It is used primarily for treating woody vegetation like poison oak, eucalyptus, tree of heaven, etc. to prevent resprouting after cutting. Triclopyr use has remained relatively study over the last few years but may increase slightly as the District increases fuels management work.

Diphacinone-treated bait decreased by 38% from the previous years, despite reasonable production in annual grass and forbs, their primary food stock. (Figure 6). Diphacinone is most commonly used in high frequency parks that contain many acres of turf that provides year round green vegetation, the preferred food source of ground squirrels. This results in robust pest populations that are annually at action thresholds for these parks. The burrowing of these populations undermines District facilities and investments that include paved trails, foundations, bridge abutments, recreational structures, etc.

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	Diphacinone (lbs)	Triclopyr (gal)	Glyphosate (gal)	Oryzalin (gal)	Indaziflam (gal)	Suppress (gal)
2016 Total	417	39	122	54	3	1
2000-2015 Mean	1065	26	84	47		
Standard Deviation	534	16	20	8		

Table 1. General park use pesticide totals for 2016 and long-term means and standard deviations (2000-2016).

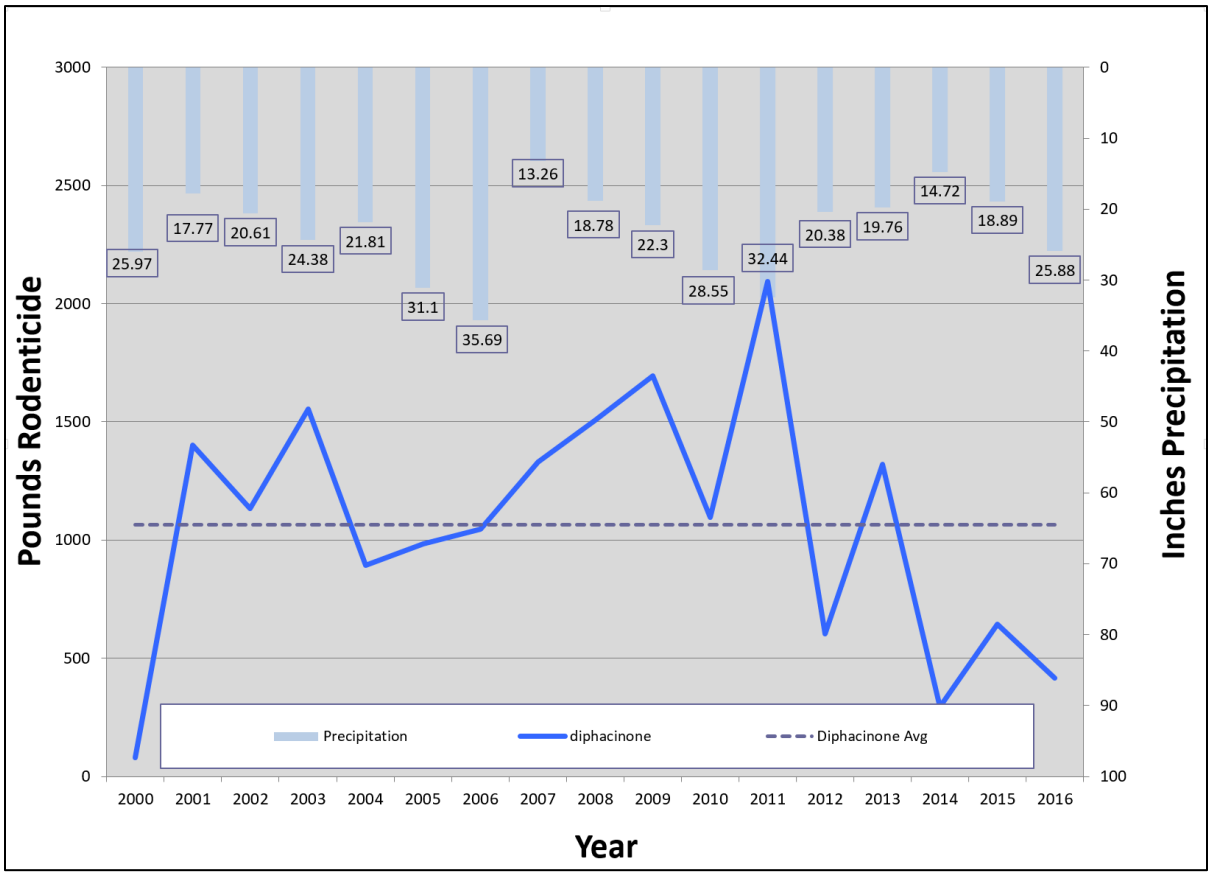

Figure 6. Rodenticide use trends and its long term average from 2000-2016.

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Why Does the District Use Herbicides?

IPM staff collects data on why pesticides are used and are categorized by objective of use. They are defined as follows:

- **Fuels applications** are for any activity that is directed by the Fire Department in the control of woody vegetation that requires herbicide.
- **Habitat enhancement** are projects that involve the management of noxious weeds and is implemented by park operations.
- **Hazardous trees** applications are performed by park operations or their contractors to treat resprouting species that were mechanically removed for public safety.
- **Park maintenance** applications occur where vegetation interferes with the use and safety of the public. These uses include campgrounds, high use picnic areas, parking lots, around buildings and infrastructure.
- **Resource projects** are Stewardship department-led projects that are on a landscape scale and support the recovery of listed species.
- **Right of way** includes any vegetation management along fire roads, paved trails and narrow gage sanctioned trails.
- **Environmental Programs** involve landscape scale restoration and mitigation projects.
- **Design and Construction** projects are large scale developments like new staging areas, bridge construction, regional trail construction, etc.

Analysis of all herbicide use by objective for all park properties (Figure 8) reveals that park maintenance continues to comprise the bulk of herbicide use. 2016 use was slightly up from 2015 but overall less than in 2011-14. Right of way applications constitute the next largest category of herbicide use in all park properties. Right of way applications increased in 2016 from 2015 due in part to the large application along the railroad corridor for the Atlas Bridge project. Herbicide use for resource projects District wide decreased slightly in 2016 due to the absence of yellow star thistle treatment at Briones.

Triclopyr use in 2016 decreased slightly from 2015. However, over recent years triclopyr use has increased slightly concurrent with an increase in fuels management work. Fuels reduction mitigates future catastrophic wildfires that may result from the warm, drying Diablo winds such as those that drove the devastating 1991 Oakland Hills Firestorm. It is anticipated that with the ongoing drought and pending FEMA grant funding, this herbicide use will remain at this level for the next few years.

Park operations and other District departments often use herbicides for habitat enhancement and resource projects. Operations and Stewardship departments have increased the number of habitat enhancement projects in recent years and herbicide use has correspondingly increased (Figure 9). Triclopyr, a selective broad leaf herbicide, is a key component in restoration projects as it allows the control of noxious thistles, mustards and others while maintaining grassland cover, forage and habitat.

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Where Does the District Use Herbicides?

In general, parks in the District are divided into units that reflect recreational focus and geographic relationship. The comparative volume of herbicide use (2011-16) by organizational unit indicates that Trails/Delta unit continue to require the most herbicide use to complement its mowing strategies, though 2016 saw a reduction of application compared to 2015 (Figure 7).

Recently, Lakes Unit has utilized more herbicide. This is in part due to the pampas grass and stinkwort programs that IPM and park staff have implemented. The top three units: Trails, Shoreline and Lakes, provide the most high density recreational areas and require intensive vegetation management and the use of this effective tool. Trails/Delta unit has over 150 miles of trail that require right of way clearance along multi-use trails for safety, fuel reduction and recreational enjoyment. The Shoreline and Lakes units have many miles of multi-use trails and hundreds of high use picnic areas, campgrounds and essential infrastructure that require vegetation management. Recreation, Interpretive Parkland, Interpretive Farm Units all have relatively steady use of herbicide in their vegetation management due to the limited areas of recreational use.

