CITY OF FLAGSTAFF
SDB, INC.

CINDER LAKE LANDFILL FEASIBILITY STUDY-LANDFILL MINING AND EXCAVATION PLAN-CELLS A, C, & D

CITY OF FLAGSTAFF FILE NUMBER 20-431-00

PROJECT NUMBER SW-0631

9/14/2015

FEASIBILITY STUDY

EXECUTIVE SUMMARY

This feasibility study is being conducted by the City of Flagstaff (City) Cinder Lake Landfill (CLL) with the assistance of SDB, Inc. The intent of this Feasibility Study is to provide guidance for the best approach for gaining airspace within existing portions of Cinder Lake Landfill, in particular Sequences A, C, and D. CLL's Solid Waste Facility Plan (Facility Plan) contains prescriptive design measures that are meant to provide a general overview of the final design of the landfill. The design is not a certified construction-set, and therefore does not provide specifications or details that would be required for a qualified contractor.

When the Facility Plan was drafted (1999), the engineer of record assumed that the City had no desire for soil beyond the elevation of the bedrock. The engineer of record also recognized that there was a deficit of 1 to 3 million cubic yards (yd^3) of soil, and that additional sources of soil would need to be found.

In anticipation of the soil deficit, staff explored methods to find alternative sources of cover materials. In November, 1998 the City received approval to implement alternative daily cover (ADC) in the form of paper millings from SCA Tissue (Flagstaff). Today, the soil deficit still exists at approximately 1.4 million yd^3. In an effort to further decrease the gap, staff proposes to re-capture portions of buried solid waste and use it as a form of ADC. Previous studies indicate that the extraction of buried solid waste costs between $6 and $14 per yd^3 ($8.89 to $18.67 per ton), which is still less costly than importing soil from an off-site location.

In 2012, CLL staff also conducted soil borings within the future boundary of the landfill cell known as Sequence D. The purpose of the sampling was to determine whether bedrock within the cell was of high enough quality to make it into an aggregate resource for regional infrastructure projects. A comprehensive analysis of soil samples concluded that the sub surface mineral aggregate (rock) was indeed ideal for base course and asphalt concrete. In addition, the larger fraction of rock (2 feet minus) has already been approved as a viable source of erosion control for stormwater projects according to the Army Corps of Engineers.

Staff is proposing to extend the landfill below the approved design elevation, thereby capturing more airspace and additional soil cover. If this project is considered, there would be a potential excavation volume of 2.3 million yd^3 of soil. The data from the 2012 drill logs allowed staff to infer that approximately 1.3 milling yd^3 of marketable mineral aggregate would be available for future infrastructure projects in Northern Arizona.

In order to have practical means of accessing soil, it would also be necessary to excavate approximately 2.4 million yd^3 of buried municipal solid waste (MSW). The additional airspace from the excavation of soil and buried MSW would ultimately result in 3 to 20 years of additional operations (depending on growth rates). In addition, much of the excavated MSW could be used as ADC for future landfill operations. The recaptured ADC could push the soil deficit out another 8 years as well (Appendix B).

The annual market demand for rock in Flagstaff is approximately 65,000 cubic yards (97,500 tons). The report provides recommendations for selling the marketable portion of rock. There are 2 scenarios for the excavation, processing, and sale of material. The 2 scenarios include:

- Complete the project In-house while using traditional design-bid-build methods for specialized services
- All work outsourced through an Aggregate Resource Contract method and Contract Administration

The expected net present value (NPV), payback period, and cost benefit analysis (CBA) were used to compare each scenario. The analysis concluded that it was in the City's best interest to use a competitive bid structure with oversight conducted by a contract administrator. The CBA demonstrates that the Rock Excavation favorable (CBA=3.38), while the landfill mining project is unfavorable (CBA=0.0.5). However, since the deeper portions of bedrock cannot be accessed without excavating portions of existing landfill footprint. The capital for infrastructure is estimated to be approximately $2.4 million.

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Cinder Lake Landfill Feasibility Study-Landfill Mining and Excavation Plan-Cells A, C, & D

VISION

The team of professionals dedicated turning today's challenges into tomorrow's resources

INTRODUCTION

The City of Flagstaff (City) and Cinder Lake Landfill (CLL) have provided solid waste services to the community since around 1965. CLL has approximately 40 years left of operation before it reaches capacity. However, one shortcoming relates to the lack of adequate soil resources necessary to cover the buried municipal solid waste (MSW). There is currently a soil deficit of approximately 1.4 million cubic yards (yd^3) and importing sand is estimated to cost CLL as much as 27$ per ton. Over the past ten years the staff has implemented alternative sources of cover material into the operation which has decreased the soil deficit dramatically. Even with the implementation of alternative daily cover, the current projection for soil depletion is 2030.

Within this study, a team of industry professionals (Team) was charged with the following tasks:

- Explore the feasibility of working within the landfill boundaries to achieve the following tasks:
    - Determine the maximum depth that can be achieved if the landfill depths were to be re-designed within accordance of Arizona Department of Environmental Quality (ADEQ) and United States Environmental Protection Agency (EPA) codes
    - Provide reasonable a projection for the mined volume of buried MSW to achieve the re-designed elevations
    - Determine the resources necessary to excavate buried MSW and soil
- Explore the contractual options best suited for the work at hand:
    - Scenario 1-Complete the project in-house using traditional design-bid-build methods for some specialized services (environmental oversight, disposal, and consulting)
        -
    - Scenario 2- All aggregate to be outsourced through an aggregate resource contract method and contract administration
- Provide recommendations for the best approach based on the tasks listed above

The Team is charged with determining what is in the best fiduciary interest of the City.

PROJECT DEFINITION (SCOPE OF WORK)

BACKGROUND

The City Public Works Department, Solid Waste Section (Solid Waste) has managed CLL since 1965. The facility was originally designated as a soil extraction pit under a special use permit through the United States Department of Agriculture (Forest Service) until 1999, when the Forest Service sold 343 acres to the City. Subsequent to receiving ownership of the land, CLL was recognized and permitted as a landfill by the Arizona Department of Environmental Quality (ADEQ). The permit requires that CLL maintain an operating record, otherwise known as the Solid Waste Facility Plan (Facility Plan), at all times. The Facility Plan (Woodward Clyde, 1998) prescribes excavation depths within the future expansion areas known as Cell D and E as shown in Figure 1 (33 Acres and 104 acres respectively). The Facility Plan is conceptual in nature and is not intended to be a construction document.

FIGURE 1- CINDER LAKE LANDFILL OPERATIONS (NOT TO SCALE)

The depths of excavation prescribed by the engineer of record were based on the elevation of marginally rippable (extractable) rock (Woodward Clyde, 1998). When drafting the Feasibility Plan, the engineer assumed that the City's only desirable method of excavation was through ripping soil and rock with bulldozers and excavators (Woodward Clyde, 1996). In addition, drilling and blasting was considered a last option because it can be cost prohibitive if there is no perceived use for the rock and soil.

Over time the operation became more state-of-the-art by installing automated truck scales for measuring incoming loads of MSW. Incoming waste is categorized by product, source, and customer identification to an accuracy of 0.1 tons (200 lbs.).

FIGURE 2-AUTOMATED SCALES ARE USED TO TRACK INCOMING MSW AT CLL

Section 8 of the Facility Plan notes a "deficit of daily/intermediate cover of 1 to 3 million cubic yards assuming no usage of Alternative Daily Cover (ADC)". Equipment Operators are required to track their use of cover material on a daily basis. The operation currently uses two types of cover; intermediate (in-situ soil), and ADC (paper millings mixed with shredded wood waste). ADC is applied as a method of decreasing the existing soil deficit. The latest re-calculation concluded that the soil deficit is still approximately 1.4 million cubic yards (last calculated in January of 2015).

FIGURE 3-THE WORKING FACE OF THE LANDFILL COVERED WITH ADC

FUTURE EXPANSION OPPORTUNITIES AND CHALLENGES FOR CLL

Approximately 300,000 cubic yards of rock and soil will be removed to achieve the existing design elevation in Cell D. Past experience indicates rock and soil is costly to extract with landfill equipment, mostly because in-situ soil is interbedded with weathered basalt; which is typically not marketable as an engineered fill.

Within the next ten years, CLL plans to construct Cell D. The Facility Plan provides limited details for how Cell D will be integrated into Cell B and C (Figure 4). Cells B and C have no leachate collection system, while cells D and E are planned to be fitted with liners. The liner in Cell D will require multiple field cuts and seams (welds) in the liner (Figure 5), which will likely raise construction costs. In addition, it has been shown that field seams are more likely to become compensated and create breaches in the liner (Seaman Corporation, 2012).

