

CALIFORNIA COASTAL COMMISSION

45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
FAX (415) 904-5400
TDD (415) 597-5885



W9a

5-24-0064 (Darryl Ford, City of Los Angeles)

May 22, 2025

EXHIBITS

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ENVIRONMENTAL SCIENTIST, DATED JUNE 17, 2024**

EXHIBIT 5 – PERIMETER FENCE CONCEPTUAL DESIGN



Venice Skatepark
Seaside skatepark
with a sunken pool

Venice Public Art Walls
Beachfront walls
covered by graffiti art

Breakwater
Lifeguard Tower

Marvin Braude bike trail

Police Substation

Project location

Windward Plaza

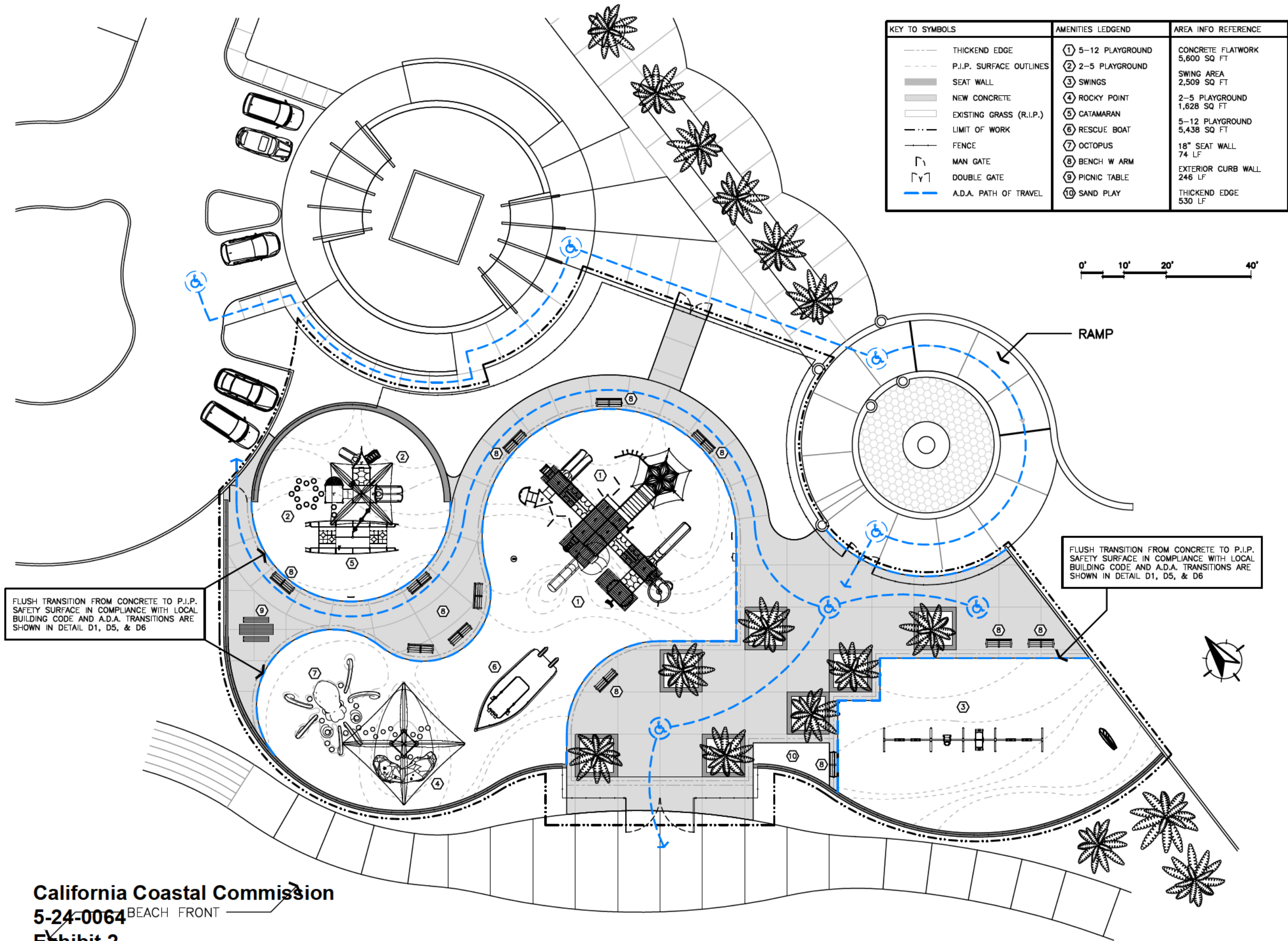
Public restrooms

Venice Beach
Basketball Courts

Venice Beach
Recreation Center

California Coastal Commission
5-24-0064
Exhibit 1
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KEY TO SYMBOLS	AMENITIES LEDGEND	AREA INFO REFERENCE
THICKEND EDGE	① 5-12 PLAYGROUND	CONCRETE FLATWORK 5,600 SQ FT
P.I.P. SURFACE OUTLINES	② 2-5 PLAYGROUND	SWING AREA 2,509 SQ FT
SEAT WALL	③ SWINGS	2-5 PLAYGROUND 1,628 SQ FT
NEW CONCRETE	④ ROCKY POINT	5-12 PLAYGROUND 5,438 SQ FT
EXISTING GRASS (R.I.P.)	⑤ CATAMARAN	18" SEAT WALL 74 LF
LIMIT OF WORK	⑥ RESCUE BOAT	EXTERIOR CURB WALL 246 LF
FENCE	⑦ OCTOPUS	THICKEND EDGE 530 LF
MAN GATE	⑧ BENCH W ARM	
DOUBLE GATE	⑨ PICNIC TABLE	
A.D.A. PATH OF TRAVEL	⑩ SAND PLAY	



150 PlayCore Drive SE
Fort Payne, AL 35967
www.gametime.com

GREAT WESTERN RECREATION
HOME OFFICE: 975 SOUTH HWY 89 - LOGAN UT 84321 PHONE: 435-245-5055

SALES REPRESENTATIVE:
LEWIS L. PAINTER
435-760-2416
lewis@gwpark.com
DATE: 6/28/2024
DWG BY: LEWIS L. PAINTER

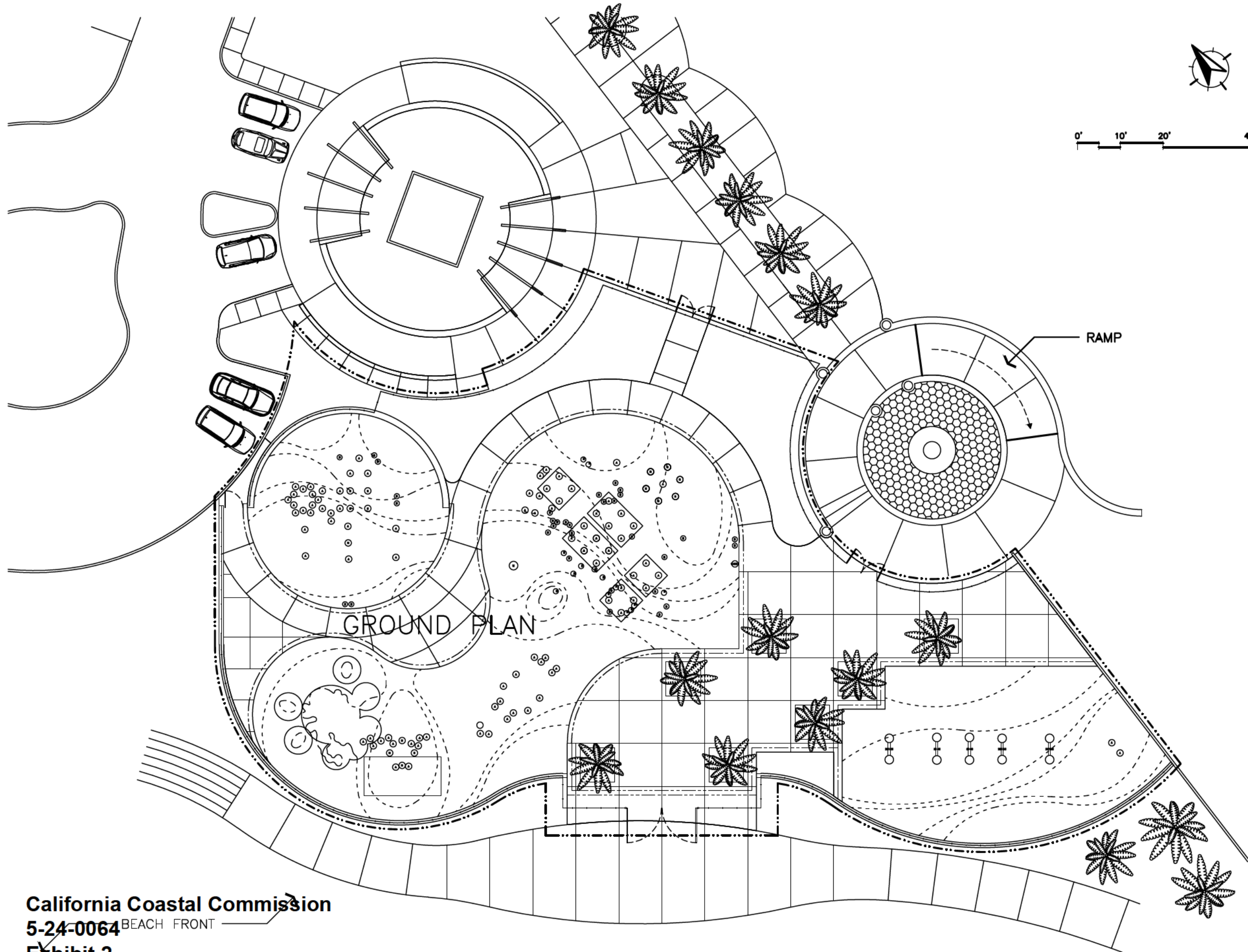
REC & PARKS

PROJECT - QUOTE #
112937-01

PROJECT TITLE:
VENICE BEACH PLAYGROUND
1800 OCEAN FRONT WALK - VENICE CA 90291

OWNER:
CITY OF LOS ANGELES REC & PARKS
3900 CHEVY CHASE DR - LOS ANGELES CA 90039

SHEET NO:
A1.03



0' 10' 20' 40'



California Coastal Commission
5-24-0064 BEACH FRONT
Exhibit 2
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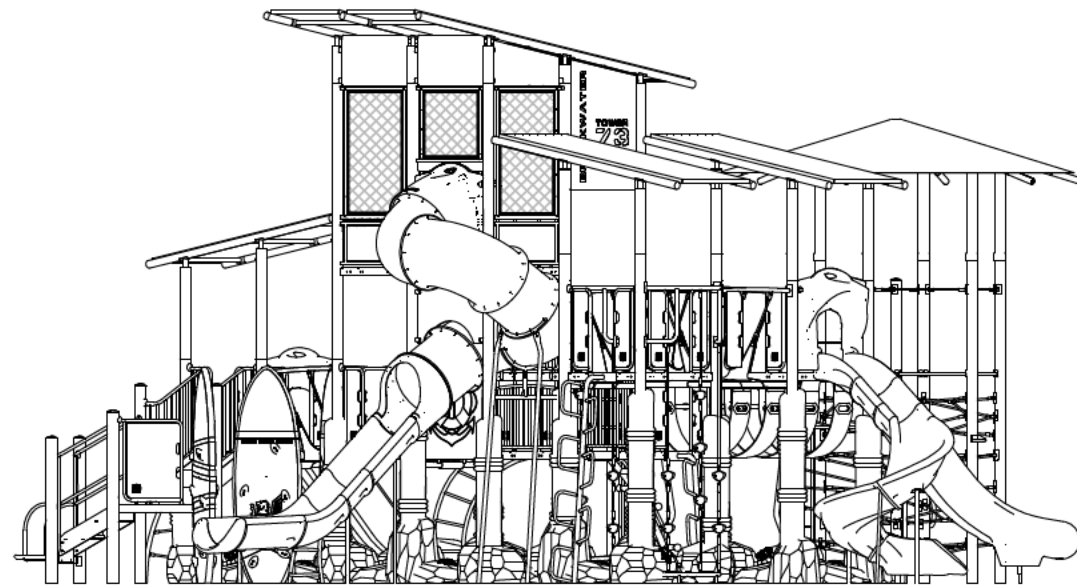
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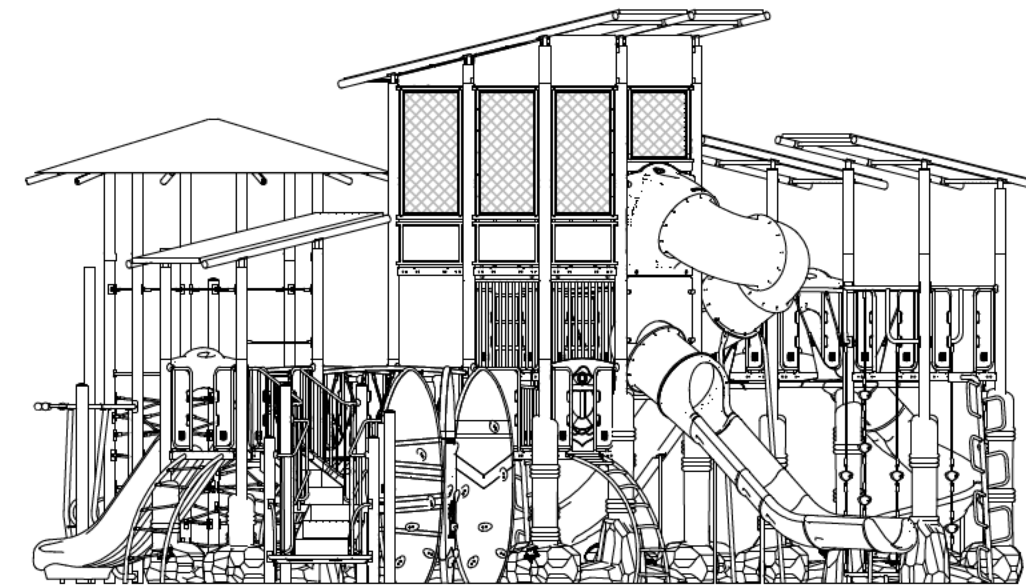
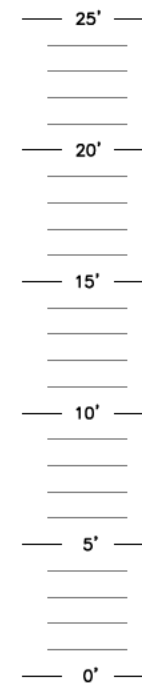
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1800 OCEAN FRONT WALK - VENICE CA 90291
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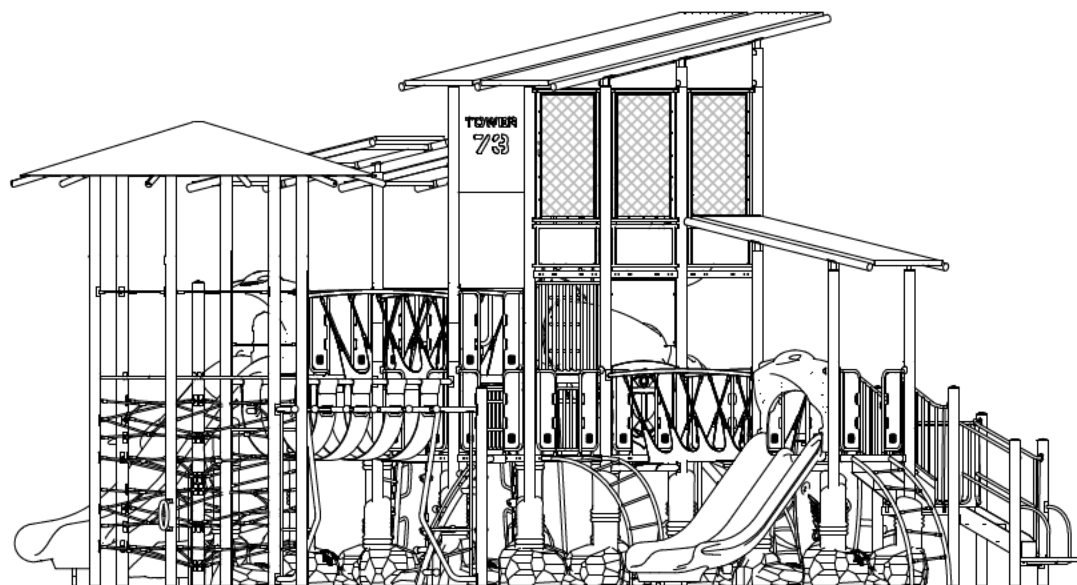
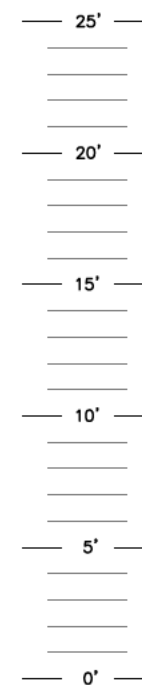
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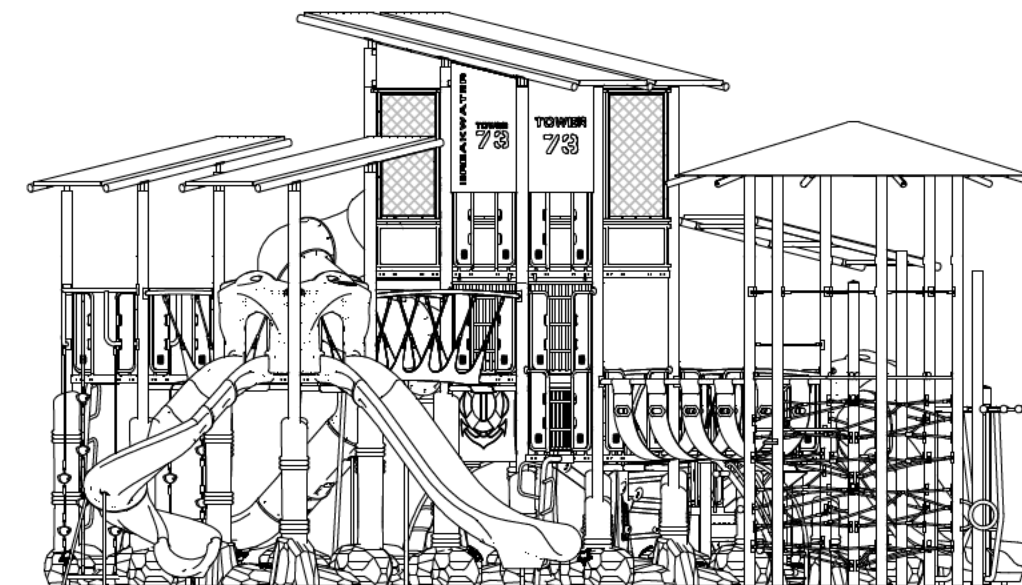
FRONT



