
BEARS EARS WEST
BEARS EARS EAST

SUSTAINABLE STEPS

SAVING MORE THAN JUST YOUR FEET

IN PARTNERSHIP WITH THE

BUREAU OF LAND MANAGEMENT

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Sustainable Steps

ABOUT

" TO CREATE A MORE SUSTAINABLE AND LONGER LASTING EARTH, ONE STEP AT A TIME. "

The goal behind Sustainable Steps is to help create a more sustainable future for our earth through footwear design.

By studying the eversion and inversion rotations of the foot, along with the foots stability and the materiality in which the shoe is constructed, I learned that you can reduce the literal impact of the footprint when walking, especially on hiking trails, which often consists of sand and various other types of sediment.

The reason this is important is that we damage our earth every single day, from greenhouse gases to stepping on dirt. We need to start looking at more sustainable design in which we not only design for the user, but also for mother nature so that we can continue to enjoy her beauty for generations to come.

Picture by: Devon Hawkins

Bryan Emerick

Table of Contents

Bryan Emerick

SUSTAINABLE STEPS

SAVING MORE THAN JUST YOUR FEET

OBSERVATIONS

BEARS EARS MONUMENT

MEETING WITH THE BLM

TRAIL DAMAGE

Bryan Emerick

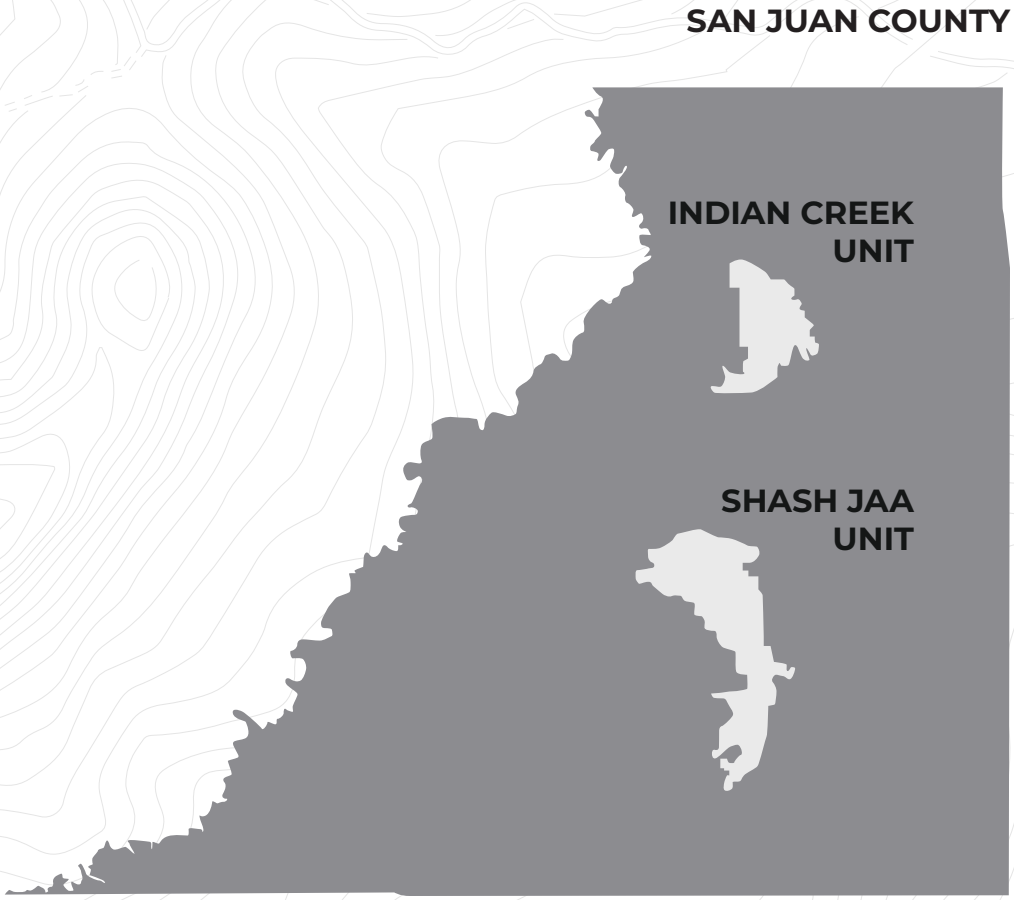
Bears Ears Monument

OBSERVATIONS

Sustainable Steps was derived by studying the terrain of Bears Ears National Monument in San Juan County Utah. I had the opportunity to meet with members from the Bureau of Land Management form the Monticello field office in San Juan County to help guide my research.

Bears Ears Monument is located in southern Utah in San Juan County. As of December 2020, it currently occupies **1,351,849 square miles** and 1.06 million acres of that land is controlled by the Bureau of Land Management.