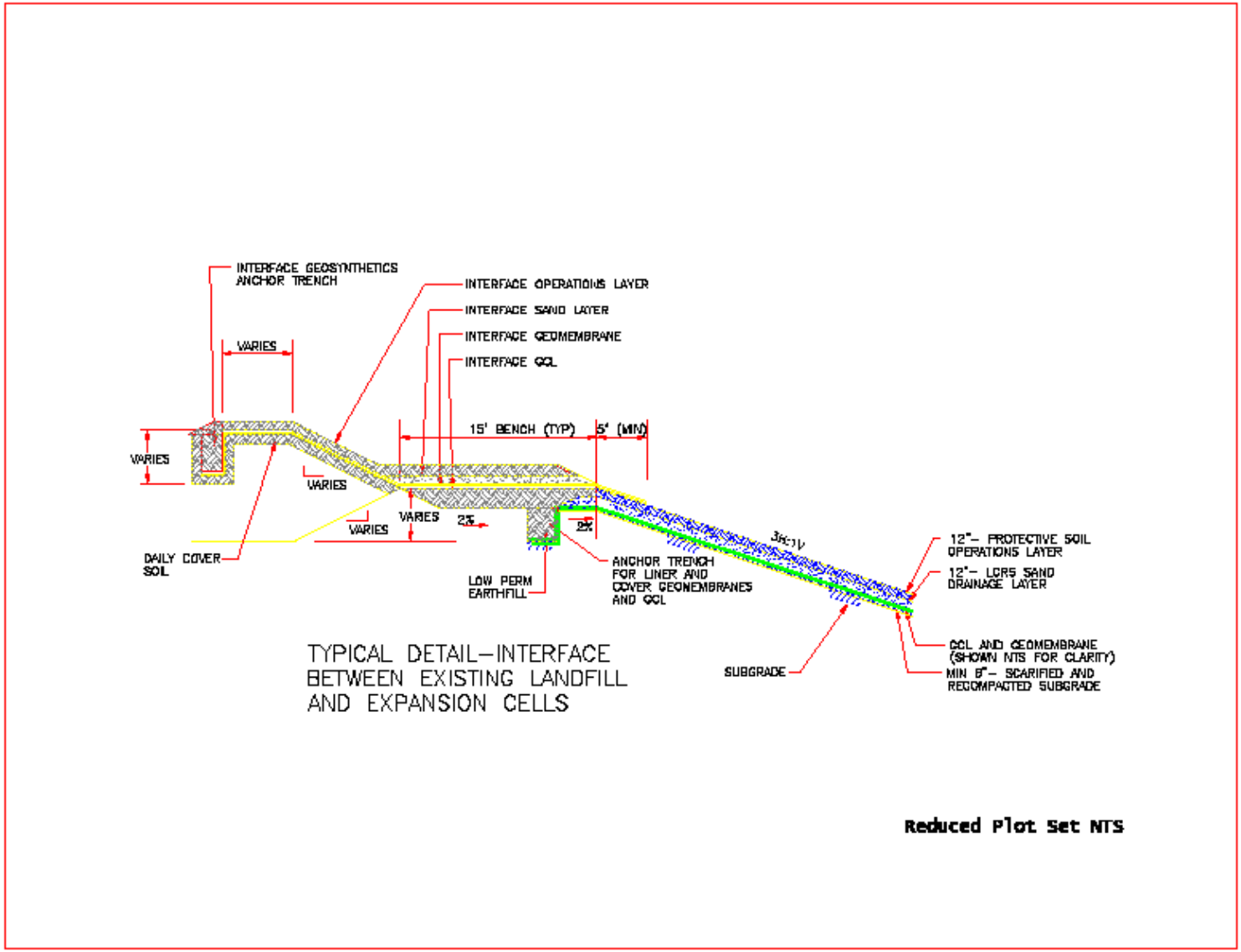


FIGURE 4-EXISTING DESIGN CONFIGURATION BETWEEN EXISTING LANDFILL AND FUTURE CELLS

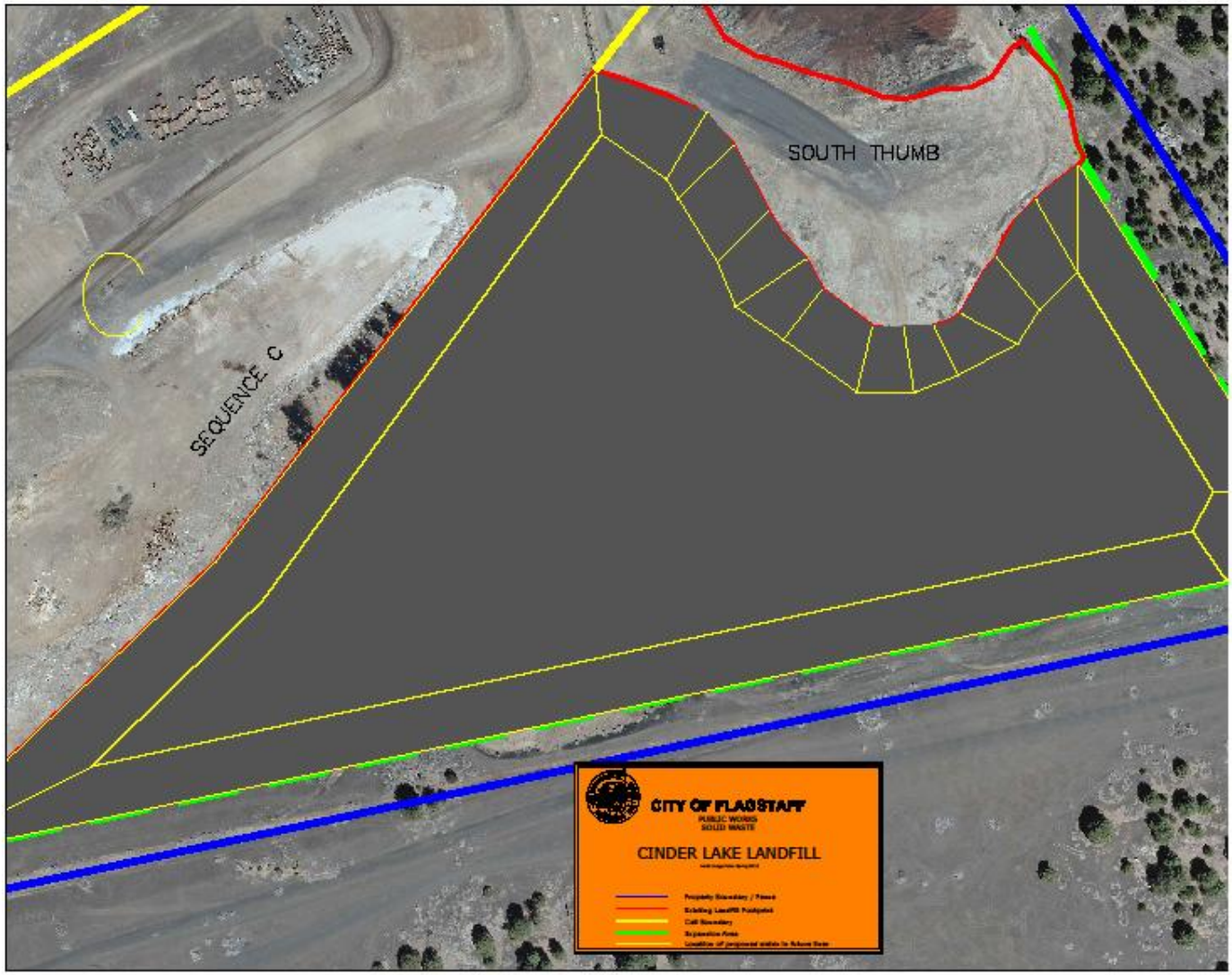


FIGURE 5-SEQUENCE D-AS CURRENTLY DESIGNED WITH LINER SUPERIMPOSED

REGIONAL INFRASTRUCTURE PROJECTS

Regional infrastructure projects (City/County Public Works, City Utilities, ADOT, Forest Service, Army Corp of Engineers) typically require large volumes of rock (crushed aggregate or rip rap). The material can be used in the following ways:

- Roadway Construction
- Roadway Abatement
- Shading for Utilities
- Landscaping
- Building Construction
- Stormwater Infrastructure

Currently, the closest source of ADOT spec aggregate is the Cemex Gray Mountain plant, approximately 40 miles north of Flagstaff. Hauling costs from such long distances comprise of a substantial portion of a projects budget.

Neither ADOT nor the County currently mine pits with quality engineered fill. The Forest Service typically acquires its rock from pits that it has dispersed throughout the region.

The following projects are tentatively scheduled over ten years:

TABLE 1-PROJECTS THAT ARE PROJECTED WITHIN THE REGION OVER THE NEXT TEN YEARS

Agency	Overlays	Rebuild/Widening	Others (Interchange, Bridges, Etc.)
City of Flagstaff	64 miles	8 Miles	2 Bridges
Coconino County	72 miles	29 miles	1 Roundabout
ADOT		57 miles	2 TI 4 Bridges
Forest Service	Variable		
Army Corps of Engineers			3,400 lineal feet of channel restoration

The table provided staff with an understanding of the future needs for affordable sources of aggregate base course and asphalt aggregate. With that in mind we determined it was in the best interest of the City to obtain baseline data for determining whether there was adequate quantity and quality of rock within the subsurface of Cells A and D.

PROJECT SUMMARY

The feasibility is a culmination of three years of research from projects conducted both off-site and on-site. Although this phase of the project is conceptual, the Team has provided a practical approach to ensuring its success. The key considerations discussed in the feasibility study are:

- Identifying City Priorities

- Project Research and Development
- Market Study
- Landfill Excavation Equipment and Methods
- Soil Excavation Equipment and Methods
- Environmental Considerations
- Training Requirements
- Permit Revisions and Requirements
- Design of Proposed Phases
- Economic Analysis
- Summary and Recommendations

KEY CONSIDERATIONS

The key considerations pertaining to this project involve the following:

- How can we increase and/or recapture landfill airspace while maintaining relatively low operational costs for the City?
- How do we maintain a high level of service while keeping disposal costs relatively low?
- How can we alter the paradox of the perception of trash, and convert it from a burden to a resource?
- How do we successfully turn undesirable rock into a resource for the region?

In the next section, the team addresses some of the priorities which help to expand on the key considerations.

CITY PRIORITIES

Identifying priorities is essential for any municipal project to be adopted by the management and the public. As early as 2006, landfill staff recognized the challenges in developing Cells D and E (discussed in the introduction). The Team developed the following list of priorities in order to provide a clear path on the future sequencing and development of the landfill:

Sequencing

As the amount of available airspace within the existing landfill footprint (Cells A, B, and C) diminishes with time, it becomes more imperative to have a clear strategy for movement into the expansion areas (Cells D and E). Disposing MSW in Cells D and E will likely result in increased tipping fees.

Competitive Fees

Excavated soil could conceivably be sold to the community for infrastructure over the next twenty to thirty years. Therefore this project has the potential to offset any necessary increases in solid waste disposal fees for future expansions.

Sustainable Use of Resources

Landfill mining projects are becoming increasingly attractive to landfill operators because it allows them to use alternative daily cover in lieu of soil. Regulatory agencies also favor the approach because it tends to decrease the amount of landfills sited in a given region.

Health and Safety

Excavating buried MSW has inherent challenges with regard to the health and safety. Much of the buried MSW is known to be inert. However the excavation needs to have adequate oversight from professionals who are trained in recognizing hazardous materials during the excavation.

Assumption of Risk

A project of this magnitude carries varying degrees of risk (economic, occupational, and otherwise). It is common for municipalities to use a cost benefit analysis as a mechanism of placing social and monetary value on a project. However placing a value on social benefits can often "lead to biased and misleading results" (Heinzerling, 2002) The Economic Analysis (located in subsequent sections) is strictly translated in monetary terms. The factors that affect risk are the following:

Cost

- New operations take on a certain level of risk for the City to assume
- Gaining additional airspace may require alternative cover options (tarps, spray foam, etc.)
- Excavation and processing rates of buried MSW is likely to vary greatly over time due to the composition of the waste

Benefit

- The sale of rock and soil to the public could offset future costs for infrastructure
- Capture of the necessary 1.4 million yd^3 of soil needed for future operations
- Excavation of the existing landfill would likely make the final design of the landfill more practical

RESEARCH AND DEVELOPMENT

EXISTING CLL REPORTS

Cinder Lake Landfill Facility Plan and Geotechnical Study

Re-sequencing a landfill is considered a substantial change to a Facility Plan (Arizona State Legistlature, 2014). Permit modifications requires approval from ADEQ. If this project is considered, then a Type IV change will be necessary. City conducted a comprehensive geotechnical study (Woodward Clyde, 1996) in concert with drafting the Facility Plan. The geotechnical study categorized the sub-surface through a series of 16 borings with over 9,000 lineal feet of seismic refraction traverses. The rock was classified based on its rippability.

> *Based on the geophysical profiles, this zone of material generally is characterized by seismic velocities ranging from about 4,000 to 7,700 feet per second (fps). Relative to published estimates of ripper performance of heavy equipment, these values of seismic velocity are low. For example ripper performance as charted in the Caterpillar Performance Handbook (1993) lists marginally rippable values for a D9 N dozer at between approximately 7,500 and 8,600 fps for basalt. Some of the variables inherent in successful ripping include; tooth penetration, operator skill and experience, fracturing and layering within the rock mass and type and number of equipment being used.*
>
> *If excavations below the marginally rippable rock surface are planned, then rock-like excavation is anticipated and larger equipment is probably called for from a practical standpoint. With heavy duty equipment (D9 or D10 or equivalent) and experienced operations, we anticipate that rock excavation could proceed to depths of at least 10 to 20 feet below the marginally rippable rock surface. Within this zone of rock excavation,*

oversized material generated in localized area of non-rippable rock will likely be encountered. Such areas would require hydraulic breakers or spot blasting to excavate.

The depth to marginally rippable rock has been estimated based primarily on a review of drill refusal depths and secondarily on the depths to high velocity layers based on the geophysical surveys performed.

In general terms, marginally rippable rock is located at an elevation of 6610 feet amsl or lower in the expansion area.

Existing Soil Deficit Calculations for CLL

The current soil deficit for the facility (based on the existing design) is approximately 1.4 million yd^3. We continue to decrease the deficit with the use of paper pulp millings and wood chips. However if paper pulp millings were to be diverted from the landfill, the cover deficit would increase to approximately 3 million yd^3, and all on-site cover resources would be expended around the year 2030, as shown in Appendix A.

Speedie and Associates Report on Subgrade Investigation

In 2012, the Team partnered with Speedie and Associates to drill, sample, and log the geologic conditions encountered in 15 borings over a total sample length of 800 feet. Sampling and testing protocol is discussed below:

> "Laboratory testing was to be limited to typical tests required for compliance with ADOT, City of Flagstaff and Maricopa Association of Governments (M.A.G.) Specifications for aggregate base materials. Tests typically required for acceptance for use as mineral aggregates in asphaltic concrete production would also be performed. Laboratory tests that could vary as a result of excavation/blasting techniques such as gradation, fractured face or flakiness index were not performed at this time."

