COMMERCIAL OPPORTUNITY
Broader Societal Need

Current EPA **stormwater** management **requirements** include the design and construction of **best management practice** (**BMPs**) that will be functional once a site is developed. BMPs that manage already concentrated flow must manage both the water itself and any pollutants that have been transported with it. A revolutionary strategy is needed to improve the performance of existing **stormwater BMP requirements**; to undo the human impact on the natural processes that serve to concentrate runoff in streams and rivers where it is much more difficult to treat. The installation and use of the device proposed for proof-of-concept funding in this SBIR Phase I proposal is that revolutionary strategy. It works by redistributing **stormwater** throughout a site so as to reduce the overland flow that transports pollutants to streams and to increase the subsurface flow that removes pollutants and provides the constant stream baseflow needed to support aquatic ecosystems.

Market

We will initially launch our product in one or two regions in the US where we have identified, through interviews conducted in the NSF I-Corps Program, the ideal combination of characteristics of population density, strict local/regional **regulations**, and easy access to raw materials. Starting in just one or two regions will help insure that we are not spreading ourselves too thinly. One possible starting region is California, which has our ideal characteristics, including a **stormwater** management hierarchy in metropolitan areas with **infiltration** second only to capture and reuse. The revenue potential of the land development industry in the US in 2017 was $11.4B. Assuming that on a given project, 25% of the project cost can go towards **stormwater** management, as stated in interviews by consulting civil engineers, the total available market would be $2.85B/year. If we assume that California's GDP percentage of the US GDP, 13.5%, can be related to their percentage of land development, we get a served available market of $390M/year. If we then look at the percentage of Californians who live in a community of over 10,000 people, 63%, we can calculate our target market for one year in California as $245.7M.

Our cost of production is based off of a 100-year storm on a five-acre development. For reference, this site would utilize something like a one-acre detention basin to manage its **stormwater** (reducing potential development to four acres) and would cost upwards of $50,000 (discovered through interviews). We calculated a linear foot unit cost of $4.33 taking into account raw materials, transportation of these materials to the manufacturing facility, and labor to make the units. Assuming that 8,712 lineal feet of the device would be required to manage the 100-year storm gave us a cost of $37,722, we then added in a $5,000 cost for R&D, sales, and G&A resulting in a cost of production of $42,722. Adding in a 20% profit of $8,544.40 gave us a total product cost of $51,266. The customer will need to pay to ship the units to the site and to excavate for the units' placement, but the increase in developable land and the increased flexibility to spread the installation around a site and under green space and landscaping more than make up for the additional cost, allowing us to use value based pricing for our installation. For example, in the Greater Los Angeles area, office property rents for an average of $2.73/ft^2/month. If we make the conservative assumption that we can reduce the one-acre of land required to manage stormwater to a half-acre, and the other half-acre is used to build a three-story office building, we have added over $2M in rental revenue per year.

Market Opportunity Validation and Basic Business Model

The two aspects of our product's market opportunity that needed to be validated were: **(1)** does **stormwater** have to be managed and **(2)** are the current solutions satisfactory? The first is validated through regulatory **requirements** in the CWA and the implementing **regulations**, requiring management of **stormwater** runoff after development; local **regulations** may interpret this as requiring a reduction of the peak discharge to what it was before development. Reducing the peak discharge can be accomplished through a variety of BMPs, which brings us to the second aspect. Interviews over the past year with engineers, regulators, property developers, installers, and other **stormwater** management technology companies demonstrated that, although regulators are approving plans and developers and engineers are implementing management methods, neither party is entirely satisfied with the current solutions.

The regulators realize that engineers often do the best they can do with the options available while being fiscally responsible, but the solutions are not producing the results they would like to see in terms of real impact on **stormwater** runoff quality and quantity. Meanwhile, engineers and developers want a solution that allows for maximum land development and minimum cost, a balance that is not easily struck.

Our technology will benefit both sides of the relationship by providing a revolutionary management solution that mimics natural processes to prevent the transport of pollutants to streams, provide the continuous stream flow that supports aquatic life, and reduce erosion and flooding downstream and allows for a lower overall project cost and greater developable land. Our technology will change the way the **stormwater** industry works by showing that a solution based upon natural processes can meet the needs of the regulators and the developers. There is a desire for different and better solutions, especially as **infiltration** and low impact development begin to be preferred and sometimes required. We also learned about other aspects needed in order to provide a complete solution: easy maintenance, straightforward installation and design, efficient use of space, and to be at least somewhat aesthetically pleasing. This showed us that the second aspect of our product's market opportunity is validated as well.