LEFT



BACK



RIGHT

TYPICAL UPRIGHT CLIMBER INTEGRATED SHADE & GRFC
FOOTING DETAIL



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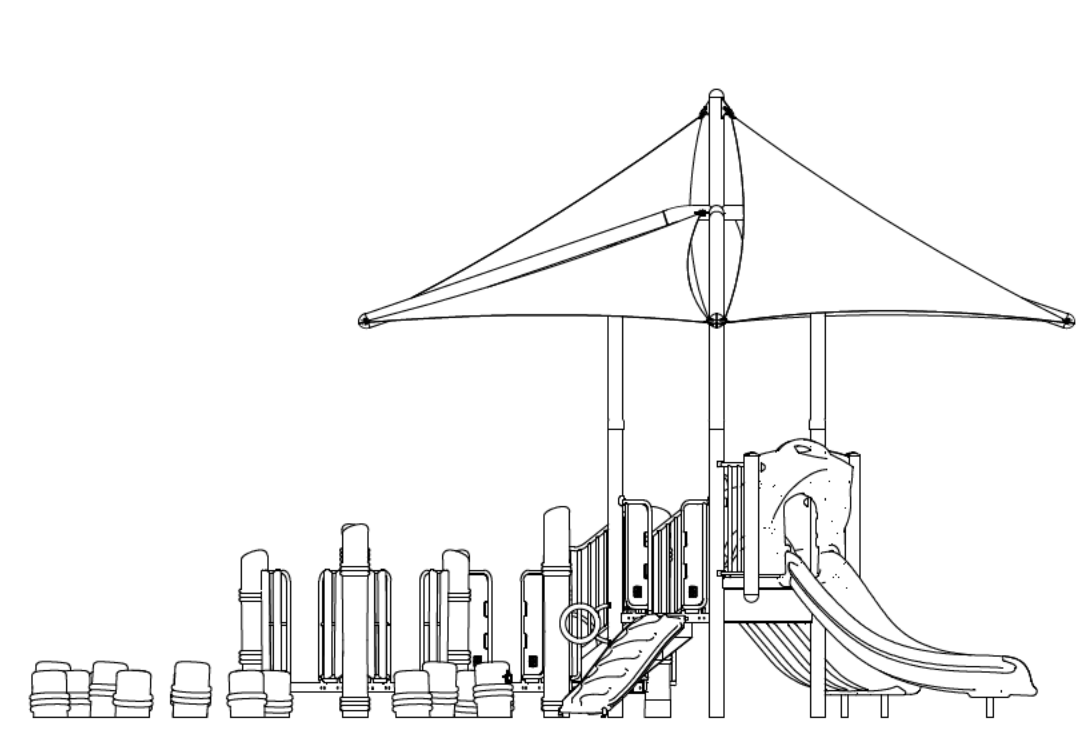
PROJECT - QUOTE #

PROJECT TITLE:
WINDWARD PLAZA
SMALL PLAY STRUCTURE / 2-5

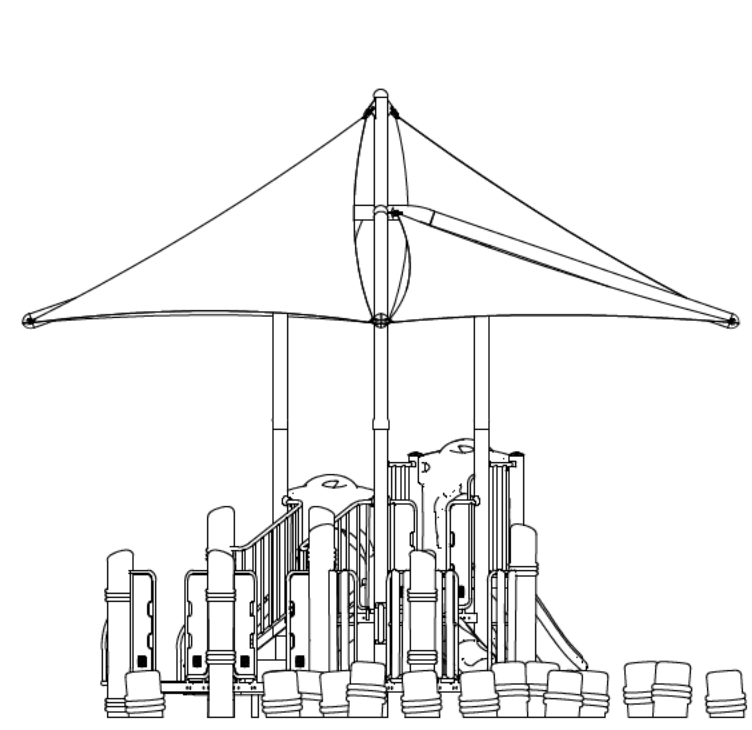
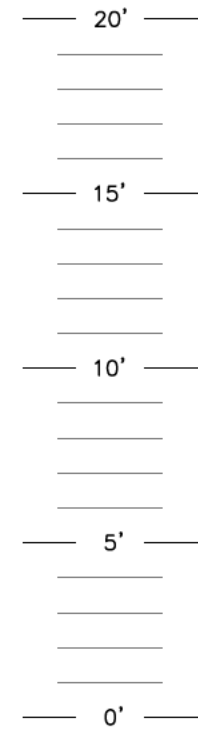
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SHEET NO:

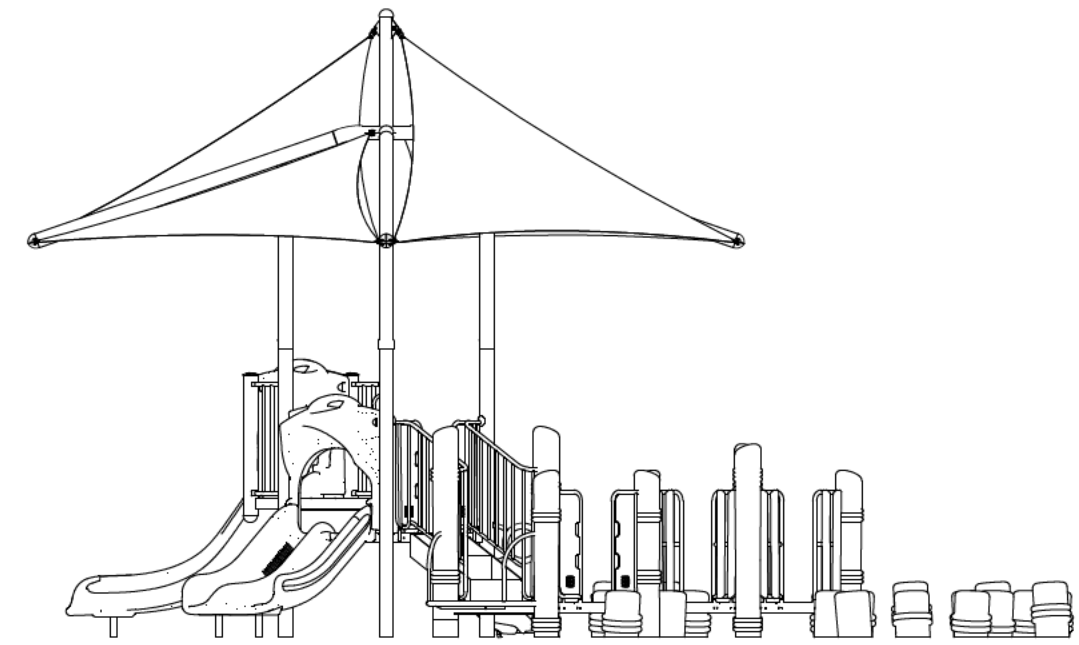
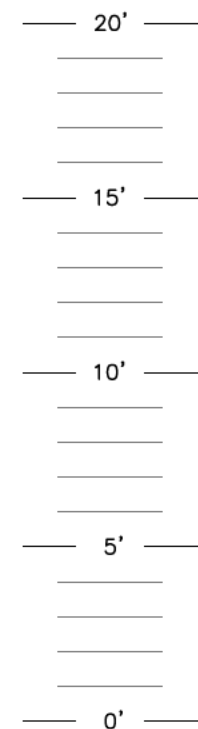
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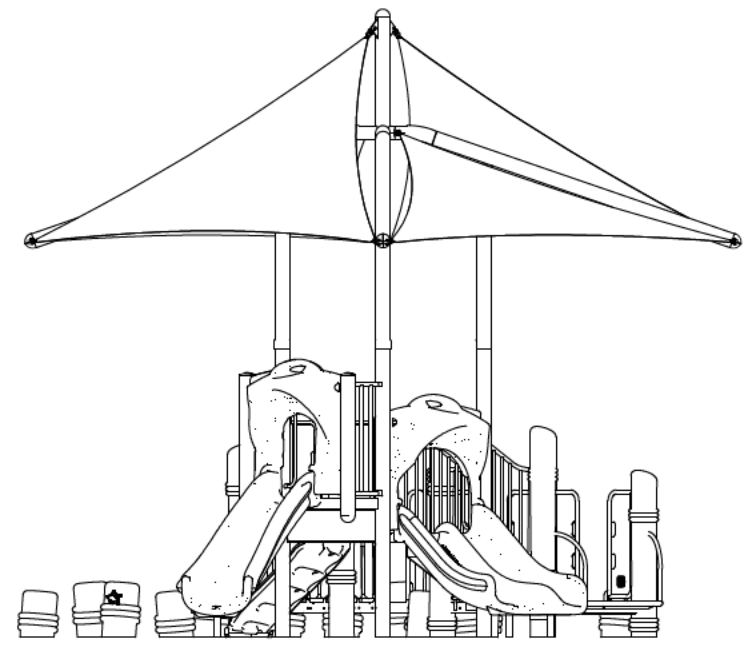
FRONT



LEFT



BACK



RIGHT



ISO 9001
150 PlayCore Drive SE
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www.gametime.com

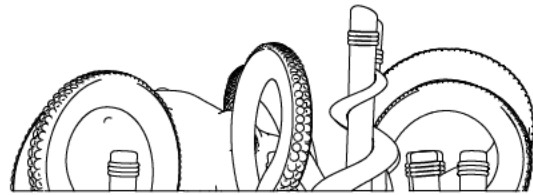
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SALES REPRESENTATIVE:
LEWIS L. PAINTER
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lewis@gwpark.com
DATE: 4/19/2024
DWG BY: LEWIS L. PAINTER

PROJECT - QUOTE #
OCTOPUS

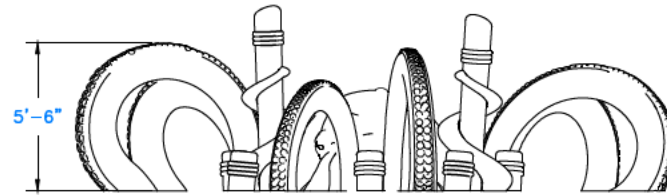
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OCTOPUS - GFRC

OWNER:

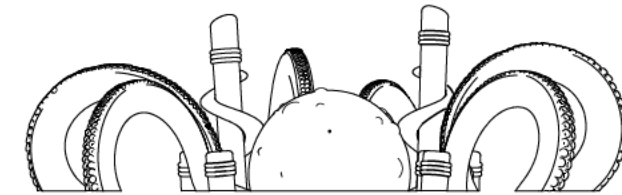
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SIDE VIEW