Test results were the following:

TABLE 2-SUMMARY OF ROCK FROM CELL D

Summary of Intact Rock Core Results				
Test Performed	**Minimum**	**Maximum**	**Average**	**Typical Specification**
Unconfined Compressive Strength (PSI)	4,478	30,112	16,822	N/A
Specific Gravity	2.715	2.987	2.844	2.350 to 2.850
Unit Weight	168.3	185.2	176.3	N/A
Absorption, %	0.18	3.97	1.08	0 to 2.5
L.A. Abrasion, %				
100 revolutions	3	5	4	0 to 9
500 revolutions	15	21	17	
Carbonates, %	0	1	0.5	0 to 20
Note: Approximately 75% of the compressive strength results are between 10,000 psi and 25,000 psi. Only one absorption value was > 2%. The sample exhibiting 3.97 was performed on the				

predominately decomposed basalt that could not be tested for L.A. Abrasion

Highlighted recommendations from the study include following:

> "Based on the field and laboratory data, the Basalt Unit should be an acceptable source for material capable of meeting local municipality/governmental agencies requirements for aggregate base. However, depending upon excavation/crushing operations, the contractor may view the upper portion of the Basalt Unit as undesirable….In addition, with the high specific gravity, the material would be suitable for use as rip-rap material. The test results conducted for mineral aggregate for use in asphaltic concrete products may be considered marginal. The material has no problem meeting typical specifications regarding L.A. Abrasion, % carbonates or % absorption. Local specifications typically have a maximum L.A. Abrasion loss of 9% and 40% for the 100 and 500 revolutions respectively. Percent carbonates must be less than 20% and absorption values less than 2.5%. However, the maximum specific gravity for mineral aggregate is 2.85. Of the samples tested, 30% had a specific gravity greater than 2.85. The average specific gravity was 2.844. Determine existing requirements for aggregate used within the City and ADOT.
>
> The basalt is weathered at the contact of the Cinder Unit. Although an L.A. Abrasion could not be performed on the weathered material, the results of the crushing of the material indicate that the material would not pass the L.A. Abrasion specifications.
>
> It is our recommendation that a shrinkage factor of 10% to 20% should be used for the Cinder Unit assuming it is used on site and compacted to 85%. Additional shrinkage will occur if used for commercial purposes that require additional compaction or if compaction greater than 85% is achieved. Within the Basalt Unit, for raw material used for aggregate base, from a banked to embankment condition, 20% to 30% swell would not be uncommon for this material when compacted to 95% to 100%. An additional 10% increase could be anticipated in a loose or trucked condition.
>
> The upper 1 to 5 feet will most likely not be suitable for use as a mineral aggregate, but may be able to be utilized as part of the sand fraction of an aggregate base. If used, the upper weathered material may need to be blended with some of the underlying slightly weathered/fresh basalt.
>
> A slope stability analysis should be performed once excavation operations are begun. However, for the feasibility study, it should be assumed that the cut slope within the Cinder Unit will require a 2:1 (h:v) lay back. Although a vertical to near vertical cut slope may be possible in the Basalt Unit, a ¼:1 (h:v) slope is recommended for this study."

Much of this data will be pertinent to the following sections related to excavation and marketability of rock.

Northern Arizona University College of Engineering and Natural Sciences-Cinder Lake Landfill re-sequencing cell D

In 2013, a team of undergraduate students were assigned a semester-long task of examining the key environmental considerations for mining portions of Sequence C. The students also reviewed previous landfill mining projects in other locations throughout the world. The review demonstrated that the types of equipment used in landfill mining were strongly dependent on the type of excavation that was being conducted. Over time, they collaborated with landfill staff to determine the most practical equipment for this particular operation. "For instance, for the separation of fines, a trommel screen was more effective than a combination of shredding and vibratory screener" (AlAzami, Martz, & Woodhouse, 2013). The environmental considerations consisted of the following:

- Air Quality

- Stormwater Management
- Hazardous Waste and Soil Management

The scope of work assumed the City was going to perform the work as a sole source, renting equipment over the period of the excavation.

TABLE 3-PROJECT EQUIPMENT FOR LANDFILL MINING

Category	Type	# of Units	Price Per Unit Month ($)	# of Months	Total Price ($)
Earth Moving Equipment	Excavator	2	8,600	60	1,032,000
	Dozer	2	9,450	60	1,134,000
	Loader	1	11,500	60	690,000
	Backhoe	1	4,200	60	252,000
Cycle Hauling	Articulated Dump Truck	3	16,660	60	2,998,800
Waste Processing	Trommel Screener	1	8,000	16	128,000
	Vibratory Screener	1	9,000	5	45,000
Stormwater Management	Asphalt Area *				83,732
	Erosion & Drainage *				388,961
Hazardous Waste	Loads of Hazardous Waste	4	58	60	14,000
					6,766,493

KEY
*Price calculated using RS Means

The data from this study has been revised in subsequent sections.

The scope of work considered a 5 year timeline for excavation of Cell C (portions), Cell D, and the South Thumb. The following timeline was projected:

- Cell C (Reconstruction Area) waste was estimated to take 16 months
- South Thumb (Buried MSW) was estimated to take 5 months
- Cell D (Rock) is estimated to take 39 months.

The project duration was based on assuming a standard of approximately 21.7 working days per month for 60 months. However, with a 20% buffer time to account for equipment breakdown or poor weather conditions, the team calculated best-case scenario would allow for a 6 year timeline.

Waste Composition

An estimated waste composition of for the South Thumb was projected based on analysis of the three cases studies cited in the NAU report. The MSW in the South Thumb is approximately 20 years old. Figure 6 shows the national average for the percent composition of MSW entering landfills in 1994 (US EPA, 1995).

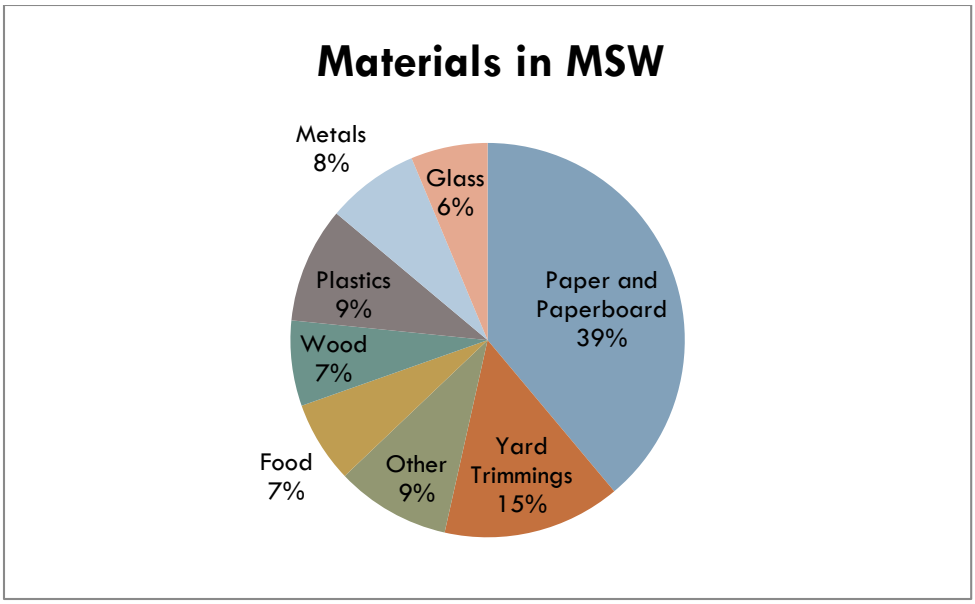


FIGURE 6-MUNICIPAL SOLID WASTE IN 1994 (U.S. ENVIRONMENTAL PROTECTION AGENCY, 1995)

From the case studies the group was able to conclude that there is about a 50% ratio (by weight) between excavated soil and MSW. It was also assumed that 50% of the organic material has degraded and become a part of the soil fraction.

Waste Segregation Area

The group also provided conceptual designs of the waste segregation and processing area (see figure below). Many of the group's elements were incorporated in the conceptual design as well.

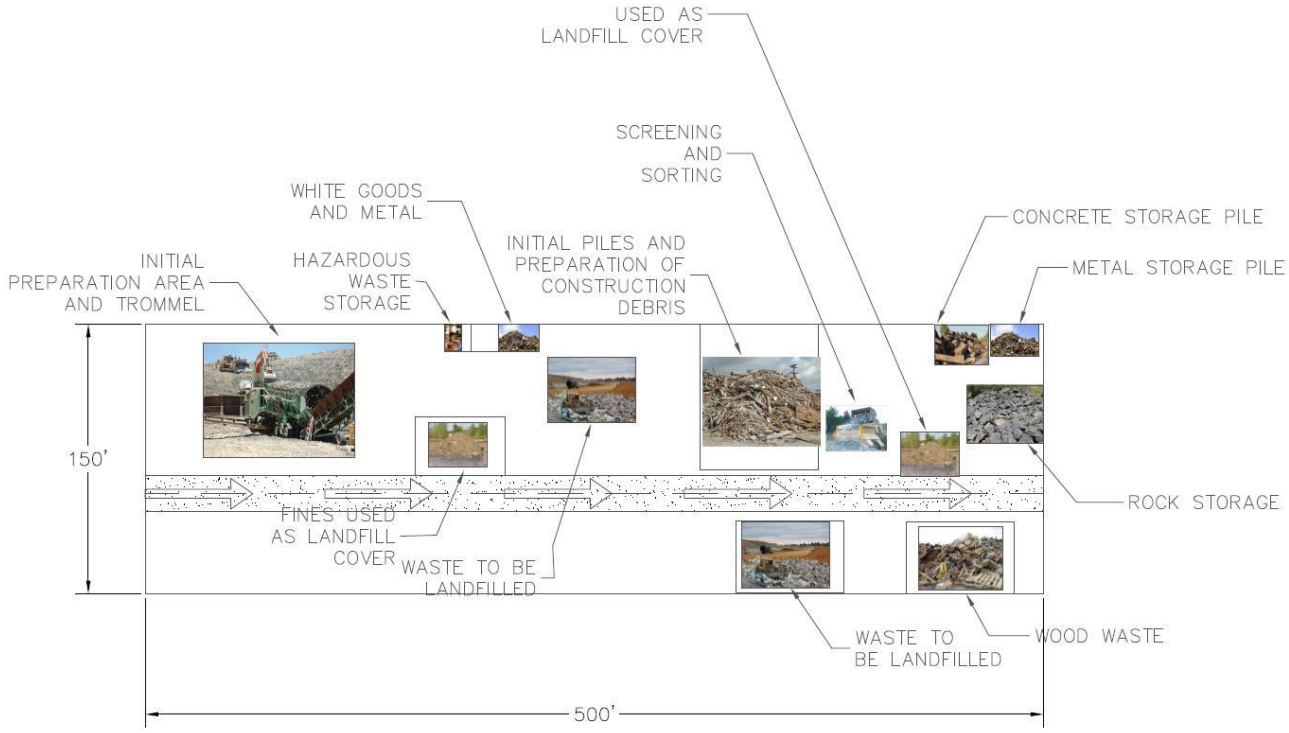


FIGURE 7-WASTE SEGREGATION AND PROCESSING AREA

PREVIOUS OFF-SITE LANDFILL EXCAVATION PROJECTS

Landfill excavation projects are becoming more common where either of the following characteristics occurs:

- Landfill airspace is limited
- Environmental issues are of concern
- Where there are proven financial advantage reclaiming landfill airspace

The following projects met all three of the previously mentioned characteristics:

Landfill Reclamation Demonstration Project-Perdido Landfill, Escambia County (Florida) Neighborhood and Community Services Bureau Division of Solid Waste Management

This test-pilot project involved excavation of approximately 54,300 yd^3 of buried MSW on 2.5 acres. The most successful methods of processing involved a trommel and subsequent vibratory screener. Approximately 38,000 yd^3 was successfully reclaimed and used as daily intermediate cover. The pilot project demonstrated that the costs of mining soil were avoided by using screened fines from the recovery of airspace. An extensive literature review was conducted by the consultant (Innovative Waste Consulting Services, LLC). The following projects were studied:

Naples, Florida Landfill Mining Project, 1986

A landfill mining demonstration project was performed at Naples Landfill in Collier County, Florida that began in 1991 and was completed in 1993. The demonstration project was established under the EPA Municipal Solid Waste Innovative Technology Evaluation (MITE) Program. The purpose of the demonstration project was to reclaim various materials such as soil, plastics, steel and aluminum. The removal of toxic and leachable materials was targeted for this project as well.

Ocean County Landfill Mining Project, Current

A landfill excavation project is also currently underway at the Ocean County Landfill in Manchester Township, New Jersey. The facility is undertaking a 3 phase approach over 15 years (Shaw, 2014). Overall the project entails 4 million cubic yards of waste that is planned to be excavated. Meanwhile approximately 2 million cubic yards of cover soil are planned to be excavated. The Team has been receiving monthly status reports from Ocean County Vice President of Engineering, Martin Ryan, P.E. By the time this project is completed it will have been one of the largest landfill excavation projects in the country.

MATERIAL STANDARDS

The following standards apply when considering the sale and marketability of the soil to the public.

