MEMORANDUM

To:	**City of Belmont** Brigitte Shearer	**From:**	**WRA** John Baas, Robin Graham
cc:	Daniel Ourtiague, Matt Ward		
Date:	June 8, 2022		
Subject:	Recreation Use Assessment and Benchmarking for the Open Space management Plan as part of the Belmont Parks Recreation and Open Space Plan		

1.0 Purpose

This Recreation Use Assessment and Benchmarking memorandum is presented as part of the Open Space Management Plan (OSMP) for the City of Belmont (City). It has drawn from the findings of the Environmental Assessment. The recommendations in this assessment were used to inform the Base Plan and Management Alternatives. The purpose of this Recreation Use Assessment and Benchmarking memorandum is to describe current and potential open space recreation trends and summarize best practices for trail usage, layout and maintenance within the City of Belmont. This memorandum includes a discussion of recent population trends in Belmont and San Mateo County, an overview of regional surveys of open space related to outdoor recreation activity participation, and recreation trends and their implications for the OSMP. Recommendations for assessing future recreation use and trail conditions are provided, and an overview of best practices for trail construction, maintenance, and management is included.

2.0 Background

2.1 Demographic Characteristics of Belmont and San Mateo County

The City of Belmont has an estimated population of 26,539 as of 2020 which is a nearly 3% increase from the 2010 census estimate. In 2020, nearly 62% of residents reported their race as White and 28% of residents reported their race as Asian. Similarly, 64% of residents report speaking only English, while 16% reported speaking Asian and Pacific Island languages. The median age in Belmont is 41-year-old and 63% of residents hold a bachelors or graduate degree. Thirty-seven percent of households reported income over $200,000 with the median being $156,000 (*Population World Review*, 2022).

The population of San Mateo County is estimated at 760,249 as of 2020 which is a nearly 6% increase from the 2010 census estimate. In 2020, approximately 51% of residents reported their race as White, 29% reported their race as Asian, and 11% reported their race as “Some other race not listed.” Similarly, 54% of residents report speaking only English, 19% reported speaking Asian or Pacific Island languages, and 19% reported speaking Spanish. The median age in San Mateo County is 40-year-old and 50% of the residents hold a bachelors or graduate degree. Twenty-nine percent of households reported income over $200,000 with a median of $122,000 (*Population World Review*, 2022).

2.2 Current Outdoor Recreational Participation

Current and potential future recreation uses of the Belmont open space areas were assessed by examining national, statewide, regional surveys of outdoor recreation participation, as well as results from the community survey for the Belmont Parks, Recreation and Open Space (PROS) Plan. Nationally, about 50% of people participate in outdoor recreation activities (Outdoor Foundation, 2022). According to the 2012 *Outdoor Recreation Trends and Futures* report, nationally, both how long and how often people spend time outdoors have increased over the previous 15 years (Cordell, 2012). However, the 2012 *Survey on Public Opinions and Attitudes on Outdoor Recreation in California*, suggested that the amount of time California respondents spend in outdoor recreation activities had remained roughly the same over the previous five years (California State Parks, 2014). This same study found that common activities for respondents were walking, hiking, and picnicking.

California State Parks (2014) also found that over 38% of San Francisco Bay Area respondents[1] visited parks at least once a week and about 27% used trails at least once a week. San Francisco Bay Area respondents also reported that their time spent at parks was increasing. Additionally, the most common activities reported by San Francisco Bay Area respondents were walking, hiking, and picnicking.

A study of visitors to San Mateo County parks found that respondents most often reported walking/hiking and running while much smaller proportions of visitors reported biking (Roberts et al., 2016). Respondents also indicated that they visited the parks to improve their physical fitness, be with family/friends, connect with nature, improve mental well-being, dog walking, and experience scenic views.

According to the 2021 *Belmont Parks, Outdoor Recreation Programs and Open Space Community Survey,* respondents typically visited open space areas multiple times per week, typically for a duration of 1-2 hours or more, and typically for the purposes of exercising, communing with nature, and experiencing peace and quiet ("Belmont Parks, Outdoor Recreation Programs and Open Space Community Survey," 2021). Belmont Parks and Recreation Department staff indicated that common activities on open space areas are walking/running, biking, and dog walking. Survey respondents reported living not only in the City of Belmont, but also in nearby neighborhoods in San Mateo, San Carlos, and Redwood City.

Both anecdotal and documented evidence has shown increased use at park and recreation resources throughout the San Francisco Bay Area since the onset of the COVID-19 pandemic. For example, WRA conducted a study in San Mateo County Parks that showed a 40% increase in use of Pillar Point Bluff and Quarry Parks from 2019 to 2020. Indeed, in 2020, more Americans reported participating in outdoor recreation than ever before (Outdoor Foundation, 2022). However, the Outdoor Foundation found that as many as 25% of participants reported that they were unlikely to continue their activities once pandemic impacts subsided. In fact, National Park Service visitation in 2021 was lower compared to the 3 years preceding the onset of the COVID-19 pandemic (National Park Service, 2022). Therefore, it is possible that Belmont Open Space Areas experienced a surge in visitor use during 2020, but that use levels have decreased to pre-pandemic levels in 2022.

[1] *Respondents comprised of residents from Alameda, Contra Costa, Main, Napa, Santa Clara, San Francisco, San Mateo, Solano, and Sonoma counties.*

2.3 Recreation Trends and Implications

2.3.1 Cycling and e-bikes

In general, cycling participation has been rising in recent years especially in large cities like San Francisco (San Francisco Municipal Transportation Agency, 2022). One likely contributor to cycling participation is the growing use of electric pedal assist bicycles (e-bikes). The use of e-bikes across the country has increased nearly 50% per year since 2013 and the use of e-bikes on trails in parks and protected areas also appears to be increasing (PeopleForBikes, 2017). In addition, mountain biking participation nationally appears to be increasing (Newcomb, 2020). Though whether e-bikes are driving the increase in mountain biking is being actively researched (Federal Highway Administration, 2022). According to the 2020 study *E-bikes on Public Lands*, the majority of e-bike owners who ride on natural surface trails (henceforth: trails) reported owning multiple standard bikes in addition to an e-bike (Perry & Casey, 2020). This finding suggests that existing cyclists are the primary users of e-bikes on trails rather than those who are new to cycling. The implication for this that the number of cyclists on trails may not be increasing dramatically, but rather existing cyclists on trails are switching to e-bikes instead of standard bikes.

Some concerns over the use of e-bikes on trails have been focused on the potential for increased environmental impacts due to e-bikes being heavier, having wider tires, or being able to be ridden further than traditional bikes (Chaney et al., 2019). However, it has been found that e-bikes are essentially equivalent to traditional mountain bikes in terms of trail impact effects (The International Mountain Bicycling Association, 2015). Alternatively, riders of standard mountain bikes have historically expressed concerns about visitor conflict and e-bike riders' behavior potentially resulting in getting all bikes banned from trails, but tensions seem to have eased in recent years as general bike restrictions have not come to fruition (Felton, 2015).

