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ACN 109 200 900

AUSTRALIAN SECURITIES EXCHANGE ANNOUNCEMENT

18 October 2018

MARTA Whitepaper Endorses Use of EdenCrete®

HIGHLIGHTS

The conclusions from the 2 year trial conducted by MARTA were:

- **EdenCrete® will provide significant savings to MARTA by reducing both the life cycle cost and the frequency of maintenance;**
- **MARTA to incorporate EdenCrete in both design criteria and specifications for suitable projects, as a viable value-added option; and**
- **U.S. transit departments invited to contact MARTA (and Eden) regarding the benefits and improvements that EdenCrete® can deliver.**

DETAILS

Eden Innovations Ltd ("Eden") (ASX: EDE) is delighted to announce that the Metropolitan Atlanta Rapid Transit Authority (MARTA) and Eden have completed and executed the Whitepaper documenting the joint evaluation, over two years, of the performance of EdenCrete® in a field trial at MARTA's Brady Mobility Facility in Atlanta (see Figure 1), as reported in the June 2018 Quarterly Activities Statement (ASX: EDE – 31 July 2018).

Figure 1. Brady Mobility Facility with EdenCrete® slab site being prepared (shown in upper left)

The field trial commenced on 12th May 2016 **(see Eden announcement ASX: EDE 16th May 2016)**. MARTA evaluated, over two years, the performance of EdenCrete® in concrete placed in a section of the fleet parking area identified by MARTA to receive the most aggressive, in-service conditions from turning, stopping, and parking of buses and other vehicles.

The field trial was to test the ability of EdenCrete® to improve a number of performance characteristics including the concrete's resistance to abrasive tyre wear, scaling from de-icer chemicals, and reduction of cracking. When combined, these characteristics provide concrete with a more effective defence against the ingress of moisture and chlorides and significantly greater durability and longevity.

A summary of results in the Whitepaper is set out in Tables 1 and 2 and the diagram below.

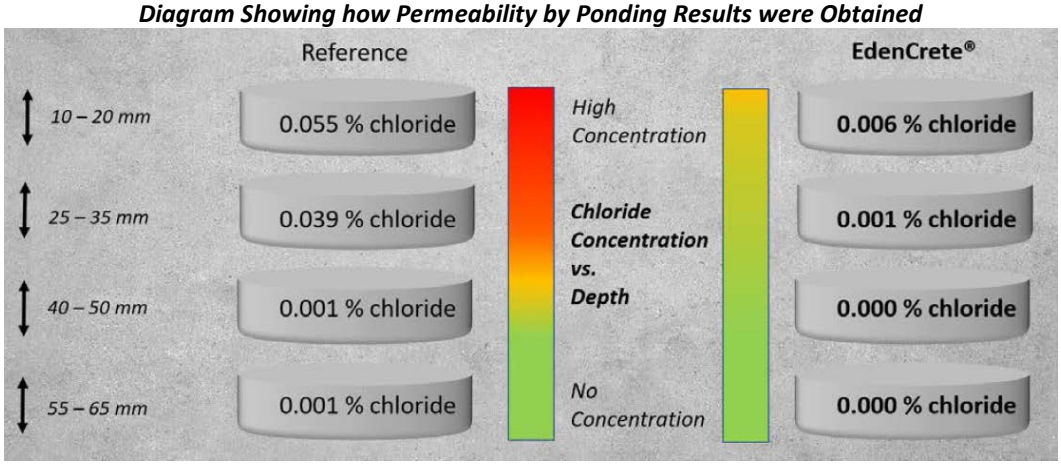
Table 1 MARTA Brady Facility - Summary of Fresh and Hardened Testing (as provided by TEC Services)