Arizona Department of Transportation (ADOT)

ADOT Road and Bridge standards (Arizona Department of Transportation, 2008) provide the minimum requirements for construction projects on State Highways. The applicable divisions include Division III (Subgrade, Sub Bases, and Bases), Division IV (Surface treatments and Pavements), Division VIII (Roadside Development), Division IX (Incidentals), and Division X (Materials) as discussed below:

Section III-Lime Treated Subgrade, Cement treated subgrade, & aggregate subbase

Lime treated subgrade is used where soil conditions are unfavorable or where load bearing characteristics need to be improved. The nearest source of Hydrated Lime and Quicklime are available in Chino Valley), AZ. The rock size within a mixture of lime treated subgrade can be no larger than 2-1/2 inches (Arizona Department of Transportation, 2008).

Cement treated subgrades also require an aggregate no greater than 2-1/2 inches (Arizona Department of Transportation, 2008). The nearest source of cement is provided locally by CEMEX.

Aggregate sub-bases and aggregate bases are categorized as Class 1 through Class 6 as demonstrated below:

TABLE 4-CLASSIFICATION OF AGGREGATES (ARIZONA DEPARTMENT OF TRANSPORTATION, 2008)

Class of Aggregate	Percent Passing Sieve (Inch or No.)							PI, Max
	3	1 - 1/2	1	3/4	1/4	8	200	
1			100	90 - 100		35 - 55	0 - 8.0	3
2		100	90 - 100			35 - 55	0 - 8.0	3
3								
4	100				35 - 70		0 - 10.0	5
5	100				30 - 75		0 - 10.0	5
6								

Notes:

(1) The percentage, by weight, passing each sieve will be determined in accordance with the requirements of Arizona Test Method 201

(2) The PI (Plasticity Index) will be determined in accordance with the requirements of AASHTO T 90

(3) Classes 1, 2 and 3 are bases; Classes 4, 5 and 6 are subbases

(4) The requirements for Class 3 and for Class 6 will be specified in the Special Provisions

(5) For Class 1 through Class 4 aggregate, the amount of fractured coarse aggregate particles shall be at least 30 percent, when tested in accordance with the requirements of Arizona Test Method 212.

(6) Resistance to abrasion for Class 1 through Class 4 aggregate will be determined in accordance with the requirements of AASHTO T 96 and shall meet the following requirements:

Maximum loss of 9 percent at 100 revolutions

Maximum loss of 40 percent at 500 revolutions

Aggregate for cement treated bases are to conform to the requirements for Class 2 aggregate.

TABLE 5-TESTING REQUIREMENTS FOR AGGREGATES (ARIZONA DEPARTMENT OF TRANSPORTATION, 2008)

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS			
TYPE OF TEST	TEST METHOD	SAMPLING POINT	MINIMUM TESTING FREQUENCY
Mineral Aggregate for Asphaltic Concrete			
Gradation	ARIZ 201	Crusher Belt or Stockpile	1 per stockpile per day
Sand Equivalent	AASHTO T 176	Crusher Belt or Stockpile	1 per 2000 Tons of total aggregate (1)
Fractured Coarse Aggregate Particles	ARIZ 212		
Uncompact Void Content	ARIZ 247		
Asphaltic Concrete			
Gradation	ARIZ 201 or 427	Cold Feed, Hot Bins, Roadway or Plant	1 per 1000 Tons
Asphalt Content	ARIZ 421, 427, or other approved methods	Roadway or Plant	1 per 1000 Tons
Voids	ARIZ 415, 417, 424	Roadway or Plant	1 per 1000 Tons each day. Maximum of 4 per day.
Compaction	ARIZ 412	Roadway	1 per 300 Tons
Note: (1) Prior to the completion of the mix design, quality control tests on mineral aggregate shall be performed based on the anticipated percent use of each stockpile. Samples taken from individual stockpiles may be composited prior to the performing the required tests, or testing may be performed on material from each stockpile and the composite test result for each required test determined mathematically.			

EXISTING MARKETS FOR ROCK

Last year's approval of County and City Bonds (Proposition 403 and 406, respectively) provided the necessary mechanism for rehabilitation of 320 miles of paved roads in the County and 660 lane miles of roads in the City over the next ten years. A majority of the projects within the City are mill and fill, and will require a relatively small volume of aggregate (72,500 yd^3). Reconstructed roadways within the City will require approximately 29,000 yd^3 of aggregate base course over the next 10 years. Other agencies were interviewed for this project and staff was able to estimate the annual demand

After recent discussion with agencies throughout Northern Arizona, the Team heeds cautious optimism for the immediate future needs of marketable rock. However there are projects that may create more demand over the next ten years. The projects that especially are worth noting include the Interstate 40 Corridor Study (ADOT,

2011). In addition the Four Forest Restoration Initiative may provide additional need for improved Forest Roads (USDA-Forest Service, 2015).

LANDFILL EXCAVATION EQUIPMENT AND METHODS

One of the more dynamic challenges that this project is likely to encounter involves optimization of screening and shredding equipment. Regardless of whether the project is completed in-house or through a competitive bid process, having various combinations of equipment on-site would theoretically be ideal. This would allow us to process both reconstruction debris and traditional MSW at the same time. However, each unit comes with relatively high capital and maintenance costs.

A shredder can be a valuable piece of equipment even after a landfill mining project is completed. Shredders are especially helpful at breaking down cumbersome portions of solid waste. The unit can handle wood, plastic, tires. Particle sizes are typically reduced from 6 to 8 inches (Innovative Waste Consulting Services, 2009). Shredders are limited by its processing rate because it is a high torque, low revolution per minute (RPM) machinery. It would be warranted to place homogenous loads of MSW through the shredder. However construction and demolition debris may be filtered faster through a screener.

FIGURE 8-EXTEC 3600 SHREDDER (DELTA MACHINERY, 2014)

FIGURE 9-TYPICAL TEETH CONFIGURATION OF A SHREDDER (DELTA MACHINERY, 2014)

Subsequent to shredding, MSW can be run through a series of screens (trommels, finger screen, shaker or screens). Finger screens will catch large shreds of plastic that may have forced their way through the shredder. Innovative Waste Consulting reported screen sizes between 1 inch and 3 inches were optimal sizes. A landfill mining pilot project is currently being conducted at the Ocean County Landfill in Manchester, NJ. Martin Ryan, Project Manager has sent correspondence to CLL staff indicating that a 2" screen seems to be the best size for productivity and filtration.

Previous landfill excavation projects used trommels to screen waste and soil for daily cover. Processing rates of trommels vary from 800 to 2,000 yd^3 of uncompacted waste per day (Naval Faclility Engineering Service Center, 2000), (Innovative Waste Consulting Services, LLC, 2009). Although the processing rates are favorable, there are some disadvantages that should be recognized including:

- Screens can clog with unshredded plastic debris
- The equipment is susceptible to damage from cumbersome materials (concrete, rebar, and rock)

FIGURE 10-DOPPSTAD SM 720 TROMMEL (THE GROUNDWORX CO., 2014)

Other screener types that have also worked favorably for other facilities include vibrating finger screens, punch plates, and magnetic separators.

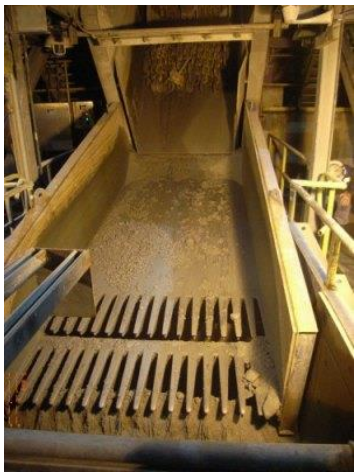


FIGURE 11-TYPICAL VIBRATING FINGER SCREEN (GENERAL KIINEMATICS, 2014)

Punch plates are also used to quickly separate fines from medium sized particles.

FIGURE 12-PUNCH PLATE FOR FILTERING FINE TO SMALL GRAIN PARTICLES (RECYCLING PRODUCT NEWS, 2011)

Conventional rock screeners can be adapted with a combination screen types and sizes to accommodate the varying waste types. Optional ferrous screeners (magnets) can be placed on the downstream side of the operation as well.

FIGURE 13-FERROUS METALS EXTRACTED WITH A MAGNETIC SEPARATOR (INNOVATIVE WASTE CONSULTING SERVICES, LLC, 2009)

The Perdido and Ocean County projects have been able to extract between 60% and 70% of organics and soil from the buried landfill cells. The remainder of the material was landfilled in lined cells.

LANDFILL MINING PROCESS RATES AND NECESSARY EQUIPMENT

Excavation rates, processing rates, and unit costs for buried MSW will vary depending on the type of material being excavated. Landfill staff conducted the majority of research and provided our recommendations to SDB, Inc. They incorporated the City's comments into a comprehensive cost estimate (Appendix C). Various projects were studied on the east coast, where soil conditions and moisture content of MSW is likely to be different what would be experienced in an arid southwest landfill. In addition, labor rates are likely to be higher in many portions of the east (union labor). However staff drew from industry professionals with experience in these types of projects to

determine a realistic processing rate for mining MSW. Using the proper equipment and operators, 800 yd^3 (90 ton per hour based on 0.9ton/yd^3 excavated in an 8 hour day) could be possible. A complete breakout of cost estimates and cycle times can be found in Appendix C. Staff assumed the following equipment would be necessary for these processing rates. The unit costs show what the City would incur if it were to take on the project internally. The costs associated with the next three tables will be discussed further in the Economic Analysis:

TABLE 6-PROPOSED EQUIPMENT FOR EXCAVATION OF BURRIED MSW

Category	Type	# of Units	Price Per Unit ($)	Total Price ($)
Waste Processing Equipment				
	CAT 345B Excavator	2	$ 350,000	$ 700,000
	CAT D9 Dozer	1	$ 900,000	$ 900,000
	CAT 966 Loader	1	$ 350,000	$ 350,000
	CAT 735 Articulated Truck	2	$ 180,000	$ 360,000
	Trommel Screener	1	$ 120,000	$ 120,000
	Vibratory Screener	1	$ 400,000	$ 400,000
	Magnetic Separator	1	$ 40,000	$ 40,000
			Total	**$ 2,870,000**
			Contingency	**$ 3,444,000**

A large scale excavation is considered a major amendment to the existing Arizona Pollution Discharge Elimination System (AZPDES) permit and Air Quality permit at CLL. The permits will likely require the need for more continuous management of haul roads. At such point in time, it will be necessary to incorporate soil stabilizers on an annual basis. Although soil stabilization will decrease the need for water, temporary roads will be ever changing and will require continuous maintenance. The table below considers the necessary equipment for maintaining compliance within the site:

TABLE 7-HAUL ROAD EQUIPMENT

CATEGORY	TYPE	# OF UNITS	PRICE PER UNIT ($)	TOTAL PRICE ($)
HAUL ROAD EQUIPMENT				
	CAT 140 M	1	$ 300,000	$ 300,000
	CAT 621 G WATER WAGON	2	$ 400,000	$ 800,000
			TOTAL	**$ 1,100,000**
			CONTINGENCY	**$ 1,320,000**

SOIL EXCAVATION PROCESSING RATES AND NECESSARY EQUIPMENT

Soil excavation rates, processing rates, and unit costs were assembled with the assistance of SDB, Inc. and their sub-contractors. We assumed a rate of 1500 yd^3 per day (2,250 tons per day based on 1.5 tons/yd^3 excavated in an 8 hour day). The table below shows the necessary equipment and the anticipated costs to the City if it were to complete the project internally.

TABLE 8-PROPOSED EQUIPMENT FOR EXCAVATION OF ROCK AND SOIL

Category	Type	# of Units	Price Per Unit ($)	Total Price ($)
Rock and Soil Excavation Equipment				
	CAT 345B Excavator	2	$ 350,000	$ 700,000
	CAT D9 Dozer	1	$ 900,000	$ 900,000
	CAT 966 Loader	1	$ 350,000	$ 350,000
	CAT 735 Articulated Truck	2	$ 180,000	$ 360,000
	Portable Rock Crusher	1	$ 400,000	$ 400,000
	Portable Rock Screener	1	$ 400,000	$ 400,000
	3,800 Gal Water Truck	1	$ 65,000.00	$ 65,000.00
			Total	**$ 3,175,000**
			Contingency	**$ 3,810,000**

ENVIRONMENTAL CONSIDERATIONS AND PROJECTED INFRASTUCTURE

The environmental controls that should be considered for this project include air quality, stormwater management, and solid waste management. It is important that environmental concerns are addressed in this project for the health and safety of the one-site workers as well as for potential long-term effects on the environment.