In California, e-bikes are not considered motor vehicles and are divided into three classes, where Class 1 e-bikes require pedaling to gain electric assist and have a maximum speed of 20mph. Class 2 bikes with throttle-controlled motor and Class 3 allow higher speeds, up to 20 mph and 28mph, respectively. References to e-bikes in this discussion refer solely to Class 1 as agencies that allow e-bikes on trails limit the policy to Class 1. Still, agency policies regulating Class 1 e-bikes on trails vary widely. The National Park Service has adopted the policy that e-bikes are allowed wherever bicycles are allowed (General Provisions; Electric Bicycles, 2020). California State Parks only allows e-bikes on trails in certain park types, i.e. e-bikes are allowed on trails in State Recreation Areas, while e-bikes are not allowed on trails in State Parks (California State Parks, 2021).[2] East Bay Regional Parks District allows e-bikes only on select paved paths (East Bay Regional Parks District, 2019). More recently, the Midpeninsula Regional Open Space Preserve - which does not allow e-bikes on trails- commissioned a set of studies to investigate visitor perceptions and ecological impacts of e-bikes. A report on these studies to the Board of Directors submitted in March, 2022 included a recommendation that e-bikes be allowed wherever bikes were allowed (Midpeninsula Regional Open Space District, 2022).

2.3.2 Electric transportation devices

The use of other electric transportation devices, such as electric skateboards, has the potential to increase usage on trails in open space lands. In fact, major manufacturers of electric skateboards already market some models for trail or "all-terrain" use.[3] Additionally, electric transportation devices can often be

[2] *E-bikes are allowed on paved roads in California State Parks and generally on paved roads that allow cars.*

[3] *See Onewheel.com and Boostedusa.com*

categorized as powered mobility devices which are protected under the Americans with Disabilities Act (Department of Justice, 2014).

2.3.3 General trends

More general recreation trends indicate that photography and nature-based activities have been increasing in popularity, replacing more traditional outdoor activities like fishing and hunting (Cordell, 2012). In addition, the *Survey on Public Opinions and Attitudes on Outdoor Recreation in California* found latent demand for some activities where respondents reported that they wanted to start participating or participate more in picnicking and camping activities (California State Parks, 2014). Implications for these trends may include a decrease in fishing in Waterdog Lake and an increase in shoreline picnicking.

3.0 Assessing Recreation Use

3.1 Visitation and Recreation Use

To better gauge recreation use levels on open space lands in the face of emerging trends, many parks assess recreation use. Recreation use is typically categorized as follows: who the visitors are, what activities they do, where they go, and how many visits a site receives (aka visitation). Measuring recreation use can provide monthly, seasonal, and annual data for visitation, but also can be used for funding requests, facility planning, utility capacity estimates, future open space planning, and management actions. Understanding the visitors and their perceptions can help the City meet visitor preferences for recreation on open space areas, evaluate the effectiveness of the diversity, inclusion, and equity goals of the PROS Plan. A brief discussion of recreation use assessment options are provided below. Table 1 outlines brief pros and cons of the assessment options as well as what types of data they can be used to collect. Note that the type of technology, survey questions, or locations of data collection must be selected appropriately for the desired data type.

Table 1. Summary of Visitor Survey and Count Methods.

Method	Who visitors are/visitor perceptions	What activities visitors do	Where visitors go	Number of visits
On-site visitor survey Pros: gather lots of information at once for people actively using the area Cons: time and resource intensive, only a snapshot in time	X	X	X	X
Online visitor survey Pros: gather lots of information at once, assess latent demand and reasons for not using open space areas, or decreased open space use Cons: Not all potential respondents have internet access, more difficult to control the sample of respondents selected to survey	X	X	X	X
Visitor counts from on-site observer Pros: easily collect digital data Cons: time and resource intensive		X	X	X
Visitor counts from remote motion-activated camera Pros: remote data collection Cons: time intensive or expensive data analysis		X	X	X
Visitor counts from automated counters Pros: remote data collection Cons: more types of data are more expensive		X	X	X
Visitor counts from cellphone location data Pros: data is voluntarily collected and preexisting Cons: unknown data reliability and potentially expensive			X	X

On-site visitor surveys are useful in gathering large amounts of information from visitors and are a great way to gather demographic and other information regarding who the visitors are, what activities they participated in during their visit, and which trailheads and trails they used in addition to counting the number of visits. Data collected from surveys are often used for many years by both the agency involved as well as other local and neighboring agencies and researchers. Pairing on-site surveys with relatively infrequent planning processes such as park and recreation master plans can help keep the snapshot of data relevant and can provide immediate applications for the data. In addition, surveys can help understand visitor perceptions and on-site recreation experiences. If an online survey is used, perceptions can be gauged for potential visitors who have never visited or used to visit but don't anymore.

Visitor counting systems are the main method park and recreation agencies employ when collecting recreation use data. The term visitor use counting system is used to describe an ongoing effort to measure primarily the number of visits as well as visitors' locations and activities. In Table 1 above, the On-site observer, Remote, motion-activated camera, and Automated counters are all methods that can be used as part of a visitor counting system.

An on-site observer can collect a variety of information in addition to the types listed in Table 1 including group size, times of entry and exit, mode of access, and direction of travel. Additionally, observers can informally track compliance with open space regulations. Observers can be placed in multiple locations to assess which trails are being used and how much. When and where observers are stationed can be designed to fill in data gaps or minimize time in the field. Technology advances have made it easy for observers to log data digitally and automatically store in an online-accessible database. Data collection can also be tailored to minimize cleaning and analysis. Unfortunately, staff time conducting on-site observations can be expensive and potentially tedious for the people assigned, sometimes resulting in quality control issues with the data being collected.

Remote, motion-sensing cameras can be used in place of an on-site observer and are already used extensively for wildlife detection. Effective and secure placement can sometimes be challenging depending on the vegetation structure and site conditions. Even with technology advances photos typically must be manually downloaded and analyzed by staff.

The most common method used in visitor counting systems is automated counters. These types of counters range in complexity from a simple tally of visitors passing by an infrared beam that must be manually downloaded; to an integrated bicycle, pedestrian, equestrian counter automatically uploading data including activity type, direction of travel, and total number of visits to an online portal. Selecting automated counters depends on the type of information desired, and the budget. Automated counters must also be regularly maintained by staff to ensure quality data.

Continuing advancements in cellphone technology allows for passive tracking of location data. Some applications facilitate location tracking and allow users to voluntarily share data which can also made publicly available. An example of this type of app is Strava. Because this data comes from specific users who decided to use a particular app designed for tracking specific activities, the information gleaned about where visitors go in the open space can only be applied to a subset of people. Without other visitor counting technologies, there is no way to determine what proportion of visitors have been accounted for. Other applications track user location continuously in the background and sell the data.[4] This data can be

[4] *Many apps collect location data which may be sold to firms like Streetlight which aggregates the data and sells analysis packages.*

expensive to purchase, but can potentially represent every visitor who recreates on open space lands with a smartphone.

Additional visitor counting systems regularly employed include automated vehicle counters and reservation systems. Vehicle counters can only be used to estimate number of visits and cannot be used to understand activity type. Reservation systems are typically employed in areas experiencing crowded conditions. Because activity type is of interest to the City and crowded conditions have not been observed or reported, these methods were determined to be unsuitable for the OSMP.

Any programming that the City or its partners want to undertake would do well to count participants not only to gauge the engagement of the program but also to understand the relationship of planned group activities with the visitation overall.

3.2 Trail Usage and Density

Both the Waterdog Lake and San Juan Canyon Open Spaces have similarly dense or less dense trail systems when compared to nearby open space areas. Waterdog Lake (293 ac) has a trail density of about .03 miles per acre for the trails included on current City maps -referred to as mapped trails.[5] Comparable to Waterdog Lake in area, the Laurelwood/Sugarloaf Open Space (225 ac) in San Mateo has a trail density of .02 miles per acre. The *Laurelwood Park and Sugarloaf Mountain Open Space Management Plan Amendment* (2015) found a number of existing trails which are not mapped and not utilized in the trail density calculation (City of San Mateo Parks & Recreation, 2015). When Waterdog Lake's trails that do not appear on current City maps are included -referred to as previously unmapped trails- the trail density increases to .04 miles per acre. The activity types allowed on trails in both areas seem to be consistent, allowing hiking, dogs on leash, and biking. Table 2 shows the trail mileage for both mapped and previously unmapped trails in Belmont's open spaces.