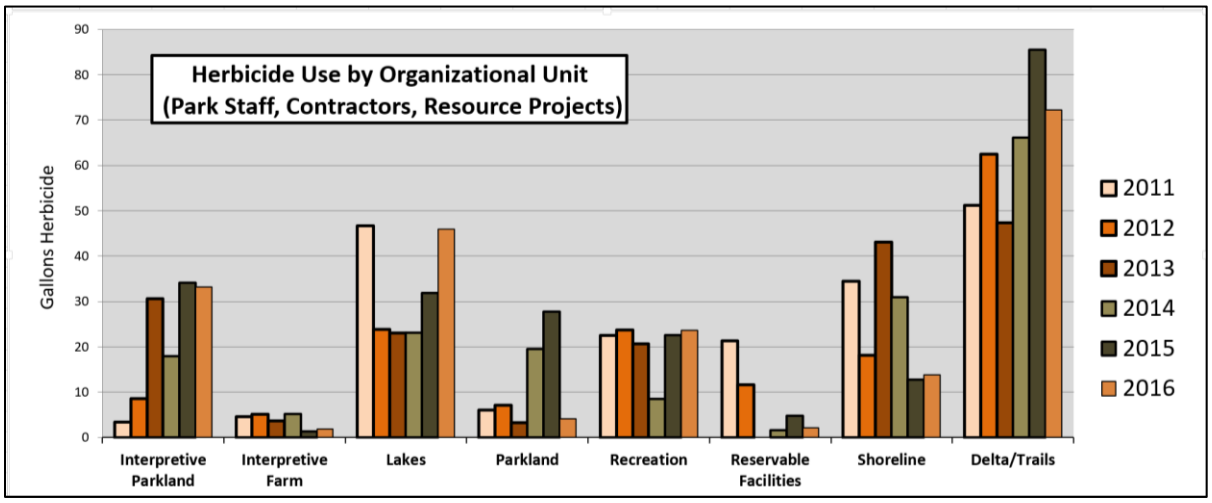

Figure 7. Volume of herbicide used by organizational unit, 2011-2016, including park operations, fuels and resource projects. This chart excludes County Ag Noxious Weed Control Program, Design and Construction Projects and Invasive Spartina Program.

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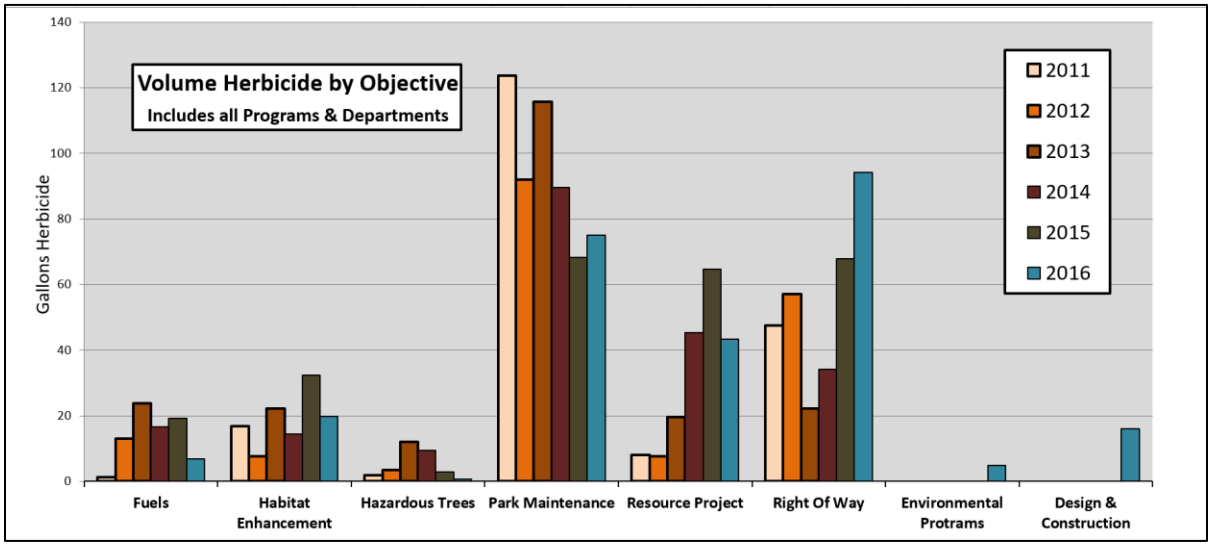

Figure 8. Total herbicide product used by purpose from 2011-2016. This chart does not include structural, golf course or organic farming data, each of which follows separately. This graph now includes Environmental Programs and Design and Construction (for the first time in 2016).

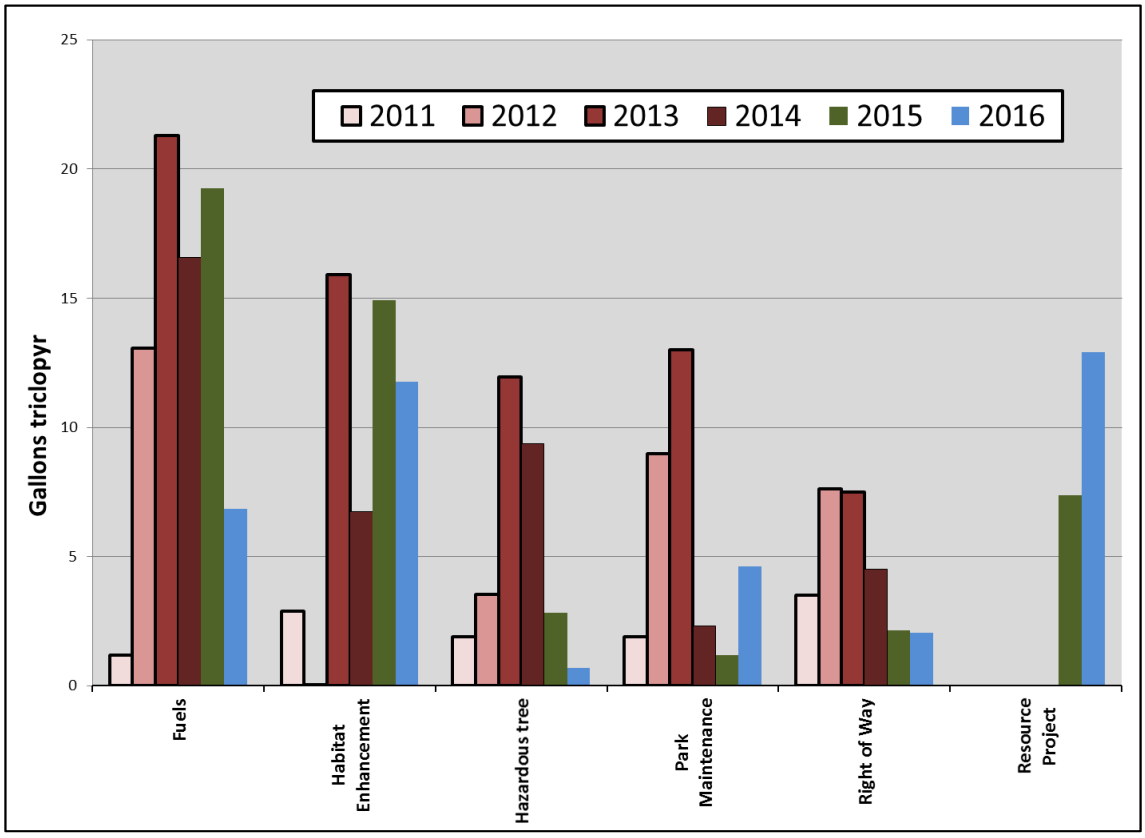

Figure 9. Comparative triclopyr use by objective 2011-2016.