There are 14 primary hiking trails which consist of rock, sand, dirt, and various other sediment. These 14 trails create over **144 miles of hiking trails** in Bears Ears. All of these hiking trails are managed by the BLM.



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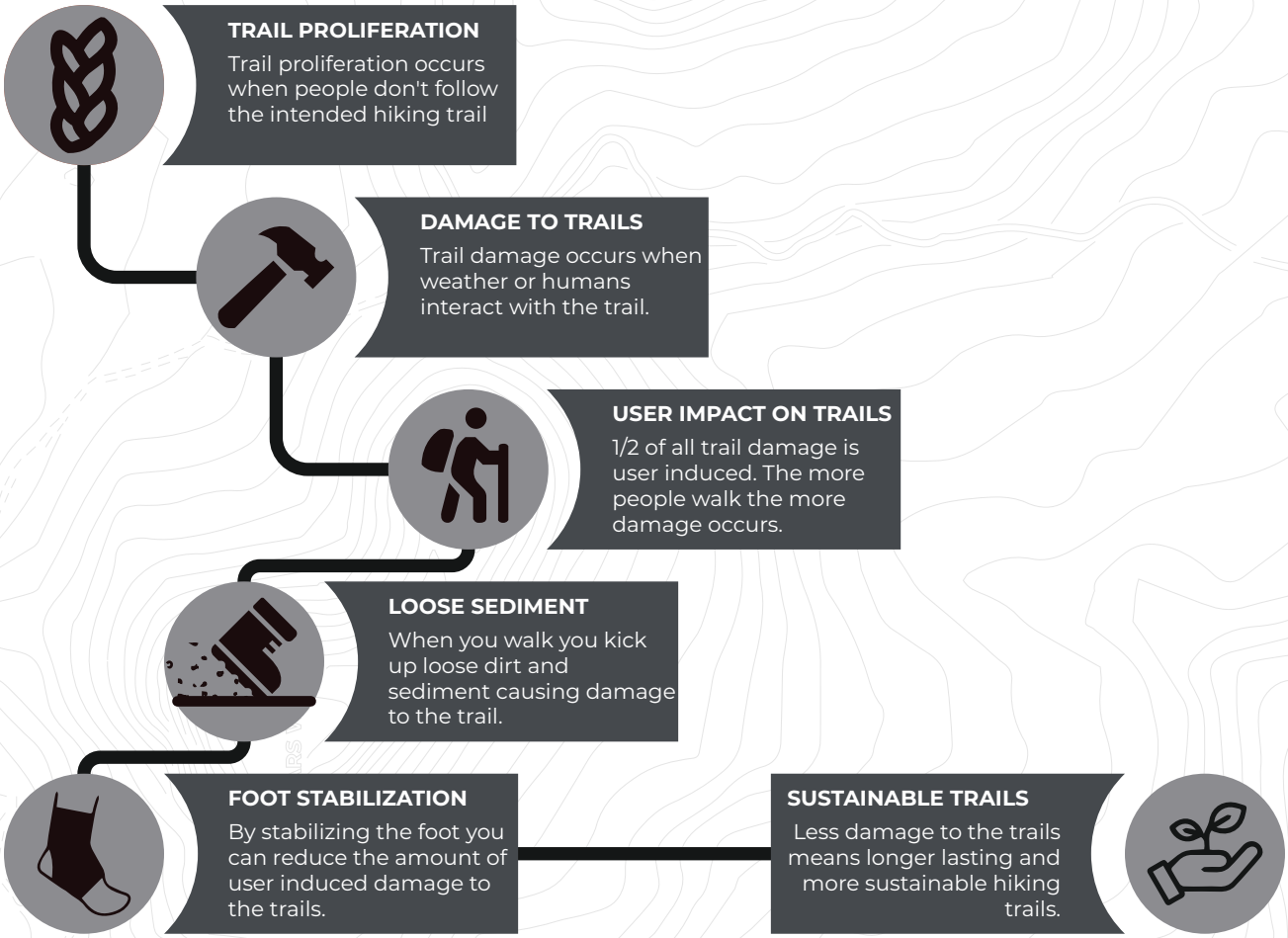
Meeting with the BLM

OBSERVATIONS

I had the opportunity to meet with the B.L.M on 3 different occasions. The first meeting was the most important and consisted of them telling us of issues they had when managing Bears Ears National Park in San Juan County Utah.

They discussed their concerns within the CRRAMP act which aims to implement a recreation plan within Bears ears national park over the next 4 years. They listed a handful of issues that needed to be addressed, but **trail proliferation** caught my attention. After doing some research, I noticed that trail proliferation can all be attributed to back trail damage and how people are unintentionally creating new trails by walking outside of the designated hiking path to avoid obstacles.