San Juan Canyon (81 acres) has a trail density of .01 miles per acre for mapped trails, though when unmapped trails are included, the density increases to .03 miles per acre. Similar in size to San Juan Canyon are Big Canyon and Eaton Parks (74 acres combined) in San Carlos, where the combined trail density is .05 miles per acre. The 2012 *San Carlos Hillside Trails Plan* also indicated that well established, unmapped trails existed (City of San Carlos, 2012). These unmapped trails would further increase the trail density in Big Canyon and Eaton Parks. These San Carlos parks allow hiking, dogs on leash, but do not allow bikes.

Table 2. Miles of trails in Belmont open spaces.

Trails	Waterdog Lake trail miles	San Juan Canyon trail miles	Total
Mapped	8.57 (81%)	1.04 (45%)	9.61 (75%)
Previously unmapped	1.96 (19%)	1.26 (55%)	3.22 (25%)
All	10.53 (100%)	2.3 (100%)	12.83 (100%)

[5] *Current City trail maps were developed in 2003. The trails shown on these maps are referred to as mapped trails. Other trails exist but are not shown on these maps, these trails are referred to as previously unmapped.*

Though research on the effects of trail density on wildlife and their habitat is limited, some studies have investigated the effect of trail creation on wildlife. Miller et al., (2020) suggest that the construction of new trails can negatively alter wildlife habitat in the short term, but species rebound and return to the area quickly. In addition, a study of urban open spaces in Ohio found that trails and recreationists did not limit the movement of wildlife (Escalambre, 2020). Similarly, a study conducted in San Francisco Bay Area open spaces found that different types of recreation activities -namely hiking and biking- do not seem to negatively impact wildlife (Reilly et al., 2017). Reilly et al., found that domestic dogs did seem to have a small effect on wildlife, but the effect was limited to a small number of species, in particular, nesting birds, and carnivores. WRA conducted an environmental assessment for Quarry Park and Pillar Point Bluff Park in San Mateo County and did not find any impacts from dogs on wildlife and plant species found in those parks. As part of this same project, WRA conducted a comprehensive review of studies that examined dog related recreation impacts on wildlife across multiple park and recreation areas but found scant evidence of chasing or killing wildlife. Finally, the Environmental Assessment section of the OSMP found that wildlife habitats in Waterdog Lake and San Juan Canyon are in good condition suggesting that the current trail usage and trail density are not having undue negative impacts.

3.3 Trail Condition Assessment

During March and April, 2022 WRA staff recorded trail conditions for the trail systems in both Waterdog Lake and San Juan Canyon. The purpose of the trail environmental condition assessment was to generally characterize environmental conditions on open space trails, which could be used to develop recommendations that could be implemented as part of the OSMP – note that this effort was not a comprehensive inventory. A qualitative assessment of trail conditions on both mapped trails and previously unmapped trails was made based on the level of erosion and vegetation impacts observed. Categories include high, medium, and low erosion; these categories are defined in Table 3 below, along with a representative photo of the category. Point data were collected along the trail feature which are shown in Figures 1 and 2.[6] In addition, WRA also noted stream crossings and if adjacent vegetation shows signs of impacts (trampling, what appears to be obvious/illegal vegetation trimming).

[6] *Note: open space boundaries may not reflect recent housing developments.*

Table 3. Definitions and Examples of Trail Erosion Categories.

High	**High Erosion** There are more than two deep ruts located along the length of the trail, and there are several observations that it significantly interferes with pedestrian and cycling activities where it causes trail users to create additional pathways to avoid this erosion feature. For this category, evidence of trail user impacts resulting from the erosion feature includes more than one of the following: trail widening, braided trails, unsanctioned trails, soil compaction, and vegetation trampling.	
Medium	**Medium Erosion** There are one or two noticeable ruts forming along the length of the trail, and there are some observations that it significantly interferes with pedestrian and cycling activities. For this category, evidence of trail user impacts resulting from the erosion feature includes one of the following: trail widening, braided trails, unsanctioned trails, soil compaction, and vegetation trampling.	
Low	**Low Erosion** There is a shallow rill forming along the length of the trail, but there are no observations that it significantly interferes with pedestrian and cycling activities. There is no evidence of trail users negatively impacting adjacent vegetation to avoid this erosion feature.	