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Which Herbicides are Used and Where?

Figure 10 and 11 illustrate General Park herbicide use by organizational unit *and* objective. In general, parks in the District are divided into units that reflect recreational focus and geographic relationship. These graphs also incorporate special use products for habitat enhancement, endangered species recovery and resource projects.

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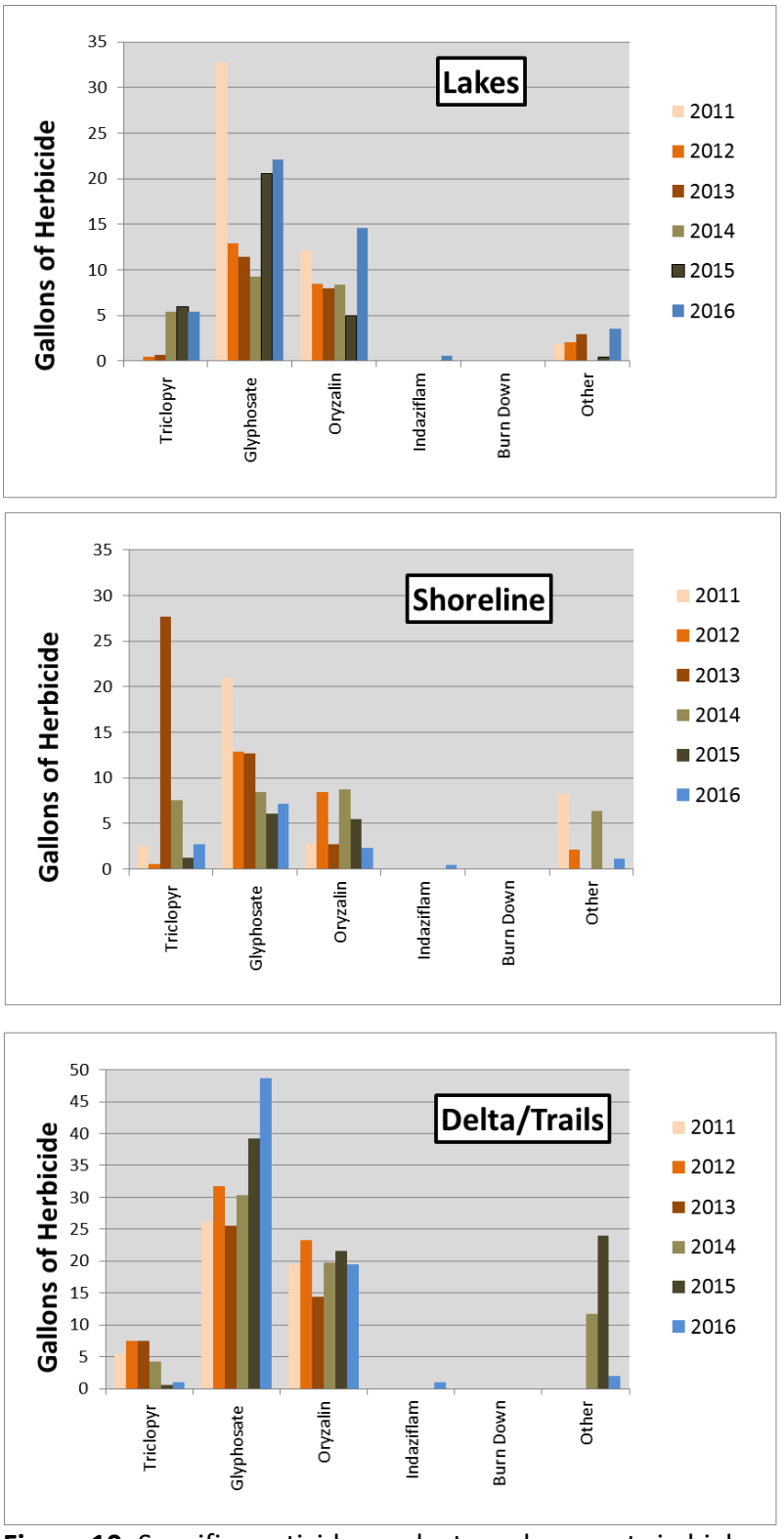

Figure 10. Specific pesticide products and amounts in high use organizational units.

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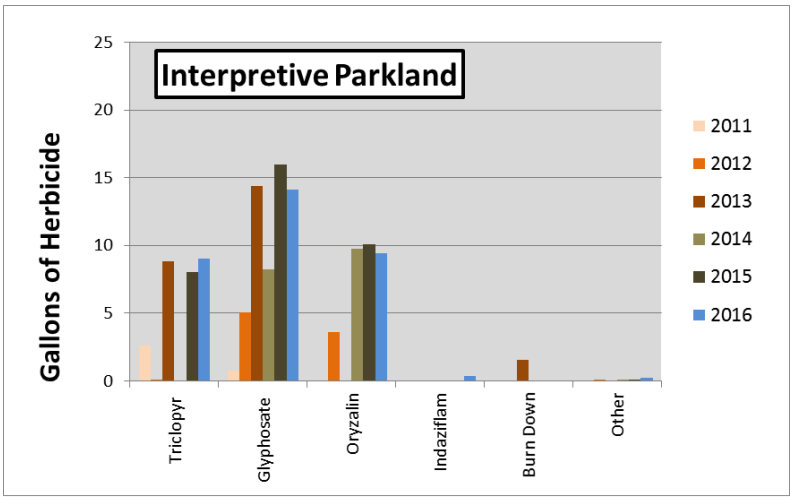

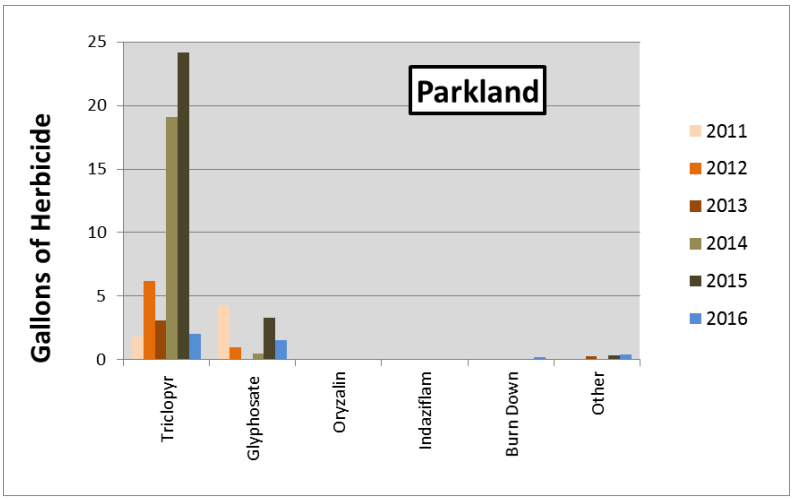

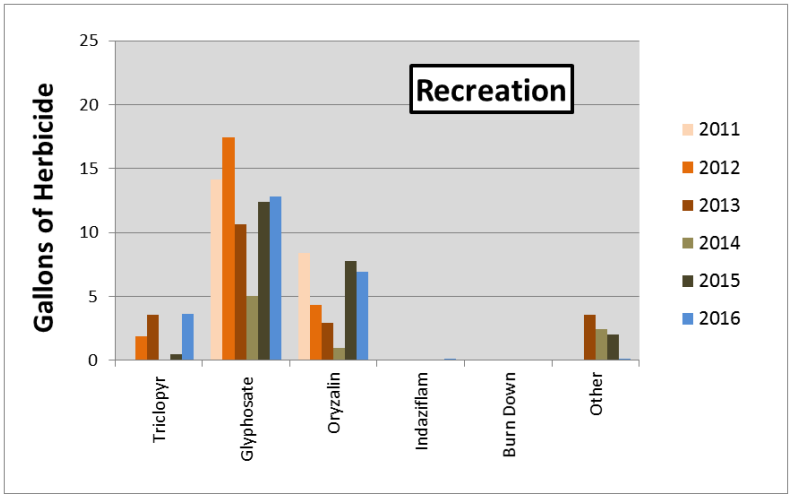

Figure 11. Specific pesticide products and amounts in low use organizational units.