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Trail Damage

OBSERVATIONS

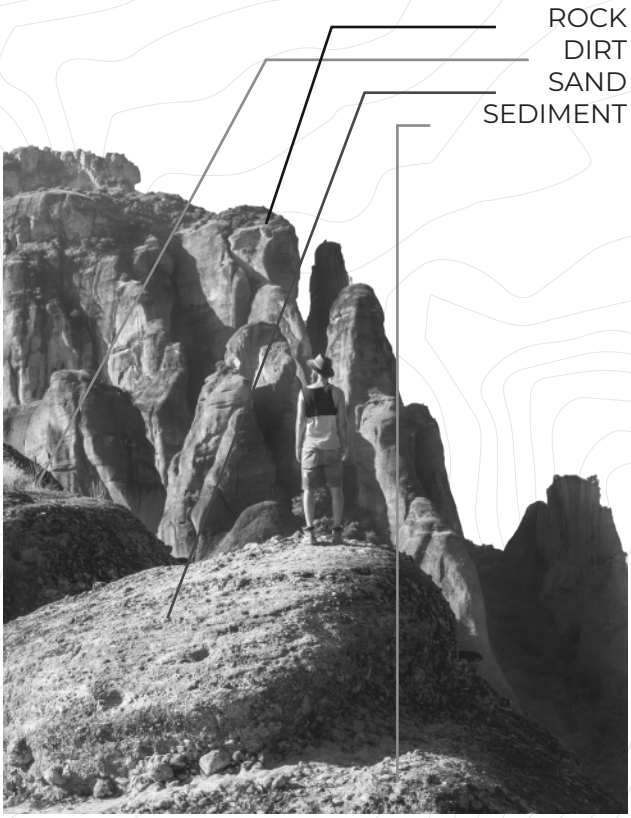
Trails are damaged by two different factors; User related and environmental factors. It is impossible to stop the environmental effects of damage on trails but it is possible to minimize the user impact on trails. It is thought that 1/2 of all trail damage is user induced. There are a handful of ways people damage trails but the main ways are from Trail widening, creation of parallel trails(trail braiding), mud avoidance, and side by side hikers. all are examples of trail proliferation and trail damage.

Ultimately all of these issues lead back to people walking on the ground where they shouldn't be. The impact of the foot on contact of the ground is what is creating the most damage, also known as shear force and Land Impact.

By analyzing how people interact and walk on hiking trails, you can start to find opportunity points about how you can reduce the users impact on the trails.

" Although similar in impact, hikers tend to produce marginally more sediment than mountain bikes through the unique shearing forces that walking produces"
(Senay Wilson 2006)

" The feet of a hiker damage trails and vegetation in two distinct phases. First the heel applies compaction in the first part of the step. Second the toe applies shearing forces as it rotates through the step. The shearing (force) accounted for the greatest share of a humans foots damage. "
(Quinn et al. 2003)



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SUSTAINABLE STEPS

SAVING MORE THAN JUST YOUR FEET

OPPORTUNITIES

FOOT STABILIZATION

WEIGHT DISTRIBUTION

MATERIALITY

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Foot Stabilization

OPPORTUNITIES

As I began my research I started looking for different ways that I could incorporate footwear design into my project. I made a list of all of the different elements that my shoe would have to incorporate in order for it to be a successful shoe. I narrowed my list down to four main things. I wanted my shoe to have proper stabilization, I wanted it to be comfortable, I wanted it to be easy to use and I also wanted to make sure it was minimizing the amount of damage it would do on the trail.
I looked at all kinds of different footwear but when focusing on stabilization, the first thing that came to my mind was basketball shoes. I ended up going down a rabbit hole of foot stabilization and discovered that by minimizing the inversion and eversion foot rotations of your foot you can have a better walking motion and will lead to a cleaner and more consistent footprint.

I found this pdf from the mayo clinic where they go into depth about the biomechanics of the foot and how you walk. This article really informed me on what foot issues people often struggle from which led me to make design decisions to help reduce injury.

Foot stabilization seemed to play a key role in keeping your foot aligned as you walk through the step as well as prevent injury by helping minimize the inversion and eversion rotations of your foot, also known as torsional force. By supporting the ankle and the lower shin you begin to develop a system where the foot you are reducing injury while also minimizing the footprint of your step by also reducing the amount of sediment that is kicked underneath the foot on each step and then pushed out as you continue the motion.