Property	Test Procedure	Reference	EdenCrete	% Improvement by EdenCrete
Air Content (%)	ASTM C231	6.1	4.0	
Slump (in.)	ASTM C 143	7.25	7.25	
Concrete Temperature (°F)	ASTM C1064	84	82	
Unit Weight (lbs./ft.^{3})	ASTM C138	140.8	145.1	
Compressive Strength	ASTM C39	6160	8490	38%
Split-Tensile Strength	ASTM C496	255	405	59%
Modulus of Elasticity	ASTM C469	3161600	3933767	24%
Abrasion Resistance	ASTM C944	0.17	0.08	47%
Length Change	ASTM C157	0.048	0.044	9%

Table 2: MARTA Brady Facility - Permeability by Ponding Results (as provided by TEC Services; ASTM C1543)

Chloride Content (Wt. %)			
Depth (mm)	Control Mix - Not Ponded	Control Mix - Ponded	Penetrated Chloride Values
10 - 20	0.004	0.059	**0.055**
25 - 35	0.006	0.045	**0.039**
40 - 50	0.004	0.005	**0.001**
55 - 65	0.003	0.004	**0.001**
Depth (mm)	Test Mix - Not Ponded	Test Mix - Ponded	Penetrated Chloride Values
10 - 20	0.006	0.012	**0.006**
25 - 35	0.004	0.005	**0.001**
40 - 50	0.004	0.004	**0.000**
55 - 65	0.003	0.003	**0.000**

Diagram Showing how Permeability by Ponding Results were Obtained



Figures 2 and 3 below are photographs showing the comparative performance of EdenCrete®-enriched concrete compared with the standard concrete mix.

Figure 2: MARTA Brady Facility – Reference slab showing significant abrasion (Left) and EdenCrete® slab showing minimal surface abrasion (Right) in the same period of time

Figure 3: MARTA Brady Facility – EdenCrete slab (Left of joint) adjacent to Reference slab (Right of joint)

A copy of the full Whitepaper is annexed (see Annexure 1).

Conclusion in Whitepaper

The very important conclusion from the two years trial was:

> *"The results of lab testing indicate the inclusion of EdenCrete® will provide a significant extension of service life to the concrete. MARTA's use of EdenCrete® is anticipated to extend the service life and reduce the frequency of maintenance projects to keep the parking areas in service. Progressive site visits over the course of 2 years in-service show the EdenCrete® sections outperforming the adjacent sections of standard concrete. The surface of the reference is abrading significantly more irregularly, and rapidly, than the surface of the slabs containing EdenCrete®.*
>
> *Over time, the reduced maintenance schedule and longer service life before needing replacement will outweigh any upfront cost of EdenCrete®. Testing also indicates that dosages of EdenCrete® below 3 gal./yd.^{3} of concrete (used in the Brady evaluation) will perform successfully in a similar environment. Lower dosages of EdenCrete® around 1.0 to 1.5 gal./yd.^{3} are anticipated to perform successfully for MARTA, while providing a savings beyond that which was trialed at the Brady facility in 2016.*
>
> *MARTA chose to undertake this evaluation based on the success GDOT has had with EdenCrete® to date. According to David Springstead, responsible for MARTA AGM Capital Programs & Development:*
>
> > *"With GDOT's specification of EdenCrete in mix design, MARTA will look to incorporate EdenCrete in both design criteria and specifications as a viable value-added option."*
>
> *The implementation of EdenCrete® into projects or applications deemed appropriate by MARTA will provide savings by reducing the life cycle cost of the concrete and reducing the frequency of disruptive maintenance projects which affect both operations and the revenue stream.*
>
> *Transit departments across the nation are encouraged to contact MARTA and Eden Innovations personnel listed below with any questions regarding the use of EdenCrete® and how it can improve concrete applications across the spectrum of use."*

Conclusion

This Whitepaper represents a very important milestone For EdenCrete® in its quest to expand its growing footprint into the huge U.S. infrastructure market because:

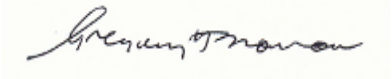
- It is the first comprehensive, written evaluation by engineers of a successful, longer-term trial of EdenCrete® in a U.S. infrastructure project;
- It provides a detailed assessment of the outstanding performance of EdenCrete® in relation to a wide range of performance characteristics;
- It gives rise to the strong probability of EdenCrete® being used by MARTA in suitable projects;
- It announces that MARTA is prepared to provide advice to other transit agencies across the U.S. about EdenCrete®;
- It will be of enormous assistance in Eden's future marketing activities, throughout not only the United States of America, but also in other countries, because it is a detailed technical review by a leading U.S. transit authority of a long field trial; and

- MARTA is the primary public transport operator in Atlanta, the sixth fastest growing metropolitan area in the U.S., with population that is expected to reach 8 million by 2020. MARTA operates a network of bus routes and a rapid transit system consisting of 48 miles (77km) of rail track with 38 train stations. It carries, in total, over 430,000 passengers per day, the sixth largest number of any U.S. city. A number of alternatives for expansion are being considered which could generate significant opportunities for the use of EdenCrete® in new projects. MARTA also undertakes considerable annual maintenance.

BACKGROUND

EdenCrete® is Eden's 100% owned, proprietary carbon-strengthened concrete additive, that enhances a wide range of performance characteristics of the concrete including compressive strength, flexural strength, tensile strength, abrasion resistance, reduced permeability and reduced shrinkage, thereby delivering stronger, tougher, more durable and longer lasting concrete.

One of the primary target markets for EdenCrete® is improving the performance of concrete used in the construction and maintenance of concrete roads, bridges and other infrastructure, particularly where it is subject to heavy wear, freeze/thaw weather conditions and/or high levels of added salt. Additionally, it has potential for use in most other concrete applications including high-rise building construction, marine and coastal applications, water storage and pipelines, hardstand areas, and pre-stressed and pre-cast concrete structures and products.



Gregory H. Solomon
Executive Chairman

ANNEXURE 1 – Whitepaper

Date: October 11, 2018

Subject: MARTA – Evaluation of performance of EdenCrete® at the Brady Mobility Facility

MARTA's Challenge – construct for durability for the long term

For the Metropolitan Atlanta Rapid Transit Authority (MARTA) transportation facilities, the general performance of the concrete placed in areas where they park their mobility fleets has a significant impact on operations, including facilities management and maintenance. MARTA, owns facilities which are home to various fleets of vehicles used throughout Atlanta to shuttle the public. Subjected to a high volume of commercial vehicles whose repetitive, rotational tire friction abrade the surface of the concrete in these parking areas, the concrete is used and abused daily. Winter conditions and deicer chemicals used to keep the motoring public safe are detrimental to the life of concrete, particularly if the surface does not remain intact during in-service conditions. The ability to keep moisture and chlorides out of the concrete used at MARTA's facilities is very important, and will extend its' life significantly, reducing the need for frequent maintenance. There are three primary mechanisms by which moisture and chlorides commonly ingress and damage concrete, an abraded surface, a scaled surface, and/or a cracked surface.

At the Brady Mobility Facility in Northwest Atlanta, a mobility fleet of 200+ buses are housed on a large concrete parking slab (on grade) where they receive the services required to function; maintenance, dispatch, washing, fueling, parking, etc. The buses drive and turn slowly across the slab, causing tires to aggressively abrade the surface of the concrete when simply entering/exiting, or driving to receive services within the property. At the end of each day, all the vehicles return to the Brady facility where they go through a series of maintenance stations before being staged for the next day's operation. With time and enough use, abrasion from turning tires can create unsafe conditions due to a lack of frictional response when vehicles are braking or turning on a wet or oily surface. The ability to keep the surface of the concrete intact is important to safe driving, but it is particularly critical to the safe operation of transportation facilities. To maintain good friction on concrete surfaces within aggressive parking areas, the concrete should be designed with a higher resistance to abrasion.