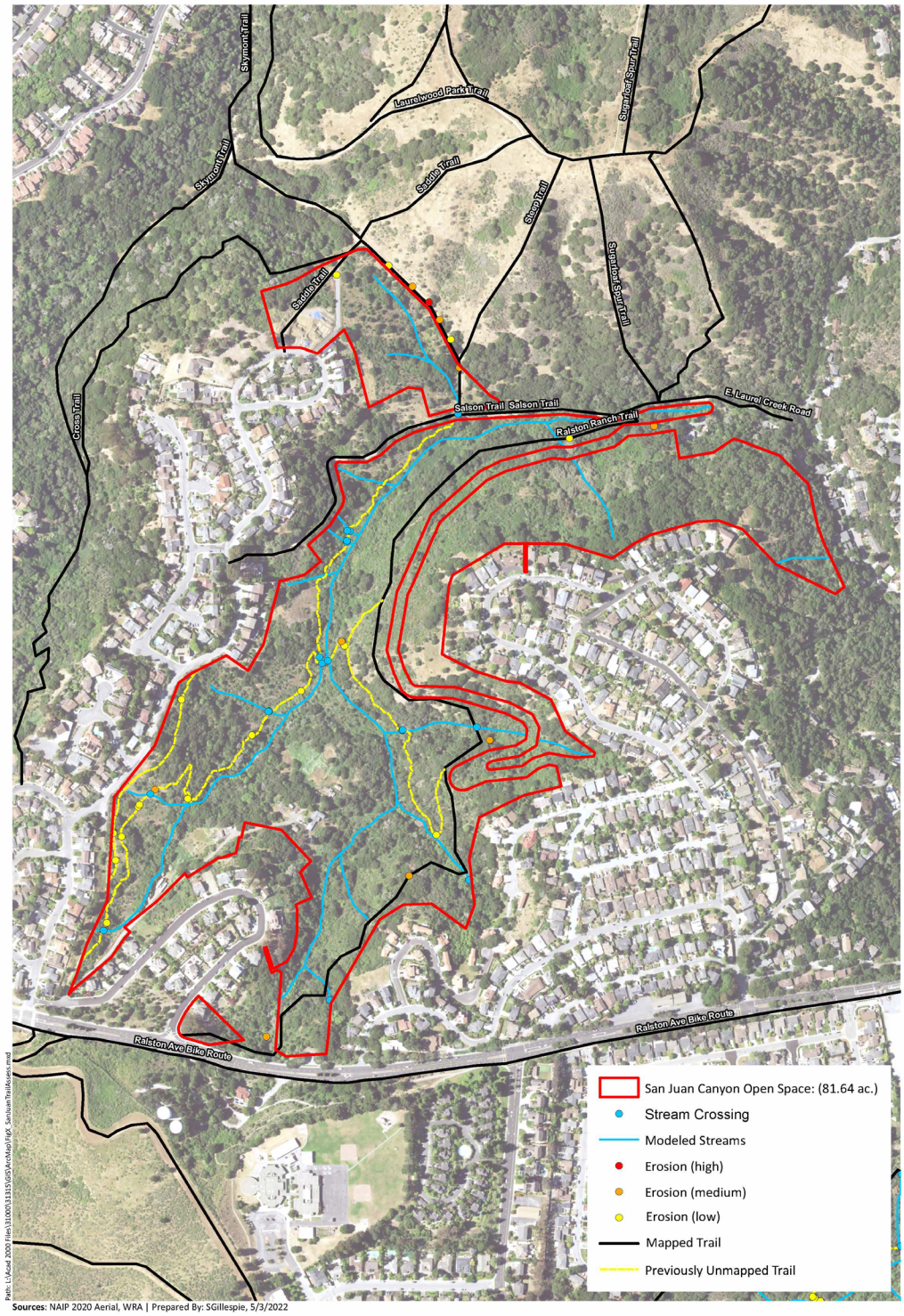

Figure 1. San Juan Canyon Open Space Trail Assessment

San Juan Canyon Open Space
Belmont, California

0 200 400 Feet N

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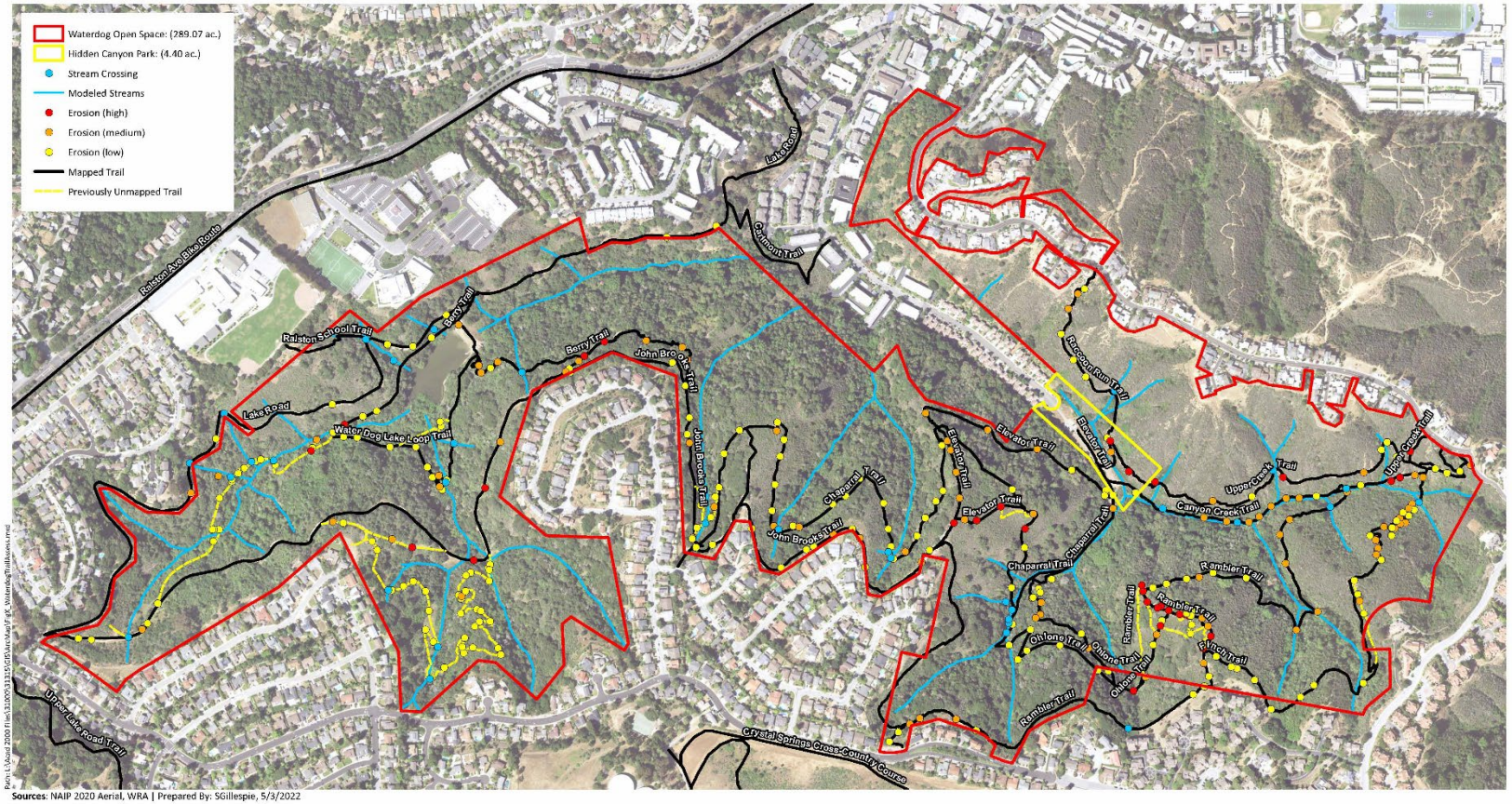

Figure 2. Waterdog Lake Open Space Trail Assessment

Waterdog Lake Open Space
Belmont, California

0 400 800 Feet

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Table 4 depicts erosions levels for the City's two open space areas. Most erosion locations were found in the larger Waterdog Lake Open Space Area, and among those locations, the majority were assessed as "low" on both mapped and previously unmapped trails. For both Waterdog Lake and San Juan Canyon the number of locations assessed as having "high" erosion were about one in ten; 8-11% for Waterdog Lake, and 0-8% for San Juan Canyon. These results demonstrate that the trail systems in each open space area are in relatively good condition overall, but that there are locations of "high" erosion that should be addressed immediately.

Table 4. Instances of Erosion on Trails

Location	Low Erosion	Medium Erosion	High Erosion	Total Erosion Instances
Waterdog				
Mapped trails	127 (56%)	77 (34%)	25 (11%)	229
Previously unmapped trails	59 (83%)	7 (10%)	6 (8%)	71
San Juan Canyon				
Mapped trails	5 (38%)	7 (54%)	1 (8%)	13
Previously unmapped trails	11 (85%)	2 (15%)	0 (0%)	13

Recreational uses can contribute to erosion on trails though the effect is largely mediated by the trail alignment, climate, and soil type (Leung & Marion, 1996). Some studies that have examined the relative impacts of different modes of recreation suggest that hiking trails experience more soil loss than biking trails, and equestrian and motorized trails experience the most soil loss. Typically, more soil loss – and other ecological impacts - results from recreation use occurring off-trail rather than on established trails (Hammitt et al., 2015).

4.0 Recommendations

The following recommendations offered are aimed at improving the condition of existing trails and managing existing and future recreation use. These recommendations describe a variety of methods by which they can be achieved. The City may choose to implement one or more methods at their discretion. Recommendations and were developed from desktop research, field visits, and public comments, and methods consist of established best practices.

4.1 Trail Condition

Address stream crossings and high levels of erosion. Attachment A shows specific locations with the most urgent need. Stream crossings should be either removed by rerouting the trail or protected with a structure (e.g. bridges). Trail professionals and hydrologists should be consulted to determine the type of structure needed for each stream crossing. [7] Additional areas identified as having high levels of erosion should to be evaluated by trail professionals to determine if trail sections can be improved with drainage features or if the trail needs to be rerouted. Consider requiring training for volunteers engaged in trail construction and maintenance.

Incorporate/Decommission previously unmapped trails. Once stream crossings and erosion issues have been remedied, most previously unmapped trails can be incorporated into City maps, named according to City policy, and wayfinding signage installed. Trail segments that should not be incorporated but rather decommissioned include trail segments surrounding erosion issues – i.e. the re-routing of a trail will result in sections being decommissioned. Additional unmapped trails that should be decommissioned are all those which exist between Waterdog Loop Trail and the shoreline of Waterdog Lake. The steep slopes in this area not only makes these informal trails hazardous to visitor safety, but also can result in erosion, water quality, and riparian impacts. Decommissioned trails should be closed with signage, soil should be de-compacted and revegetated if needed.