Through our interviews we learned about whom our customers are and what motivates them. There are two components to our customer because the property developer pays for the physical product, but in interviews we conducted with property developers, they told us they rely on the professional judgment of the engineers to specify practices to meet the technical and regulatory **requirements**. Thus, we need to reach and engage with engineers. The engineering archetype is a licensed professional civil engineer who works at a consulting firm on the water and site components of development projects. They are 30-50 years old and at the point in their career where they have the authority on their projects to make choices on methods and products used. They are also interested in trying new and better products and processes to solve their engineering problems. The budgets on the projects they work on vary but can be hundreds of thousands of dollars. They are motivated by **regulation**, serving clients, and reducing negative environmental impacts and are influenced by professional organizations and their colleagues.

Our business model is based off of work we did with the Business Model Canvas in the I-Corps Program and customer discovery. We will sell subscriptions to our online design software tool to engineers to design the system of units efficiently and then sell systems of physical units to property developers. Property developers and engineers will want to use our product because it will meet regulatory **requirements**, allow for additional developable land on a site, create a positive environmental impact, be aesthetically pleasing, decrease design time, be straightforward to install, and easy to maintain.

Competition

Our competition falls into two different categories: **(1)** non-proprietary **BMPs** and **(2)** proprietary or manufactured **BMPs**. Examples of non-proprietary **BMPs** are basins and swales. Many non-proprietary **BMPs** in use are widely accepted by regulatory bodies and their design and installation are often outlined in manuals and design software created by the regulatory bodies. They are not often composed of expensive components but their installation and maintenance can be difficult and they can have a large footprint on a site, reducing the amount of developable land on a site, thus reducing revenue. Both basins and swales have issues with maintenance and size. An example of a manufactured **BMP** is a below ground detention system. Manufactured **BMPs** for quantity management are also generally accepted, once they successfully demonstrate that they work on test sites. The regulating agency is not likely to provide design guidelines for them. These devices can be expensive but the companies that produce them often provide design and installation software and information. They typically are used for their smaller footprint on sites. Maintenance and installation vary depending on which product is used but it can still be cumbersome. Below ground detention systems have high maintenance requirements and cost.

Basins reduce the peak of the runoff hydrograph from the impervious surfaces by holding and slowly releasing water to a storm sewer or stream. They are constructed by excavating the volume of soil required to produce the necessary size basin and then fitted with piping to allow for the release of collected water. A detention (dry) basin needs to be mowed regularly and can be an eyesore according to property developers. For a retention (wet) basin, landscaping maintenance needs to be performed leaks need to be fixed, make-up water needs to be added during dry periods, and vermin must be controlled.

Swales reduce the peak hydrograph by collecting runoff from impervious surfaces and by slowing and infiltrating the water locally. Swales and our system must both be careful not to impact the soil structure and require precise slope construction, but swales must be constructed on the contour line while our device can more easily fit the site landscape. Because the water in the swale must evaporate or infiltrate in a few days, they may need to be quite large or many may need to be constructed on a site. Maintenance is a big issue, as the vegetation within the swale needs to be taken care of every few months and sediment that collects needs to be removed.

One installation that may seem similar to our technology is the French drain, however they have very different functions and purposes. French drains are composed of a sloped trench with gravel and a perforated pipe laid at the bottom. Additional gravel is placed on top of the pipe, filter fabric is placed over the gravel, and soil is replaced on top They are used to convey water, such as may exist around a foundation or any other saturated area, away from the site to protect the foundation or allow for other land uses such as gardening. They may also be used as under drains in conjunction with **stormwater** management methods such as pervious pavement. Their goal is to move water as quickly as possible, mainly through a pipe, from inlet to outflow point. They are not designed to slow the flow, filter or infiltrate water into the soil.

Below ground detention systems can be pipes, arched chambers, vaults, or attenuation crates. They reduce the peak of the runoff hydrograph by holding water and slowly releasing it. Some can include **infiltration** aspects, but it is localized, and with the extensive land work required, soil is compacted, reducing its ability to infiltrate water. This solution is often used for large projects in urban areas where a lot of water needs to be managed and where land is expensive. Maintenance can involve vacuuming out sediment from the units themselves or from a pretreatment device. The major downside of this solution is the cost of the product, the extensive excavation required for installation, and the lack of environmental benefits.

Our technology and the competing technologies all reduce the peak of the runoff hydrograph. However, the increase in developable land, the increased aesthetics, the ability to mimic natural processes, a streamlined design process, and the ease of installation and maintenance allow our device to generate an overall more cost effective and environmentally focused solution. In contrast to the shortcomings of these competitors our device works to spread the collected **stormwater** out over a larger area to allow it to infiltrate into the surrounding soil, it takes up a smaller area and the area that is required could be under already planned landscaping and could be spread out around a site, maintenance for our system will include cleaning out an easy to access sedimentation basin and regular landscaping for the site, it can be placed by hand, and it only requires shallow excavation. Additionally, we will provide a software tool to assist in design.