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Resource & Public Safety Projects

Operations Habitat Enhancement Projects

Park staff continues to utilize an integrated and adaptive management approach to weed management with minimal pesticide use. The integrated methods used included propane torching of seedlings, mechanical brush removal (pulling and grubbing) and mechanical mowing with line trimmers, scythes and weed whips. Mechanical and Cultural methods are difficult to quantify and are not currently tracked but are estimated to comprise the majority of vegetation management performed by staff.

Park operations continues to implement a number of habitat enhancement projects on a park scale that target invasive, non-natives. Examples include perennial pepper weed, yellow star thistle, pampas grass, eucalyptus, acacia, puncture vine, tree of heaven, fennel, stinkwort, medusa head, barbed goat grass, etc. These non-native exotics substantially reduce habitat, forage, groundwater availability and recreational opportunities in rangelands, wetlands, parklands and trails. Park staff primarily utilizes herbicides from the general park use list. Operations and IPM programs are detailed below by pest species.

More than 36,000 hours were logged by volunteers District-wide for invasive plant removal projects. Park staff, volunteers and park users report substantial improvement in recreational enjoyment and desirable species coverage in areas that were mechanically treated. Most importantly, volunteers led by park staff continue to maintain these areas with mechanical control until weed seed banks are depleted and a more sustainable vegetation composition is achieved.

Stewardship Programs

Volunteers

IPM department staffed and supervised over 12 programs of volunteer and school groups, totaling 9,700 hours of volunteer service by 486 volunteers up from 2015. Projects include mapping invasives through CalFlora, hand removal of French broom, stinkwort, yellow star thistle, forget-me-nots, pampas grass and fennel, mulching as well as native planting and seeding. Groups like PG&E, Hoover Elementary, Head Royce Middle School and College Preparatory School assist IPM staff in noxious weed control and habitat and species recovery.

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Figure 12. Head Royce 7th graders clear broom and count Johnny Jump Ups in Redwood Park.

Figure 13. Left: PG&E employees help weed around native tree plantings at Quarry Lakes; Right: Hoover 1st graders remove forget-me-nots for redwood forest regeneration.

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Figure 14. Earth Team teen volunteers remove invasive pants and plant native trees at Oyster Bay Regional Shoreline.

Barn Owl Box Program

Park staff and IPM have installed and maintain several dozen barn owl boxes, providing additional vertebrate pest control in District lawns and picnic areas.

Furthermore, staff contracts with the Alameda and Contra Costa Departments of Agriculture to control pests that threaten buildings, park infrastructures and public health throughout District parklands. These county biologists and contractors assist park staff in the control of gophers, ground squirrels and yellow jackets. Following are narratives of these projects with pesticide totals for 2016 and previous years in table 2.

IPM staff leads a robust intern program that focuses on water quality in high use watersheds and mapping of invasive species. Furthermore, interns experience a diverse palette of stewardship opportunities from sampling rare plants to electrofishing the District's recreations fisheries (Figure 15).

Figure 15. IPM interns count rare plants and assist with logistics during artichoke thistle treatment.

IPM Resource Project Programs

The IPM team continues to lead and support a number of special resource projects with the intent of eradicating exotic invasive plants that degrade the quality of habitat in District parklands and helps facilitate endangered species recovery. Often, habit enhancement projects are purely mechanical- employing timed mowing, sheet mulching, torching etc. In some circumstances, staff utilizes general park use herbicides for high density infestations so that mechanical methods can be more effective. The District's IPM policy allows the use of pesticide products outside of the approved general park use list with the approval of the IPM Specialist for special projects and needs.

Vertebrate Control in High Use Turf

In 2016, Alameda County Department of Agriculture controlled gopher populations in several, high use lawns at Quarry Lakes in an effort to provide more stable playing surfaces, and reduce damage to turf infrastructure at (table 2). The use of aluminum phosphide and diphacinone in irrigated lawns by county biologists has proven to be an effective means of controlling this pest species while keeping the public safe during recreational activities. As of 2017 aluminum phosphide will no longer be used in the District and the addition of carbon monoxide machine to staff tool box will help reduce diphacinone use.

Least Tern Island Vegetation Management

The IPM department has assisted the wildlife department since 2008 with the management of various weedy species, most notably chamomile mayweed on Least Tern Island. Exotic

weeds reduce the nesting area of the Least Tern, *Sternula antillarum browni* on a man-made island in the Hayward Regional Shoreline brackish water marsh complex. A mix of pre and post-emergent product applied by IPM staff maintain the low vegetative cover that this federally endangered species requires for successful nesting. 2016 brought another successful breeding season with increasing nesting success due to the cooperative vegetation management and predator reduction.

Barb Goatgrass and Medusahead

Barb goatgrass and medusahead threaten to reduce forage, native grass and forb diversity and ecosystem functions in grasslands. As a result, IPM staff prioritized control of these noxious grasses and completed its first treatment season in 2015. The primary goal was to develop an integrated and flexible approach that would be effective and rapidly deployable by park staff on geographic outliers, spreading edges (such as along roads and trails), and areas with special-status native plant species. Barb goatgrass is known to infest approximately 110 acres in four parks in eastern Contra Costa and Alameda Counties. It is anticipated to be elsewhere. It is commonly found along fire roads and all populations are located in grazing units. Considerable effort was put into mapping by academic interns over the last two years.

Treatment efforts focused on Morgan Territory Regional Preserve and the Galvin land bank in eastern Contra Costa County. The phenology of medusahead was extremely advanced and timing for San Joaquin Regional Conservation Corps contractors was not possible. A total of 10.62 acres were treated using an integrated strategy. Contractors, supervised by IPM, line trimmed (7.8) acres and mowed (2.31 acres) barb goatgrass populations at the flowering stage. In sensitive areas where significant native grasses or around a vernal pool, hand pulling was employed. Follow up hand pulling in mowed and line trimmed areas occurred approximately 3-4 weeks after initial treatment. No herbicide was used this season for follow up spot treatment (Figure 16).

Elsewhere in the park district park rangers employed timed line trimming and hand pulling for barb goatgrass and medusahead in Lake Chabot, Diablo Foothills and Black Diamond Mines.

Figure 16. IPM contractors mowed in the background and IPM spot line trimmed and hand pulled barb goatgrass around a vernal pool in Morgan Territory.