https://www.mayoclinicproceedings.org/article/S0025-6196(12)61642-5/pdf

INVERSION **EVERSION**

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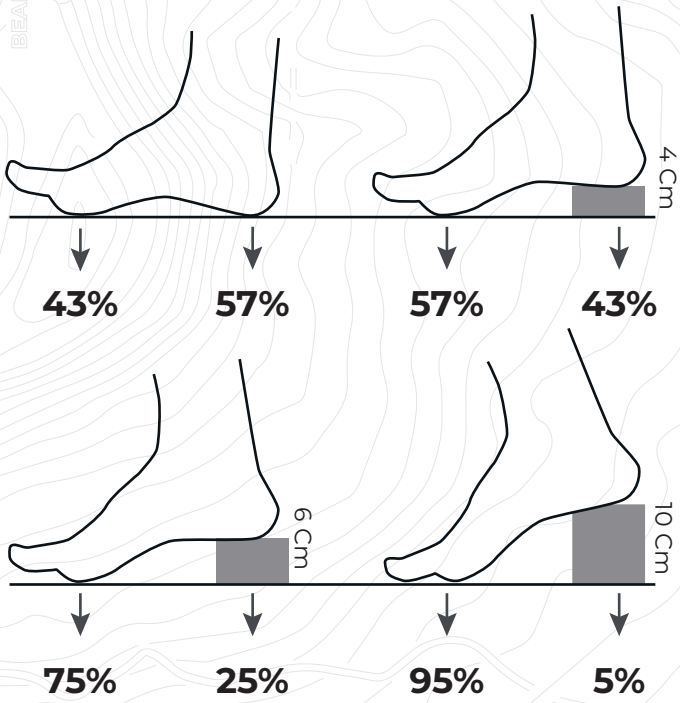
Weight Distribution

OPPORTUNITIES

Proper weight distribution is one of the main keys when designing a comfortable shoe. I looked over a handful of different studies and learned that your weight is most evenly distributed when your heel is slightly elevated from the ball of your foot. Not only is weight distribution important on your foot but as well as your whole body needs to be well distributed or else it can be increasingly more difficult to walk.

On average your heel is producing around 57% of the force on impact and the balls of your feet and your toes produce the other 43% when barefoot. This means your heel is doing a significant amount of damage to hiking trails on impact with the ground. By elevating your heel up just 3 centimeters you can even out the force that is enacted upon the ground when walking. You will see that my final design has the heel lifted 3 centimeters above the ball of the foot for this exact reason. An even weight distribution leads to your weight is spread out more evenly when walking which not only benefits the sustainability of your bones and your body but the trail as well.

You can see that the more you start to raise your heel off the ground the more lopsided the weight distribution numbers get. For example, a 10cm high heel is putting 95% of the force on the ball of the foot and only 5% on the heel. You can see how these numbers start to affect the way people walk and that the most comfortable and most practical design would to have the heel and toe weight be distributed as close to even as possible.



https://www.researchgate.net/figure/Redistribution-of-the-weight-of-the-body-on-the-plantar-area-of-the-foot-a-in-case-of_fig1_325359275

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Materiality

OPPORTUNITIES

When designing a hiking shoe or boot, materiality is one of the most important things when creating the final product. I started off by looking at all the different elements of a shoe from the midsole to the toe cap to the tongue and the laces and figuring out what materials are most commonly used in those parts of the shoe.

By looking at what materials other companies are using for their shoes, I started figuring out what the most popular and most sustainable materials were that I could start to incorporate into my shoe. Because the whole point of the shoe is to help push a more sustainable future, it wouldn't make sense to use traditional materials in this design, instead, I wanted to make sure my materials were reused and sustainable such as Nike's Crater foam which uses grounded up rubber from old shoes as well as a mix of their React foam technology which is often found in their most popular running shoes.

There were many elements that were important to me when designing a successful shoe. I wanted to make sure my shoe was waterproofed, comfortable, easy to use, durable, with lockdown support while allowing the user to create a smaller impact on hiking trails when compared to a traditional shoe.

SUSTAINABLE STEPS

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DESIGN RESEARCH

CONCEPT FOOTWEAR

FOOTWEAR STUDY

30% FOOTPRINT REDUCTION

DESIGNING FOR DISABILITIES

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Concept Footwear

DESIGN RESEARCH

I started by taking my favorite pair of shoes (Nike Air Force 1) and started adding all kinds of crazy materials to the shoe to try and get a visual representation of how I can start to move forward with my research. I tried making an attachable device for my shoe using paper bags, I glued a foam football and Marshmallows to the bottom of the shoe to replicate weight distribution along with a foot rocker to help propel the user through the step. I even used play-dough and a stress ball to get my concept of my head and into a physical form.

These visual representations of my shoe really helped give me a better understanding of what I wanted my shoe to look like, as well as to see what is working and what's not. Ultimately I found the Marshmallow and the foam football to be the best conceptual iteration so I decided to try and incorporate the weight distribution of the marshmallow along with the rocker foot of the football in my designs moving forward.

Stress Ball

Marshmallow & Foam Football

Play-Dough

Paper Bag & Velcro

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Footwear Study

DESIGN RESEARCH

I wanted to analyze what types of shoes make the best impact on the ground. I set up a large tub and filled it with sand and rocks to simulate the traditional hiking trail in Bears Ears. I then gathered 13 different pairs of shoes that I had lying around and tried to recreate the same step through the sediment with each of them. I had everything from a regular tennis shoe to a soccer cleat and I studied which imprint left the least amount of damage.