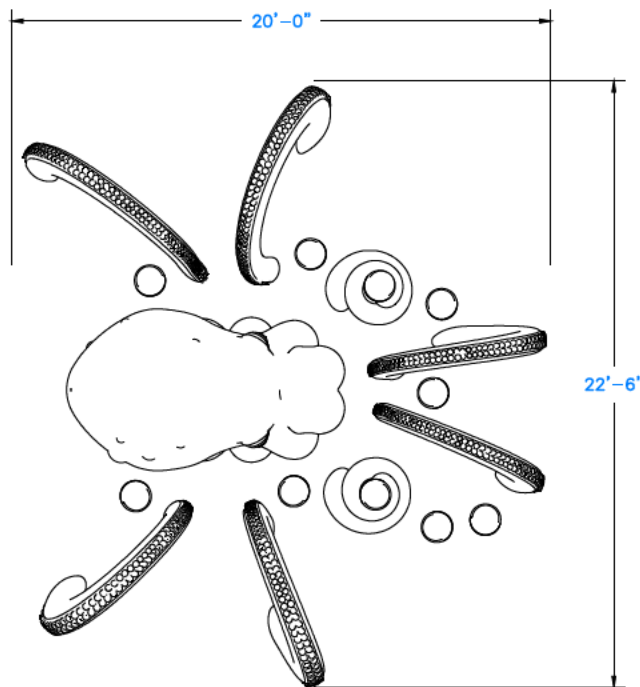


SIDE VIEW

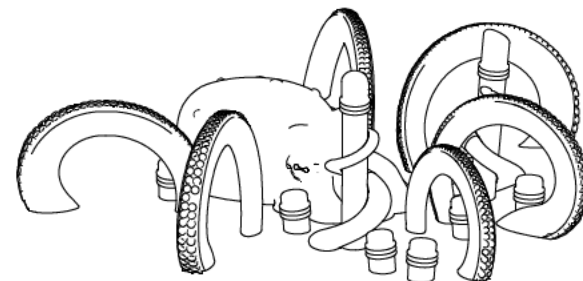


SIDE VIEW

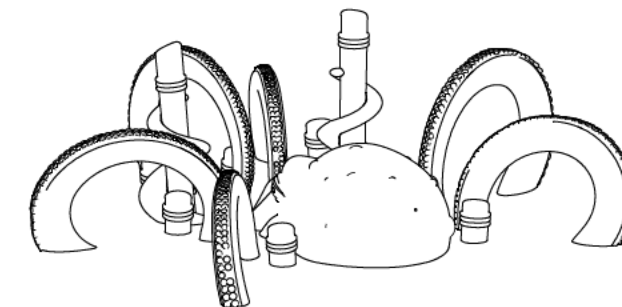
TYPICAL G.F.R.C. ELEMENTS
FOOTING DETAIL



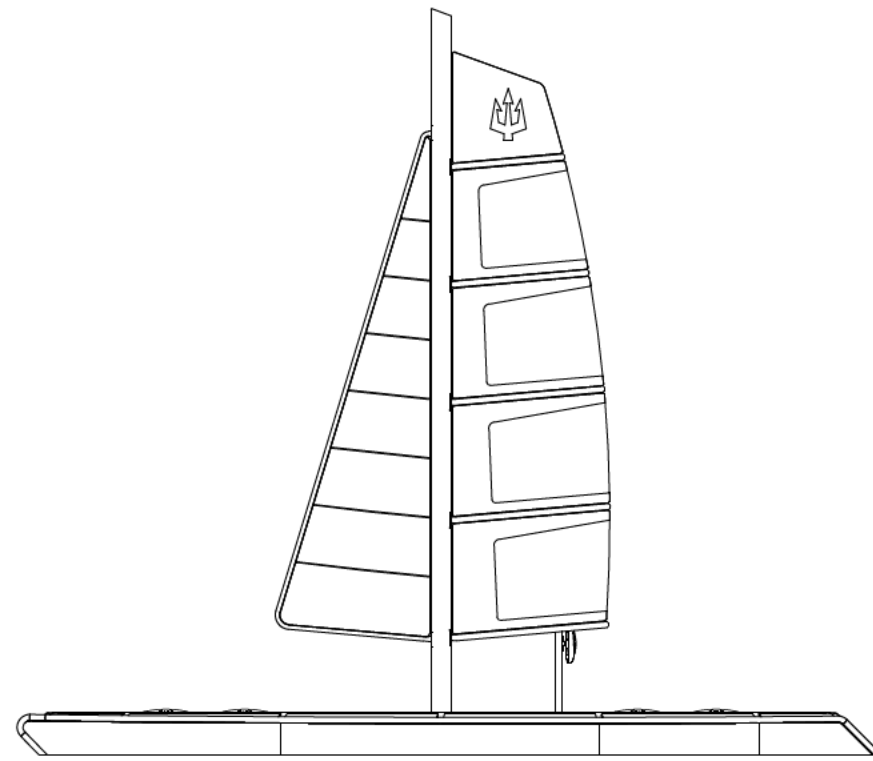
SIDE VIEW



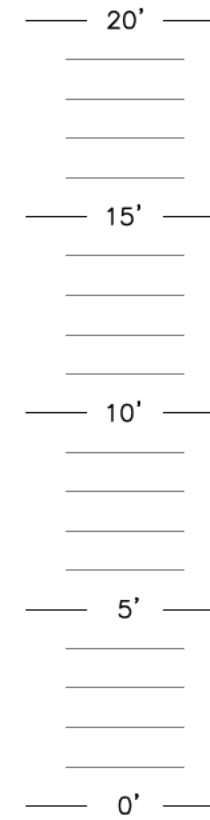
SIDE VIEW



SIDE VIEW

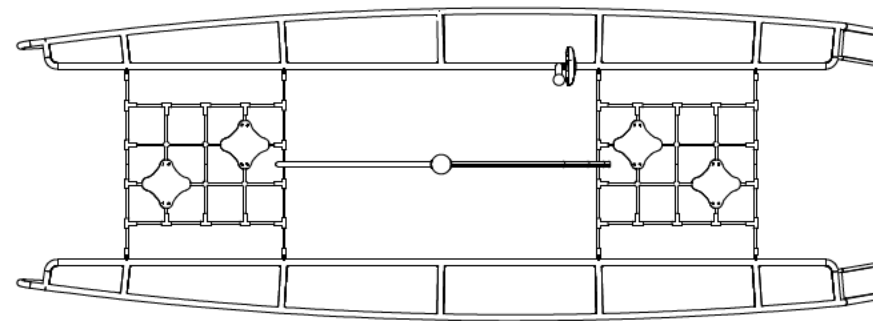


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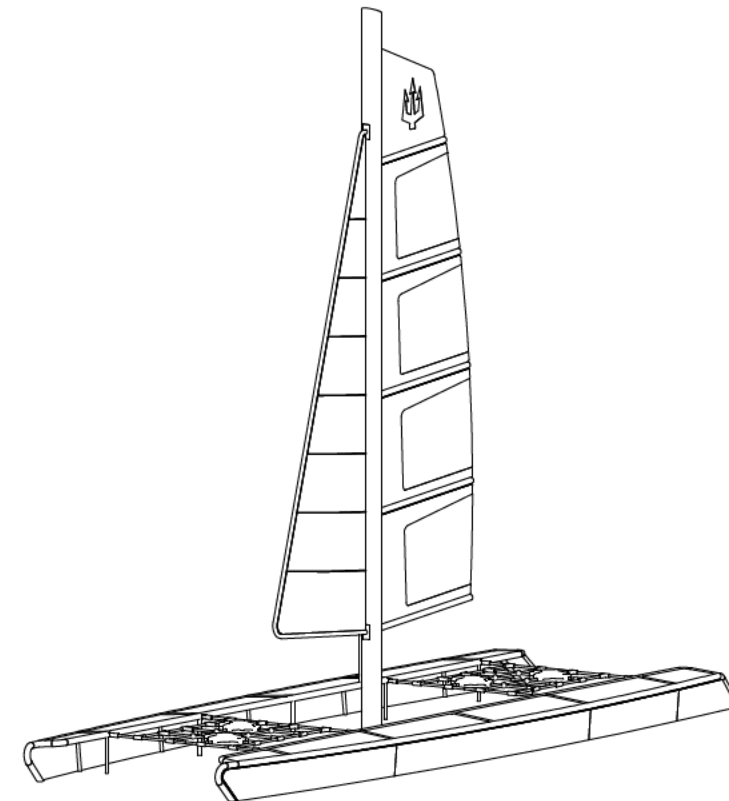
FRONT

TYPICAL UPRIGHT CLIMBER & INTEGRATED SHADE
FOOTING DETAIL



TOP

ISO



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PROJECT - QUOTE #

PROJECT TITLE:
WINDWARD PLAZA
CATAMARAN

OWNER:

SHEET NO:

A1.09



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lewis@gwpark.com
DATE:

DWG BY: LEWIS L PAINTER

PROJECT - QUOTE #

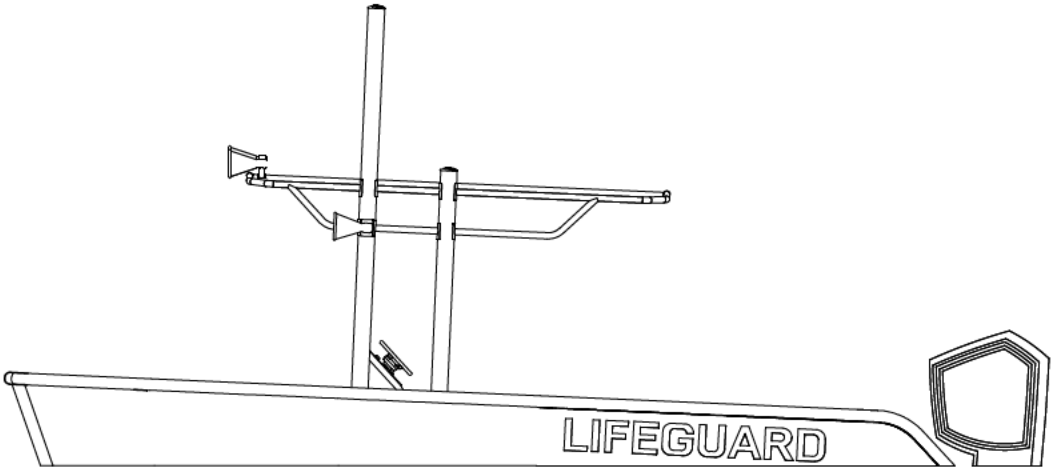
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WINDWARD PLAZA
LIFEGUARD RESCUE BOAT

OWNER:

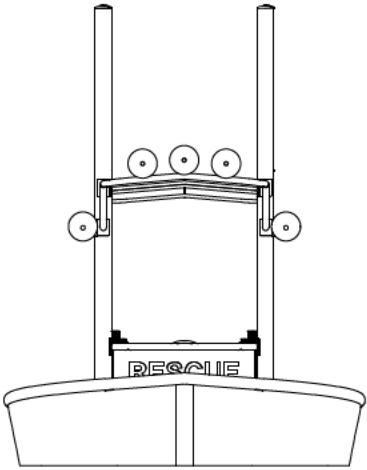
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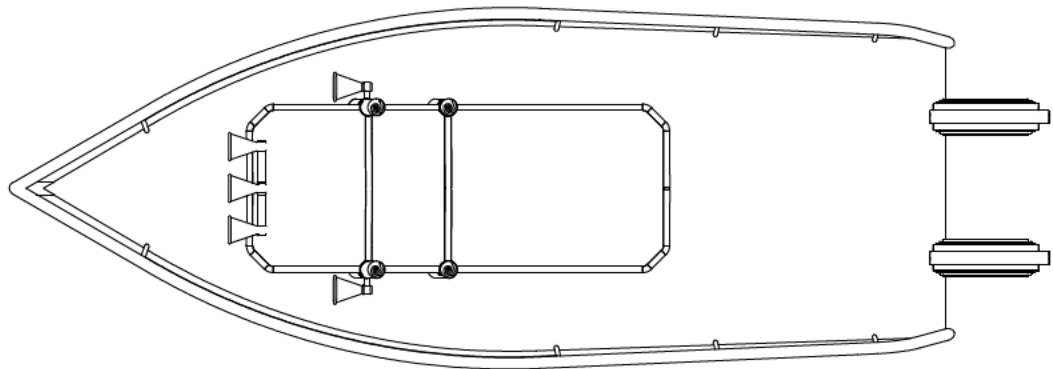
TYPICAL UPRIGHT & CLIMBER
FOOTING DETAIL



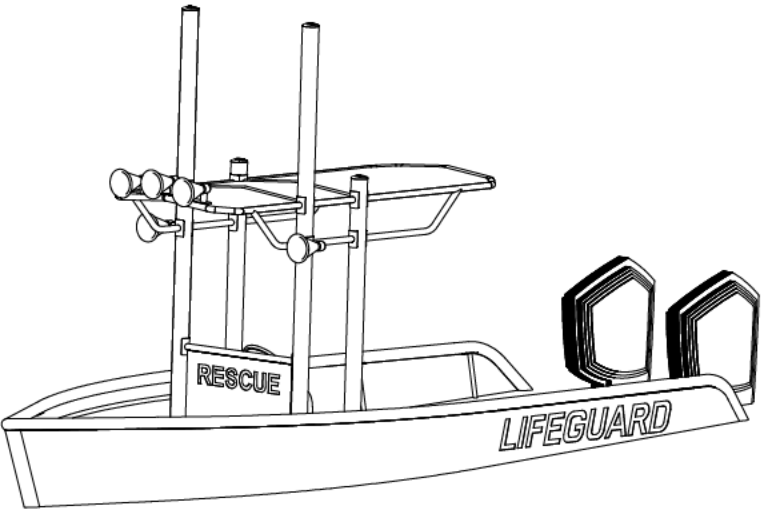
SIDE



BACK



TOP



ISO



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lewis@gwpark.com
DATE:

DWG BY: LEWIS L. PAINTER

PROJECT - QUOTE #

PROJECT TITLE:
WINDWARD PLAZA
SURFBOARD CLIMBERS

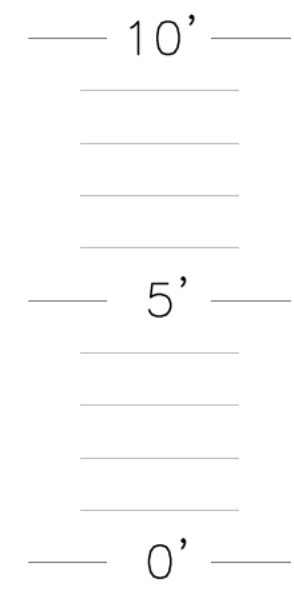
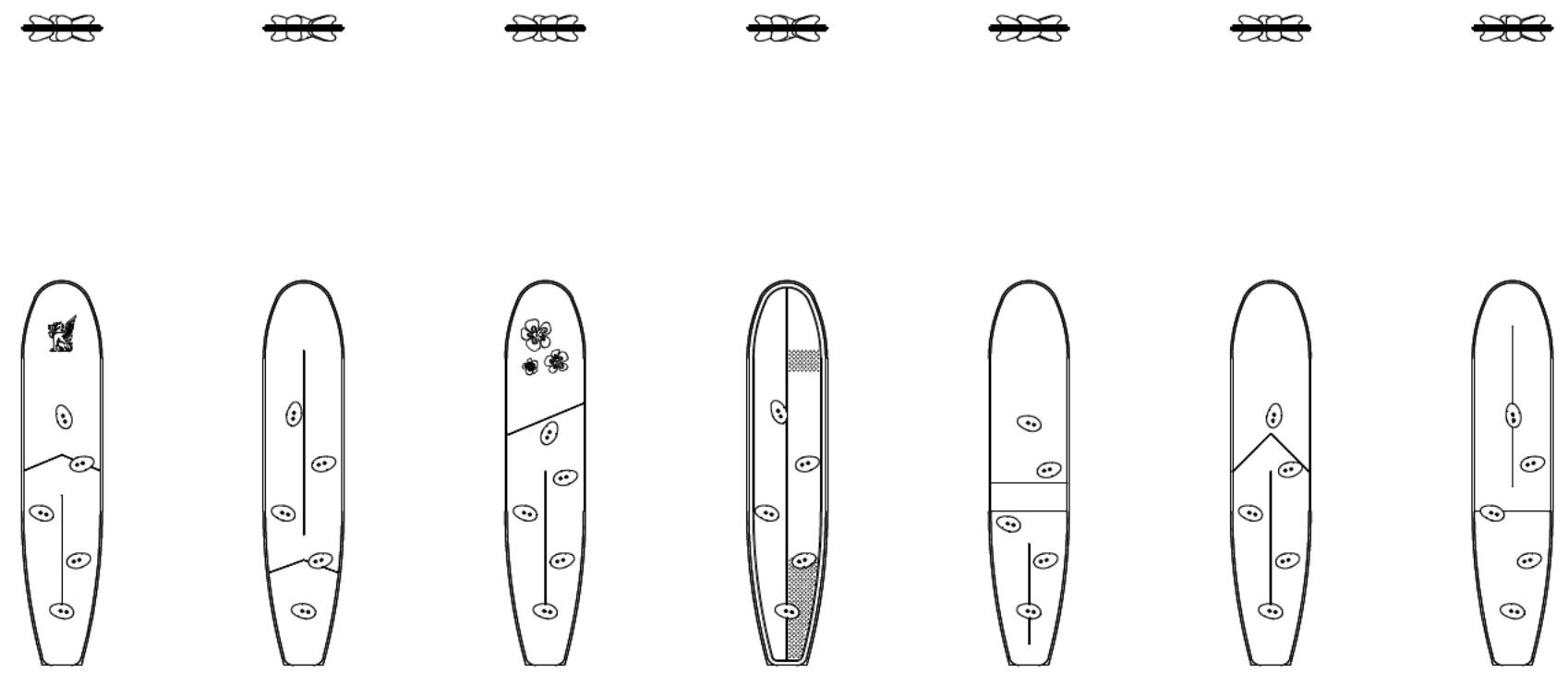
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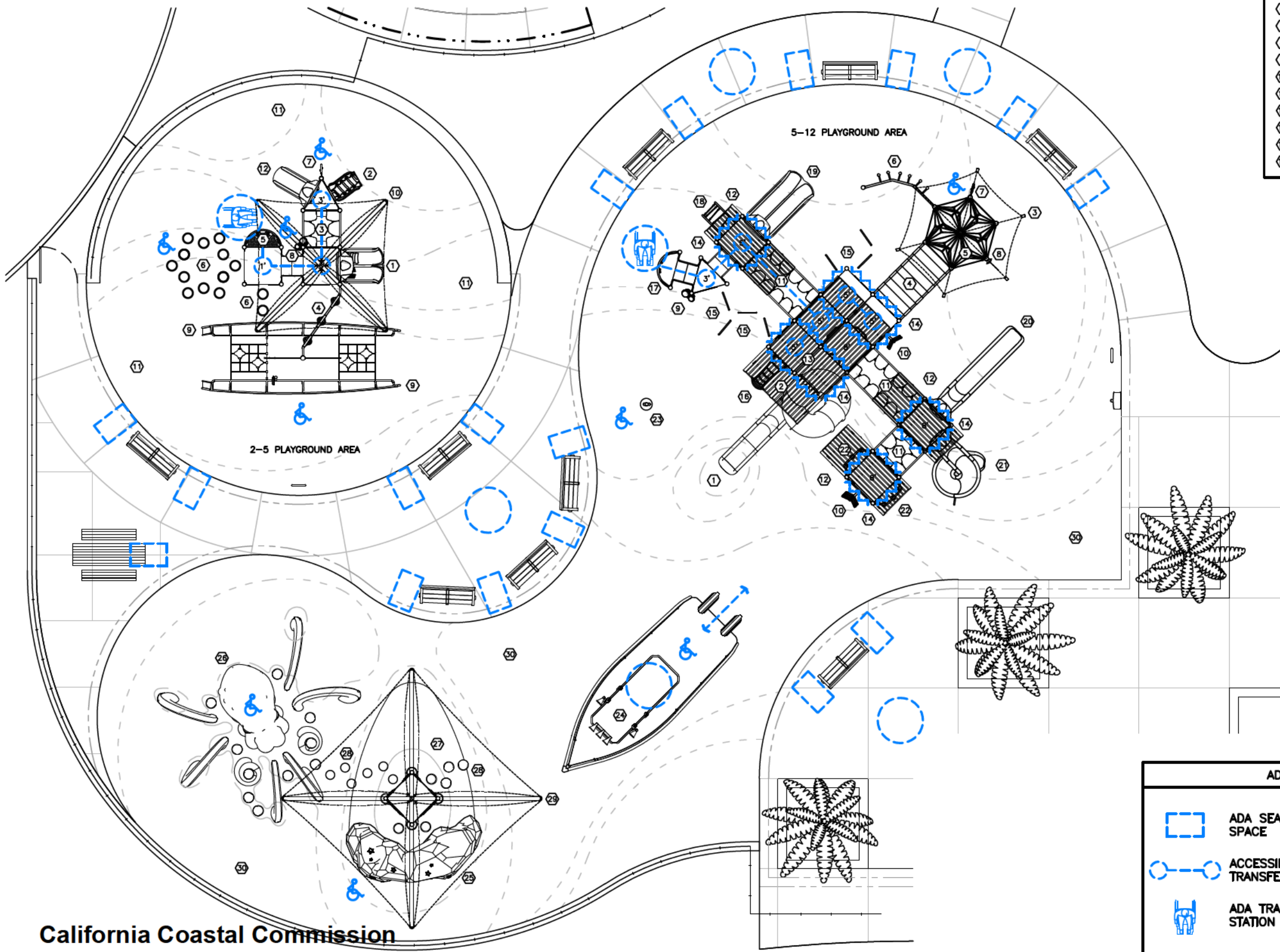
TOP

FRONT



TYPICAL UPRIGHT & CLIMBER FOOTING DETAIL

NOTE:
PLAYGROUND STRUCTURES COMPLY WITH
A.S.T.M. F1487-11 SECTION 7.1-7.5.5
PERTAINING TO ACCESS & EGRESS



PLAY COMPONENT KEY/5-12	
1 TOWER SLIDE	16 HOURGLASS CLIMBER
2 TOWER ROOF 4-SQUARE	17 TRANSFER STATION
3 HEX SHADE	18 NET RACE CLIMBER
4 WIGGLE WOBBLE LINK	19 DOUBLE SLIDE
5 FALCONS NEST CLIMBER	20 ZIP SLIDE
6 GET-A-GRIP OVERHEAD	21 WILDER SLIDE
7 HAND-CYCLE	22 CHAIN POD CLIMBER
8 CRUNCH BAR	23 SOLO SPINNER
9 BONGO	24 RESCUE BOAT
10 STEGO CLIMBER	25 ROCKY POINT-SENSORY
11 HIGHRISE LINK	26 OCTOPUS & TENTICALS
12 MONOSLOPE ROOF	27 ISLAND MOUND
13 CUSTOM PANEL	28 PIER STEPPERS
14 TIDE POOL BELOW	29 SAIL SHADE
15 SURFBOARDS	30 P.I.P. SAFETY SURFACE

PLAY COMPONENT KEY/2-5	
1 DOUBLE SLIDE	
2 RIDGE CLIMBER	
3 HIGHRISE LINK	
4 WEAVE AROUND LINK	
5 TRANSFER STATION	
6 PIER STEPPERS	
7 HAND CYCLE	
8 BONGO	
9 CATAMARAN	
10 SAIL SHADE	
11 P.I.P. SAFETY SURFACE	
12 ZIP SLIDE	

COMPONENT COUNTS	
5-12 PLAYGROUND AREA	
19	ELEVATED COMPONENTS
11	ELEVATED COMPONENTS ACCESSIBLE BY TRANSFER
21	ACCESSIBLE GROUND LEVEL COMPONENTS
2-5 PLAYGROUND AREA	
7	ELEVATED COMPONENTS
7	ELEVATED COMPONENTS ACCESSIBLE BY TRANSFER
8	ACCESSIBLE GROUND LEVEL COMPONENTS

ADA SYMBOL LEDGEND	
	ADA SEATING SPACE
	ACCESSIBLE TRANSFER PATH
	ADA TRANSFER STATION
	ACCESSIBLE GROUND LEVEL
	BELOW DECK SENSORY AREAS
	ADA 60" TURN-AROUND



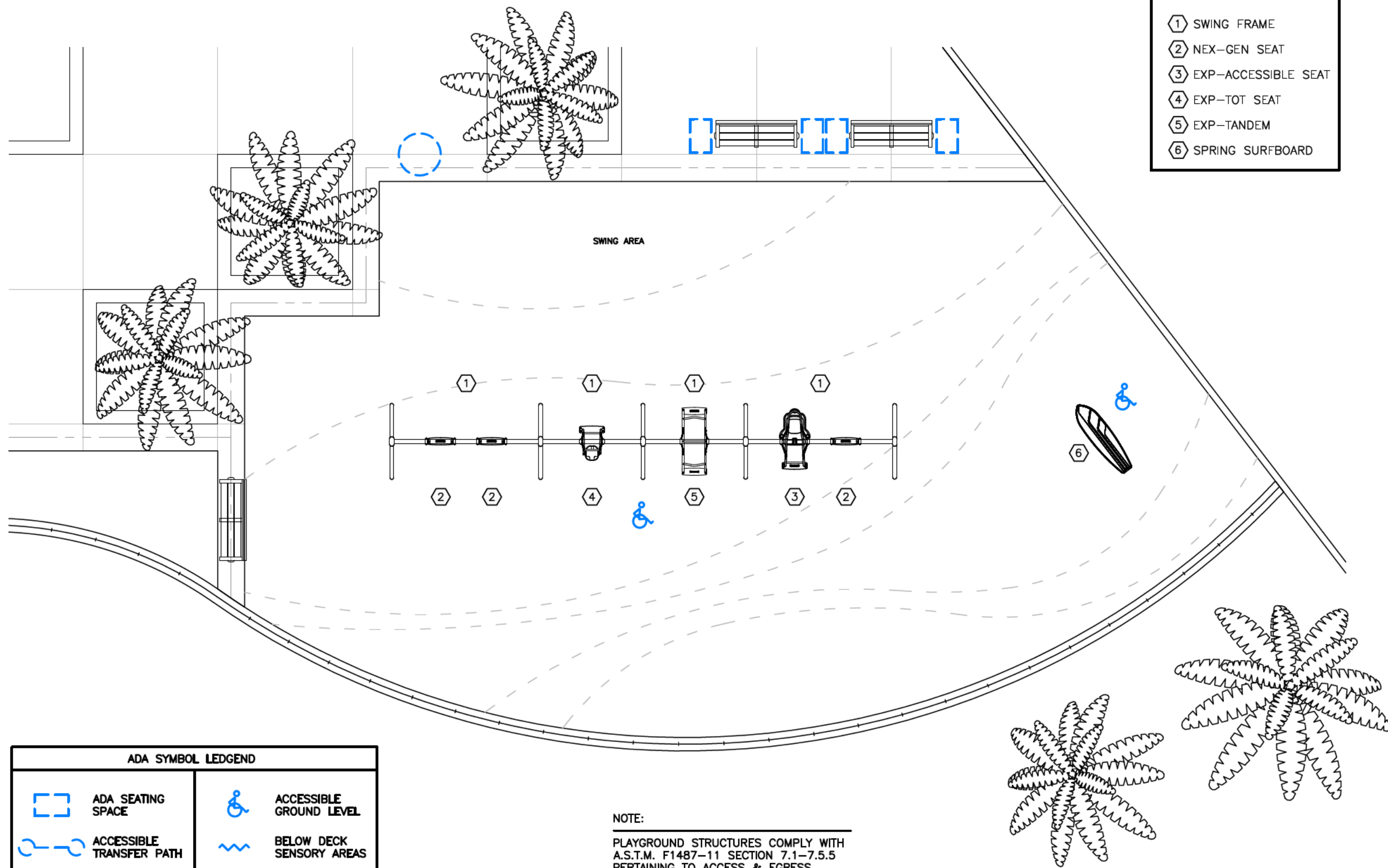
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lewis@gwpark.com
DATE: 6/28/2024
DWG BY: LEWIS L. PAINTER



PROJECT - QUOTE #
112937-01

PROJECT TITLE:
VENICE BEACH PLAYGROUND
1800 OCEAN FRONT WALK - VENICE CA 90291
OWNER:
CITY OF LOS ANGELES REC & PARKS
3900 CHEVY CHASE DR - LOS ANGELES CA 90039

SHEET NO:
A.D.A. SHEET 1



PLAY COMPONENT KEY	
1	SWING FRAME
2	NEX-GEN SEAT
3	EXP-ACCESSIBLE SEAT
4	EXP-TOT SEAT
5	EXP-TANDEM
6	SPRING SURFBOARD

ADA SYMBOL LEDGEND	
	ADA SEATING SPACE
	ACCESSIBLE TRANSFER PATH
	ACCESSIBLE GROUND LEVEL
	BELOW DECK SENSORY AREAS
	ADA TRANSFER STATION
	ADA TURN-AROUND

NOTE:
PLAYGROUND STRUCTURES COMPLY WITH
A.S.T.M. F1487-11 SECTION 7.1-7.5.5
PERTAINING TO ACCESS & EGRESS



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SHEET NO:
A.D.A. SHEET 2

**Windward Plaza Playgrounds- Project 112937-01-Opt 4
Los Angeles, CA**



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5-24-0064

Exhibit 2

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STAYING INVOLVED IN PLAY FOR OVER 50 YEARS

P: (435) 245-5055 / F: 435 245-5057 Nate@gwpark.com



**Windward Plaza Playgrounds- Project 112937-01-Opt 4
Los Angeles, CA**



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A STRONG FOUNDATION IN PLAY FOR OVER 50 YEARS

5-24-0064

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Exhibit 2

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Windward Plaza Playgrounds- Project 112937-01-Opt 4
Los Angeles, CA



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A STRONG FOUNDATION IN PLAY FOR OVER 50 YEARS

5-24-0064

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Windward Plaza Playgrounds- Project 112937-01-Opt 4
Los Angeles, CA



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A STRONG FOUNDATION IN PLAY FOR OVER 50 YEARS

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Los Angeles, CA**



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A STRONG FOUNDATION IN PLAY FOR OVER 50 YEARS

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Exhibit 2
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Los Angeles, CA**



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5-24-0064
A STRONG FOUNDATION IN PLAY FOR OVER 50 YEARS

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Los Angeles, CA**



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5-24-0064

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**Windward Plaza Playgrounds- Project 112937-01-Opt 4
Los Angeles, CA**



A STRONG FOUNDATION IN PLAY FOR OVER 40 YEARS P: (433) 245-5055 / F: 435 245-5057 Nate@gwpark.com



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Exhibit 2

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Los Angeles, CA**



STRONG FOUNDATION IN PLAY FOR OVER 40 YEARS P: (433) 245-5055 / F: 435 245-5057 Nate@gwpark.com