4.2 Trail Use and Management

Implement a pilot policy regarding the use of e-bikes, and other electric transportation devices on trails which adheres to ADA regulations. A policy that can be implemented for at least 1 year during which usage, behavior, and visitor perceptions can be monitored is recommended. This policy may allow Class 1 e-bikes on trails where traditional bikes are allowed. Other electric transportation devices like electric skateboards may not be allowed on natural surface trails as they do not qualify as a bike or e-bike. Other-powered mobility devices as defined by the ADA may only be used by individuals with mobility disabilities on open space trails.

Improve wayfinding and site identification signage. Wayfinding signage will need to be added to newly incorporated trails and closed signage to newly decommissioned trails to eliminate ambiguity. The City may also consider developing a trail naming policy. Consistent site identification signage should utilize a similar design across all open space lands and be installed at all designated trailheads. Attachment B shows examples of inconsistent signage design and ambiguous trailheads needing identification.

Survey visitors and non-visitors to gather information on the effect of management actions on visitor experiences. Some management actions are only measurable by asking visitors about their experience,

[7] *See Santa Cruz Mountain Trail Stewardship*

such as visitor feelings of safety and crowding. Online surveys are recommended to capture responses from people who may not be visiting and help to understand why and if people are being displaced.

Measure recreation use in open spaces. Consider automated counters installed at key trailheads that can differentiate between pedestrians and cyclists. On-site observers could be used instead of automated counters. Observers must be strategically deployed to collect data during all types of hours, days, seasons. Only staff should be used as on-site observers to avoid any bias or perception of bias that may come with the use of volunteers. Any group events should provide an estimate of the number of attendees.

Manage multi-use trails to improve visitor experiences. During the OSMP process, public meeting participants have expressed a wide range of experiences from wonderful to feeling unsafe. It is recommended that both visitors and non-visitors be surveyed to identify what types of negative experiences they may be having to better guide management actions to improve those experiences. Given that concerns over safety regarding trail user speed have already been voiced, a variety of options to slow speeds and improve perceptions of safety are provided. Which options are chosen and how/where they are employed will need additional evaluation.

Trail user speed can effectively be reduced through a number of biking specific trail design features described in section 4.1.3 below. Additional general design features include installing flat landings to narrow trails to provide areas of respite and a wider area for passing.

Visitors' feeling of safety may be improved through the addition of regulations around trail user speed, such as signed speed limits or designated slow/walk zones. Many parks have a 15-mph speed limit on trails, however, without speedometers, users are unaware of their speed. Additionally, regulations rely on education and enforcement which can be challenging with limited staffing.

Educating visitors on trail etiquette can help improve feelings of safety. The Slow and Say Hello philosophy encourages all trail users to slow down and communicate when passing any other visitor (Marin County Bicycle Coalition et al., 2022). This method does not rely on users memorizing the "share-the-trail" rules, and encourages general friendliness. Additionally, educating cyclists to use passive bells, or providing loaner bells at trailheads can help all users hear when a bike is approaching.[8] Educating hikers to listen for bells can help reduce startling situations.

Designating trails as single use can improve feelings of safety by increasing predictability by allowing only one activity type. Attachment C provides suggestions for one potential pedestrian only trail segment and one potential biking only trail segment. Further evaluation would be needed before attempting to implement single use trail segments. Criteria for evaluation may include visitor perceptions, trail alignment, current trail usage.

Designating trails as one-way can reduce the need for passing as well as reduce speed by making steep sections uphill only. One trail within Waterdog Lake appears to have been recommended as one-way by users already (see Attachment C) though further evaluation would be needed to determine if this is desired and/or effective at reducing speeds.

[8] *WRA staff noted during field visits that many cyclists already use passive bells when riding.*

4.3 Trail Standards and Guidelines

All trail maintenance, erosion control, stream crossings, and safety features should be conducted and constructed in accordance with the trail standards and guidelines presented and referenced below.

4.3.1 Trail Construction

The following section contains guidelines and standards for designing and constructing the trail system. General information is presented that applies to all trails, followed by specific details for mountain bike trails and for trails that comply with the American with Disabilities Act (ADA). Many of these standards and guidelines can be found in the California State Park's *Trails Handbook* (California State Parks, 2019).

General Standards and Guidelines

Locations for new trails should take advantage of existing roads, trails, or other disturbed areas wherever possible and appropriate.

Strategies should be implemented to keep visitors on trails and discourage informal trail creation. This is particularly important where there are steep slopes and sensitive resources and unauthorized trails that can sometimes result in environmental impacts. These strategies include:

- install clear directional signage at trailheads and intersections,
- provide educational signage on trail stewardship, including prohibition of establishment of new trails, shortcuts, etc. without City authorization
- install natural features as barriers to minimize unauthorized trail development,
- use volunteer trail patrols to monitor and document newly developed unauthorized trails,
- engage trail users in park stewardship,
- use logs and vegetation debris to block newly developed unauthorized trails

Trails will be aligned along cross slopes and outsloped as feasible; running slopes will be minimized to avoid erosion to the greatest extent feasible.

Full bench construction shall be used where feasible. This means the full tread width is supported by undisturbed soil without the need for fill on the downhill side. This technique results in more stable trails that are less susceptible to erosion.

Locally-sourced materials shall be used for trail construction as available.

Rolling dips shall be constructed to direct water off the trail for minor seasonal drainage crossings and at appropriate intervals to effectively dewater trail based on trail slope.

Armored rolling dips shall be constructed at moderate seasonal drainage crossings to minimize erosion and sediment impacts and provide all weather access for trail users.

New riparian/creek crossings shall be located on geomorphically stable sites (i.e. low slopes in channel and banks) and constructed to minimize, to the greatest extent possible, streambank and bed erosion.

Development of new public trails through landslide areas shall be avoided.

Trail cross slope (perpendicular to the direction of travel) shall be 5% maximum, except at armored crossings and rolling dips where cross-slope shall not exceed 10%.

ADA Standards and Guidelines

The Americans with Disabilities Act (ADA) requires that some portion of a recreation resource or trail offer opportunities for those with disabilities. The following standards apply to trail design and construction to ensure reasonable access to all trail users.

A clear tread width of accessible trails shall be 48" minimum, and 72" maximum.

Cane-detectable edging shall be provided along at least one side of accessible trails. This can either include an elevation change (such as curb, 3" minimum height), or texture change (such as a transition from gravel to vegetation).

Running slopes of accessible trails in the direction of travel shall be as follows:

- 5% or less for any distance.
- From 5.1% to 8.33% for 200' maximum.
- Cross slope (perpendicular to the direction of travel) of accessible trails shall be 3% maximum.

Where accessible trail clear tread width is less than 60", and the running slope is greater than 5%, a 60" long resting space shall be provided at least every 200'.

Accessible trails shall be constructed with an all-weather surface that retains its surface integrity when wet. Examples include stabilized soil or decomposed granite, wood or plastic decking, unit pavers, asphalt paving, or concrete.

Steps shall not be permitted on accessible trails.

Accessible trails shall not have tread obstacles, such as roots or rocks, higher than 3"

Objects that protrude into an accessible trail between 27" and 80" from the ground shall not protrude more than 4". Objects mounted below 27", such as interpretive exhibits or benches, may protrude any amount but shall not reduce the clear width of the trail to less than 36".