AIR QUALITY

Air quality includes air monitoring as well as dust monitoring and control. On-Site air monitoring will either need to be performed at a minimum of three times per day by trained personnel, or continuously monitored by remote sensing equipment Air monitoring tests should measure the level of common landfill gases including, methane, carbon dioxide, hydrogen sulfide and oxygen (see GEM 2000 in Table Below). It is important that these gasses are carefully measured because they can exhibit either explosive characteristics or low oxygen conditions at high concentrations. Volatile Organic Compounds (VOC's) and hazardous air pollutants may also be required to be measured during the landfill mining process. The MiniRAE 3000 is ideal for monitoring on-site conditions for VOC's.

It is anticipated that high concentrations of dust will be emitted into the atmosphere during the work day. The existing air quality permit requires one person to be certified in Method 9 Visible Emission monitoring. However installation of virtual technology such as the Digital Opacity Compliance System (DOCSII) is likely to be required in future evaluations of air quality permits (according to informal discussions with ADEQ). Water spraying with a water wagon (see the above table for Haul Road Equipment) will also be a requirement for the revised air quality permit.

TABLE 9-AIR QUALITY MONITORING EQUIPMENT

Category	Type	# of Units	Price Per Unit ($)	Total Price ($)
Air Quality Monitoring Equipment				
	GEM2000	1	$ 10,000	$ 10,000
	MiniRAE3000	1	$ 1,200	$ 1,200
	DOCSII System	1	$ 2,500	$ 2,500
			Total	**$ 13,700**
			Contingency	**$ 16,440**

Gases and Odors

Gas and odor emissions are likely to present potential operational issues for on-site personnel. Although the facility is located at least ¾ mile away from neighborhoods to the northwest, considerations also must be made on days when the winds could potentially convey odors. Previous projects experienced less odors during the colder months compared to warmer months and were confined mostly to the working face (Innovative Waste Consulting Services, LLC, 2009).

Gas emissions shall be monitored on site with the use of LEL and toxic gas probes. Discussion of protocol shall be addressed in the landfill gas portion of the Health and Safety Plan.

SOLID WASTE MANAGEMENT

At Cinder Lake Landfill, the wind consistently blows throughout the year. Therefore excavating MSW from the landfill can cause dust and windblown litter issues. Innovative Waste Consulting (2009) reported "minimal dust problems, as the excavated waste was in many cases moist". However the MSW in Cell A is likely to be dry due to the age of the waste and arid conditions of the site. Therefore windblown litter is likely to be a factor in Cell A, and litter fences shall be installed on the north and west side of the site (predominant winds come from the southwest). The nature of buried MSW on the south side of Cell C consists of construction and demolition debris on the top 15 feet of the cell. 25 foot high litter fences already lie to the north and west of Cell C. Therefore it is unlikely that additional fencing will be required in the limits of Cell C.

Staff has been in contact with the Ocean County, New Jersey landfill manager about his experience with landfill mining projects. He indicates that they are achieving approximately 40% recovery of cover material in the waste filtration process. Staff assumed that even higher volumes of ADC recovery are possible in Cell A because of the nature of cell construction during the 1980's (see Overview of Assumptions in the section titled "Re-Design of Proposed Cells"). The overburden of buried MSW (remaining 60%) will be delivered to the working face (area where the current operation is building cells). The Team accounts for the 40% of recovered MSW as ADC (Appendix B).

Hazardous Materials and Exceptional Waste Management

Although there is no known inventory of hazardous materials disposed in the existing cells, hazardous materials are accounted for in the waste excavation. Previous landfill mining projects encountered minimal hazardous materials (Innovative Waste Consulting Services, LLC, 2009). The most common waste included lead-acid batteries or compressed gas tanks. Should suspicious waste be encountered then the Contract Administrator should be qualified to provide guidance for proper inventory and disposal. A qualified on-call subcontractor will be notified to handle accumulated hazardous waste a minimum of every 90 days. The contractor will use best practices in properly identifying, testing, storing and transporting hazardous waste.

Although Cinder Lake landfill's Hazardous Product Center is considered a transfer station for hazardous materials, it is not equipped to handle waste that has come in contact with other solid waste. An on-site hazardous waste facility would likely need to be constructed in a strategic location near the cells. The facility would also need to consider methods for preventing the material to come in contact with stormwater runoff. This would require the installation of a well-ventilated facility that could be moved as the staging areas change over time. A domed canopy has been considered as a viable option for temporary management and storage of hazardous materials, or other prohibited waste. The area outside of the footprint shall be graded to drain away from the site. The surface immediately underneath the canopy shall be bermed and underlain by a clay liner to prevent any runoff from seeping into the subsurface.

FIGURE 14- TEMPORARY STORAGE OF HAZARDOUS MATERIALS (TYPICAL) (TEKSUPPLY, 2014)

CLL's solid waste permit does not allow for storage of solid waste above ground. Therefore a permit to operate as a transfer station should be included in the proposed Type IV permit revision. With that revision in place, the facility would be allowed to store hazardous waste on-site for no longer than 90 days. Subsequently, the waste must be transported to an approved Treatment, Storage or Disposal (TSD) facility.

ASBESTOS

Asbestos is likely to be encountered within the landfill, especially in the occurrence when construction debris is mined. Asbestos are small fibers that cannot be seen with the naked eye, and are widely found in building materials. If inhaled, there is a possibility that an asbestos fiber will travel into the lungs. The fibers become lodged in the lungs, and over time can result in scarring of lung tissue, shortness of breath, and eventual terminal illnesses. Therefore, worker safety is high priority when asbestos are on site. OSHA categorizes abatement of asbestos containing material (ACM) in regulated areas in the following manner (Occupational Safety and Health Administration, 2002):

- **Class I** asbestos work is the most potentially hazardous class of asbestos jobs. This work involves the removal of asbestos-containing thermal system insulation and sprayed-on or trowel-on surfacing materials. Employers must presume that thermal system insulation and surfacing material found in pre-1981 construction is ACM. That presumption, however, is rebuttable. If you believe that the surfacing material or thermal system insulation is not ACM, the OSHA standard specifies the means that you must use to rebut that presumption. Thermal system insulation includes ACM applied to pipes, boilers, tanks, ducts, or other structural components to prevent heat loss or gain. Surfacing materials include decorative plaster on ceilings and walls; acoustical materials on decking, walls, and ceilings; and fireproofing on structural members.
- **Class II** work includes the removal of other types of ACM that are not thermal system insulation such as resilient flooring and roofing materials. Examples of Class II work include removal of asbestos-containing floor or ceiling tiles, siding, roofing, or transite panels.
- **Class III** asbestos work includes repair and maintenance operations where ACM or presumed ACM (PACM) are disturbed.
- **Class IV** work includes custodial activities where employees clean up asbestos-containing waste and debris produced by construction, maintenance, or repair activities. This work involves cleaning dust-contaminated surfaces, vacuuming contaminated carpets, mopping floors, and cleaning up ACM or PACM from thermal system insulation or surfacing material.

The categories shown above are geared toward abatement in regulated areas, which are defined as:

> "A regulated area is a marked-off site where employees work with asbestos, including any adjoining areas where debris and waste from asbestos work accumulates or where airborne concentrations of asbestos exceed, or can possibly exceed, the PEL."

It is most likely that Class III conditions will be experienced in the excavation of ACM. However that does not preclude the occurrence of Type I conditions. In either case, when ACM is encountered during the excavation, an on-call contractor shall determine employee exposure measurements from breathing zone air samples representing the 8-hour TWA and 30-minute short-term exposures for each employee. When Class I or II conditions are present, daily monitoring is required. In addition all personnel shall wear respirators when conducting any classification of work. Additional discussion on this topic will be addressed in the Health and Safety Plan.

CONTAMINATED SOILS

The age of waste material excavated from Cells B and C are greater than 15 years, and are not likely to be of pose a major concern with respect to organics or metals. Therefore petroleum contaminated soils are not likely to pose an issue. However we must be prepared (financially and logistically) to address this issue should the soil and MSW deemed to be in excess of the residential soil limits (Arizona Department of Environmental Quality, 2007).

Soils in excess of the residential soil limits are categorized as Special Waste Petroleum Contaminated Soil (PCS). According to ADEQ a minimum of one sample per every fifty yards of soil should be collected and tested to determine the level of regulated contaminants. However because this rule is more applicable to industrial sites, staff would propose an alternative sampling plan. Processing rates will be limited if the lab results cannot be determined in a timely manner. Therefore it will be in the best interest to contract with a consultant who can provide either of the following:

- On-site sampling and testing services-Although these services will come at an added cost to the project, it will cost the operation less in down-time. At the time of drafting this document, general cost estimates have been considered for sampling and testing.
- On-call contractor who can efficiently sample questionable stockpiles of material

Portions of the waste that are deemed contaminated shall be transported to a to an approved disposal facility. The nearest disposal facility is the Painted Desert Landfill in Joseph City, AZ.

Metals may be attenuated in the mixed media. However there is no immediate threat to the health and safety of individuals who are involved in the excavation.

STORMWATER MANAGEMENT

The site will be required to implement and maintain a Stormwater Pollution Prevention Plan in accordance with the Arizona Pollutant Discharge Elimination System (AZPDES) 2010 permit program. In an instance where piles of excavated waste are exposed to precipitation, a retention basin should be constructed adjacent to the waste segregation area. The waste segregation area shall be plated with asphalt runoff is conveyed to a retention basin lined with an impermeable membrane.

Runoff collected in the retention basins shall be treated as wastewater and tested to determine whether it is below the Maximum Contaminant Levels (MCL's). In this case the liquid could potentially be used as a dust suppressant on the haul roads adjacent to the site. Otherwise Wildcat Hill Wastewater Treatment plant will require test results before the liquid can be accepted at the plant.

LEACHATE MANAGEMENT

Although the facility is recognized as an arid landfill, considerations for seepage of leachate must be considered in the operation. Leachate shall be conveyed to designated retention ponds lined with an impermeable membrane. Leachate shall be treated as wastewater until tested. If the liquid is below MCL's then it may also be used as dust suppressant on the haul roads adjacent to the site.

INFRASTRUCTURE

The Team considered utilities, buildings, and construction materials that would be 1) necessary to keep the site in compliance and 2) provide amenities for facility upgrades. The projected upgrades are outlined below:

TABLE 10-PROJECTED INFRASTRUCTURE COSTS

Category	Type	# of Units	Price Per Unit ($)	Total Price ($)
Infrastructure				
Waterline	L.S[1]	1	$ 315,000	$ 315,000
12,000 Gallon Water Storage Tank/Tower	LS	1	$ 55,000	$ 55,000
3 Phase Power	LS	1	$ 450,000	$ 450,000
Delineators and Segregation Blocks for Stockpiled Select Rock	2'x2'x6' Concrete Blocks	200	$ 1,500	$ 300,000
Traffic Control Barriers	K-Rail	150	$ 1,000	$ 150,000
Used Asphalt Concrete for Permanent Roads	Asphalt Millings (square feet)	10,648	$ 10	$ 106,480
Yearly application of soil stabilizer for permanent haul roads	Geopolymer	10,648	$ 4	$ 42,592
Stormwater Management Control Measures	Erosion & Drainage[2]	1	$ 388,961	$ 388,961
Temporary Dome Structure for Hazardous Waste Storage	26'W x 60'L	1	$ 13,000	$ 13,000
25' High Litter Fence	Netted with 35' long Utility Poles and Hardware	1500	$150	$225,000
Scales with Infrastructure	LS	1	$ 150,000	$ 150,000
New Entryway Improvements at Landfill Entrance	LS	1	$ 500,000	$ 500,000

[1] LS is Lump Sum
[2] Calculated Using RS Means

			Total	**$ 2,696,033**
			Contingency	**$ 3,235,240**

TRAINING REQUIREMENTS

Due to the hazardous nature of the working environment, all personnel shall attend continuous training, while maintaining certifications for annual refresher courses.

CONTINUOUS TRAINING

Weekly Tailgate Meetings-Personnel will be required to attend tailgate meetings in order to review SOP's, JHA's, and other items pertinent to the Health and Safety Plan.

ANNUAL TRAINING

All personnel working on site will be required to attend annual trainings in the following topics while MSW is being excavated.