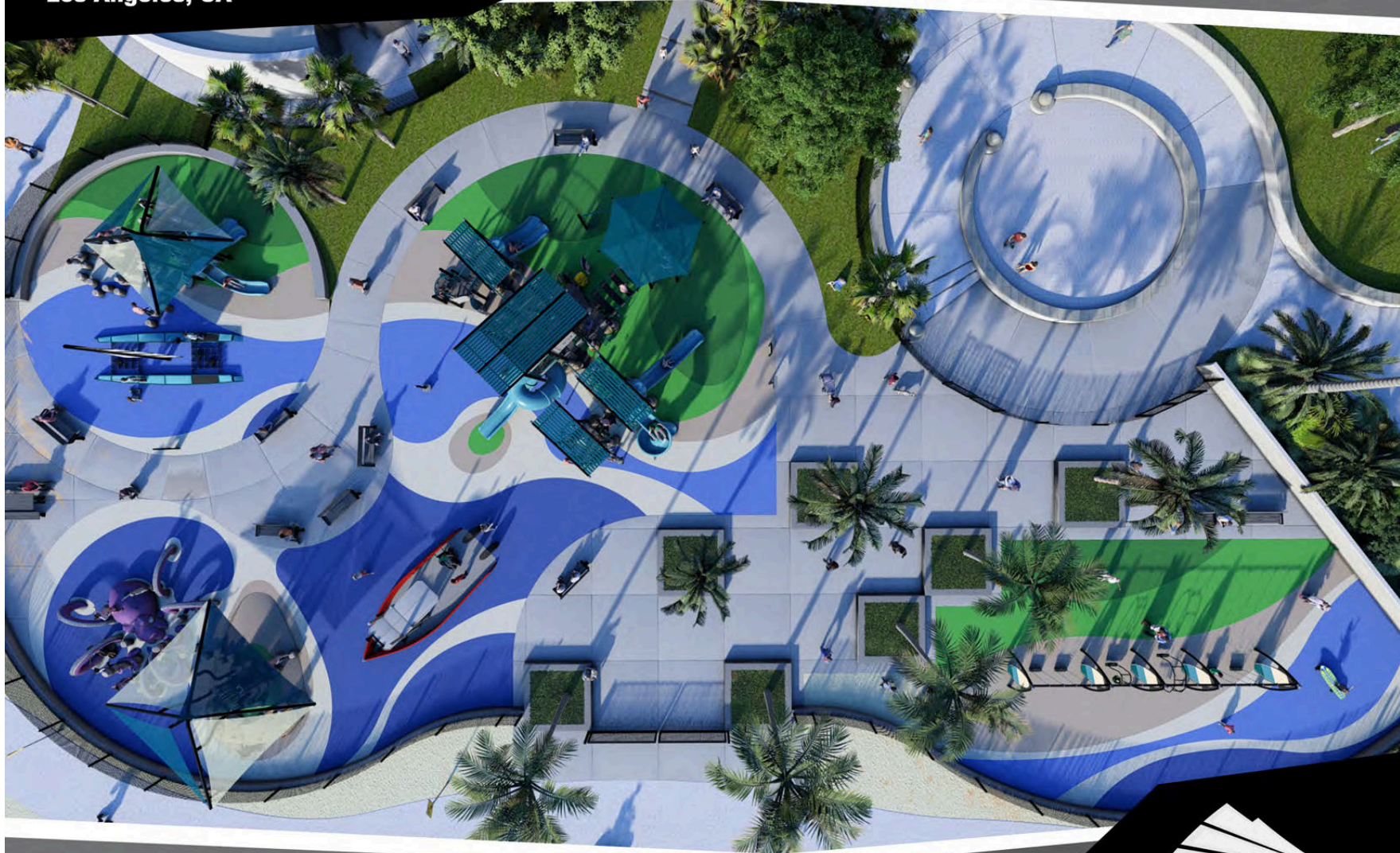
California Coastal Commission

5-24-0064

Exhibit 2

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Los Angeles, CA**



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5-24-0064

Exhibit 2

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Los Angeles, CA**



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NATE@GWPARK.COM / P: 435 245-5055 / F: 435 245-5057 Nate@gwpark.com

5-24-0064

Exhibit 2

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California Coastal Commission

A-5-VEN-22-0048

Exhibit 3

Page 1 of 3

SAFETY DATA SHEET

This form may be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200 and WHMIS Canadian Legislation.

03/29/2021

Premium Recycled Rubber Granules (5/8, ½ , 1-5mm, 1-4mm, 1-3.5mm, 1.3mm, .5-2mm)

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name: 5/8 Chunk Premium Black Rubber Granules

Chemical Family: Polymeric *(fully processed)* Cured.

Specific Materials: EPDM, SBR *(high quality virgin industrial polymers)* Pre consumer Post industrial Reclaimed Scrap Rubber

Product Weight: 50 lb bags

Details of the supplier of the safety data sheet:

Supplier: American Recycling Center, Inc.

655 Wabassee Drive

Owosso, MI 48867

Emergency Telephone Number

24-Hour Emergency Phone number: 800-424-9300

Customer Information Center: 989-725-5100

SECTION 2: HAZARDS IDENTIFICATION

Non-Hazardous as defined by OSHA Hazard Communication Standard CFR Title 29 Part 1910.1200 and the WHMIS Canadian Legislation.

SECTION 3: COMPOSITION/ INFORMATION ON INGREDIENTS

Specific Gravity (H2O = 1): 1.15 – 1.20

Solubility in water: Insoluble

Appearance & Odor: Granular, Black – Mild Characteristic Odor

% of Volatiles by volume: None

SECTION 4: FIRST AID MEASURES

Inhalation: Not Relevant

Eye Contact: Avoid Dust in Eyes, Do Not Rub eye.

Effects of Ingestion: None expected. Treat Symptomatically

First Aid Procedures: Not expected to require First Aid

SECTION 5: FIREFIGHTING MEASURES

Extinguisher Media:

Standard fire extinguisher, water, CO2 Foam, Water fog, Water spray, Protein type air foam, Dry Chemical.

Special Fire Fighting Procedures:

Regular procedures for rubber fires.

Wear self-contained breathing apparatus.

Treat as a hydrocarbon fire.

Unusual Fire & Explosion Hazards:

NONE

SECTION 6: ACCIDENTAL RELEASE MEASURES

Not Relevant

No special procedures necessary.

Waste disposal method:

Sweep, vacuum into disposal containers

Dispose of according to Federal, State, and local regulations

SECTION 7: HANDLING AND STORAGE

California Coastal Commission

A-5-VEN-22-0048

Exhibit 3

Page 2 of 3

Ventilation: Local exhaust

Eye Protection: Safety glasses

Precautions in handling:

Personal hygiene: frequent washing with soap and water of exposed areas, remove and clean solid clothing.

Precautions in storage: Normal material storage

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective Equipment

Hand Protection



For prolonged or repeated skin contact use suitable protective gloves

Use eye protection when necessary depending on use

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Appearance Granular

Color black

Odor Odorless.

Solubility Insoluble in water

SECTION 10: STABILITY AND REACTIVITY

Stable under normal temperature conditions and its designed use

Conditions to avoid: Do not heat above ambient temperature. Do not store near flame or ignition source.

Hazardous Polymerization: Will not occur

SECTION 11: TOXICOLOGICAL INFORMATION

Skin contact No specific health warnings noted.

Eye contact No specific health warnings noted.

Health Warnings No specific health warnings noted.

SECTION 12: ECOLOGICAL INFORMATION

Eco toxicity: Not regarded as dangerous for the environment

Not regarded to be toxic to fish

Degradability The product is not biodegradable

SECTION 13: DISPOSAL CONSIDERATIONS

Dispose of in accordance with Local, State, and Federal Regulations

Dispose of at authorized landfill

SECTION 14: TRANSPORT INFORMATION

No transport warning sign required

SECTION 15: REGULATORY INFORMATION

Not Relevant

SECTION 16: OTHER INFORMATION

CALIFORNIA PROPOSITION 65:

SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT: TITLE 22 CALIFORNIA CODE OF REGULATIONS: California Proposition 65 provides for labeling and disclosure of the presence of a chemical(s) known to the State of California to cause cancer or reproductive toxicity. This product does contain carbon black that is bound in the rubber, therefore if used as designed it is not found to be listed as an airborne, unbound particle.

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Exhibit 3

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**June 27, 2024**

TO: Coastal Commissioners and Interested Parties

FROM: Vanessa Metz, Ph.D., Senior Environmental Scientist, Water Quality Program

SUBJECT: Potential adverse environmental effects of proposed Poured-in-Place rubber playground surfacing product and recommendations for alternative materials. (CDP No. 5-23-0345, Newport Mesa Unified School District).

Overview

The applicant proposes to replace the existing sand playground with a Poured-in-Place (PIP) rubber playground surfacing product. The materials used to make PIP rubber playgrounds—shredded recycled tires in the cushioning layer and synthetic rubber granules in the top wear layer—contain many chemicals that are known to be hazardous to human health and the environment. Many studies have documented that hazardous chemicals in tire rubber can leach into water and soil, off-gas, and be transported via dust and particles into the environment, causing toxicity in a wide range of aquatic and terrestrial organisms. The synthetic rubber granules in the top layer of this product contain many of the same hazardous chemicals. A scientific review article published this month by researchers at the U.S. EPA, along with several universities and research institutions, synthesized numerous recent research studies on the “emerging environmental impacts of tire wear particles and their chemical cocktails.”¹

Another issue of concern is that the synthetic rubber granules (classified as microplastics) in the top layer of PIP rubber playgrounds are continuously dislodged from the playground’s surface, often in large numbers. Tire shreds (also microplastics) may also be dislodged from the base layer as the playground’s surface layer deteriorates. These granules and tire shreds are transported by wind, stormwater runoff, maintenance sweeping, power-washing, and playground users’ shoes and clothing to the environment, where they contribute to microplastic pollution of soil, waterways, and the ocean. Due to their toxicological effects, environmental persistence, and bioaccumulation, microplastics have been documented to cause chronic toxicity in numerous aquatic organisms—including fish, mammals, amphibians, marine birds, aquatic invertebrates, and zooplankton—and to adversely impact human health.

¹ Mayer, P., et al. (2024). Where the Rubber Meets the Road: Emerging Environmental Impacts of Tire Wear Particles and Their Chemical Cocktails. *Science of The Total Environment*, Volume 927, 1 June 2024, 171153927:171153. <https://www.sciencedirect.com/science/article/pii/S0048969724012920?via%3Dihub>.

The human health risks from toxic chemicals released from recycled tires and synthetic rubbers used to make PIP rubber playgrounds remain uncertain, as studies about the chemical safety of these materials in playgrounds are limited. However, several studies have been conducted on the human health and environmental impacts of synthetic turf playing fields, which commonly use granules of recycled tires (“crumb rubber”) as infill.^{2,3} A recent federal government study investigated players’ exposure to toxic chemicals in synthetic turf fields with crumb rubber infill, and concluded that chemical exposures (via inhalation, ingestion, and dermal contact) are likely limited.⁴ Notably, the authors emphasized that this study is not a risk assessment and cannot be interpreted as evidence of safety. Children’s chemical exposures on a playground may also differ significantly from that of players on a synthetic turf field. The health risks of children’s cumulative exposure to toxic chemicals in PIP rubber playgrounds has not yet been assessed.

While additional research is needed on human health risks, the significant adverse impacts to the environment of toxic chemicals and microplastic pollution from PIP rubber playground materials are well-documented. A precautionary approach would entail choosing playground surfacing materials that avoid the chemical and microplastic concerns posed by PIP rubber playgrounds.⁵ Several alternative playground surfacing options are available that do not contain tire rubber and other synthetic rubbers, and that meet government requirements for playground fall safety and wheelchair accessibility.

Composition of Poured-in-Place Rubber Playground Surfacing

A PIP rubber playground, often installed in colorful patterns, is a popular choice for children’s schools and public playgrounds. PIP playground surfaces comply with government requirements for fall safety (“critical fall height”)⁶ and the wheelchair accessibility requirements of the Americans with Disabilities Act (ADA).⁷ PIP rubber playgrounds also require less frequent maintenance than many other playground surfacing options.

² Booker, N.W., et al. (2024). Children and Athletes at Play on Toxic Turf and Playgrounds. National Center for Health Research, Washington D.C. <https://www.center4research.org/children-athletes-play-toxic-turf-playgrounds/#:~:text=The%20authors%20concluded%2C%20%E2%80%9CThe%20use,most%20exposed%20bracket%20of%20population.>

³ Massey, R., et al. (2019). Athletic Playing Fields: Choosing Safer Options for Health and the Environment. Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.turi.org/var/plain_site/storage/original/application/b9727dedf5860ae7e83e3226d058b7ee.pdf.

⁴ U.S. Environmental Protection Agency, and Centers for Disease Control and Prevention. (April 2024). Synthetic Turf Field Recycled Tire Crumb Rubber Research Under the Federal Research Action Plan. Final Report Part 2- Exposure Characterization Volume 1. <https://www.epa.gov/chemical-research/tire-crumb-exposure-characterization-report-volumes-1-and-2>.

⁵ Pollard, L. and R. Massey. (2023). Playground Surfacing: Choosing Safer Materials for Children's Health and the Environment. Lowell Center for Sustainable Production and Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.uml.edu/docs/Playground_surfacing_report_Dec2023_tcm18-377890.pdf.

⁶ U.S. Consumer Product Safety Commission. (2015). Public Playground Safety Handbook. <https://www.cpsc.gov/s3fs-public/325.pdf>

⁷ U.S. Access Board. (2007). Accessible Play Areas: A Summary of Accessibility Guidelines for Play Areas. <https://www.access-board.gov/files/ada/guides/play-areas.pdf>.

PIP rubber playground surfacing is a two-layer system, with a base cushioning layer (up to 5½" thick) consisting of shredded recycled vehicle tires, topped by a wear layer (about ½" thick) consisting of small granules of synthetic rubber mixed with pigments and several proprietary additives (such as for UV-resistance). The synthetic rubber granules in the PIP product proposed for this project (Surface America's PlayBound) will be either ethylene propylene diene monomer (EPDM) or thermoplastic vulcanizate (TPV). The materials in each layer are held together by a polyurethane binder, but both layers remain porous, allowing rainwater and wash-water to drain through to the sub-base. This project proposes installation of a concrete sub-base; asphalt or crushed stone are also options.



Poured-in-Place rubber playground surfacing.⁸

Product descriptions of PIP rubber playground surfacing products often do not clearly identify that the product is made from waste tires and synthetic rubber. The shredded tire material used in the cushioning layer is typically called rubber, recycled rubber, or recycled SBR (styrene-butadiene rubber). The synthetic rubber granules in the top wear layer are typically called rubber, recycled rubber, or virgin rubber (indicating a synthetic rubber not derived from recycled materials). Labeling the materials used in PIP playgrounds simply as "rubber" may lead to the misconception that this is a natural rubber product and therefore non-toxic.