During winter weather conditions, vehicles returning from service will be coated with deicer salts placed by Georgia's Department of Transportation. While intended to keep road conditions safe for the motoring public, deicer salts drip down with the melting snow and accumulate under parked vehicles, pooling on the concrete around the tires. When salt and moisture penetrate the pore structure of concrete, the inherent chlorides chemically degrade the surface and internal structure of the concrete, causing scaling and problems which will ultimately lead to reduced durability and increased life cycle costs (e.g. corrosion of steel reinforcement, damage from freeze/thaw, joint rot, scaling, alkali-silica reaction, and sulphate attack). Depending upon the number of freeze/thaw cycles for a given season, joint rot and deicer salt scaling can occur over the course of a single winter. To combat the problem of deicer scaling, the permeability of the concrete should be reduced by design. Concrete with lower permeability has less porosity within the capillary structure, reducing the pathways in which chlorides can percolate down into the cement matrix and cause damage. Lowering the permeability should extend the life of concrete placed in regions using deicer road salt and brines on their roadways.

Any type of cracking provides a point of access where moisture may access the concrete structure. With time, cracking may occur due to drying/thermal shrinkage, improper jointing, weight transfer across uneven concrete surfaces, or when the surface of concrete is abraded to the point where the capillary structure is opened. Cracks, regardless of the cause, will allow chlorides to penetrate inward and jeopardize the durability of concrete on an accelerated schedule; increasing the frequency of maintenance repairs (i.e., increasing costs). During repair work, a section (or multiple sections) of the parking lot will be roped out of service for as long as two to three days, reducing space for vehicle movement and parking. The Brady facility is designed to support 200+ buses in a mobility fleet, so any concrete repair work has a significant impact on the general maintenance, dispatch, and service operations for MARTA. Ultimately, disruptions from concrete repair work at an otherwise fully functional facility, equates to lost revenue.

In today's construction industry, challenging in-service conditions and shortened construction schedules make it difficult to place good-quality concrete while meeting the demands of the project. Traditional design methods must now be incorporated with unique raw materials and new age technologies to create a superior level of concrete performance. New technologies are a necessary part of good-quality concrete in construction projects of today.

Options to Meet the Challenge

What is defined as good-quality concrete for a given project can vary quite extensively. In recent years, countless new technologies have been developed to enhance concrete performance, including chemical admixtures.

Depending upon the region, supplementary cementitious materials (SCMs) such as fly ash, slag, and silica fume are commonly used to reduce the permeability of concrete, while improving the strength and durability. When used, SCMs replace a percentage of the cement in the concrete mix design. From a sustainability aspect, replacing cement by using SCMs can be desirable due to the high level of carbon dioxide emitted during the cement manufacturing process. Fly ash and slag can improve the fresh properties and reduce the permeability of concrete, but this is at the cost of early strength development. In FastTrack construction applications, this delay in early-strength development is not an option. As such, the ability to resist abrasive wear would also be delayed beyond what is acceptable in many of today's accelerated construction schedules.

Silica fume is effective in reducing permeability while increasing strength (at all ages), but it is very expensive, often exceeding the cost of cement. It is only available in ~50 lb. bags which must be cut open and dumped into the truck, releasing harmful airborne particles which are a respiratory risk to workers using the product. The added step of throwing silica fume into the truck is not only a labor cost, but it is unsafe to have workers climbing up/down a truck and working so close to the concrete drum. The incorporation of silica fume can create undesirable effects on the fresh properties of the concrete, increasing the water demand and the need for additional chemicals to produce concrete which can be reasonably placed and finished. For those reasons, silica fume is often excluded from the mix designs for ready-mix concrete producers.

Over the years, the concrete industry has developed countless chemical admixtures capable of providing a variety of unique benefits to concrete. Chemical admixtures are commonly used to change the

concrete properties, but typically one admixture is designed to improve only one property; e.g., air entrainment, shrinkage reduction, water reduction, surface hardness. When admixtures made by different manufacturers are mixed together to improve several properties at once, there may exist incompatibilities at the chemical level. Many times, this causes inconsistent effects to the fresh and hardened properties that can be extremely difficult to control at the plant, yet alone understand. To reduce a potential incompatibility, it is always a good idea to minimize the total number of chemicals used in a single concrete mix, particularly those from different manufacturers.