Those not directly involved in excavation or handling hazardous materials shall be trained in an 4 hour Hazardous Waste Recognition Training (CFR Part 1910 Subpart H 12320 (q)(6) (i)) prior to working on the job site. This course can be provided by City personnel on an as-needed basis. All personnel involved in the excavation and potential handling of hazardous materials should be 40-hour HAZWOpER (CFR Part 1910 Subpart H 120 (q) (6) (ii)) trained. In addition all personnel shall attend annual Hazardous Waste Recognition training in the subject. The course may also serve as an annual refresher for any 40-hour HazWOpER employees.

All personnel involved with the excavation and handling shall attend an asbestos training course. After training, the workers will be fully knowledgeable when working in an asbestos abatement area. The Asbestos Institute based in Phoenix, AZ, offers class I asbestos training that meets all EPA, OSHA and AHERA requirements. The worker initial course is a 32-hour course that costs $550 per person.

City personnel will conduct annual 2 hour SWPPP training sessions for all personnel. Any new personnel working on the construction site during the project shall be provided training by the City.

HEALTH AND SAFETY

All personnel working on-site shall be familiar with the health and safety plan. Daily tailgate meetings shall be conducted with all personnel. In addition a comprehensive Job Hazard Analysis (JHA) shall address the job specific concerns involved in the operation. Further discussion will continue in the next section.

PERMIT REVISIONS AND REQUIREMENTS

Given the breadth of environmental considerations listed in previous sections, ADEQ will require a proposal that addresses each component sampling and reduction of contaminant transport, which will require a Type IV revision to the existing solid waste permit. The type IV change will entail a comprehensive review from the ADEQ Solid Waste Plan Review Unit, along with a public comment period. Relevant portions that will need to be addressed in the submittal will include a comprehensive health and safety plan, risk management assessment, sampling plan, excavation plan, revised financial assurance report, and revised timeline for closure

HEALTH AND SAFETY PLAN

A health and safety plan is an integral part of landfill operations plans. The following will be pertinent to the operation:

1. Identification of key personnel, site-entry procedures and control, site characterization, personal protective equipment and monitoring, decontamination, communication procedures, emergency medical procedures, spill prevention, and standard operating procedures.
2. Procedures for managing hazardous wastes when encountered, including provisions for work stoppage when a hazardous waste is encountered, monitoring that takes place when a hazardous waste is encountered, and how the material is managed upon discovery.
3. Specific listing of potential hazards, including:
    - Chemical compounds
    - Biological hazards
    - Radioactive materials
    - Fire/explosive hazards
    - Excavation/shoring/engulfment
    - Extreme temperatures
    - Noise
    - Terrain/trip-fall/sharp objects
    - Equipment guards
    - Mental stress/fatigue
    - Asbestos
    - Drums
    - Nuisance dusts
    - Confined spaces
    - Lockout Tagout Procedures
4. Personal air monitoring equipment, including combustible gas indicators, photoionization detectors (for monitoring organic vapors other than methane), a radiation survey meter, personal asbestos monitors, and personal organic vapor badges were used to characterize and monitor any vapors and/or materials emanating from the landfill during excavation activities.
5. Personal protective equipment specification for the work, which may include full-face air purifying respirators with high-efficiency particulate/organic vapor cartridges, Tyvek coveralls, chemical resistant boots and gloves, in addition to normal work clothes and construction gear.
6. Training requirements, including OSHA HAZWOPER, supervisor training, and medical surveillance.

RISK MANAGEMENT PLAN

The City pays a premium based on all industrial activities that are assumed within their facilities. The existing operation has been successful at mitigating any major claims in the past. However when considering the potential interaction of the public in a large scale excavation, it may be in the best interest of the City to consider re-assessing the current disposal practices for residential and commercial customers. In the past an alternative disposal facility was considered at the front entrance of the landfill. A conceptual plan for a customer dropoff center has already been designed with the assistance of Northern Arizona University College of Engineering and Natural Science Capstone Design Team in 2013. The findings from their research demonstrated that a dropoff center would not only mitigate potential hazards in the working face, but it could also help to capture more recyclables from customers. Additional discussion on this topic can be found in the Recommendations portion of this report.

SAMPLING PLAN

A sampling plan shall be submitted and approved by ADEQ prior to construction. The following topics shall be addressed in the Sampling Plan:

Air Quality Sampling

Although previous projects did not pose immediate dangers to personnel, sampling hazardous environments (LEL and toxicity), sampling should be conducted at regular intervals throughout the day. The Health and Safety Plan should also provide an action plan with a clear set of procedures to follow if LEL or toxic levels are experienced.

Soil Sampling

Soil extracted from within the landfill footprint shall not be marketed to the public. Instead CLL will propose to re-use the soil and degraded waste as ADC at CLL. The cover material shall be stored on the south end of Sequence E on an as needed basis during daily operations. No soil sampling is required at this time. However a line item has been included in the cost estimate as a contingency.

Leachate Collection

Stormwater runoff that comes in contact with unexcavated or unprocessed waste shall be treated as leachate. Testing is only required if the liquid is planned to be reused (as dust abatement) or disposed at the wastewater treatment plant. Otherwise the liquid could be detained during the spring and summer months in on-site evaporation ponds.

Excavation Plan

The excavation plan will provide an overview of how the project will be sequenced from year to year. Much of this topic is addressed in the next section.

REVISION TO FINANCIAL ASSURANCE

The economic analysis, discussed in subsequent sections, will address project costs. However ADEQ will also require the City to re-assess how much it would cost the State to close the facility in a timely manner.

Re-Design of Proposed Cells

Appendix D shows the existing design and the proposed design of the landfill cells. The industry standards for landfill design recommend the bottom of a landfill cell have no greater than 5% slope along the bottom. In addition, side slopes are to be maximum of 18.3 degrees (3H:1V). All of these factors played a role in determining the maximum depth that could be achieved in Cells A and D.

OVERVIEW OF ASSUMPTIONS

Neither the mined MSW nor the excavated rock is expected to be homogeneous. Therefore the team had to make following assumptions for both resources:

BURRIED MSW

Because a majority of the waste in Cell's A and C are either 1) older than 20 years (Cell A and lower portions of Cell D) or 2) consist primarily of construction and demolition debris (upper portions of Cell C) the team assumed the following:

- Average in-situ compaction rate of 1,800 lb/yd^3 (0.9 tons/yd^3)
- The average depth to the bottom of MSW in Cell A is 30 feet
- The average depth to the bottom of MSW in Cell C is 30 feet
- The MSW lies atop weathered to competent basalt

ROCK AND SOIL

The existing geotechnical reports indicate that the consistent presence of competent basalt is found in deeper soil horizons (below 30 feet). Therefore staff made the following assumptions for Cells A, C, and D.

- 60% of the lower soil horizons consist of competent basalt
- 15% of the lower soil horizons consist of slightly weathered basalt
- 15% of the lower soil horizons consist of decomposed rock
- 10% of the lower soil horizons consist of cinder, scoria, and loose rock

CELL A

Cell A would be separated into two phases. Phase IB would entail excavating down to the bottom of the buried MSW (see Sheet 3 and Sheet 9 in conceptual plan set). Phase II would consist of excavating buried MSW to the level of the revised design elevations (see Sheet 10 in conceptual plan set).

No drilling has been conducted in the vicinity of Cell A. Therefore we can only assume elevations of strata based on historical drill logs within the vicinity of the facility. We reviewed transects from the existing geophysical survey (HydroSystems, Inc., 2011). The depth of cinders and scoria in the vicinity of Cell A were estimated based on the report. The cinders and scoria are assumed to lie at depths of approximately 6,610 feet above mean sea level (see Cross Section 2 in the HydroSystems report). However it should be noted that the boreholes only provide a glimpse of what could be encountered when the subsurface is excavated.

CELL C AND D

Excavation of Cell D would also be separated into two phases. Phase IA consists of excavation of a soil extraction pit on the southeast side of the site (Appendix D). While Phase IB would excavation down to the lower elevation of the buried MSW within Cell C and the South Thumb (see sheet 5 thru 9 in conceptual plan set). Phase II would entail excavation and processing soil and rock in the southern portions of Cell C and all of Cell D (see sheet 11 in the conceptual plan set).

CELL E

Cell E has not been considered in this study. However it should be noted that Cell D will have to integrate with Cell E. We will address the potential need for additional geotechnical exploration in the Recommendations.

REVISED EXCAVATION VOLUMES

The following section addresses the additional airspace that would be realized by excavating Cells A, C, and D. The approximate volume of trash within each phase has been approximated using Autodesk Civil 3D software (Appendix D). The software interpolates between discrete points throughout the site. We also accounted for the types of machinery in the cells so as to assure a minimum of 25' turning radius be attained in each phase. The volumes of trash soil and rock can be found in the tables below. A breakdown of those volumes is located in each Appendix A and Bas well.

OVERVIEW OF ASSUMPTIONS

ROCK, SOIL, AND EXCAVATED TRASH EXPANSION FACTORS

The following excavation factors were assumed based on research and previous experience with rock and soil.

- Buried MSW expansion after excavation-35%

- Cinder and loose scoria-20% (Speedie and Associates, 2013)
- Basalt and weathered rock 20%

CAPTURE OF FINES FROM DEGRADED MSW

Landfill staff relied on previous research (AlAzami, Martz, & Woodhouse, 2013) and discussion with other landfill managers to ascertain that an ADC capture rate of 40% was acceptable rate for excavation of MSW. That portion of fines would be accounted for as ADC instead of MSW

GROWTH RATES FOR CINDER LAKE LANDFILL

This factor plays a role in the determination of landfill life. A conservative factor of 3% growth was assumed. In the current economy we are seeing a maximum of 1% growth annually. However in 2004 we saw growth rates as high as 6%. It is worth noting that the graphs in this section would show an even further extension in landfill life if they were projected with today's growth (less than 1% annually).

EXCAVATED MSW-AND ITS USE AS ADC

Landfill staff have been accounting for ADC usage since 1999 as shown in the figure below.

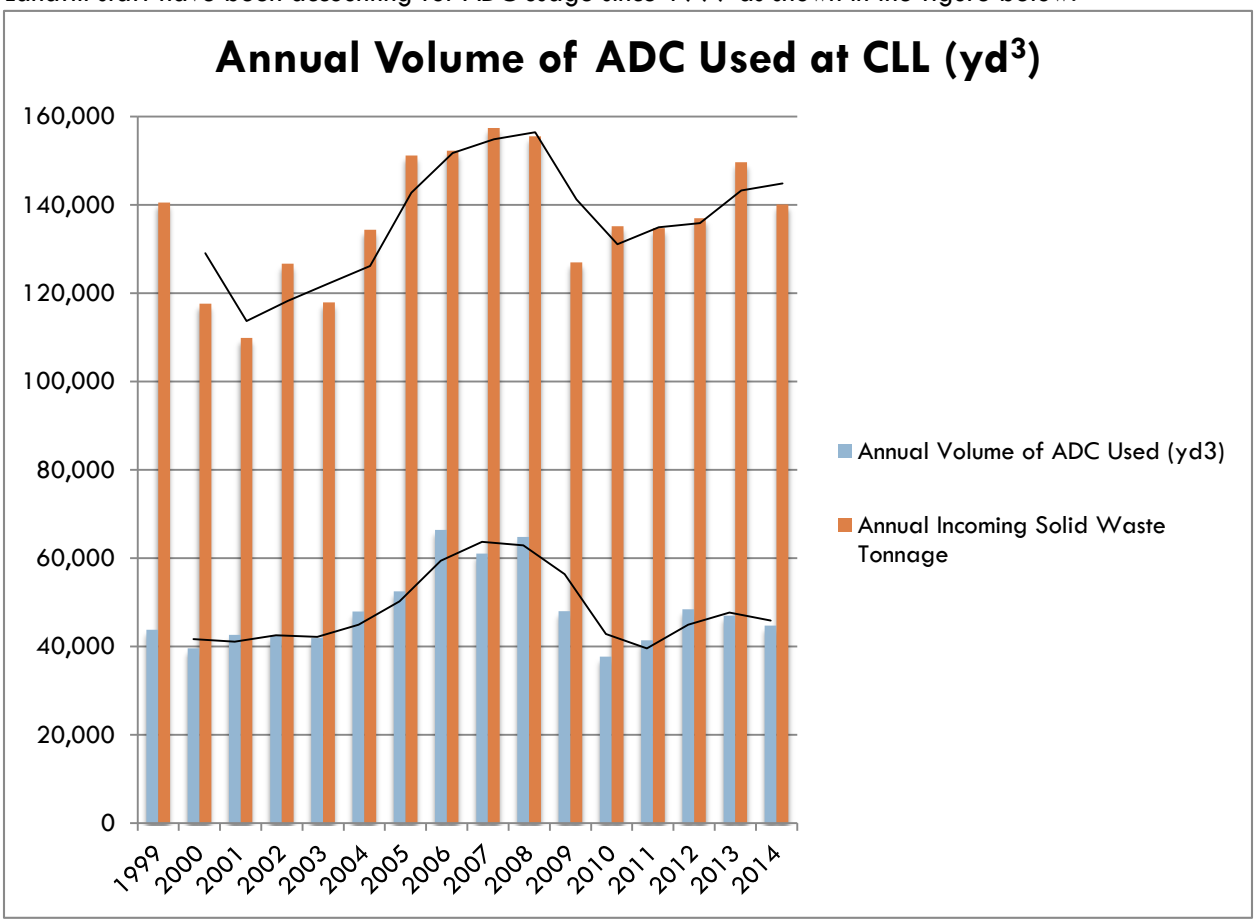


FIGURE 15-HISTORIC ANNUAL VOLUME OF ALTERNATIVE DAILY COVER USAGE

The average annual volume of ADC used was 48,138 yd^3. This value was used to determine how many years we would be able to theoretically store ADC on-site to eventually use it for cover material.