Environmental and Health Impacts of Chemicals in PIP Rubber Playground Materials

- **Materials and Chemicals in PIP Rubber Playgrounds**

PIP rubber playgrounds are often touted as being "environmentally friendly" because they recycle waste tires, which are considered hazardous waste and are thus banned from disposal at landfills. However, the materials used to make PIP rubber playgrounds —

⁸ Surface America's PlayBound Poured-in-Place rubber playground surfacing product.
<https://www.surfaceamerica.com/product/playbound-poured-in-place/>.

shredded recycled tires and synthetic rubber granules—contain numerous chemicals and compounds known to be hazardous to aquatic and terrestrial life, including human health.⁹

Tires contain a complex proprietary mixture of ingredients, including synthetic rubber (styrene-butadiene rubber or SBR), natural rubber, fillers, and numerous chemical additives including, for example, stabilizers, vulcanization (curing) compounds, and antioxidants (to slow deterioration).¹⁰ Hazardous chemicals and compounds in tires include heavy metals (e.g., lead, zinc, mercury, and arsenic), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), 6-phenylenediamine (6PPD), phthalates, organophosphate esters (OPEs), and per- and polyfluoroalkyl substances (PFAS), among many others.

The synthetic rubber granules used in the top wear layer of PIP rubber playgrounds (EPDM or TPV for this project) contain several of these same hazardous chemicals and compounds. EPDM synthetic rubber can contain toxic chemicals including lead, PAHs, VOCs, and OPEs, among others.¹¹ EPDM has high levels of proprietary additives and is a vulcanized (cured) rubber product like tires, so it also contains toxic vulcanization compounds.¹² Pigments used in the top layer of PIP playgrounds may also contain toxic heavy metals, including chromium. These synthetic rubber granules potentially pose less toxicity concern than shredded tires, as they may contain lower chemical concentrations.¹³ However, a 2016 federal government report found that research supporting the safety of EPDM and other synthetic rubbers for recreational surfaces was lacking or limited.¹⁴

- **Adverse Impacts to Aquatic Life from Chemicals in Tire Particles**

Impacts to aquatic life from chemicals in tires include acute and chronic toxicity, with significant adverse effects on survival, reproduction, and growth. Many of the chemicals of concern are persistent in the environment and bioaccumulate in organisms. Mayer et al. (2024) provided a review of recent research on the environmental impacts of tire wear particles, including impacts on numerous aquatic organisms.¹⁵ The California Department of Toxic Substances Control (DTSC) found that research studies also indicate the potential

⁹ Mayer, P., et al. (2024). Where the Rubber Meets the Road: Emerging Environmental Impacts of Tire Wear Particles and Their Chemical Cocktails. *Science of The Total Environment*, Volume 927, 1 June 2024, 171153927:171153. <https://www.sciencedirect.com/science/article/pii/S0048969724012920?via%3Dihub>.

¹⁰ Pollard, L. and R. Massey. (2023). Playground Surfacing: Choosing Safer Materials for Children's Health and the Environment. Lowell Center for Sustainable Production and Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.uml.edu/docs/Playground_surfacing_report_Dec2023_tcm18-377890.pdf.

¹¹ Ibid.

¹² Massey, R., et al. (2019). Athletic Playing Fields: Choosing Safer Options for Health and the Environment. Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.turi.org/var/plain_site/storage/original/application/b9727dedf5860ae7e83e3226d058b7ee.pdf.

¹³ Pollard, L. and R. Massey. (2023).

¹⁴ U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and U.S. Consumer Product Safety Commission. (2016). Status Report: Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds. <https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb>.

¹⁵ Mayer, P., et al. (2024). Where the Rubber Meets the Road: Emerging Environmental Impacts of Tire Wear Particles and Their Chemical Cocktails. *Science of The Total Environment*, Volume 927, 1 June 2024, 171153927:171153. <https://www.sciencedirect.com/science/article/pii/S0048969724012920?via%3Dihub>.

for cumulative effects of exposures to toxic chemicals from tire particles on aquatic organisms.¹⁶ DTSC also reported that co-exposure to metals and other chemicals can cause synergistic effects and exacerbate aquatic toxicity. For example, PAHs can increase the toxicity of metals, and likewise metals can increase the toxicity of PAHs. Environmental weathering of tire particles may also increase their toxicity to marine organisms compared to non-weathered particles.¹⁷ Additional information on the aquatic toxicity of some of the chemicals of concern in tire rubber is included in the Synopsis of Selected Chemicals in PIP Rubber Playgrounds section, below.

- **Human Health Impacts from Chemicals in Tire Particles**

Chemicals in tires have been found to be carcinogens, endocrine disruptors, neurotoxins, and respiratory irritants. A 2019 study (based on published research) by the Yale School of Public Health identified 306 chemicals in crumb rubber used in synthetic turf playing fields; 52 of these chemicals were classified as carcinogens and 197 as suspected carcinogens.¹⁸ The researchers concluded that “Our study highlights a vacuum in our knowledge about the carcinogenic properties of many chemicals in crumb rubber infill.”¹⁹

The human health risks from toxic chemicals released from shredded tires and other synthetic rubbers used to make PIP rubber playgrounds are uncertain. The U.S. Consumer Product Safety Commission stated in 2016 that studies about the chemical safety of these materials in playgrounds are lacking or limited.²⁰ The health risks of children’s cumulative exposure to toxic chemicals in PIP rubber playgrounds has not yet been assessed.

However, several studies have been conducted on the human health and environmental impacts of synthetic turf playing fields, which often use granules of recycled tires (“crumb rubber”) as infill.^{21,22} A recent federal government study investigated players’ exposure to toxic chemicals in synthetic turf fields with crumb rubber infill, and concluded that chemical

¹⁶ California Department of Toxic Substances Control. (2023). Rationale Document for Motor Vehicle Tires Containing Zinc. https://dtsc.ca.gov/wp-content/uploads/sites/31/2023/11/Zinc-in-Tires-Rationale-Document_Final.pdf.

¹⁷ Halsband, C., et al. (2020). Car Tire Crumb Rubber: Does Leaching Produce a Toxic Chemical Cocktail in Coastal Marine Systems? Front. Environ. Sci., 22 July 2020. Sec. Biogeochemical Dynamics Volume 8. <https://www.frontiersin.org/articles/10.3389/fenvs.2020.00125/full>

¹⁸ Perkins A.N., et al. (2019). Evaluation of potential carcinogenicity of organic chemicals in synthetic turf crumb rubber. Environmental Research: 169:163-172. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6396308/>.

¹⁹ Perkins A.N., et al. (2019). Evaluation of potential carcinogenicity of organic chemicals in synthetic turf crumb rubber. Environmental Research: 169:163-172. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6396308/>.

²⁰ U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and U.S. Consumer Product Safety Commission. (2016). Status Report: Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds. <https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb>.

²¹ Booker, N.W., et al. (2024). Children and Athletes at Play on Toxic Turf and Playgrounds. National Center for Health Research, Washington D.C. <https://www.center4research.org/children-athletes-play-toxic-turf-playgrounds/#:~:text=The%20authors%20concluded%2C%20%E2%80%9CThe%20use,most%20exposed%20bracket%20of%20population.>

²² Massey, R., et al. (2019). Athletic Playing Fields: Choosing Safer Options for Health and the Environment. Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.turi.org/var/plain_site/storage/original/application/b9727dedf5860ae7e83e3226d058b7ee.pdf.

exposures (via inhalation, ingestion, and dermal contact) are likely limited.²³ Notably, the authors emphasized that this study is not a risk assessment and cannot be interpreted as evidence of safety. Children's chemical exposures on a playground may also differ significantly from players' exposures on a synthetic turf field.

Playground users may potentially be exposed to hazardous chemicals from PIP rubber playgrounds via dermal contact with the playground surface, inhalation of dust and off-gassed volatile chemicals, and accidental ingestion of dust and dislodged fragments of playground surfacing materials via hand-to-mouth transfer. Many loose granules of synthetic rubber are commonly found on the surface of PIP rubber playgrounds, and small pieces and fine particles of playground materials may break off as the playground surface deteriorates over time. These playground surfacing materials may be picked up on children's shoes, clothing, and skin, bringing these materials into homes and thereby continuing exposure to these materials for many hours beyond the time that a child spends on the playground.

The Consumer Product Safety Commission recommends the following precautions to children playing on rubber playground surfacing materials:²⁴

1. Avoid mouth contact with playground surfacing materials, including mouthing, chewing, or swallowing playground rubber. This may pose a choking hazard, regardless of chemical exposure.
2. Avoid eating food or drinking beverages while directly on playground surfaces, and wash hands before handling food.
3. Limit the time at a playground on extremely hot days.
4. Clean hands and other areas of exposed skin after visiting the playground, and consider changing clothes if evidence of tire materials (e.g., black marks or dust) is visible on fabrics.
5. Clean any toys that were used on a playground after the visit.

Release of Hazardous Chemicals from PIP Rubber Playgrounds

Numerous studies have documented that hazardous chemicals in tire rubber particles can leach into water and soil, off-gas, and be transported via dust and particles into the environment.

²³ U.S. Environmental Protection Agency, and Centers for Disease Control and Prevention. (April 2024). Synthetic Turf Field Recycled Tire Crumb Rubber Research Under the Federal Research Action Plan. Final Report Part 2- Exposure Characterization Volume 1. <https://www.epa.gov/chemical-research/tire-crumb-exposure-characterization-report-volumes-1-and-2>.

²⁴ Consumer Product Safety Commission. (2019). Webpage: Status of CPSC's Review of Playgrounds with Crumb Rubber: Federal Research Action Plan. <https://www.cpsc.gov/Safety-Education/Safety-Education-Centers/Crumb-Rubber-Safety-Information-Center>.

- **Leaching**

Both surfacing layers in PIP rubber playgrounds are porous, allowing rainwater and wash-water used during cleaning to drain through the synthetic rubber granules and shredded tires to the concrete sub-base. Many of the toxic chemicals in PIP rubber playgrounds are water soluble. Therefore, rainwater and wash-water can leach these chemicals from the playground and discharge the leached chemicals via runoff into adjacent soil, waterways, and the ocean, either by direct runoff flows or indirectly via a stormwater drainage system. Potential groundwater contamination from toxic chemicals leached from PIP rubber playgrounds is also a concern.

Many laboratory and field studies have demonstrated that water leaches a variety of toxic chemicals from tire particles (e.g., zinc, PAHs, 6PPD, and phthalates), and that this leaching continues long-term. One study showed that PAHs continued to leach from tire particles for the duration of the 2-year study, and that the toxicity of the PAHs was even higher at the end of the study than at the beginning.

The applicant stated that custodial staff inspects and cleans the district's playgrounds daily. Although the cleaning methods were not identified for this proposed playground, power-washing is a common method to clean PIP rubber playground surfaces. Therefore, frequent infiltration of wash-water through the playground surfacing layers is expected to occur, in addition to infiltration of rainfall. Surface flows of runoff from the playground to surrounding areas are also likely if rainwater or wash-water flows exceed the infiltration rate of the playground surfacing materials.

The materials in each layer of the proposed PIP rubber playground surfacing—shredded tires and granules of synthetic rubber—are held together by a polyurethane binder. The polyurethane binder may reduce, but does not prevent, the leaching of chemicals from the playground's materials. Studies are limited, but one study (from a urethane manufacturer) found that a polyurethane coating on tire rubber mulch reduced leaching of zinc by 30% compared to uncoated tire rubber.²⁵ UV, ozone, heat, and foot traffic degrade the polyurethane binder in PIP playgrounds over time; therefore, any reduction in chemical leaching provided by the binder is likely to decline as the binder ages. Periodic recoating of the playground surface with polyurethane is typically required.

Most chemical additives in tires are not strongly bound (i.e., covalently bound) to the rubber polymer, which allows these chemicals to be continuously released into the environment during use of the tire, and during use of a playground made from shredded tires. For example, 6PPD is designed to continuously migrate through the tire rubber to the

²⁵ Morris, B.R., R.J. Golden, and J.W. Pierson. (2009). The Effects of PU Coated Rubber Mulch on the Leaching of Contaminants Compared to Uncoated and Acrylic/Latex Coated Rubber Mulch. Stockmeier Urethanes USA, Inc. https://libertytire.com/content/documents/Resources/Research_Studies/Environmental-Leaching-of-Contaminants-Studies-Zinc.pdf.

tire's surface, where it functions to protect the tire from degradation from ozone. However, the side effect is that this chemical continuously leaches into the environment.²⁶

When tire rubber particles are found in soil, the tire's chemical additives migrate through the tire rubber and leach readily into the soil, making these chemicals available for uptake by plants. A study showed that chemicals leached into the soil from tire rubber particles, including 6PPD, are readily taken up by lettuce plants and accumulate in the leaves, which may have human health implications.²⁷ Zinc also leaches from tire particles into the soil, where it can accumulate in plants; high zinc levels can be toxic to flora, fauna, and humans.²⁸

- **Off-gassing**

The materials in PIP rubber playgrounds contain volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) which can off-gas, releasing these chemicals into the air where they may be inhaled. The U.S. EPA reported that several VOCs that are known or suspected carcinogens have been found in waste tire materials.²⁹ Exposure to VOCs may also cause respiratory irritation and may be correlated to allergic reactions and asthma.³⁰ PIP rubber playground surfaces are often reported to get hot, which can cause some VOCs to off-gas at a higher rate. The surface temperature of one PIP rubber playground was measured at over 171° F while the air temperature was 75° F.³¹

Synopsis of Selected Chemicals in PIP Rubber Playgrounds

The following is a synopsis of the environmental and human health impacts of a few of the many hazardous chemicals of concern in PIP rubber playgrounds:

- **6PPD.** 6-phenylenediamine is an additive in tires that protects the tire from degradation by ozone. This chemical continuously migrates to the surface of the tire (and to the surface of shredded tires used in playground surfacing), where it is released into the environment. In a 2020 publication, researchers in Washington State identified 6PPD-quinone (6PPD-q) as the likely chemical responsible for extensive pre-spawn mortality

²⁶ California Department of Toxic Substances Control. (2023). Adopted Priority Product: Motor Vehicle Tires Containing 6PPD. https://dtsc.ca.gov/scp/motor_vehicle_tires_containing_6ppd/.

²⁷ Castan, S. et al. (2023). Uptake, Metabolism, and Accumulation of Tire Wear Particle-Derived Compounds in Lettuce. *Environ Sci Technol.* 2023 Jan 10; 57(1): 168–178. <https://pubs.acs.org/doi/10.1021/acs.est.2c05660>.

²⁸ Balafrej, H. et al. (2020). Zinc Hyperaccumulation in Plants: A Review. *Plants (Basel)*. 2020 May; 9(5): 562. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7284839/>.

²⁹ U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and U.S. Consumer Product Safety Commission. (2016). Status Report: Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds. <https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb>.

³⁰ American Lung Association. (2023). Volatile Organic Compounds in the Home. Editorial Staff Blog November 29, 2023. <https://www.lung.org/blog/volatile-organic-compounds-at-home#:~:text=Some%20VOCs%2C%20like%20formaldehyde%20and,a%20higher%20concentration%20of%20VOCs>.

³¹ Pollard, L. and R. Massey. (2023). Playground Surfacing: Choosing Safer Materials for Children's Health and the Environment. Lowell Center for Sustainable Production and Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.uml.edu/docs/Playground_surfacing_report_Dec2023_tcm18-377890.pdf.

of Coho salmon in Puget Sound streams over the last 25 years.³² Up to 90% of adult Coho migrating up certain streams to spawn would die after rainstorms. The researchers discovered that 6PPD is converted by ozone into a previously unknown compound, 6PPD-q, which is highly lethal to Coho. 6PPD-q is also acutely lethal to brook trout and rainbow trout/steelhead, and toxic to a variety of invertebrates and other fish including Chinook salmon.