EdenCrete® is a liquid chemical admixture for concrete which is infused with carbon-nanotubes, and is manufactured by Eden Innovations LLC (Eden) in Littleton, CO. It is classified as a Type S chemical admixture for special performance in concrete, as defined by ASTM C494. EdenCrete® improves the durability and strength of concrete by densifying the cement paste matrix and reducing the overall permeability. The use of EdenCrete® in MARTA's projects is intended to extend the service life of the concrete placed in parking areas and to reduce the frequency of maintenance projects which disrupt the day-to-day operations of a mobility fleet hub.

MARTA Brady Mobility Facility - Trial Evaluation of EdenCrete®

The MARTA Brady Mobility facility is home to administrative functions, operations, and maintenance for a fleet of 200+ Mobility vehicles (specialized vans and cutaway buses). The MARTA Brady facility is approximately 78,200 ft.^{2}, sitting on 11 acres with an estimated total project cost of $38, 000,000. The new facility was built on the exact site where the previous facility was located before demolition and was completed in May 2016. Realizing the significant impact that a concrete repair project can have on the business operations at a facility such as Brady, MARTA reviewed the latest technologies being evaluated by the Georgia Department of Transportation (GDOT), and decided to evaluate EdenCrete® as a solution for the challenges described above.

MARTA chose to evaluate EdenCrete® in a trial section of the fleet parking area identified to receive the most aggressive, in-service conditions from turning, stopping, and parking vehicles.. The purpose of including EdenCrete® in the trial is to improve the concrete's resistance to abrasive tire wear, scaling from deicer chemicals, and to reduce cracking. When combined, these properties provide further defense to reduce the ingress of moisture and chlorides. EdenCrete® is a liquid additive and has negligible effect on the fresh properties of the concrete while simultaneously improving multiple properties, unlike using SCMs and admixture cocktails which can negatively impact the fresh properties and/or have interaction or incompatibility issues. On May 12, 2016, MARTA placed a section of approximately 150 yd.^{3} of concrete containing EdenCrete®, at a dosage equal to 3 gal./yd.^{3} of concrete, at the Brady facility.

ARGOS Ready Mix supplied the concrete from their plant, located at 342 Armour Dr. NE, in Atlanta, GA. TEC Services is a MARTA-approved test lab and was contracted by Eden to be on-site at the plant to test and ensure fresh properties met design specifications, as well as to fabricate test samples for strength and durability testing at later ages. It was agreed upon between engineers for both Eden and MARTA, that TEC would test compressive strength, abrasion resistance, and permeability by ponding. To demonstrate the full potential of the EdenCrete® admixture, Eden also chose to include split-tensile strength, modulus of elasticity (MOE), and length change in the test program.

Trucks were loaded with concrete at the plant in the normal fashion, before driving 100 feet where the EdenCrete® was added using a mobile system and a dispensing wand. The drivers were asked to spin their drums an additional 70+ revolutions after the admixture was dosed and before providing technicians a sample for testing. For comparison, later in the day ARGOS was kind enough to provide a truck containing the same concrete mix, but without the EdenCrete® admixture, to be used as a reference. During the batch process, it is important to note that the water content between the EdenCrete® trucks and the reference was held constant, by subtracting the volume of EdenCrete® from the design water content in the computer.

Testing was conducted at the plant to eliminate any influence of water added to the truck at the site by the finishing crew. Table 1 provides a summary of the reference mix design.

Table 1: MARTA Brady Facility – Concrete Mix Design

Item	Weight	Unit
Buzzi Type I/II	532	lbs.
Boral CFlyAsh	178	lbs.
#57 Stone	1138	lbs.
#4 Stone	615	lbs.
Sand	1097	lbs.
Water	283	lbs.
AEA	3.0	oz.
WRNL	28.4	oz.
HRWR	24.85	oz.

Results and Analysis:

Table 2 below provides a summary of the fresh and hardened properties as tested by technicians from TEC Services.