Invasive Spartina

The Invasive Spartina Project (ISP) completed its 13th consecutive season of treatment with a net treatment of 5.52 net acres with 21.3 gallons of Polaris (imazapyr) at Martin Luther King, Jr. Shoreline, Point Pinole and Hayward Regional Shoreline. Treatment acres are up from the previous year due to a large expansion in Point Pinole's Giant Marsh. Consecutive treatment, guided by the ISP, has resulted in an impressive reduction of spartina coverage accomplishing the goal of recovery of valuable open mudflat marsh habitat for foraging shoreline birds and maintaining critical, open channel foraging habitat for endangered Ridgway's rail (formerly California Clapper rail). However, federally mandated no-treat zones for Ridgway's rail will continue to supply seed to adjacent areas until rail populations have reached mandated levels. This means that the magnitude and cost of work on hybrid spartina will continue at this level. While there are fewer populations and individuals to treat, the same amount of acreage must be surveyed each year. Most of the remaining invasive spartina is in or adjacent to District property and all of the no-treat zones are on District property. By the end of 2014, we were at a 29 net acre infestation, down from 805 acres in 2005, an amazing accomplishment.

Pampas Grass and Stinkwort

IPM and park staff at Lake Chabot worked cooperatively on their third season of pampas grass and stinkwort control. In the 2016 treatment season, the entire infestation around the perimeter of the lake was treated with a combination of chemical and mechanical hand pulling of stinkwort. Despite continued germination and bolting of stinkwort, staff have observed substantial reduction in cover and extent of this noxious species. IPM and park staff treated pampas grass at Oyster Bay with herbicide product left over from Spartina treatments and hand pulling and grubbing seedlings.

Euphorbia

Tilden Park continued manage Euphorbia and added more glyphosate products to their strategy. After two years of pulling staff determined that the amount of impact and work required was not sustainable and opted to use more chemical control. 6 acres were spot treated with 1.5 gallons of glyphosate product. Volunteers at Redwood Regional Park continue to hand pull euphorbia along East Ridge Trail.

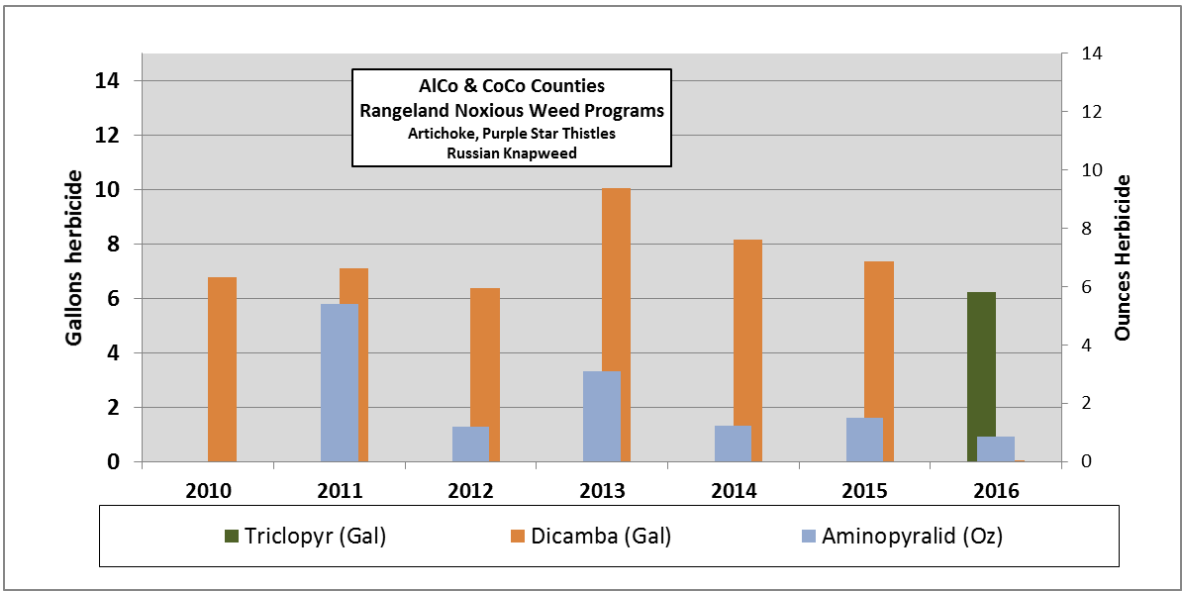

Figure 17. Priority resource management project for rangland noxious weeds: artichoke, purple star thistles, perennial pepperweed, hoary cress, Russian knap weed, etc.

Yellow Star Thistle

IPM and operations continued to target the state-listed noxious yellow star thistle in a number of areas for habitat enhancement, right of way and recreational area maintenance. In 2016, IPM, park staff and their contractors treated over 100 acres of yellow star thistle infestation chemically to complement their hand pulling programs. These parks include Del Valle, Sunol, Crown Beach, Lake Chabot, Shadow Cliffs, East Contra Costa County Trails, Miller Knox, Black Diamond, Diablo Foothills and Point Pinole.

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Noxious Rangeland Weeds & Santa Cruz Tarplant Recovery

The IPM department continues to work closely with the Agriculture Departments in Contra Costa and Alameda counties on the eradication of several noxious rangeland weeds: artichoke and purple star thistles, perennial pepperweed, hoary cress and Russian knapweed (table 2 and figure 17). This program is ongoing and continues to make progress in reduction of older established populations and eradication of smaller populations in newly acquired parklands. Treatment of artichoke thistle in these areas benefits and protects the federally listed Santa Cruz Tar plant (*Holocarpa macradenia*) as well as many other non-listed native plants and grasses. More than 168 acres were surveyed and treated in both counties for these priority noxious rangeland weeds. Total treatment areas continue to increase due to continued acquisition of properties. Point Pinole and Lake Chabot continued its comprehensive attack on Teasel in coastal prairies using mechanical and chemical methods.

The IPM team, its contractors and park staff have continued its treatment of the most interior of populations of artichoke thistle in Wildcat Canyon Park for the third consecutive year. In 2016, crews spot treated 19.6 gross acres with a mix of 1% triclopyr and .03% aminopyralid. Staff have observed substantial reduction of extensive populations and recruitment of native perennial grasses in treatment areas. Additionally, IPM interns seeded in areas where artichoke once covered 90+%.

Figure 18. Near 100% coverage treated in 2015 on the left. On the right, IPM interns sowing native grass and forb seed during the wet winter.

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Blue Green Algae

IPM and Water Management staff worked cooperated to tackle high levels of microcystin in Lake Temescal during the 2016 summer swim season. Staff applied PhosLock, a product that binds phosphorous in the water column and sediments. Staff augmented this longer term treatment with Pak 27 and Phycomycin, both hydrogen peroxide derived algaecide products to treat acute outbreaks of algae growth. Cyanobacteria blooms continued throughout the District; some of which produced levels of toxins that required posting and/or closure.

IPM and Water Management staff were pleased to support and see the production the master's thesis "*Sources of excess phosphate leading to cyanobacteria at Lake Temescal*." Key components of the phosphorous cycle and physical cycles of the lake were elucidated (figure 19). This work will help to inform future remediation of harmful algal blooms in Lake Temescal.