By the time our product enters the market we expect more products and methods that try to mimic natural processes to be available. As communities and their regulating bodies move more towards low impact design and utilizing more natural processes, the industry will adapt and move in that direction as well. We will be at the forefront of meeting this new demand in the **stormwater** industry.

Key Risks

The key risks in bringing our innovation to market involve the functioning of the device and its entrance into an established market. If successful, our product will change how the **stormwater** industry works. Regulating agencies will have evidence that a management method that mimics natural processes can be a viable solution on a wide range of projects from management and economic viewpoints. This could lead to more widespread **requirements** for management practices that focus on mimicking natural processes, which would be beneficial for our company, Infiltronics Environmental. Consulting civil engineers will have a new method to employ on their projects that would meet regulatory and project **requirements** while producing positive environmental impacts. As we transform the industry, the risk of sabotage and eventually imitation by other companies in the industry is possible. Data, case studies, high-quality verifiable products, and design and installation services will be used to mitigate these challenges. When it comes to testing and data collection, there is uncertainty and with that, risk. Although we have produced 3D flow and continuation of flow between segments in a lab setting we have no data on how the device interacts with soil. From our research and calculations we believe it will be a complete solution for **stormwater** quantity management but until we conduct outdoor laboratory testing we will not know for sure. This testing will require a variety of soil types, large areas of land to test a variety of potential MVPs, and a time frame long enough to collect sufficient data. There are also risks that only certain soil types are suitable for the device, that the number of units required would be excessive, and that the system would not be accepted by regulatory bodies and consulting civil engineers.

Commercialization Approach

Our approach to commercialization is based upon the fundamentals learned during our NSF I-Corps experience, which will be leveraged through our engagements with both industry and commercialization experts. We are a client of the Missouri Innovation Center, a successful, non-profit, tech transfer and commercialization organization that has been assisting high-tech entrepreneurs since 1984. We have also developed a partnership with a local, professional engineering firm, Allstate Consultants LLC, from whom we have secured industry expertise as well as laboratory facilities.

To reach a dominant position in the target market we will incorporate the customer discovery data and testing results into the production of a set of **Minimum Viable Products** (**MVP**s). We must test the feasibility of our devices/system through rigorous bench, pilot and field testing. We have designed and constructed our device production system and our testing apparatus, and run numerous and iterative bench tests. During this testing we produced 3D flow and continuation of flow from one segment to the next.

With Phase I funding, we will conduct pilot testing in an outdoor laboratory setting. A variety of potential MVPs will be installed in the ground in various plots of land. These sites will contain a section of impervious cover and will feature a variety of moisture sensors and rain gauges to monitor relevant metrics, as well as sprinkler systems to control the amount of water each is subjected to. Based on the findings of our pilot studies, we will modify the devices, and the testing protocol as necessary, and concurrently reinstall them in our pilot facilities. This phase of the project is particularly important because it will produce in situ data that will allow us to see if the device works, under what configurations and conditions the device works, and to facilitate the creation of a software tool. During a potential Phase II SBIR, field testing will occur. These field test sites will be secured with the help of our industry partner and will be outfitted with the necessary equipment to collect all important data. Through this field testing, we will collect supporting data and generate case studies on how our product works and the benefits it provides. We learned from our I-Corps interviews that these data are key to creating user confidence and acceptance by regulatory entities and the engineers responsible for specifying **stormwater** management systems. Naturally, throughout these field studies, we will be validating the fixed and variable costs associated with production and distribution of the devices.

With our MVP tested and ready to be introduced to early adopters, we intend to partner with a leading water technology company, with whom we have had initial conversations, to gain access to existing distribution channels, as well as explore a mutually beneficial sales and marketing relationship. We will initially launch our product in one or two regions in the US. As our product utilization grows in the initial market we will spread to other areas with similar characteristics. Over time, as **requirements** move towards mimicking natural processes, we will continue to grow and will become a dominate player in the **stormwater** management market. Beyond the relationships we develop with key industry partners, we will develop our own robust sales and marketing efforts to get, keep and grow our customers.

To estimate our revenue, potential assumptions must be made. First, we will begin selling units after three years of development and commercialization efforts. This takes into account twelve months of Phase I feasibility work including pilot testing. Near the end of Phase I feasibility work, a proposal for Phase II funding will be completed. Assuming we receive Phase II funding, the next two years will include field testing, followed by angel investor funding, and then the initiation of large scale commercialization actions required to get us ready to sell. When we begin selling units we will do so in a market such as California. We intend to sell 10 systems during year four in this market. Each system will have an average of 8,700 lineal feet and a total cost of $52,000 per system. The software yearly subscription will be $2,000, and we assume 10 subscriptions will be purchased in the first year. Our revenue for year four will be $540,000. In year five we intend to sell 25 systems of 8,700 lineal feet with 25 new subscriptions for a total revenue of $1,350,000. At this point we will begin looking to expand to other similar markets.