I narrowed down my results to the 3 most successful shoes which left the smallest imprint. I realized that the top 3 each have different aspects of making the most minimal footprint. The first aspect was to have a lot of surface area. More surface area touching the ground allowed the weight to be distributed more leading to a smaller indent in the ground. The second shoe had a lot of negative space which basically left the sediment untouched. The final shoe was made of really squishy foam which was similar to how the marshmallows squish and expand on the ground. These 3 elements of the shoe led to me being able to minimize the footprint that the user leaves behind.

Lots of surface area

Negative space on the bottom of the shoe

Soft foam allows the shoe to expand and mold

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30% Footprint Reduction

DESIGN RESEARCH

I ended up doing the previous study with marshmallows and football shoes. I wanted to see how it would compare to the traditional footprint of the Nike Air Force 1. I started by walking through the sand with the Air Force 1 and then recorded the footprint. I then did the same step but I wore the concept shoe and noticed a pretty substantial difference in the size of the imprint that was left behind. I decided to redo the test put to measure how much sand is displaced with each shoe.

After doing a side-by-side comparison I realized that the concept shoe displaced around 30% less sand than the Air Force 1. This proved that it is possible to minimize the amount of damage that is produced when hiking through sand and dirt. By reducing the 30% footprint reduction across the 144 miles of Bears Ears hiking trails, you will be able to hike an additional 43 miles before creating the same amount of damage as someone hiking in their Air Force 1s. Imagine if everyone was producing 30% less damage when hiking. Trails would almost instantly become more sustainable and the National Parks would be able to continue to flourish for generations to come.

Air Force 1 Sand Displacement

Concept Shoe Sand Displacement

Left: Nike Air Force 1
Right: Concept Shoe

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Designing for Disabilities

DESIGN RESEARCH

While deep diving for research about footwear, I came across this really interesting article about how some diabetics need to have custom made insoles for their feet to help alleviate stress as well as to help minimize the torsional movements of the foot so that way blood can flow better. I thought this was really interesting and figured that my shoe shouldnt only just help the average hiker but should also allow diabetics who suffer from foot ulcers to have the opportunity to easier explore the world.
Traditionally in the past, when companies design for users outside of their traditional target market, they often end up producing a better product because they are focusing on the details that really matter. By designing for diabetics with foot ulcers I learned that there was a lot of overlapping topics from torsional force to form-fitting shoes. This inspired me to make the shoe easy to use by going away with the traditional lace system but instead incorporating a “pull to sinch” system which will provide more foot lockdown while still allowing for proper blood flow.

Diabetic Foot Ulcers

“Reducing shear or side-to-side stresses on the plantar surfaces of feet in patients with diabetes is of particular interest lately. Conflicting clinical trial data of custom pressure-reducing footwear suggest that other offloading or footwear approaches may be necessary.Gait lab studies suggest shear stresses are in a different location and magnitude versus age-matched controls.”

Jeffrey Wensman(2014)

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DESIGN RESPONSE

PRECEDENCE

CONCEPT SKETCHES

PROTOTYPE

FINAL ITERATION

FEATURES

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Precedence

DESIGN RESPONSE

My precedence consists of all kinds of different shoes and footwear designs. On this board I have anything and everything that helped me start making design decisions and inspired my concept sketches. I looked at a lot of successful hiking shoes and tried to identify what was working well for them and what could be improved.

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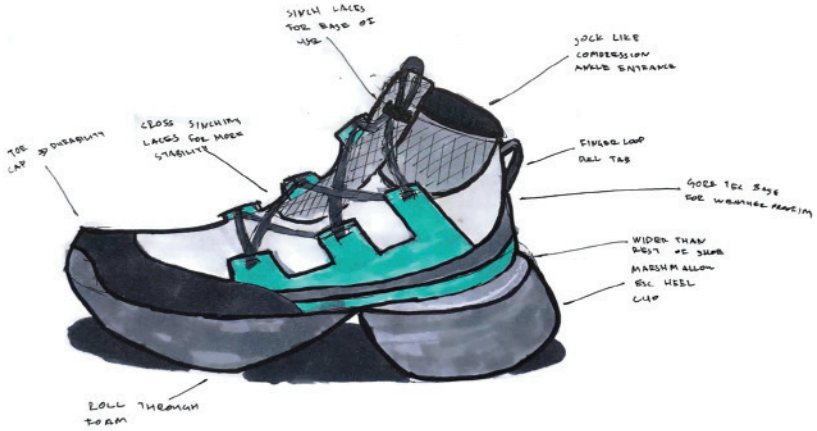
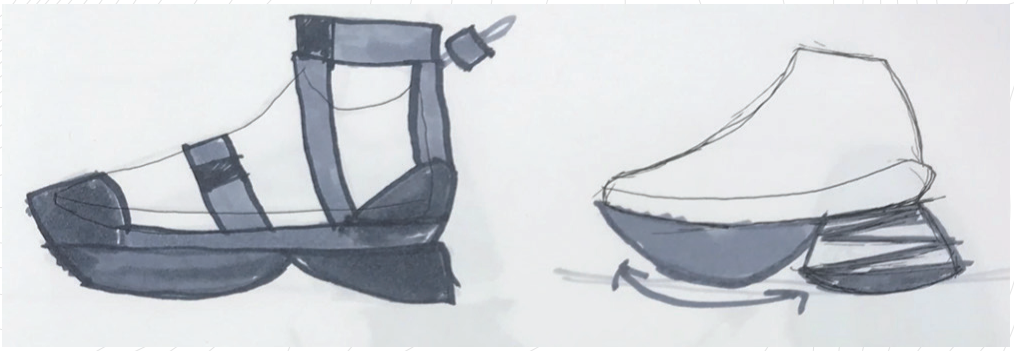
Concept Sketches