Trail Design Features Specific to Mountain Bike Trails

Most of this section offers general standards and guidelines that are applicable to any trail type. However, there are specific aspects of mountain bike trail use that need to be carefully considered during the design process. According to the *California State Parks Trail Handbook* (Handbook) an important element in mountain bike trail design is reducing the speed of cyclists. High rates of speed can lead to increased user conflicts with cyclists and other trail users, safety issues, resource degradation, and trail sustainability issues. Reducing mountain biker speed is a means of addressing these issues, and there are several design techniques that can be used to help reduce bike speed, including:

- Increasing trail sinuosity
- Reducing long sight lines

- Staying within the maximum sustainable grade
- Reducing tread width
- Use “run outs” at the bottom of lengthy downhill trail segments to provide for adequate braking distances
- Using natural or artificial features to create pinch points
- Avoiding flat ground to the extent feasible
- Texturing the trail tread

Using these design techniques collectively rather than simply relying on a single technique will result in greater speed reduction, user safety, and user satisfaction. Additional details on each of these techniques may be found in Chapter 6 of the Handbook.

Design of Drainage, Wetland, or Stream Crossings

The open space areas managed by the City of have multiple stream crossings. To maintain the City’s trails in an environmentally sustainable manner, proper cross drainage will be required when a trail or road crosses an existing drainage, wetland, or stream. Whether a pipe or open conveyance is chosen, adequately sizing and sloping the cross drainage to convey up to the 100-year design flow is critical to ensuring long-term functionality with minimal maintenance. Selection and design of each crossing installation will consider, at a minimum, the trail type, required vehicle use and load-bearing capacity, stream type, fish-passage requirements, and estimated flood flows. Project-specific engineering design and analysis will be conducted to ensure correct size, material, and placement before construction can begin.

The following standards and guidelines are generally applicable to drainage feature design, and or crossing wetlands and streams.

Blocked culverts may affect water quality, change the watercourse, increase erosion or sediment runoff, or affect wildlife. Therefore, trails should be designed to minimize the need for culverts.

Any unstable fill slopes and cut banks that have the potential to erode and negatively affect water quality of nearby wetlands and waters should be removed entirely and graded to a stable contour. These areas should be revegetated with appropriate native species.

Sediment filtration barriers should be deployed around the edges of unstable slopes as necessary to prevent erosion and runoff into wetlands and waters.

Grading and other activities associated with road or trail maintenance shall only occur during the dry months (generally April 1 to October 31), when associated erosion can be reduced to the maximum extent possible.

Dips and Water Bars

Rolling/reverse grade dips or water bars will be constructed to disperse flow and to minimize the potential for concentrated flow, which might otherwise cause rilling or gullying. Rolling dips are more durable and drivable than water bars and are therefore the preferred method.

Dip and bar spacing is dependent upon grade, soil type, and expected runoff volume. General guidance for spacing dips is as follows, although the specific engineering specification may differ, depending on site conditions and other factors:

- 2% - 3% grade = 200 to 300 feet
- 5% - 7% grade = 160 to 180 feet
- 8% - 10% grade = 140 to 150 feet

Ditch Relief Culverts and Outlets

Ditch relief culverts are necessary to drain an inside ditch at specified intervals to prevent excess velocities in the ditch or overflow onto the trail from the ditch. Relief culverts convey the flow under and across the trail or roadway to the outsloped area below. When a ditch relief or permanent culvert empties onto a steep slope, an extension of the piping may be warranted to prevent erosion at the outlet.

Slope Stability

Steep slopes adjacent to trails and roadways can result in slumping or gullying that can damage the road or trail and degrade water quality. The following measures are to be considered in stabilizing steep slopes adjacent to trails and roads:

- lay back the slope (modify to 2:1 or flatter) and vegetate
- rip rap a steep slope (1:1)
- retaining wall

Slopes that are sloped back to 2:1 or flatter and seeded may also require temporary erosion-control blanket installations to stabilize the hill slope while the vegetation matures. A retaining wall may only be applicable in special cases where a short vertical slope (around 3 to 5 feet) needs to be stabilized in a park area that includes some urban or residential interface.

Biotechnical treatments, such as wattles or woody debris revetments, are the preferred method for slope stabilization over hardscape solutions, such as rip rap, when the designs are feasible under existing and forecasted site conditions.

Catchment Basins

The following methods may be used to capture and infiltrate runoff from any trails or parking areas. Method selection will be based on the site's available land area, soil type, groundwater level, and estimated volume of runoff to be collected. All the following options require engineering design prior to installation:

- dry basin
- wet basin
- infiltration trench
- subsurface infiltration gallery or drywell

4.3.2 Best Management Practices for Sensitive Resource Protection

The best way to protect sensitive resources is to avoid locating trails in sensitive areas to the extent possible. The following standards and guidelines pertain to those situations for which trails cannot not avoid traversing sensitive areas. While many routine maintenance activities will not require special permits, some maintenance activities and new trail construction may. When required, this process will typically result in implementation of best management practices required by the resource agencies. As defined in the OSMP, a best management practice (BMP) is a practice, or combination of practices, that has been determined to be most effective and practicable in preventing or reducing the level of environmental harm created from an activity to a level compatible with environmental goals and regulatory standards.

BMPs can be drawn upon during the resource permitting process and can be supplemented by any additional practices required by the resource agencies. For projects not requiring permits or regulatory involvement, appropriate BMP's should be implemented as necessary and practicable to protect sensitive resources on the City's open space areas. The general and topically specific practices can be considered as standards to be followed and implemented as appropriate for any road and trail management action. The BMP's have been divided into categories listed below:

- General
- Sensitive Natural Resources Best Management Practices
- Special-Status Wildlife Best Management Practices
- Special-Status Plants
- Invasive Plants
- Construction contracts
- Cultural Resources
- Water Quality
- Geologic Hazards
- Air Quality
- Noise

The specific BMP's within each of the categories may be found in Tables 6.2 through 6. 11, in chapter 6 of the Marin County *Road and Trail Management Plan* (Marin County Parks & Marin County Open Space District, 2014).

4.3.3 Trail Maintenance Guidelines

Recommended trail maintenance standards and guidelines for the City's open space areas are based on information found in chapter 5 of the *County of Los Angeles Trails Manual* (County of Los Angeles Department of Parks and Recreation, 2013).

Trail maintenance should be based regular assessments of trail conditions. For many park and recreation agencies these are done on an annual basis, documenting trail conditions and need for maintenance and or repair. Trail inspectors should record information about runoff and potential effects on water quality of nearby habitats, spread of invasive exotic plants, and status and quality of any known sensitive resources in the immediate vicinity that could be affected by road or trail use and/or maintenance.

Generally, assessments should address the need for conducting the following activities:

- Tree and brush trimming
- Trail grading and reducing surface erosion
- Culvert cleaning
- Maintaining water crossings and structures for wet areas
- Maintaining signage
- Graffiti removal
- Homeless encampment removal
- Fire fuels reduction

4.3.4 Trail Operation and Design

For trail operation, hours of use should be clearly posted at major access points like trailheads. Other relevant information, such as local regulations, or trail etiquette guidelines, should also be posted in these locations. Closure policies (e.g., wildfire hazard, wet weather conditions) should also be clearly posted. In addition, changes to trail or open space conditions may need to be communicated through multiple methods simultaneously such as website updates, and social media, as well as on-site signage.

Trail design elements can be effective at protecting the surrounding habitats and in managing visitor use. Delineating edges of trails can help visitors identify authorized trails and discourages off-trail travel. Delineating trails can be done with natural materials such as logs or rocks, or with built materials like a short curb on a paved path. Often times, if resources are especially sensitive or if off-trail travel is becoming a problem, barriers can be installed at trail margins. Barriers can include fencing or other structures, or they can consist of live vegetation like shrubs. However, sometimes barriers can be ineffective at preventing off-trail travel like that which results in trail braiding and trail widening. Usually in these situations, either a wider trail is needed, or the trail surface needs to be hardened with materials like gravel, or decomposed granite.