The table below shows that if we excavate 158,400 yd^3/year (600 yd^3/day) and assume 40% (63,360 yd^3/year) of the material is recoverable as ADC, then the City would have additional access to soil for 9 years.

TABLE 11-PROJECTED ADC BALANCE FOR EXCAVATED FINES AS ADC

Year	Projected Excavation Volumes of MSW (yd^3)	Recovered Material for ADC (yd^3)	Annual Stored Volume (Recovered ADC minus the Average Used) (yd^3)
2017	158,400	63,360	15,222
2018	158,400	63,360	30,044
2019	158,400	63,360	45,666
2020	158,400	63,360	60,888
2021	158,000	63,360	76,110
2022	158,400	63,360	106,554
2023	158,400	63,360	121,776
2024	158,400	63,360	152,220
2025	158,400	63,360	55,944
2026	158,400	63,360	7,806

In the meantime, paper pulp millings are scheduled to be stored in a designated location in Cell E for future use.

RESULTS

The following tables represent the projected gross volumes of trash, soil, and rock that are expected to be excavated from the site. The figures help illustrate conservative estimates where the landfill operation could be extended by a minimum of four years.

TABLE 12-PROJECTED VOLUMES OF TRASH AND SOIL IN CELL A AND D (EXPANSION ACCOUNTED FOR)

Phase	Trash Volume (yd^3)	Soil Volume (yd^3)	Rock Volume (yd^3)
Cell D, Phase IA	NA	240,000	360,000
Cell A, C and D, Phase IB	2.4 Million	50,000	22,000
Cell A, C and D, Phase II	NA	630,000	950,000

Sub Total	**2.4 Million**	**920,000**	**1.3 Million**

TABLE 13-TOTAL ADDED AIRSPACE FOR EACH CELL

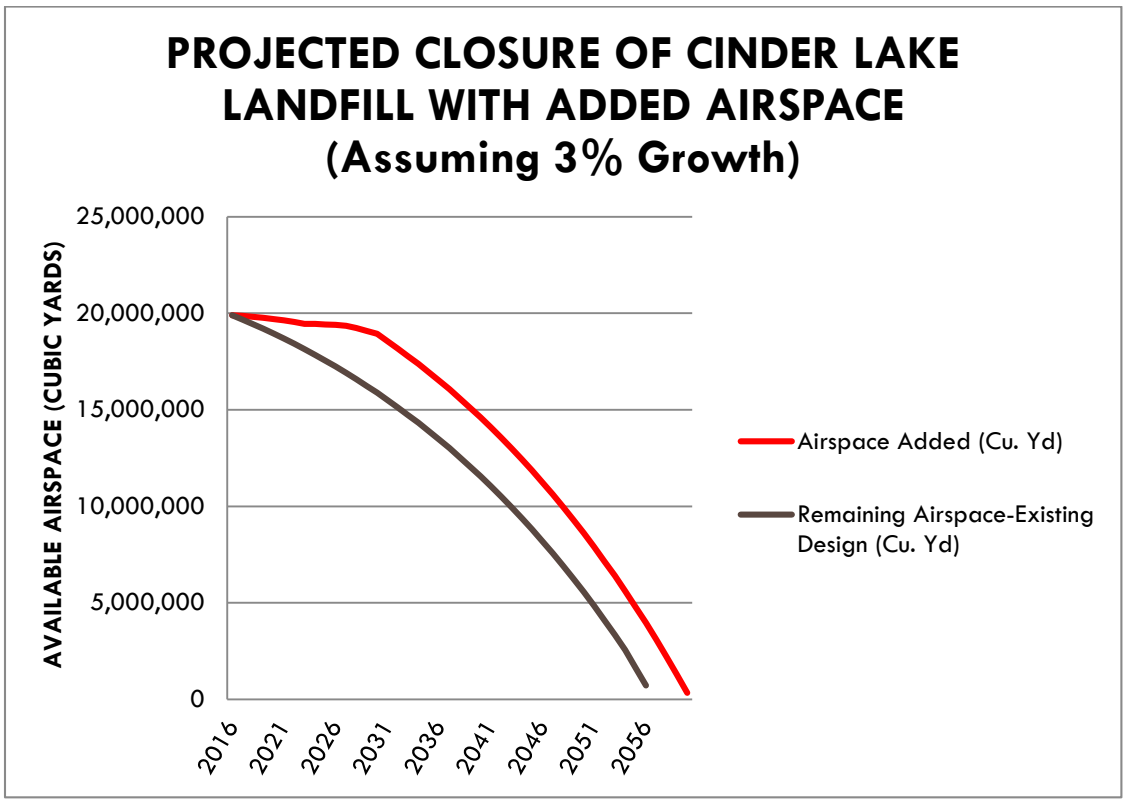
Cell	Additional Airspace (yd^3)
A	1.1 million
C and D	3.6 million

TABLE 14-PROJECTED SOIL VOLUME FOR CELLS A AND D[4]

	Basalt	Slightly Weathered Basalt	Decomposed Rock	Cinder, Scoria, and Loose Rock	Total Volume
Approximate soil volume available in Phase IA, Cell D	360,000	90,000	90,000	60,000	600,000
Approximate volume of soil and rock available in Phase IB, Cell C	22,000	29,000	11,000	11,000	72,000
Approximate Soil Available in Phase II Cell A and D	950,000	235,000	235,000	160,000	1,520,000
Total (Cell A and D)	**1,310,000**	**354,000**	**336,000**	**231,000**	**2,192,000**

[4] All Volumes are rounded to the nearest 10,000. Refer to the Appendices for more accurate assessment of soil types

FIGURE 16-PROJECTED LANDFILL CLOSURE



PROJECT SCENARIOS

Two scenarios were analyzed under this project. Additional details for each scenario can be found in Appendix E and F. They consist of:

Scenario 1-Complete the project in house while using traditional design-bid-build methods for specialized services

Scenario 1 entails the excavation of rock to be completed by City staff with City-owned equipment. The City would also establish its own rock crushing, screening, and general operations center within the landfill boundary.

Buried MSW would also be excavated, sorted, and processed so as to recover the largest fraction of fines for use as alternative daily cover. The capital investment for this type of project is likely to significant risk to the City (see Economic Analysis below).

City staff would consist of one full-time Project Manager, one Lead Worker, 3 Operators, and one Sales Specialist.

In the past, the City has used traditional project delivery methods for public works projects. Scenario 1 assumes the following services would be outsourced in a D-B-B method:

- Engineering Design and Permitting
- Construction Services
    - Health and safety
    - Drilling and blasting
- Environmental oversight
    - Compliance

    - Monitoring and testing
    - Off-site hauling of hazardous products

Scenario 2-All aggregate to be outsourced through an aggregate resource contract method and contract administration

The project would entail outsourcing the excavation of buried MSW and rock for two separate contracts. The two successful bidders would be hired under one contract or as two separate projects. Regardless, the successful bidder(s) would be required to provide City with combination of the following elements:

- Successful rock excavation proposals will meet the following criteria::
    - Projected timeline for excavation rock and soil from the designated landfill expansion areas
    - Projected timeline for removal of rock and soil from the site. Otherwise the successful bidder shall provide a stockpile plan for locations within CLL
    - Demonstration of previous successful excavation projects
    - Best return value to the City in the form of:
        - Royalty for the sale of material
        - Maximum residual fines left behind for cover material
    - Ability to maintain roads within the site boundaries
    - Ability to integrate within the existing infrastructure
    - Provide resolutions to infrastructure limitations
- The following services would be provided facilitated through a contract administrator
    - Site Preparation
    - Proposed unit cost for excavation of buried MSW
    - Projected timeline for excavation of Cells A and B
    - Approach to segregation of excavated MSW
    - Demonstration of previous successful landfill mining projects
    - Ensuring the fiduciary interests of the City are met
    - Health and Safety
    - Coordination of project schedule, timeline, and cashflow projections
    - Environmental Oversight
    - Projecting future revenue sources for the project
    - The highest scoring bid for removal
    - Oversight would be provided by a part-time City Project Manager.

Other necessary forms of outsourced work that could be handled through a contract administrator would comprise of the following:

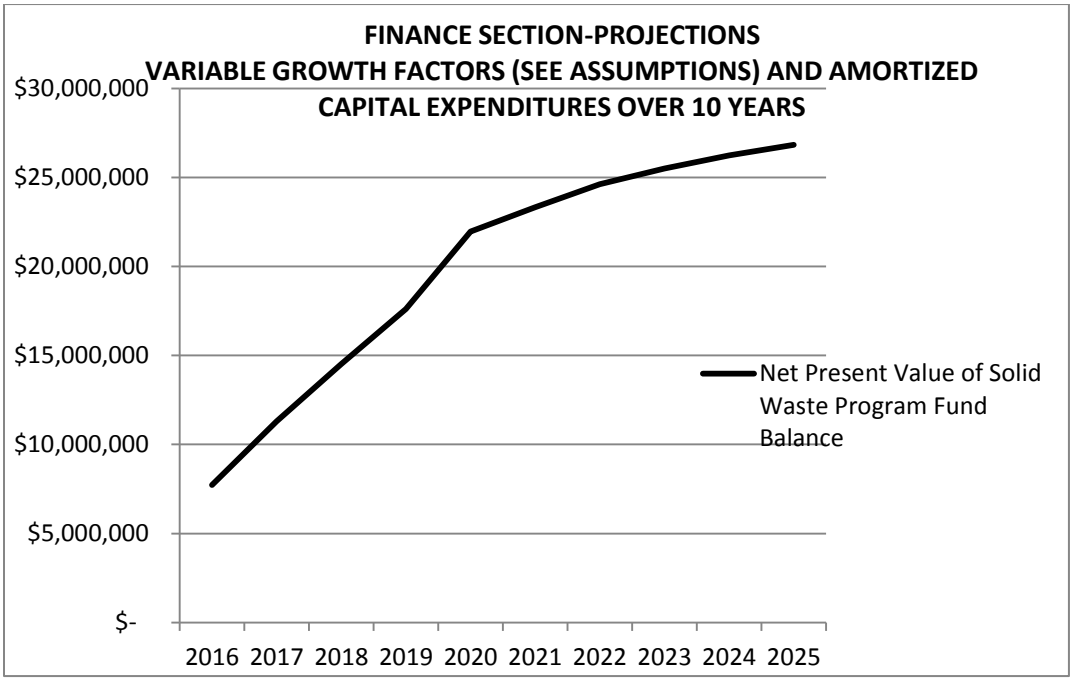
- Engineering Design and Permitting
- Construction Service
    - Health and safety
    - Drilling and blasting
    - Excavation, processing, and extraction of MSW from old landfill cells
    - Rock and soil excavation and earth moving
- Environmental oversight
    - Compliance
    - Monitoring and testing
    - Off-site hauling of hazardous products

ECONOMIC ANALYSIS

EXISTING PROJECTIONS FOR THE SOLID WASTE PROGRAM

The Solid Waste program has remained financially solvent, and continues to adjust its revenues based on growth projections (increases and decreases). The program managers conduct annual assessments and try to plan for the next decade. When Solid Waste equipment is not maintained, costly expenses can begin to take a toll on the bottom line of the fund balance. Therefore it is policy that the fund balance should not drop below $2 million. The figure below demonstrates the health of the program today and over the next ten years.