Tire wear particles containing 6PPD are shed onto roadways and carried by stormwater runoff into waterways, where 6PPD leaches into the aquatic environment. 6PPD-q has been found in waterways across the west coast, including in San Francisco and Los Angeles. In California streams, 6PPD-q has been detected at concentrations shown in laboratory experiments to kill at least half of Coho salmon.³³

A 2022 study in China found 6PPD and 6PPD-q in humans, but the health impacts are unknown.³⁴ The authors concluded: “Considering that 6PPD-Q was a lethal toxicant to multiple aquatic species, the potential human health risks posed by its long-term exposure require urgent attention.” As 6PPD-q was only recently identified, studies of health effects of children’s exposure to chemicals in recycled tire materials used in playground surfacing have not yet included 6-PPD and 6PPD-q.³⁵

In 2023, the California Department of Toxic Substances Control (DTSC) designated vehicle tires containing 6PPD as a Priority Product containing a Chemical of Concern; therefore, DTSC now requires tire manufacturers to evaluate safer alternatives.³⁶ They reported that 6PPD is toxic to many aquatic organisms and can impair wildlife survival. DTSC determined that exposure to 6PPD and 6PPD-q derived from tires “may cause or contribute to significant adverse impacts to aquatic organisms.”

- **Zinc.** Zinc is a heavy metal added to tires to aid in the vulcanization process and improve rubber performance. Vehicle tires contain approximately 1-2% zinc by weight. Tire wear particles containing zinc are shed into the environment and carried by stormwater runoff into waterways, where they are ingested by aquatic organisms. Ingestion of tire particles can be toxic to marine invertebrates such as purple sea urchins, which are eaten by endangered sea otters. In marine and freshwater environments, zinc has been shown to leach continuously from tire particles, in

³² Tian, Z.Y., et al. (2020). Ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. *Science*, Vol 371, Issue 6525: pp. 185-189. <https://www.science.org/doi/10.1126/science.abd6951>.

³³ California Department of Toxic Substances Control. (2023). Adopted Priority Product: Motor Vehicle Tires Containing 6PPD. https://dtsc.ca.gov/scp/motor_vehicle_tires_containing_6ppd/.

³⁴ Du, B., et al. (2022). First Report on the Occurrence of N-(1,3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD) and 6PPD-Quinone as Pervasive Pollutants in Human Urine from South China. *Environ. Sci. Technol. Lett.* 2022, 9, 12, 1056–1062. <https://pubs.acs.org/doi/pdf/10.1021/acs.estlett.2c00821>.

³⁵ Massey, R. and Z. Tian. (2023). 6PPD in Tires: A Concern for Playgrounds, Artificial Turf, and More. Collaborative for Health and Environment. <https://www.healthandenvironment.org/join-us/blog/6ppd-in-tires-a-concern-for-playgrounds-artificial-turf-and-more>.

³⁶ California Department of Toxic Substances Control. (2023). Adopted Priority Product: Motor Vehicle Tires Containing 6PPD. https://dtsc.ca.gov/scp/motor_vehicle_tires_containing_6ppd/.

concentrations that are lethal to marine invertebrates.³⁷ Zinc toxicity has been reported in a wide range of taxa, including plants, algae, protozoans, sponges, mollusks (e.g., oysters), crustaceans (e.g., crabs), echinoderms, fish, and amphibians.³⁸ The presence of tire particles in waterways has the potential for long-term ongoing release of zinc to aquatic environments.

DTSC proposed in 2023 to designate vehicle tires containing zinc as a Priority Product containing a Chemical of Concern, and therefore to require tire manufacturers to evaluate safer alternatives.³⁹ They reported that zinc is known to leach out of tire wear particles, and “has the potential to cause or contribute to significant and widespread adverse impacts to aquatic organisms.” DTSC also stated that the advanced stormwater treatment required to minimize adverse impacts of zinc exposure on aquatic organisms “is often prohibitively expensive or technically infeasible.”

- **Lead.** Lead is a heavy metal found in tires and in EPDM synthetic rubber granules used in PIP rubber playground surfacing. The lead comes from vulcanizing (curing) agents used to manufacture tires. Lead is a developmental neurotoxin that causes cognitive and motor deficits; because post-exposure treatment cannot reverse the cognitive effects of lead exposure, preventing lead exposure is essential.⁴⁰

Researchers at Harvard University’s School of Public Health summarized the hazards of lead exposure to children on PIP rubber playgrounds as follows:⁴¹

“Children at playgrounds are especially susceptible to lead exposure and the neurotoxic effects of lead due to their early stage of development, higher absorption rates, and high exposure risk behaviors such as frequent ground contact and hand-to-mouth behavior. Children can be exposed to lead from rubber material through dermal contact, ingestion, or inhalation, and risk of exposures should be minimized.”

The Harvard researchers examined lead levels in 28 playgrounds in Boston, and they found that average lead levels on PIP rubber playgrounds were more than twice as high as on playgrounds with sand or wood mulch surfacing. They recommended that these findings be used to inform playground design to optimize children’s health.

In 2019, the Ecology Center tested several elementary school playgrounds in Washington, DC and found high levels of lead contamination on some of the PIP

³⁷ Halsband, C., et al. (2020). Car Tire Crumb Rubber: Does Leaching Produce a Toxic Chemical Cocktail in Coastal Marine Systems? *Front. Environ. Sci.*, 22 July 2020. Sec. Biogeochemical Dynamics Volume 8. <https://www.frontiersin.org/articles/10.3389/fenvs.2020.00125/full>.

³⁸ California Department of Toxic Substances Control. (2023). Rationale Document for Motor Vehicle Tires Containing Zinc. https://dtsc.ca.gov/wp-content/uploads/sites/31/2023/11/Zinc-in-Tires-Rationale-Document_Final.pdf.

³⁹ Ibid.

⁴⁰ Abelsohn, A. (2010). Lead and Children: Clinical Management for Family Physicians. *Can Fam Physician*. 56(6): 531–535. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2902938/>.

⁴¹ Almansour, K.S. et al. (2019). Playground Lead Levels in Rubber, Soil, Sand, and Mulch Surfaces in Boston. *PLoS One* 14(4): e0216156. <https://doi.org/10.1371/journal.pone.0216156>.

rubber surfaces, up to 100 times higher than allowable lead levels in children's products.⁴² High lead levels have also been found in numerous other PIP rubber playgrounds in several states in the U.S.; several of these playgrounds were closed or replaced.^{43,44} Power-washing and high-efficiency particulate air vacuuming of the playground surface mitigated the high lead level in some playgrounds;⁴⁵ however, power-washing discharges lead-contaminated runoff to surrounding soils or the storm drain system, which discharges to local waterways. Several municipalities, including Westport, Connecticut, and Edmonds, Washington have banned the installation of PIP rubber playgrounds.⁴⁶

- **PAHs.** Polyaromatic hydrocarbons are semivolatile organic compounds. Oils and carbon black fillers used in tire manufacturing often contain significant, and sometimes high, levels of PAHs.⁴⁷ Fine tire debris containing PAHs that is shed on roadways can become airborne; dust and fine debris from shredded tires in PIP rubber playgrounds may also have that potential.

Several PAHs are known or suspected human carcinogens, and the U.S. EPA reports that breathing air contaminated with PAHs may increase a person's risk of developing cancer.⁴⁸ Many of these carcinogenic PAHs have been found in waste tire rubber, in leachate from tire rubber, and in the air around tire rubber, according to an EPA literature review.⁴⁹

Recent studies have shown that PAHs are toxic to aquatic animals, including invertebrates, and bioaccumulate in these organisms.⁵⁰ Several of the PAHs found in tire rubber are considered very toxic to aquatic life, with long-lasting effects. PAHs are leached from tire particles and other tire debris in water, soil, and biological fluids, and

⁴² Ecology Center. (2019). New Test Results Show Elevated Lead in Rubber Shred at Playground in Washington, D.C. <https://www.ecocenter.org/new-test-results-show-elevated-lead-rubber-shred-playground-washington-dc>.

⁴³ Montgomery Community Media. (2020). Elevated Lead Levels Found at Four County Playgrounds. <https://www.mymcmedia.org/elevated-lead-levels-found-at-four-county-playgrounds/>.

⁴⁴ American University Radio, WAMU88.5. (2019). D.C. Closes Three Playgrounds After Tests Show High Lead Levels. <https://dcist.com/story/19/08/07/d-c-closes-three-playgrounds-after-tests-show-high-lead-levels/>.

⁴⁵ American University Radio, WAMU88.5. (2019). D.C. Officials Remediate Elevated Lead Levels At 17 School Playgrounds. <https://wamu.org/story/19/09/23/d-c-officials-remediate-elevated-lead-levels-at-17-school-playgrounds/>.

⁴⁶ The Guardian. (2019). US playgrounds: fears grow over health risks from rubber particles. <https://www.theguardian.com/us-news/2019/jun/25/lawmakers-concerned-chemicals-rubber-playgrounds-push-safety-rules>.

⁴⁷ Pan, J. (2018). Determination of PAHs in tires by GC/MS and NMR. Southwest Research Institute: Rubber & Plastics News, October 29, 2018. <https://s3-prod.rubbernews.com/s3fs-public/RN118580128.PDF>.

⁴⁸ U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and U.S. Consumer Product Safety Commission. (2016). Status Report: Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds. <https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb>.

⁴⁹ Pollard, L. and R. Massey. (2023). Playground Surfacing: Choosing Safer Materials for Children's Health and the Environment. Lowell Center for Sustainable Production and Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.uml.edu/docs/Playground_surfacing_report_Dec2023_tcm18-377890.pdf

⁵⁰ Honda, M. and N. Suzuki. (2020). Toxicities of Polycyclic Aromatic Hydrocarbons for Aquatic Animals. Int J Environ Res Public Health. 2020 Feb; 17(4): 1363. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7068426/#:~:text=Several%20researchers%20found%20that%20crude,25%2C26%2C27%5D>.

can persist in the environment. Much of the toxicity observed in leachate from tire debris has been attributed to PAHs. PAHs can cause carcinogenic and non-carcinogenic impacts, and PAH exposure can cause immunotoxicity, cardiotoxicity, and impact reproduction in wildlife.⁵¹

- **SBR and Carbon Black.** Tires are made from about 20% natural rubber and 24% synthetic styrene-butadiene rubber (SBR). Both styrene and butadiene in the synthetic rubber in tires (SBR) are human carcinogens. Carbon black, which is usually about 20–35% of the mass of waste tire rubber, is a filler that increases tire abrasion resistance and tensile strength. Carbon black is listed by the state of California as a human carcinogen,⁵² and it is also a respiratory irritant.

Microplastic Pollution from PIP Rubber Playground Materials

Small synthetic rubber granules (classified as microplastics) are continuously dislodged from the surface of PIP rubber playgrounds, often in large numbers. Tire shreds (also microplastics) may also be dislodged from the base layer when the playground surface deteriorates. Granules of synthetic rubber and tire shreds are transported by wind, stormwater runoff, maintenance sweeping, power-washing, and playground users' feet and clothing into surrounding areas, where they contribute to microplastic pollution of soil, air, waterways, and the ocean. Mayer et al. (2024) states, "Once entrained in sediments and soils, tire wear particles may serve as a source of adverse effects to benthic and soil populations, communities, and ecosystems." Tire particles can also remain in the air up to 28 days, during which time the tire particles can travel long distances and pollute distant environments.⁵³

Microplastics transport pollutants into waterways and the ocean, and both the particulates and their leachates can cause adverse impacts to aquatic species. Due to their toxicological effects, environmental persistence, and bioaccumulation, microplastics have been documented to cause chronic toxicity in numerous aquatic organisms—including fish, mammals, amphibians, marine birds, aquatic invertebrates, and zooplankton—and to adversely impact human health. Particles of EPDM synthetic rubber, such as the granules used in PIP rubber playgrounds, have been found in the digestive system of sea turtles, harbor seals, and gray seals;⁵⁴ the toxicity effects of EPDM in these animals is unknown.

UV, heat, ozone, and foot traffic degrade the polyurethane binder that holds the synthetic rubber granules together in the top layer of PIP rubber playground surfacing, increasing

⁵¹ Mayer, P., et al. (2024). Where the Rubber Meets the Road: Emerging Environmental Impacts of Tire Wear Particles and Their Chemical Cocktails. *Science of The Total Environment*, Volume 927, 1 June 2024, 171153927:171153. <https://www.sciencedirect.com/science/article/pii/S0048969724012920?via%3Dihub>.

⁵² California Office of Environmental Health Hazard Assessment. (2003). Chemical Listed Effective February 21, 2003 as Known to the State of California to Cause Cancer: Carbon Black (airborne, unbound particles of respirable size). <https://oehha.ca.gov/proposition-65/cnr/chemical-listed-effective-february-21-2003-known-state-california-cause-cancer>.

⁵³ Mayer et al. (2024).

⁵⁴ Hudak, C.A. and L. Sette. (2019) Opportunistic detection of anthropogenic micro debris in harbor seal (*Phoca vitulina vitulina*) and gray seal (*Halichoerus grypus atlantica*) fecal samples from haul-outs in southeastern Massachusetts, USA. *Marine Pollution Bulletin* Volume 145, August 2019, pp. 390-395

the dislodgement of the EPDM rubber granules as the polyurethane ages. Periodic recoating of the playground surface with polyurethane is typically required. Power-washing or sweeping while cleaning the playground surface is also likely to increase dislodgement and release of rubber granules from the playground. Increased releases of microplastic debris may also occur when the top wear layer of the PIP rubber playground becomes damaged or degraded over time, exposing the tire shreds underneath.



Left: Deteriorated top wear layer of PIP rubber playground exposing tire shreds underneath. Right: Synthetic rubber granules shed from a PIP rubber playground in sand near the playground. Photos courtesy of University of Massachusetts, Lowell Center for Sustainable Production.⁵⁵

A playground company described the dislodgement of rubber granules from a PIP rubber playground as follows:⁵⁶

“Now imagine a bunch [of] rubber granules held together by glue. That glue slowly disappears with the sun beating down on it and foot traffic dislodging it as the bond becomes weak enough. When more granules dislodge, the wear layer becomes thinner and thinner. That's when you see a sea of loose granules on the perimeter of the playground and on kids' shoes and hands.”

An Australian study near the Great Barrier Reef documented the extensive loss of synthetic rubber granules from six small PIP rubber playgrounds to the area immediately surrounding each playground.⁵⁷ The playgrounds range in size from 944 - 3,875 ft² and were from 2-10 years old. Core sampling of the top 2 cm of soil (about ¾ inch) was conducted to count the number of granules found within 4 meters (about 13 feet) of each

⁵⁵ University of Massachusetts, Lowell Center for Sustainable Production. Athletic Playing Fields and Playgrounds (webpage). <https://www.uml.edu/research/lowell-center/athletic-playing-fields/>.