Table 2: MARTA Brady Facility - Summary of Fresh and Hardened Testing (as provided by TEC Services)

Property	Test Procedure	Reference	EdenCrete	% Improvement by EdenCrete
Air Content (%)	ASTM C231	6.1	4.0	[redacted]
Slump (in.)	ASTM C 143	7.25	7.25	
Concrete Temperature (°F)	ASTM C1064	84	82	
Unit Weight (lbs./ft.^{3})	ASTM C138	140.8	145.1	
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Compressive Strength	ASTM C39	6160	8490	38%
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Abrasion Resistance	ASTM C944	0.17	0.08	47%
Length Change	ASTM C157	0.048	0.044	9%

Per MARTA's direction, the only required testing was done to ensure the concrete was within design specifications. All mixes were within job specifications before leaving the plant, with slump as the primary focus to ensure placement was possible in the Georgia heat. A difference of 2% in air content was measured between the EdenCrete and reference mixes, but both were within job specifications and

released for the site. The results of the lab testing demonstrate EdenCrete's® superior performance over the reference concrete, with regards to strength and ductility, beyond what would be provided by a 2% difference in air content.

The incorporation of EdenCrete® improved the concrete's resistance to abrasive wear by greater than 40%. Based upon lab results, the in-service performance of EdenCrete® is anticipated to significantly exceed that of the reference concrete, helping to extend the life cycle of the concrete and minimize the loss of frictional response between the concrete and vehicle tires.

During fabrication of length change specimens, technicians were removing the #4 and larger stone by eye because they did not have the proper wet sieve. As a result, it is believed that the influence of oversized stone in the forms may have contributed to such a low percentage improvement in shrinkage over the reference. Regardless, the shrinkage (length change) was reduced by nearly 10% with the incorporation of EdenCrete®.

Permeability was measured using ASTM C1543, or Permeability by Ponding. This is a common method employed by GDOT and MARTA to determine the ability of concrete to resist moisture ingress over time. The results from permeability testing are provided in tabular format in Table 3, while Figure 1 illustrates the percolation of moisture as a function of depth as an indication of the concrete permeability.

Table 3: MARTA Brady Facility - Permeability by Ponding Results (as provided by TEC Services; ASTM C1543)

Chloride Content (Wt. %)			
Depth (mm)	Control Mix - Not Ponded	Control Mix - Ponded	Penetrated Chloride Values
10 - 20	0.004	0.059	**0.055**
25 - 35	0.006	0.045	**0.039**
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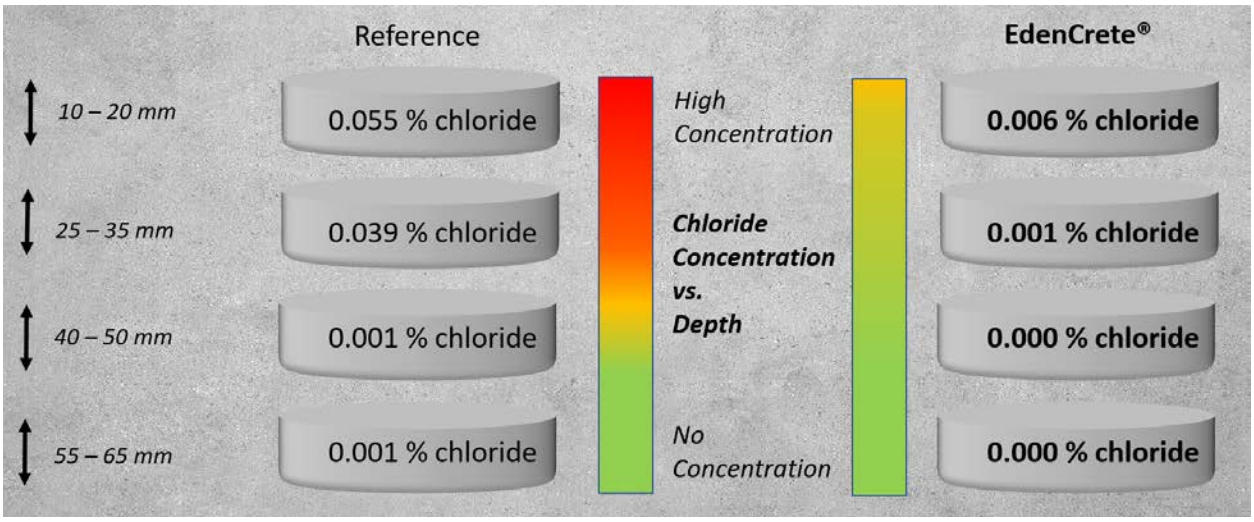