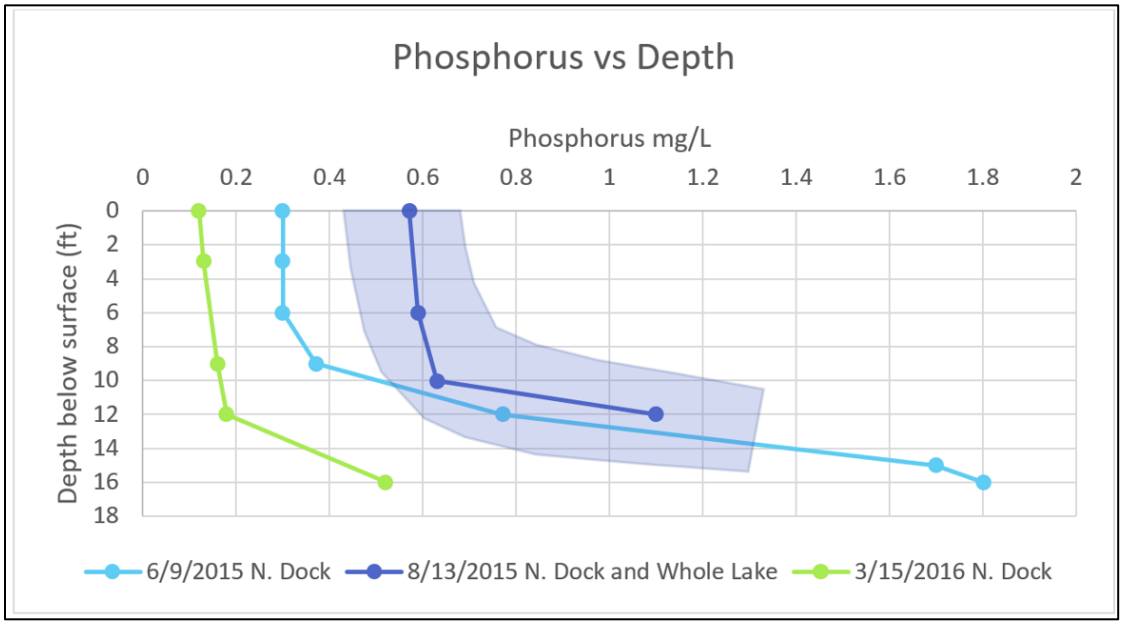

Figure 19. Phosphate concentrations for four depth profiles at Lake Temescal from the master's thesis. Phosphate increases with depth throughout the lake and levels are well above recommended levels to prevent algal blooms.

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Pesticide	Active Ingrediant	Applicator	Type	Signal Word	Pest	Parks	Pupose	2011	2012	2013	2014	2015	2016
Aluminum phosphide		Counties	Rodenticide	Danger	Gophers	Quarry Lakes	Safety	7 lbs	17 lbs	11 lbs	9.66 lbs	6.39 lbs	4.6 lbs
Dimension 40WP	dithiopyr	Stewardship	Herbicide	Caution	Mayweed	Least Tern Island	Endangered species recovery		15 oz	24 oz	15 oz	10 oz	13 oz
Milestone	aminopyralid	Stewardship Counties	Herbicide	Caution	YST, AT, PST, Teasel, thistles	District Wide	Habitat Enhancment	2.4 gal	2.8 gal	3.4 gal	15.06 gal	26.6 gal	2.5 gal
Transline	clopyralid	Staff contractors	Herbicide	Caution	YST	Lake Chabot, Sunol, Del Valle	Habitat Enhancment	1.8 gal	0.4 gal	1.4 gal	47 oz	56 oz	50 oz
Polaris	Imazapyr	Staff contractors	Herbicide	Caution	Non-native spartina	MLK, Hayward Shoreline, Point Pinole, ESSP	Habitat Enhancment	35 gal	44 gal	32 gal	24 gal	21.3 gal	21.5 gal
Vanquish/ Clarity	dicamba	Counties	Herbicide	Caution	AT, PST	District Wide	Habitat Enhancment	7.1 gal	6.36 gal	10.03 gal	8.19 gal	7.3 gal	1.33 oz
Garlon 4 Ultra	triclopyr	Counties	Herbicide	Caution	AT, PST	District Wide	Habitat Enhancment						6.2 gal
Garlon 3A & 4 Ultra	triclopyr	Stewardship Contractors	Herbicide	Caution/ Warning	Dittrichia	Lake Chabot	Habitat Enhancment				5.2 gal	7.4 gal	15.4 gal
Polaris	Imazapyr	Staff & IPM	Herbicide	Caution	Pampas grass, dittrichia	MLK, Lake Chabot	Habitat Enhancment				1.2 gal	10.9 gal	25 oz
Pak 27, Phycomycin, Green Clean	Sodium Carbonate Peroxyhydrate	IPM & Contractors	Algaecide	Danger	E. coli, Blue green algae	Temescal, Shadow Cliffs, Lake Chabot	Public Safety				3750 lbs.	50 lbs.	6230 lbs
Glyphostate		IPM & Contractors	Herbicide	Caution	Medusahead, barb goatgrass, LT island, dittrichia	Round Valley, Morgan Territory, Hayward Shoreline	Endangered species, habitat enhancement					3.1 gal	8.1 gal

Table 2. Pesticide use for special needs, habitat enhancement and resource projects 2009-16. Products highlighted in orange will be discontinued in 2017.

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Structural Pesticide Use

In 2015, IPM began tracking structural pest control contractors and the products and amounts. IPM staff has also developed an Approved List for Structural Pest Control that identifies which products structural pest contractors can use beginning in 2016. Two contractors applied pest control products to control nuisance rodents and insects to a number of District offices, buildings and residences in 2016. The bulk of pesticides used were insecticides for ant and termite control. Table 3 compiles these products and amounts by active ingredient. The District's structural contracts are limited use which means they utilize the most environmentally safe products.

Pesticide	Active Ingredient	Amount	Unit
Contrac Lumitrack Blox	bromadiolone	18	Ounces
Talstar PL Granular	bifenthrin	12	Ounces
fastrac	bromethalin	21	Ounces
InTice 10 Perimeter	boric acid	116	Ounces
Terad3 AG Blox	Cholecalciferol	4	Ounces
Temprid	Imadacloprid, Cyfluthrin	0.8	Ounces
Alpine Dust	Dinotefuran, Diatomaceous Earth	0.2	Ounces
Vikane	sulfuryl flouride	256	Ounces
Altriset	chlorantraniliprole	68	Ounces
Spectracide Bug Stup	gamma-cyhalothrin	0.2	Ounces

Table 3. Structural pest control products listed by active ingredient that were used on District buildings in 2016.

Farming

J.E. Perry Farms has operated an organic farm at Ardenwood Historic Farm since 1990. Perry farms now operates on 92 acres that include wheat, ornamental and popcorn fields. Squash bug is their primary and most costly insect pest, followed by worms in the corn and aphids on all crops. Table 4 compiles the insecticides and fungicides utilized by Perry farms in 2016.

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Additionally, the District has acquired farm land in recent years that remains in land bank and continues to operate leases for conventional farming. Conventional farming use is reported in table 8.

Organic Pesticides					
Pyrethrins (oz)	Potassium Salts (oz)	Citrus Oil (oz)	Bacillis thuringiensis (lbs)	Azadirachtin (oz)	Spinosad (oz)
352	1764	52	2	28	42

Table 4. 2016 Organic farming pesticide use at Perry Farms, Ardenwood Historic Farm, Newark, CA.

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		Fungicides																						
Course	Year	Chlorothalonil (gal)	Chlorothalonil/Propiconazole	Propiconazole (gal)	Confront (Triclo/Clopy)	Iprodione (gal)	Mefenoxam (gal)	Fluazinam	fluxapryoxad (gal)	myclobutanil	Tebuconazole	Thiophanate-methyl	Triticonazole	PCNB	Aluminum Tris (lbs)	Mancozeb lbs	azoxystrobin lbs	Metaconazole lbs	Polyoxin D Zinc lbs				
WPGC	2011	9		1												96							
	2012	30			0.5							1.64				120							
	2013		7.5	1.25								0.38				72							
	2014		10.43			5										120							
RCGC	2015			2.11				0.35	0.30							32							
	2016					4.70	1		0.50		3.28												
TGC	2011	45		16			1			3.4		10		5	63	146	30	3					
	2012	44		2			2					4	4	5	48	132		1					
	2013	20	5	2		10	4					10	4	13	66	192							
	2014	16.5	5	4		8	8					8	2	13	66	36		**6**	7.2				
	2015	45		7		15					2	11			66	186	35						
	2016	32.5		4		25					2.75	1			66	48	10						

Table 5. Comparative pesticide use at District Golf Courses 2011-16.