DESIGN RESPONSE

Coming into this project I had never been able to really sketch a shoe. With enough time and practice, I started getting the hang of things and I was soon able to get my ideas out of my head and onto a page. Over this process, I managed to fill a 150-page sketchbook filled with all parts of the shoe. I starting using Copic markers and my ideas quickly started coming to life and I could put an emphasis on some parts over others which led to my designs being quicker and often times more successful. I became obsessed with sketching and it is now one of my favorite hobbies when trying to kill time.





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Prototype

DESIGN RESPONSE

My first proto type took a lot of inspiration from the marshmallows and the foam football. I knew that if I had a nice soft heel that would expand, then the user would be able to gain more energy from each step from the spring of the heel as well as it would allow you to roll through the step with the rocker bottom. These two parts together really make the shoe and allow it to work in unison to create a shoe that leaves less damage to the trail, ultimately leading to a more sustainable and longer lasting future for the planet.

You can see there is a lot more going on than just the midsole of the shoe. I incorporated a cross foot lacing system which allows your foot to be completely locked down when hiking which brings the user more confidence and the peace of mind when hiking through any terrain. Another design touch I added in this iteration is the stretchy nylon around the ankle. This allows the ankle to have compression on it which helios to eliminate the torsional rotations of the foot. Everything on this shoe is intentional and helpful and reduces the users impact on the trail when hiking.

Final Iteration

DESIGN RESPONSE

The final iteration of the shoe took a lot of redesigning and effort to get it where it is today. I wasn't pleased with how the midsole of the shoe looked so I designed it to be a little less extreme with the rover bottom and I merged the heel and the rocker into one piece instead of two separate pieces. I added two rubber contact plates to the bottom to improve the traction of the shoe. The whole shoe has been completely remodeled from the first prototype and could continue to be pushed, because a good project is never really finished. I added a heel cap that wraps around the foot to act as an orthotic which will also help with the torsional forces of the foot and will help create a less damaging footprint.

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Features

DESIGN RESPONSE

Every aspect and every detail has been designed to help either the user or help the earth. From the small finger tabs to ease the shoe on to the toe caps to improve the durability, all aspects of the shoe have a job and a purpose to help make the earth a more sustainable place.

Nylon Collar: Starting at the top of the shoe, The nylon collar has been designed out of a stretchy compression like nylon that will compress your ankle as you walk. This proved the ankle with the proper support it needs as you walk through any terrain. By using around the entry of the shoe, the shoe becomes much easier to get on and off unlike traditional hiking shoes where it can be extremely difficult and time consuming.

Cross Lacing: Moving down to the lacing system, you can immidoiatley see that it is unlike almost every other shoe on the market. A traditional shoe only tightens the top of your shoe and keeps your foot from slipping out, where as this cross lacing system provides the full foot with the lockdown support it needs. There is also a sinch in the back of the heel to easily tighten your shoe instead of having to worry about the hassle of laces. You can easily adjust the tightness of the laces with the sinch method which will stop your foot from slipping.

Heel Stabilizer: The Heel Stabilizer is a hard piece of plastic that wraps around the exterior of the shoe and prevents your foot from rotating in any awkward direction. The heel stabilizer acts as an orthotic for the foot and works in unison with the nylon collar. By having a heel stabilizer you minimize the inversion and eversion rotations of your foot while still being able to comfortably tackle any terrain.

Toe Cap: The toe cap is a traditional feature that you can find on most hiking boots and shoes. The toe cap provides the user with a more durable shoe and protects the user from scrapes. It also helps keep your toes safe from any incoming rocks that you might encounter on your journey.