⁵⁶ Trassig: The Playground People. (Undated blog). The Anatomy of Playground Rubber Surface Damage. <https://trassig.com/blogs/playground-blog/the-anatomy-of-a-playground-rubber-surface-damage#:~:text=When%20more%20granules%20dislodge%2C%20the,of%20the%20wear%20layer%20weakens.>

⁵⁷ Reef Clean. 2021. Rubber Crumb Loss Assessment from Play Areas in the Great Barrier Reef Catchment. https://www.tangaroablue.org/wpfd_file/reefclean-ausmap-rubber-crumb-loss-report-2021/.

playground's perimeter. The results show that the PIP rubber playgrounds each released an estimated 1.2 million granules on average into the immediate environment (within 4 meters of the playground), and two of the playgrounds each released well over 2.5 million granules. The two playgrounds with the greatest rubber granule loss recorded densities of 25,000 granules per meter² adjoining the playground. The rubber granules measured 1-5 mm, and thus are classified as microplastics; microplastics are defined as < 5 mm in size (about ¼ inch), about the diameter of a peppercorn.

Several PIP rubber playgrounds in Australia have been replaced by alternative surfacing materials due to concerns about the release of microplastic debris and toxic chemicals from the playground to the environment.⁵⁸

Removal of Microplastics and Other Pollutants in Runoff from PIP Rubber Playgrounds

The applicant for this project did not propose to install a treatment Best Management Practice (BMP) to remove dislodged rubber granules from runoff from the playground. Few studies have tested the effectiveness of treatment BMPs to capture and remove rubber microplastic particles from stormwater runoff, and no studies were found that specifically evaluated removal of rubber granules dislodged from PIP rubber playgrounds. Low Impact Development (LID) BMPs, including rain gardens, stormwater bioretention basins, and stormwater infiltration trenches, offer opportunities to capture both large plastic debris and microplastics from roadway runoff, and can provide additional pollution reduction.⁵⁹

Studies have shown that stormwater bioretention facilities can effectively remove inorganic and organic pollutants from stormwater, including tire wear particles; however, the effectiveness depends on factors such as design and maintenance.⁶⁰ Also, some pollutants that leach from tires may be problematic to remove. For example, the California Department of Toxic Substances Control (DTSC) stated that the advanced stormwater treatment required to minimize adverse impacts of zinc exposure on aquatic organisms "is often prohibitively expensive or technically infeasible."⁶¹

Rain gardens and other bioretention BMPs have been shown to be effective at treating some of the hazardous chemicals (such as 6PPD) from tire dust and tire leachate in roadway runoff. Mayer et al. (2024) states that "The most promising stormwater treatment

⁵⁸ Australian Broadcasting Corporation. (2023). Playground rubber surfaces at Bargara criticised for effects on health and environment. <https://www.abc.net.au/news/2023-01-31/rubber-playground-surface-health-environmental-concerns/101910170>.

⁵⁹ Statewide Microplastics Strategy. (2022). Ocean Protection Council. https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20220223/Item_6_Exhibit_A_Statewide_Microplastics_Strategy.pdf.

⁶⁰ Mayer, P., et al. (2024). Where the Rubber Meets the Road: Emerging Environmental Impacts of Tire Wear Particles and Their Chemical Cocktails. Science of The Total Environment, Volume 927, 1 June 2024, 171153927:171153. <https://www.sciencedirect.com/science/article/pii/S0048969724012920?via%3Dihub>.

⁶¹ California Department of Toxic Substances Control. (2023). Rationale Document for Motor Vehicle Tires Containing Zinc. https://dtsc.ca.gov/wp-content/uploads/sites/31/2023/11/Zinc-in-Tires-Rationale-Document_Final.pdf.

systems for tire particles and chemicals are rain gardens (bioretention cells) and similar soil-based pollutant capture and infiltration systems.”⁶²

One experimental study compared the effectiveness of removing microplastics from roadway runoff by two side-by-side treatment BMPs—a non-vegetated sand filter and a vegetated biofiltration cell—during nine storms.⁶³ The results showed a 46-99% removal rate of small rubber particles (0.1 - 0.3 mm) by the biofiltration cell and a 77-98% removal rate by the sand filter. However, there was also a net release of rubber particles from the biofiltration cell during 1 of the 9 storms, which indicates that rubber particles captured by the BMP were being resuspended and released during a subsequent storm. Release of rubber particles from the sand filter occurred during 2 of the 9 storms. Because the rubber particles float, many rubber particles were observed at the water surface of the BMPs near the overflow outlet, where they are at risk of being released from the BMP if additional rainfall occurred.

In addition, filtration BMPs such as a sand filter and biofiltration cell are typically designed to treat the stormwater runoff from the 85th percentile 1-hour storm (multiplied by a safety factor of 2), meaning that historically 85% of storms were that size or smaller. However, that also means that runoff from the largest 15% of storms will overflow or bypass the BMP and not receive any treatment, thus releasing microplastics in the overflow runoff. Designing filtration BMPs to accommodate the runoff from larger storms is often infeasible, due to the increased cost and larger area needed.

Frequent maintenance is needed to remove collected rubber particles from a sand filter BMP to avoid resuspending and releasing the particles. The California Stormwater Quality Association (CASQA) Stormwater BMP Development Handbook recommends inspection and maintenance of a sand filter BMP as often as before and after each storm.⁶⁴ Frequent removal of rubber particles from a vegetated biofiltration cell may be difficult without damaging the vegetation. Therefore, neither of these BMPs would likely be effective at removing most rubber granules released from a PIP rubber playground surface. Other filtration-type BMPs may also require frequent maintenance, and they are also likely to be designed to bypass flows from the largest 15% of storms without treatment.

Many rubber granules dislodged from a PIP rubber playground are likely to be dispersed into nearby areas by wind, sweeping or power-washing, sheet-flow runoff, or carried on the clothing and shoes of playground users, without entering the drainage system leading to a stormwater treatment BMP. It would therefore be preferable to choose playground surfacing materials that do not provide a source of synthetic rubber microplastic pollution that is likely to be continuously released into the environment.

⁶² Mayer, P., et al. (2024).

⁶³ Langer, K. et al. (2021). Removal of rubber, bitumen and other microplastic particles from stormwater by a gross pollutant trap - bioretention treatment train. Water Research Volume 202, 1 September 2021, 117457. <https://www.sciencedirect.com/science/article/pii/S0043135421006552?via%3Dihub>.

⁶⁴ California Stormwater Quality Association (CASQA) Stormwater BMP Development Handbook. <https://www.casqa.org/resources/bmp-handbooks>.

Acceptable Alternatives to PIP Rubber Playground Surfacing

There are several acceptable playground surfacing materials to minimize the discharge of hazardous chemicals and microplastic debris. Alternatives to PIP rubber playground materials that use natural materials and comply with both fall protection and wheelchair-accessibility standards include natural cork PIP surfacing, engineered wood fiber (EWF), and stabilized EWF (i.e., EWF bonded with adhesive).

In addition, there are several loose-fill playground surfacing materials (including sand, pea gravel, and wood chips) that meet fall protection standards when installed to the correct depth and properly maintained. Perforated interlocking tiles, natural rubber mats, or roll-out access mats (not made from waste tire materials) can be installed on loose-fill materials to comply with standards for wheelchair-accessible pathways to playground equipment. These mats and pads can also be placed in high-use areas to prevent displacement of loose-fill materials, such as under swings and slides. Note that mentions of brand names of products do not constitute endorsements.

A. Natural Materials.

Playground surfacing options that use natural materials are preferable, if feasible. Options include but are limited to the following:⁶⁵

1. Engineered Wood Fiber (EWF). EWF consists of finely shredded wood fibers that lock together to create an accessible, impact-attenuating surface. EWF is designed specifically for use as playground safety surfacing. The wood is required to be tested for hazardous chemicals, including heavy metals and wood preservatives. When properly installed and maintained, EWF surfacing meets both fall safety and wheelchair-accessibility requirements.⁶⁶ EWF does require frequent maintenance, such as raking dislodged materials back into place, but this may be minimized by placement of a scuff mat on top of the EWF in high-use areas.
2. Stabilized EWF. Stabilized or Bound EWF has a chemical binder such as polyurethane added to the top layer of the EWF, to enhance wheelchair accessibility and reduce maintenance requirements.
3. Cork Poured-in-Place Surfacing. This product contains natural cork particles held together with a polyurethane binder (such as the binder in PIP rubber playgrounds). Cork PIP surfacing is the least hazardous choice of any PIP product, and it meets both fall safety and accessibility requirements. Cork PIP playground surfaces also require less frequent maintenance than EWF and loose-fill materials.

⁶⁵ Pollard, L. and R. Massey. (2023). Playground Surfacing: Choosing Safer Materials for Children's Health and the Environment. Lowell Center for Sustainable Production and Toxics Use Reduction Institute, University of Massachusetts Lowell. https://www.uml.edu/docs/Playground_surfacing_report_Dec2023_tcm18-377890.pdf.

⁶⁶ EWF wood fibers must meet the specific particle size, consistency, purity, and drainage standards in American Society for Testing and Materials (ASTM) 2075: Standard specification for engineered wood fiber.

4. Loose-fill Natural Materials. Sand, pea gravel, wood chips, and natural rubber mulch are loose-fill playground surfacing options that if installed to the correct depth and properly maintained meet playground fall safety requirements, but not wheelchair-accessibility requirements. Trace amounts of crystalline silica dust in playground sand may be inhaled and affect the lungs, but some brands of playground sand are free of crystalline silica dust. Pea gravel is made mostly from quartz, which does not pose chemical concerns. Wood products must be tested to ensure they do not contain wood preservatives. It's important to read product information carefully to ensure that rubber mulch is made of natural rubber, not recycled tire rubber.

Although loose-fill materials do not meet playground wheelchair-accessibility requirements by themselves, accessible pathways to playground equipment can be created by adding roll-out access mats, pads, or interlocking tiles on top of EWF or loose-fill playground materials. ADA accessibility standards do not require the entire play surface area to be accessible: a route from the entry of the play area, a connection to each accessible play component, and a clear space adjacent to accessible play components are required. Access mats, pads, or tiles may include products made from low-toxicity non-granular plastics (see section B., below).

5. Natural Rubber Scuff Mats or Pads. Mats or pads (e.g., swing mats or scuff mats) made from natural rubber may be placed on top of EWF or loose-fill materials in high-use areas such as under swings, to avoid displacement of the playground materials. Avoid use of products made with materials derived from recycled tires (commonly labeled simply as “rubber” or “recycled rubber”).



Left: Engineered Wood Fiber playground surfacing.⁶⁷
Right: Poured-in-Place cork playground surfacing.⁶⁸

⁶⁷ Sof'Fall Engineered Wood Fiber. <https://sof-fall.com/playground-wood-chips/>.

⁶⁸ Corkeen by Amorim. <https://corkeen.com/en/corkeen/case-studies/>.

B. Low-Toxicity Non-granular Plastics

Playground surfacing products made from types of plastics that have documented low toxicity are acceptable if natural surfacing materials are not feasible. Plastic products used for the top surface of the playground should contain only non-granular plastics, not resin-bonded granules, to minimize microplastic pollution. Acceptable low-toxicity non-granular plastic playground surfacing products that can be used for accessible pathways, scuff mats, or entire playground surfacing include, but are not limited to:

1. Roll-out Polyester Beach Access Mats. Woven or non-woven roll-out polyester beach access mats can be used to provide wheelchair-accessible pathways in playgrounds. However, these access mats do not provide adequate fall safety protection under playground equipment. Polyester beach access mats have been approved by the Coastal Commission in several locations to provide ADA-compliant wheelchair-accessible pathways to the beach.⁶⁹ For example, a beach access mat was recently installed to provide access across the sand dunes to Clam Beach in Humboldt County. These mats are typically made of polyester fabric made from recycled plastic bottles; polyester is considered a low-toxicity plastic. Also, beach access mats are made from fibers, not from granular and shredded materials such as are used in PIP rubber playgrounds. Therefore, these access mats are much less prone to shedding plastic particles. Repair or replacement of the access mats is also easier than with PIP rubber surfacing materials.
2. PVC Interlocking Perforated Tiles. Injection-molded polyvinyl chloride (PVC) interlocking perforated tiles can integrate with loose-fill surfacing materials to provide wheelchair-accessible pathways through a playground. They can also be used as scuff mats to prevent displacement of EWF or loose-fill surfacing materials under high-use playground equipment (such as swings and slides), with a cushioning layer underneath the tiles as needed. In addition, when used on top of a cushioning layer, these tiles can be used to surface an entire playground. It's important to ensure that tire material is not used in the cushioning layer under these tiles. PVC is considered a low-toxicity plastic. These perforated tiles are porous, available in multiple colors, made from recycled materials, and are recyclable.
3. Polyethylene Foam (XPE) Shock Pads. Cross-linked polyethylene foam (XPE) shock pads are made of recycled post-industrial scraps of foam held together with a binder such as urethane. XPE foam shock pads can be used for cushioning under playground surfacing products such as molded PVC tiles, and they provide up to 12 ft. of critical fall height protection. XPE is considered a low toxicity foam and is thus a preferable alternative to traditional playground cushioning pads made from shredded waste tires. XPE foam shock pads are porous and recyclable.

⁶⁹ California Coastal Commission webpage on Beach Wheelchairs. <https://www.coastal.ca.gov/access/beach-wheelchairs.html>.



Left: Beach access mat at Clam Beach, Humboldt County, California.⁷⁰

Right: XPE foam shock pad.⁷¹



Left: Interlocking PVC tiles integrated with loose-fill playground surfacing for wheelchair accessibility and as scuff pads below playground equipment.⁷² Right: Interlocking PVC tiles used for playground surfacing at a Los Angeles public school.⁷³

Types of Playground Surfacing Materials to Avoid

A. Playground Surfacing Made from Tire Materials

Playground surfaces made from shredded or granulated waste tires should be avoided, including, but not limited to:

1. Poured-in-Place (PIP) Rubber Playground Surfacing. PIP rubber surfacing products with a cushioning layer made from shredded tires. Typically labeled in product descriptions as rubber, recycled rubber, or recycled SBR (styrene-butadiene rubber).
2. Rubber Mulch. Loose-fill shreds or pieces of tires.

⁷⁰ County of Humboldt: News Flash. (2023). Individuals with Disabilities Can Now Access Clam Beach County Park with Ease. <https://humboldt.gov/CivicAlerts.aspx?AID=5118>.

⁷¹ Polygreen Play XPE foam pads. <https://www.polygreenfoam.com/>.

⁷² PlayMatta Scuff Pads. <https://www.mattaproducts.com/product/play-matta-scuff-pads>.

⁷³ PlayMatta Original. <https://www.mattaproducts.com/product/play-matta-tm-original#case-studies>.

3. Bonded Rubber Mulch. Tire shreds or chunks held together with a resin binder. Typically labeled as bonded rubber mulch.
4. Pads, Mats, & Tiles Made from Tire Material. Synthetic rubber mats, pads, or tiles manufactured from tire crumb rubber. Typically labeled as rubber or recycled rubber products.
5. Synthetic Rubber. Playground surfacing materials made from synthetic rubber granules should also be avoided, including, but not limited to, those commonly used in the top layer of PIP rubber playground surfacing products:
 - a. Ethylene propylene diene monomer (EPDM). EPDM may be labeled as “virgin rubber” if it is not derived from recycled materials; however, this is a synthetic rubber, not natural rubber.
 - b. Thermoplastic vulcanizate (TPV).
 - c. Thermoplastic elastomer (TPE).

B. Synthetic Grass

Synthetic grass (i.e., artificial turf”), with or without granules of recycled tire material called “crumb rubber” used as infill, should be avoided as a playground surfacing product.