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			Growth Regulators		Rodenticides			Herbicide gallons										
	Course	Year	Ethephon gal	Trinexapac-Ethyl gal	Gopher Getter Type 2	Aluminum Phosphide lbs	Talpirid g	Clopyralid (gal)	Powerzone (gal)	Vanquish (Dicamba)	Orazalin 4 Pro	Copppper Sulfate lbs	Glyphosate (gal)	Quinclorac	Penoxsulam (gal)	Triclopyr (gal)	Fluridone (lbs)
WPGC		2011					76				0.09						
		2012			120		90	0.05		0.38		0.16					
		2013			266		176										
		2014			215		20	0.05				35					
RCGC		2015															
		2016													0.08		20
TGC		2011	15	3.4		2			6.41				0.13	0.18			
		2012	20	2													
		2013	20	0.41					17.80				22				
		2014	20	0.84					3								
		2015	25	5.45					11.59				2.78				
		2016	15	4.66				1.17	0.875				2.43		0.7	0.63	

Table 6. Comparative pesticide use at District Golf Courses 2011-15.

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		Bee Bopper (oz)	Capstone (milestone, triclopyr,	Clarity (dicamba, gal)	Clearcast (imazamox, gal)	Competitor (adjuvant, gal)	Deadline (oz)	Dimension Ultra (dithiopyr, oz)	Diphacinone (lbs)	Envoy plus (clethodim, gal)	Gallery 75 DF (isoxaben, oz)	Garlon 3A (triclopyr, gal)	Garlon 4 Ultra (triclopyr, gal)	Gas Cartridges (oz)	Glyphosate Products (gal)	Hasten Oil (adjuvant, gal)	Liberate (adjuvant, gal)	Milestone (aminopyralid, gal)	No Foam B (adjuvant, gal)	Pathfinder II (triclopyr, gal)	Polaris (imazapyr, gal)	Pro-Spreader (adjuvant, gal)	R-11 (adjuvant, gal)	Sonar Genesis (Fluridone, lbs)	Specticle Flo (indaziflam, gal)	Stylet Organic Oil (gal)	Suppress (fatty acids, gal)	Surflan AS (oryzalin, gal)	Transline (clopyralid, gal)	Treflan EC (trifluralin, gal)	Vanquish (Dicamba., gal)	vistaXRT (fluroxypry, gal)
Anthony Chabot	Park Staff					13.16							5.96	135		0.78																
Alameda Creek Trails	Park Staff					0.50							0.50		0.05																	
Ardenwood Farm	Park Staff	66							42				0.09	505													0.75					
	Contractor														0.88																	
Black Diamond Mines	Park Staff					10.00							5.00		4.51					2.50						0.15						
	IPM																				0.02											
	Contractor		4	0.01		0.55							1.60					0.25														
Botanical Garden	Park Staff						32.00								0.02													1.28				
Briones	Park Staff								15						1.42					0.32												
	Contractor												0.21					0.01														
Camp Arroyo	Park Staff														0.91													1.28				
Crown Beach	Park Staff					0.15				0.39			0.02		0.44	0.12		0.02														
Cull Canyon	Park Staff														3.50													0.59				
	Contractor												2.00			3.00																
Contra Costa Trails	Park Staff														16.40							1.37				0.76						
	Contractor												0.12					0.01														
Coyote Hills	Park Staff												0.13																			
Contra Loma	Park Staff														4.06											0.14		3.28				
	Contractor												0.21					0.02														
Carquinez Martinez	Park Staff																															
	Contractor												0.64					0.05														
Don Castro	Park Staff														1.27																	
Diablo Foothills	Park Staff					0.27			18						2.05			0.11										3.06				
	Contractor												0.12					0.01														

Table 7a. All general and special use pesticides by park (applied by staff and contractors).

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		Bee Bopper (oz)	Capstone (milestone, triclopyr, gal)	Clarity (dicamba, gal)	Clearcast (imazamox, gal)	Competitor (adjuvant, gal)	Deadline (oz)	Dimension Ultra (dithiopyr, oz)	Diphacinone (lbs)	Envoy plus (clethodim, gal)	Gallery 75 DF (isoxaben, oz)	Garlon 3A (triclopyr, gal)	Garlon 4 Ultra (triclopyr, gal)	Gas Cartridges (oz)	Glyphosate Products (gal)	Hasten Oil (adjuvant, gal)	Liberate (adjuvant, gal)	Milestone (aminopyralid, gal)	No Foam B (adjuvant, gal)	Pathfinder II (triclopyr, gal)	Polaris (imazapyr, gal)	Pro-Spreader (adjuvant, gal)	R-11 (adjuvant, gal)	Sonar Genesis (Fluridone, lbs)	Spectricle Flo (indaziflam, gal)	Stylet Organic Oil (gal)	Suppress (fatty acids, gal)	Surflan AS (oryzalin, gal)	Transline (clopyralid, gal)	Treflan EC (trifluralin, gal)	Vanquish (Dicamba., gal)	vistaXRT (fluroxypry, gal)
Del Valle	Park Staff								150						6.95										0.44							
	Contractor														4.00	1.25	2.00	0.26													1.50	
East Contra Costa County Trails	Park Staff														28.91													19.45				
	IPM				2.00	2.00									2.00																	
Garin/Dry Creek	Park Staff					0.09									0.02		0.50															
	IPM				0.22													0.02						2.00								
Hayward Shoreline	Park Staff					0.76									0.56			0.02			0.75											
	IPM					0.80		0.10													2.24											
Kennedy Grove	Park Staff														0.20																	
	Contractor												0.02					0.00														
Lake Chabot	Park Staff							0.31			0.20		0.19		2.42							1.80										
	IPM					3.60						3.00																				
Las Trampas	Park Staff												1.50		7.73								2.50					8.75				
	Contractor												0.37					0.02														
Miller Knox	Park Staff					0.02			25						5.73			0.01										2.36				
	IPM					0.11															0.25											
Martin Luther King Shoreline	Park Staff					0.09							0.59			0.59					0.31											
	IPM					4.40						0.06			0.16					0.14	12.85											
Point Pinole	Park Staff												1.87	130	0.02	5.16																
	IPM					2.41															7.02											
	Contractor					0.55									13.71			0.06							0.49					5.00		0.26
Pleasanton Ridge	Contractor					1.74												0.21														

Table 7b. All general and special use pesticides by park (applied by staff and contractors).