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Features Continued

DESIGN RESPONSE

Gore Tex Upper: The gortex Upper is one of the most important parts of the shoe when it comes to comfortability. The lightweight, breathable, waterproof material is the perfect for any hiking shoe. Because the upper takes up such a large part of the shoe, it is important that it is light so that your shoes don't feel clunky. It is also a very breathable material which allows your foot to cool down when you are on a hot summer hike in Bears Ears. The best part is the waterproofing which gives you the ability to tackle any stream you may encounter. Because there is no tongue on the shoe, the entire shoe is waterproof and is super practical for hiking.

Insole: The insole is a particularly important part of the shoe because it's slightly thicker than a traditional insole. This allows it to better mold to your foot. A lot of inspiration from diabetic insoles played a big role in coming up with this design. A soft memory foam insole provides the user with exceptional comfort. The insole is also raised around 3cm in the heel which provides the user with the optimal amount of weight distribution when making contact with the earth, which ultimately creates less damage on the trails.

Weight Dispersion Heel: The heel is designed out of a springy foam that shoots back to its original place after compression. The heel is around a quarter inch wider than the rest of the shoe to provide maximum surface area so that the user minimizes the divots their heel makes on impact. The springy nature of the foam also provides the user with a small energy return which helps propel them into their next step. It's like having springs on the bottom of your feet.

Rocker Bottom: The rocker bottom acts as the football from the concept slide. A rocker bottom has been implements in a couple other shoes such as the Z-coil and it helps the user roll though the step which has been clinically proven on the z coil to reduce the amount of stress on your bones. By having the rocker bottom, it helps promote a more natural bending motion and will allow the user to easily glide. The most important reason for the rocker bottom is because it creates the most minimal footprint and does the least amount of damage to the trail.

Rubber Plates: The rubber plates on the bottom of the shoe are very thin but provide you with all the traction you need on any trail. On the bottom of the plates is a topographic map of Bears Ears National Park. When buying the shoes you can select any national park topographic map to inscribe on the bottom of the shoe to show the people behind you that you are helping save the earth one step at a time. Popular to contrary belief, your hiking shoes dont need to look like off road tires to give you the proper traction you need. Most hiking shoes are designed with big bulky rubber tread on the bottom of the shoe and that is one of the biggest causes to trail damage. When users have large tread on the bottom of their shoes they are actually damaging the trails significantly faster when compared to just a regular tennis shoe. The Sustainable Steps shoe would be the best footwear solution on the market when it comes to creating the smallest footprint on the hiking trails.

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SUSTAINABLE STEPS

SAVING MORE THAN JUST YOUR FEET

CONCLUSION

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Who Benefits?

CONCLUSION

When designing this project I had 3 users in mind, The User, The Bureau of Land Management and the most important, The earth.

The User benefits because the shoe is providing user stability, improved comfort, pain relief as well as injury prevention. The heel stabilizer and the midsole are there to help you walk longer and farther while exerting less energy.

The BLM benefits due to the fact they have to do less trail maintenance due to the longer-lasting and more sustainable hiking trails. This means they are saving money on maintenance and now that money can be used for other incredible projects. Better hiking trails also mean more visitors who get to come and experience the beauty of bear's ears.

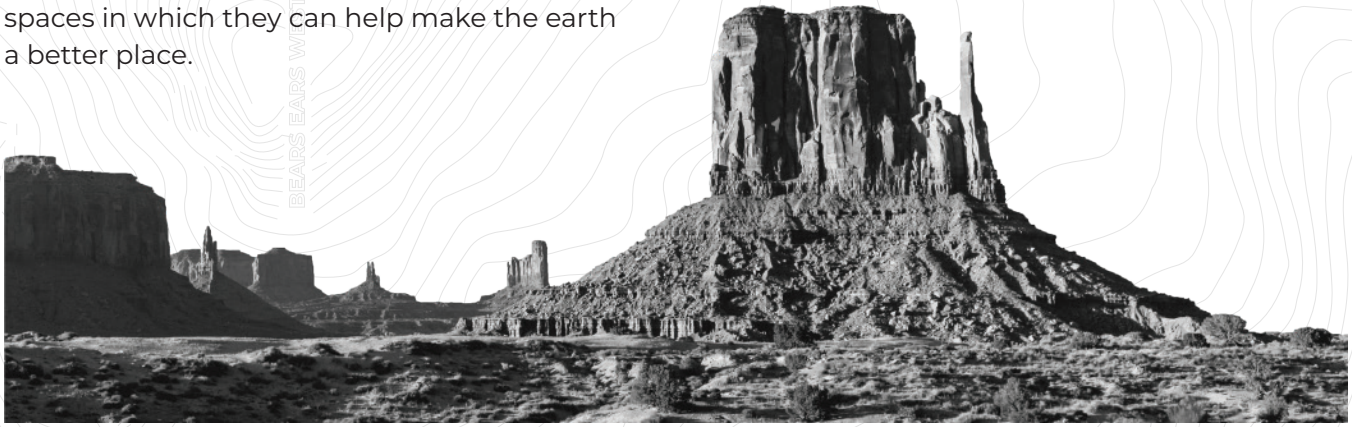
As for the earth, the earth is benefiting from the shoe because each step does less harm to mother nature. This means the landscape is becoming more sustainable and can be experienced by more people while doing less damage. People who purchase the shoe are much more likely to become sustainability activists and will start recognizing other spaces in which they can help make the earth a better place.