Effective trail design can be as simple as ensuring authorized trails access places that people want or need to go, and unauthorized trails are decommissioned effectively. Other trail design elements depend on the current use and desired use of the trail system. Seating, and wider gathering places are often installed at vistas. For these and areas with interpretive signage, such as trailheads, trail surfaces should be wider and hardened.

Changes in visitor use patterns to enhance visitor experiences and protect sensitive resources can be facilitated through clearly communicated regulations and result in decreasing visitor conflict and decreasing environmental impacts. Trail closures during or immediately after rain events may help reduce erosion and may reduce vegetation trampling/trail braiding around wet/muddy areas. Temporal separation of visitor activities has also shown success in reducing conflict and unauthorized trail creation. Direction of travel on trails can be another dynamic management tools. Involving visitors in trail maintenance or clean-up days can be an effective way to teach visitors about trail etiquette, habitat protection, and engagement in management.

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ATTACHMENT A: TRAIL SEGMENT ENVIRONMENTAL MANAGEMENT RECOMMENDATIONS

Specific locations and recommendations for improving stream crossings and trail segments with high levels of erosion are included below.

Location: 37.49919, -122.2958

Recommendation: Drainage feature to convey stream flows, and a single path of travel across the bridge.

Location: 37.49953, -122.2971

Recommendation: Drainage feature to convey stream flows, and a single path of travel across the bridge.

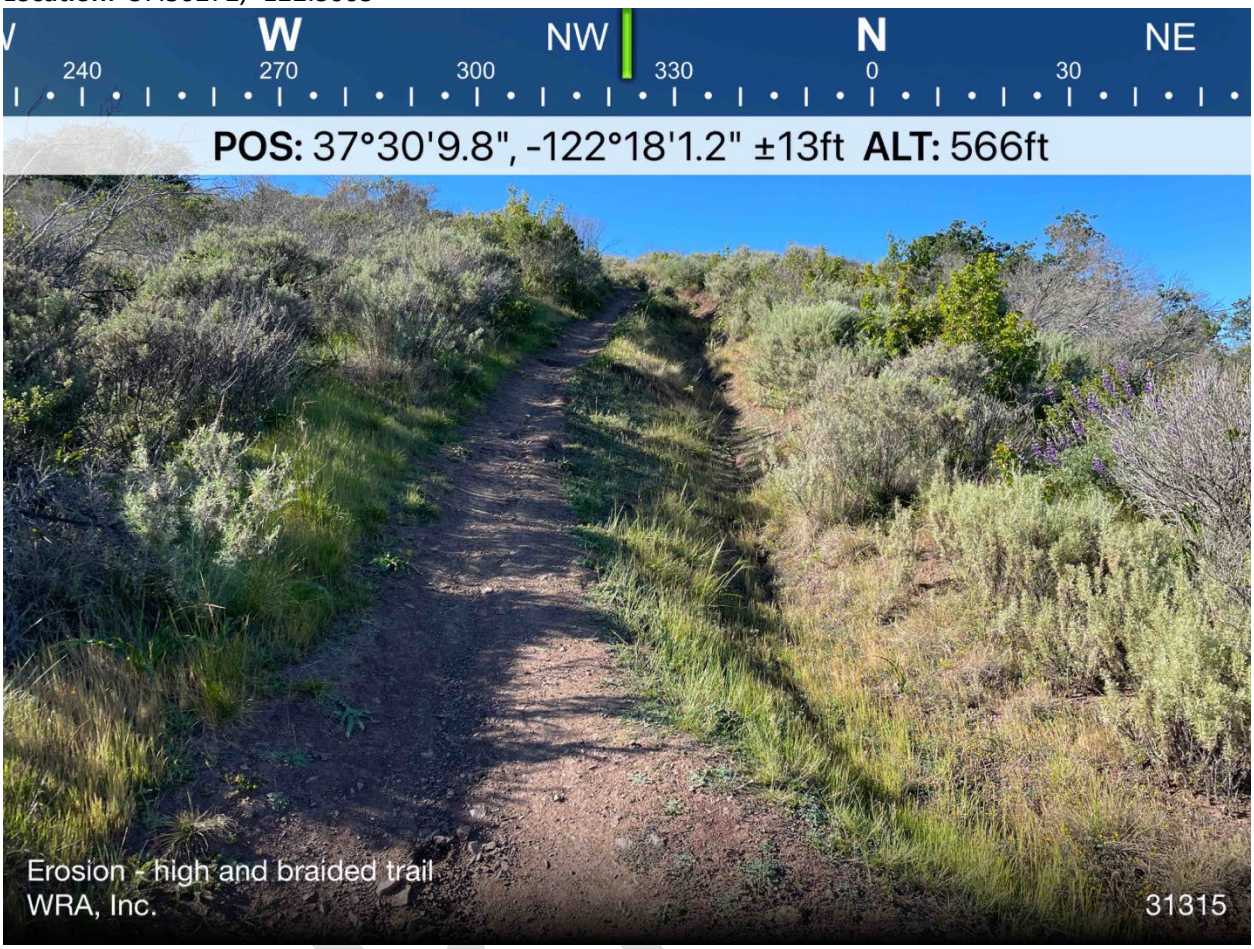
Location: 37.50067, -122.2967

Recommendation: Narrow the trail tread and re-contour to avoid channelizing storm flows.

Location: 37.50154, -122.2979

Recommendation: Replace existing with a wider bridge, and eliminate the braided trail through the stream channel.

Location: 37.50272, -122.3003



Recommendation: Re-contour to outslope trail tread, and/or add drainage feature to ensure water flows in the ditch instead of the trail.

Location: 37.51764, -122.3218

Recommendation: Install puncheon since the areas before and after this stream crossing are frequently muddy.