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		Bee Bopper (oz)	Capstone (milestone, triclopyr, gal)	Clarity (dicamba, gal)	Clearcast (imazamox, gal)	Competitor (adjuvant, gal)	Deadline (oz)	Dimension Ultra (dithiopyr, oz)	Diphacinone (lbs)	Envoy plus (clethodim, gal)	Gallery 75 DF (isoxaben, oz)	Garlon 3A (triclopyr, gal)	Garlon 4 Ultra (triclopyr, gal)	Gas Cartridges (oz)	Glyphosate Products (gal)	Hasten Oil (adjuvant, gal)	Liberate (adjuvant, gal)	Milestone (aminopyralid, gal)	No Foam B (adjuvant, gal)	Pathfinder II (triclopyr, gal)	Polaris (imazapyr, gal)	Pro-Spreader (adjuvant, gal)	R-11 (adjuvant, gal)	Sonar Genesis (Fluridone, lbs)	Specticle Flo (indaziflam, gal)	Stylet Oil Organic Oil (gal)	Suppress (fatty acids, gal)	Surflan AS (oryzalin, gal)	Transline (clopyralid, gal)	Treflan EC (trifluralin, gal)	Vanquish (Dicamba., gal)	vistaXRT (fluroxypry, gal)
Quarry Lakes	Park Staff														1.56							0.39					0.20	2.34				
	IPM																				0.01											
	Contractor								60																							
Roberts Park	Park Staff					1.50						1.50			0.19																	
Redwood	IPM																			0.38												
Shadow Cliffs	Park Staff														7.08													2.70				
	IPM											1.56							3.00			1.00	0.94									
	Contractor																															
Sibley Park	Contractor					0.94							1.22					0.02														
Sunol/Mission Peak	Park Staff														0.34																	
	Contractor																	0.26														
Tilden	Park Staff					0.45							0.29		1.55	0.04											0.19					
	Contractor					2.61							2.61																			
Temescal	Park Staff														1.56																	
	IPM																															
Vasco Hills Parks	Park Staff														1.49											0.06		0.70				
	IPM														0.05																	
	Contractor												0.18					0.01														
Wildcat Creek Regional Park	Park Staff												0.16			0.16																
	IPM					2.94							1.66					0.38				0.14	0.25									
	Contractor												2.50	135		1.16		0.19														

Table 7c. All general and special use pesticides by park (applied by staff and contractors).

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	Product	Active Ingrediant	gal
Nunn Property	Bifen 2 AG Gold, Fanfare 2 EC	Bifenthrin	0.35
	Shark EW	carfentrazone	0.05
	DuPont Coragen, DuPont Express	CHLORANTRANILIPROLE	0.09
	Bravo Weather Stik	Chlorothalonil	0.50
	Belay	Clothianidin	0.14
	Asana, Asana XL, Mustang	Esfenvalerate	1.02
	Belt SC	Flubendiamide	0.02
	Chateau	flumioxazin	0.47
	Sivanto prime	flupyradifurone	0.11
	Roundup Custom, PowerMAXX	glyphosate	13.28
	Onager	Hexythiazox	0.38
	MCPA	MCPA	0.63
	DuPont Lannate	Methomyl	1.63
	MSR	Oxydemeton-methyli	0.25
	Goal 2XL	Oxyfluorfen	0.50
	Prowl	pendimethalin	0.50
	Comite	propargite	0.25
	Quilt Xcel	propiconazole, azooxystrobin, triazole	0.33
	Cabrio EG	pyraclostrobin	0.25
	Dual II Magnum	S-Metolachlor	1.34
	Oberon 4 SC	Spiromesifen	0.13
	IAP Dusting Sulfur	sulfur	5.00
	Toledo	tebuconazole	0.19
	Triclopyr 3A	triclopyr	1.88
Orowood Property	Admire Pro	Imidicloprid	0.21
	Intrepid 2F	Methoxyfenozide	0.60
	Poast	Sethoxydim	2.25
	Success	spinosad	0.75

Table 8. Conventional farming pesticide use in recent land bank acquisitions.

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Evaluation and Conclusion

Herbicide use in 2016 continued to be primarily for park maintenance and right of way applications. Both park maintenance and right of way usage amounts of chemical products were up from the previous year. Herbicide use for resource projecst (third in amount) was down from 2015. The change in relative frequency of use by objective may be due to increased education of park staff that results in more accuracy in reporting.

Notably and despite continued growth in acreage and opening of land bank areas, chemical control has stayed relatively stable. The overall quantity of chemical products for the control of pest species has remained constant over the last sixteen years despite exponential growth, fluctuating between 0.1 and 0.3 ounces of herbicide per acre. The bulk of pesticide use (glyphosate and diphacinone) is largely driven by moisture inputs in the form of winter rains and accumulated degree days. Pre-emergent herbicide use will decrease in coming years due the phase out of oryzalin and the increased use of sustainable practices. Thus, use of the newer, less toxic new pre-emergent product Spect(i)cle Flow will remain relatively constant and increase slowly with the acquisition and development of new and land banked properties. Triclopyr use may grow slightly as fuel reduction activities increase, but is not expected to be much greater than 2013. Over the very long term, once fuel reduction levels are achieved and maintained, triclopyr is expected first to decrease and then remain relatively consistent.

The IPM department has replaced several older pesticides with newer, safer and more effective chemicals. IPM staff will continue to replace less effective and safe products in the coming years. IPM staff expanded its worker safety training to a more comprehensive IPM training and continues to offer mechanical and cultural control trainings that include working with volunteers, vertebrate trapping, invertebrate control, etc.

District park staff carefully balances the physical demands of park maintenance and land management while ensuring a safe and enjoyable environment for park users and healthy habitat for the flora and fauna that attract so many visitors to District parklands. The IPM department is proud to assist the hardworking park staff serving the diverse public that recreates in the East Bay Regional Park District.

WORKING GOALS AND COMMITMENTS

1. Continue to replace older pesticides with more effective, less toxic products.
2. Continue to update the District's IPM policy.
3. Continue to provide annual safety and IPM training to all District applicators.
4. Continue to work with individual parks to develop and refine park specific IPM programs.

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5. Continue to develop and implement a variety of IPM related trainings for park staff, including weed identification and control techniques, vertebrate control, invertebrate control, etc.
6. Continue to monitor and improve pesticide applications by outside agencies in District parklands.
7. Continue to identify and procure funds to expand the control of harmful invasive plants in order to enhance habitat, increase native cover and biodiversity and support recreational activities.
8. Increase volunteer opportunities to leverage additional resources for the control and/or eradication of non-native, invasive species in District parklands through habitat enhancement projects.
9. Work with golf course concessionaires to develop and expand adaptive management and integrated methods for pest control.
10. Develop a program to track and quantify the use of non-chemical methods like mechanical and cultural.

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Appendix A

General Park Use Pesticide Descriptions

Glyphosate is a broad spectrum, non-selective post-emergent herbicide used in landscape, right-of-ways and open space. All products in this category have a caution signal word. These products include: Roundup Pro (EPA Reg. No. 524-475), Roundup Custom (formerly Aquamaster) (EPA Reg. No. 524-343) and Roundup Pro Max 524-579.

Oryzalin is a broad spectrum, somewhat selective pre-emergent herbicide used in landscape and right of ways. Products in this category include Surflan AS (EPA Reg. No. 70506-44), has 40.4% active ingredient and a signal word of caution. This product has been replaced with the reduced risk, pre-emergent herbicide, Spectacle (indaziflam). Approximately 30 gallons remain in District stocks.

Indaziflam is a broad spectrum pre-emergent herbicide used in landscape and right of ways. This product is sold as Spect(i)cle Flo (EPA Reg. No. 432-1518). This product contains 7.4% of the active ingredient indaziflam and has no signal word.

Triclopyr is a broadleaf, selective, post-emergent herbicide used principally for the control of resprouts from woody plant species such as eucalyptus, mayten, acacia and broom species. Products in this category include Garlon 4 Ultra (EPA Reg. No. 62719-527) with 60.45% active ingredient and a caution signal word and Pathfinder (EPA Reg. No. 62719-176) with 13.6% active ingredient and a caution signal word.

Diphacinone is an anticoagulant rodenticide dispensed in bait stations specifically for the control of ground squirrels and commensal rodents (rats and gophers). Products in this category include treated grain bait (0.005% active ingredient) manufactured by Alameda County Agricultural Department (CDFA Reg. No. 10965-50001). This product has a caution signal word.

Suppress EC is an OMRI registered non-selective, foliar burndown herbicide (EPA Reg. No. 51517-9). This product contains 79% the active ingredients caprylic and capric acids and has a warning signal word.