Figure 1: MARTA Brady Facility - Permeability by Ponding Results (as provided by TEC Services; ASTM C1543)

The results of the lab testing indicate a dramatic improvement in permeability. The maximum depth at which any level of chloride was detected in the EdenCrete® samples is near 1 inch, versus 2in.+ for the reference samples. In a typical reinforced concrete slab, there is only 1.5 to 2.0 inches of concrete over the topmost piece of steel, known as 'cover.' In the reference sample, the chlorides have penetrated deeply enough to reach the reinforcing steel, often resulting in corrosion. For a slab on grade in a MARTA parking area, this translates to a significant reduction in the ability of moisture and chlorides to penetrate the concrete matrix and deteriorate its' performance.

Final Field Evaluation – June 2018

A tour of the facility in June 2018 revealed the slab containing EdenCrete® to be performing extremely well, with no cracking, joint rot, scaling, or abrasion occurring on the surface. The slab containing EdenCrete has a brighter albedo, which is often indicative of concrete having low permeability due to the lack of discoloring in the surface pore structure. In Figure 2, the picture shows the reference slabs to be experiencing significant abrasion. In Figure 3, the picture shows the joint side of the reference slab to be cracked (on the right and parallel to joint), and the surface is abraded. On the left side, the EdenCrete® slab is undamaged in the field and/or the joints and is showing minimal indication of abrasion due to the frictional wear of turning vehicle tires.

Figure 2: MARTA Brady Facility – Reference slab showing significant abrasion (Left) and EdenCrete® slab showing minimal surface abrasion (Right) in the same period of time

Figure 3: MARTA Brady Facility – EdenCrete slab (Left of joint) adjacent to Reference slab (Right of joint)

Figure 4: MARTA Brady Facility – EdenCrete® slab outlined with border

Conclusion:

The results of lab testing indicate the inclusion of EdenCrete® will provide a significant extension of service life to the concrete. MARTA's use of EdenCrete® is anticipated to extend the service life and reduce the frequency of maintenance projects to keep the parking areas in service. Progressive site visits over the course of 2 years in-service show the EdenCrete® sections outperforming the adjacent sections of standard concrete. The surface of the reference is abrading significantly more irregularly, and rapidly, than the surface of the slabs containing EdenCrete®.

Over time, the reduced maintenance schedule and longer service life before needing replacement will outweigh any upfront cost of EdenCrete®. Testing also indicates that dosages of EdenCrete® below 3 gal./yd.^{3} of concrete (used in the Brady evaluation) will perform successfully in a similar environment. Lower dosages of EdenCrete® around 1.0 to 1.5 gal./yd.^{3} are anticipated to perform successfully for MARTA, while providing a savings beyond that which was trialed at the Brady facility in 2016.

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design criteria and specifications as a viable value-added option." The implementation of EdenCrete® into projects or applications deemed appropriate by MARTA will provide savings by reducing the life cycle cost of the concrete and reducing the frequency of disruptive maintenance projects which affect both operations and the revenue stream. Transit departments across the nation are encouraged to contact MARTA and Eden Innovations personnel listed below with any questions regarding the use of EdenCrete® and how it can improve concrete applications across the spectrum of use.

Signed:	Signed:
MARTA David Springstead AGM Capital Programs & Development	Eden Innovations LLC Robert Cavaliero Product Manager