3 PRIMARY USERS

User
- Provides Stability
- Extra Comfort
- Pain Relief
- Injury Prevention

BLM
- Less Trail Maintenance
- Longer Lasting Trails
- More visitors
- Saved money goes into other projects

Earth
- Less Damage to trails
- Sustainable
- Sustainability activists



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Closing Statements

CONCLUSION

As I designer I have been incredibly selfish when it comes to my projects, oftentimes I only think about how the user can benefit from my work. Companies are pushing these sustainable movements where they are creating all this attention about how they use sustainable materials and how they are reducing their carbon footprint which is great, but we all seem to disregard the earth as a user of our products. The earth is a user of all of our products whether she wants to be or not. Sustainable Steps may not be making a huge change in the grand scheme of things, but it is definitely a step in the right direction.

Moving forward I want to make sure that I continue to think of the earth as a user for all of my projects. I want to help leave the earth in a better place than when I entered it and good design is the solution to a lot of our sustainability issues. Sustainability initiatives need to be taken across the industry. Understanding the whole lifecycle of every product, from shoes to computers is important when trying to design a better, more sustainable future.

Bibliography

CONCLUSION

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3799134.pdf

https://www.extension.purdue.edu/extmedia/FNR/FNR-121.pdf

https://www.nytimes.com/1981/05/18/us/hikers-heavy-boots-called-a-peril-to-tender-trails.html

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5702506/

https://jfootankleres.biomedcentral.com/articles/10.1186/s13047-015-0105-6

https://www.mayoclinicproceedings.org/article/S0025-6196

https://www.alltrails.com/parks/us/utah/bears-ears-national-monument

https://www.podiatrytoday.com/blogged/what-studies-reveal-about-torsional-stiffness-and-injury-risk-athletes

https://www.blm.gov/visit/bears-ears-national-monument

https://www.blm.gov/node/9857

https://www.blm.gov/programs/national-conservation-lands/utah/bears-ears-national-monument/know-before-you-go

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4926450/

https://care.diabetesjournals.org/content/26/5/1435

https://www.verywellmind.com/what-is-compliance-2795888

https://extension.usu.edu/iort/ou-files/San-Juan-Co_JZ_rev.pdf

https://utah.hometownlocator.com/features/cultural,class,locale,scfips,49037,startrow,1.cfm

https://earthjustice.org/news/press/2020/bears-ears-grand-staircase-trump-administration-finalizes-plans-drilling-grazing?

https://www.washingtonpost.com/graphics/2019/national/bears-ears/

https://www.webmd.com/pain-management/what-are-shoe-orthotics#1

http://conceptkicks.com/origami-inspired-tread-patterns/

https://www.mayoclinicproceedings.org/article/S0025-6196(12)61642-5/pdf

https://www.podiatrytoday.com/blogged/what-studies-reveal-about-torsional-stiffness-and-injury-risk-athletes

Colophon

CONCLUSION

MARGINS

This project deck was assembled using a quarter inch grid. There is a .75 inch margin on the left and right sides of the page. The title of every page is left aligned 1.25 inches down on every page. The bottom margin is 1 inch and page number and logos are aligned .25 inches from the bottom. There is a bears ears topographic map which spans every page over a 7.5x10 inch space.

TYPEFACE

This project deck uses 2 typefaces.
The Titles use Bebas Neue Pro with bold styling at 36 pt font.
The Sub Titles use Montserrat in all caps with a bold styling at a 12 pt font.
The body paragraph use Montserrat with regular styling at a 10 pt font. Bold and italic styling is used when approprite to highlight quotes and breaks in paragraphs.
Page numbers use Montserrat with a bold styling at 12 point font.

COLOR GUIDE

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Acknowledgments

CONCLUSION

I want to give a special thank you to Elpitha Tsoutsounakis for guiding me through this project and sitting me down and asking what I wanted to do with this project. Without her guidance and support, I would have been lost and I would have been stuck designing something that I wasn't passionate about.

I want to give another special thanks to Jesse Butterfield for the excellent and supportive critique along the way. I really appreciate him for going the extra mile with me on this project and sending me to excellent websites that would help guide my design process.

I want to thank the Bureau of Land Management for allowing our class to invade their lives with crazy design concepts and trusting that we could make something amazing along the way. Thank you for the insightful critique and for allowing us to experience the beauty of Bears Ears through your stories. You guys were extremely helpful and you helped make this project what it is.