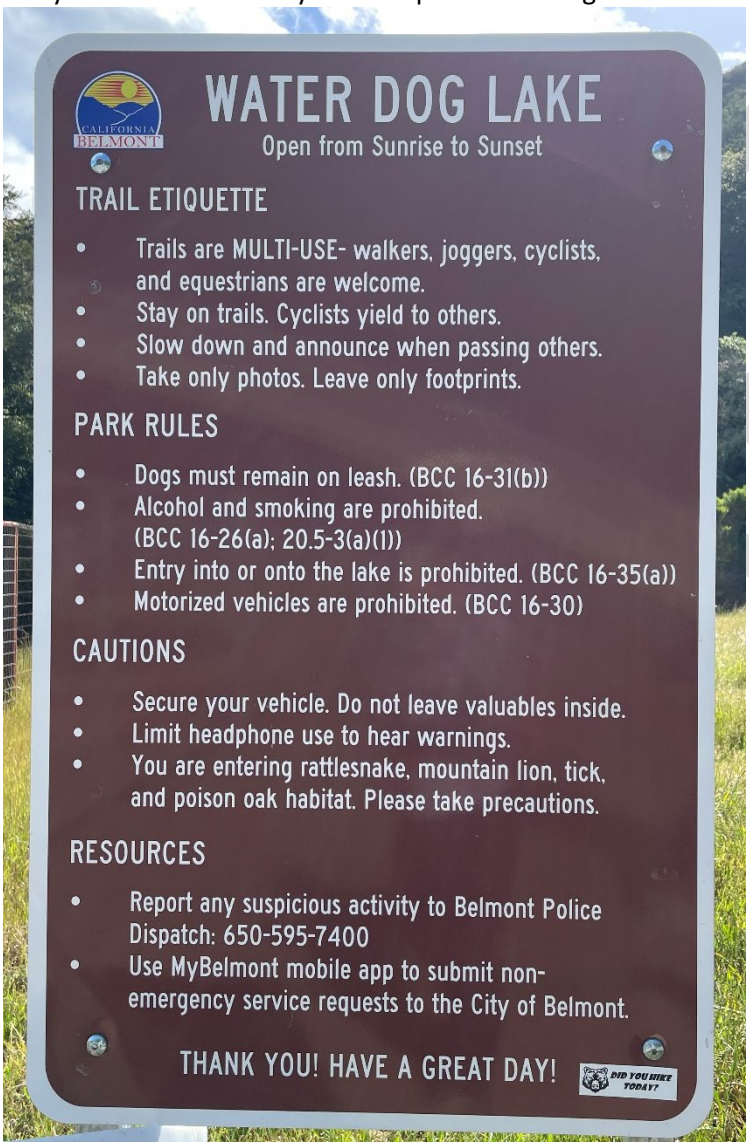
Location: 37.499898, -122.298454

Recommendation: Close trail segment and install physical barrier to prevent future use. Reroute trail using nearby existing segments.

ATTACHMENT B: SIGNAGE RECOMMENDATIONS

Attachment B
Specific examples of signage recommendations.

Use consistent naming conventions on all open space messaging. The photo below shows a sign indicating the location as Waterdog Lake, however, on City trail maps this location is listed on Google as Hidden Canyon Park. This creates confusion for visitors not only trying to access or navigate the site, but also when interpreting regulations and where they may apply. Occasional information such as post-rain closures, and wildfire risk should also be communicated through on-site signage since many local visitors likely do not read the City website prior to visiting.



Use consistent sign design across City open space lands. The photo above and the photo below are both signs containing trail etiquette and regulatory information, but the design is drastically different. This can create confusion for visitors over what is an enforceable regulation and what is not. Different styles of signage also typically indicate different locations.

Use open space identifying signage at trailheads. Site and trail identification are necessary pieces of information at every trailhead. This lets visitors know they are in the right place and helps visitors distinguish designated trailheads from unauthorized access points. The photo below shows what Google labels as the John Brooks Trailhead. However, the signage does not identify the open space by name (Waterdog Lake and Open Space) nor does it identify the trail by name. It is also recommended that trailheads be equipped with a trail map, trash can with lid, and dog waste bags.

ATTACHMENT C: TRAIL USER EXPERIENCE RECOMMENDATIONS

Specific locations and recommendations for managing trail use for enhancing visitor experiences. Prior to incorporating these trails into City maps, all stream crossings and erosion issues must be improved as noted in Attachment A. In addition, prior to designating any trail as single use or single direction, visitors should be surveyed and assessments of use on trail segments should be performed.

Trail recommendations for designating as single use.

Number 1 on the map below, trail connecting the John Brooks Trail with the Waterdog Lake Loop Trail. This trail could be a good candidate for designating as pedestrian use only due to the low tree branches and unique shady experience that may encourage slow travel through this area. There are also two parallel trails so access to trailheads would not be restricted. This trail may need additional improvements like realigning trail away from the creek in areas.

Number 2 on the map below, loop trail to the south of the John Brooks Trail. This trail could be a good candidate for designating as cycling only due to its winding alignment and banked corners. Because this trail is a loop branching off of the John Brooks Trail, trailhead access would not be restricted. Users of this trail may already be encouraging a single direction of travel (see photo below) which they City may choose to codify and install official signage. However, this decision should rely on assessments of the need for a single direction of travel and visitor surveys.

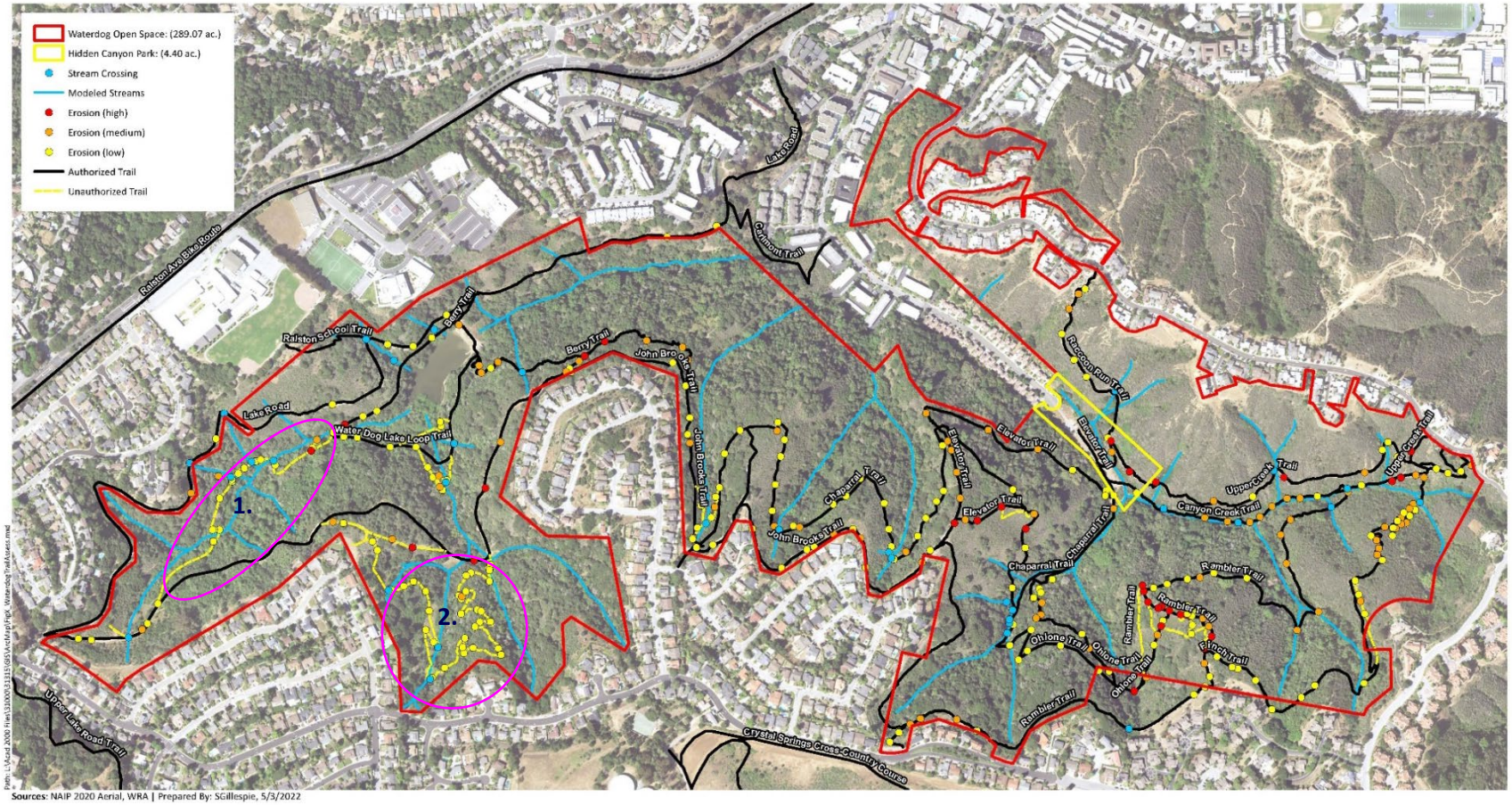


Figure 2. Waterdog Lake Open Space Trail Assessment

Waterdog Lake Open Space
Belmont, California

Photo of visitor-encouraged one-way trail.