TABLE 15-EXISTING FINANCIAL PROJECTIONS



OVERVIEW OF ASSUMPTIONS

Although the Team is well researched in this project, there are some inherent assumptions that had to be made before a thorough analysis could be completed. The assumptions were based on the timeline of the project, discount rates, avoided costs

TIMELINE

Key factors that affect a project's value include cost benefit analysis (CBA), payback period, and internal rate of return (IRR) over ten years. The team assumed that fiscal year 2016 would theoretically be budgeted for engineering, design, and permit review. Construction would subsequently begin in FY17. It is estimated that the project will take a minimum of ten years to complete.

DISCOUNT RATE

An assumed inflation adjusted discount rate used in all pro-formulas was 0.61%. The inflation-adjusted discount rate was estimated based on the following equation:

$$r_a = \frac{1+r_n}{1+i} - 1 \text{ (Campbell, 2001)}$$

Where r_n is the cost of capital provided by the City at 3% and I is the average inflation rate assumed for the project of 2.38%[5].

AVOIDED COSTS

Avoided costs for this project are realized when the process equipment can produce enough fine to medium grain sized portions of MSW (organic and inorganic) so that the material can be used as ADC. Using the fine to medium grain size particles of filtered MSW would allow the operation to bank soil and paper pulp millings for future use. The current cost to import medium grained sand from the Verde Valley averages $27 per ton (includes delivery).

Other avoided costs include typical costs for cell development, in particular the costs for rock excavation. Rather than deferring the cost, we would be associating it to a more justified revenue stream. In addition the additional airspace is realized as an asset as each cell is completed. In this case some of the airspace could be realized as early as FY 17 (July 2016 thru June 2017).

OVERVIEW OF VARIABLES

The variables involved in this project create a certain level of risk that cannot be realized until the project is started. The team has attempted to account for such risks by adding a 20% contingency to the capital expenditures.

VALUE OF ADDITIONAL AIRSPACE

Landfill staff previously tracked the average value of the airspace within the existing landfill cells. The 2014 value averages out to $14.97 per yd^3.

VALUE OF COVER MATERIAL

The market value for Class I Aggregate Base Course is approximately $13.50 per yd^3 ($9/ton based on the typical bulk density of 1.5 tons per yd^3).

Assumed City Royalty for Rock and Soil sold by a contractor is $2/ton

TYPICAL COVER USAGE

The landfill uses approximately 68,000 tons (104,729 yd^3) of landfill cover per year

The annual cost to excavate soil with existing methods is approximately $34,200

OVERVIEW OF CONSTRAINTS

TIMELINE

The timeline of all phases of this project is limited by the following:

- Annual expenses incurred program-wide
- Production rates stated in previous sections.

The team was able determine that the most reasonable timeline of an overall timeline of ten years. The table below outlines the projected timeline for each phase.

[5] Based on the average inflation rate from 20 year average (Bureau of Labor Statistics, 2014)

TABLE 16-PROJECTED PHASES OF EXCAVATION OF MSW AND SOIL

Phases of Excavation	Fiscal Year
Additional Geotechnical Exploration (To be discussed in Recommendations) Engineering Design and Permitting	2016
Phase IA and Phase IB-Cells A, C, and D (soil and trash)	2017
Phase IA and Phase IB- Cells A, C, and D (soil and trash)	2018
Phase IA and Phase IB- Cells A, C, and D (soil and trash)	2019
Phase IA and Phase IB- Cells A, C, and D (soil and trash)	2020
Phase IA and Phase IB- Cells A, C, and D (soil and trash)	2021
Phase IA, Phase IB, Phase II-Cell A, C, and D (soil and trash)	2022
Phase IA, Phase IB, Phase II-Cell A, C, and D (soil and trash)	2023
Phase IA, Phase IB, Phase II-Cell A, C, and D (soil and trash)	2024
Phase IB, Phase II-Cell A, C, and D (soil and trash)	2025
Phase IB, Phase II-Cell A, C, and D (soil and trash)	2026
Phase IB, Phase II-Cell A, C, and D (soil and trash)	2027
Phase IB, Phase II-Cell A, C, and D (soil and trash)	2028
Phase II, Cell D (soil)	2029
Phase II, Cell D (soil)	2030 thru 2044

PROJECT SCENARIOS

The two project scenarios, discussed in the previous section, were conceived as a means of providing the City with a range of options to consider. Both options have theoretical advantages and disadvantages to the City. However a project of this scale requires the use of tangible metrics to vet out its validity. Additional details to each scenario can be found in Appendix C.

The scenarios were analyzed with the same assumptions, variables, and constraints. However Scenario 1 assumes the operation will be revenue-neutral, since most of the operations would be taken-on by the City. As previously mentioned, those portions of work that are outsourced would be dealt with in the traditional design-bid-build format.

Scenario 2 assumes that a contract administrator would oversee the project from the design phase to the final closeout. The essential function of a contract administrator would be to reduce the risk to the City. In essence, the owner pays an escalator for a certain level of risk that is deemed by the contract administrator. The following tables show the operations cost variables to the City under Scenario 1 and Scenario 2.

TABLE 17-PROJECTED INDIVIDUAL OPERATIONAL COSTS TO THE CITY FOR EACH SCENARIO

Variables	Scenario 1	Scenario 2
Costs for Excavation of Soil and Rock	$7/yd^3	None
Costs for Outsourcing Excavation and Processing of MSW (Appendix F)	$12.83/yd^3	$12.83/ yd^3

The biggest variable affecting the financial outcome of each scenario is the cost for excavation and processing MSW. Other noteworthy cost variables to the City include capital expenditures and annual contractual costs as shown in the table below.

TABLE 18-CAPITAL EXPENDITURES TO THE CITY UNDER EACH SCENARIO

City Expenditures	Scenario 1	Scenario 2
Capital[6]	$11.5 million	$2.4 million
Annual Administration and Contractual Costs	$0	$300,000

The annual revenue for each scenario is relatively high, as shown in the table below. However, higher levels of reward also bring risk. The risk is calculated in sections below.

MARKET STUDY

The feasibility study intended to take a "reverse engineering" approach to the excavation by determining what the necessary minimum amount of rock would need to be sold to make the project successful. Staff contacted many of the region's largest government agencies (ADOT, Forest Service, County, & City). Initial projections indicate the annual demand for rock is approximately 65,000 yd^3. The Team calculated that in order for the rock excavation and sales model to be successful, a minimum of 60,000 yd^3 needs to be sold annually (see table below).

[6] Includes contingency of 20%

TABLE 19-PROJECTED VOLUMES AND REVENUE FROM THE SALE OF AGGREGATE BASE COURSE

Fiscal Year	Minimum Volume (yd^3) of Aggregate Sold	Gross Revenues from the Sale of Aggregate Base Materials (applies to Scenario 1)[7]	City Royalty for the Sale of Aggregate Base Materials (only applies to Scenario 3)[8]
2017	60,000	$1.3 million	$179,000
2018	60,000	$1.3 million	$179,000
2019	60,000	$1.3 million	$179,000
2020	60,000	$1.3 million	$179,000
2021	60,000	$1.3 million	$179,000
2022	60,000	$1.3 million	$179,000
2023	60,000	$1.3 million	$179,000
2024	60,000	$1.3 million	$179,000
2025	60,000	$1.3 million	$179,000
2026	60,000	$1.3 million	$179,000
2027	60,000	$1.3 million	$179,000
2028	60,000	$1.3 million	$179,000
2029	60,000	$1.3 million	$179,000
2030	60,000	$1.3 million	$179,000
2031	60,000	$1.3 million	$179,000
2032	60,000	$1.3 million	$179,000
2033	60,000	$1.3 million	$179,000

Although the base demand shown in Table 1 is encouraging, the Team heeds cautious optimism for assuming that the rock from CLL will make regional projects more feasible, and thereby create increase demand over time. Based on interviews with many agencies, there are many encouraging projects that could increase the demand for more rock. However funding sources, especially at the state and federal levels, are not likely to increase in the next five years. Some of the future projects that have a potential to increase local demand are the following:

- Initial Design Concept Report for Interstate 40 from Bellemont to Winona (ADOT, 2011)
- Pavement Reconstruction from Walnut Canyon to Twin Arrows (ADOT, 2015)

[7] Based on an average unit weight of 1.5 tons/yd^3 & average market rate of $9.00 per ton
[8] Based on average market rate of $9 per ton and $2 City royalty

- Four Forrest Restoration initiative (4FRI) (USDA-Forest Service, 2015)

RESULTS

The team incorporated the potential revenues into a balance sheet for Scenarios 1 and 2. In the case where benefits outweigh costs (CBA equal to or greater than 1) a project would be considered favorable. Staff reviewed the CBA for landfill mining as both stand-alone and it's affect to the Solid Waste program over 10 years. The rock excavation is a standalone project that would theoretically be housed within the City's general fund. Comparing the CBA between two scenarios will provide more light on which scenario is more favorable. The following table outlines the viability of the entire project through a Cost Benefit Analysis (CBA).

TABLE 20-SUMMARY OF CBA'S FOR THE STAND ALONE PROJECTS (10 YEARS)

Factor	Scenario 1		Scenario 2	
	Landfill Mining	Rock Excavation	Landfill Mining	Rock Excavation
Cost Benefit Analysis (CBA)	0.05	1.68	0.05	3.38

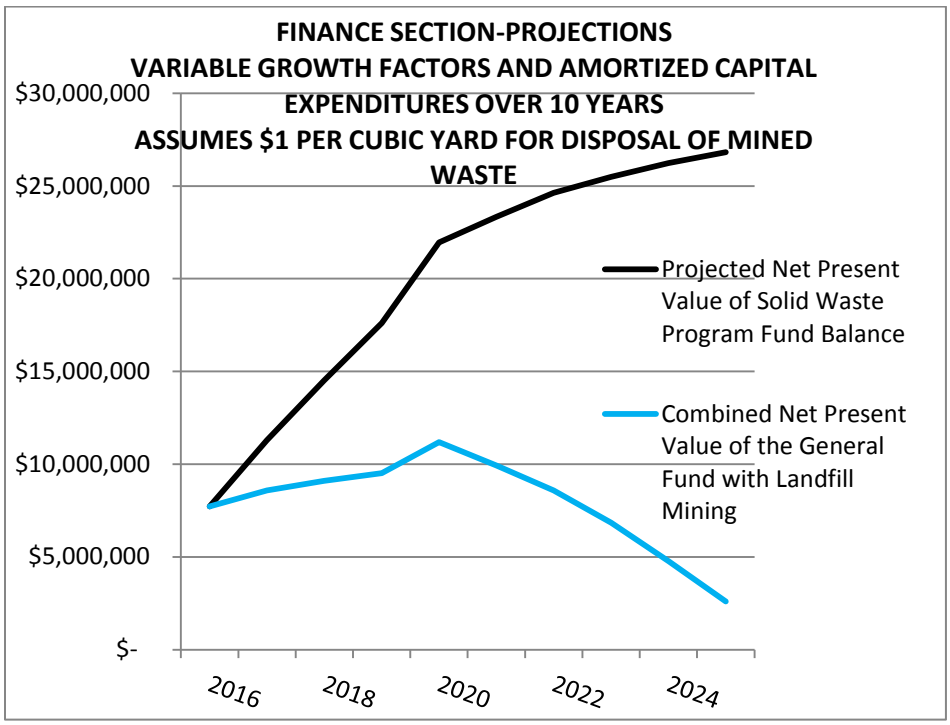
Rock excavation for Scenario 2 is far less sensitive due to the relatively small amount of capital and the value of the realized airspace; and is therefore a better option for the City to consider. The CBA for landfill mining is unfavorable because the MSW will eventually be returned back into the landfill (as cover or refuse). The cost analysis is also highly sensitive to variables such as excavation and processing of MSW. The balance sheets for landfill mining were combined with the Solid Waste Program balance sheets to calculate the overall CBA (see table below).

TABLE 21-CBA WHEN LANDFILL MINING IS ABSORBED INTO THE SOLID WASTE PROGRAM (10 YEARS)

Factor	Solid Waste Program
Cost Benefit Analysis (CBA)	0.96

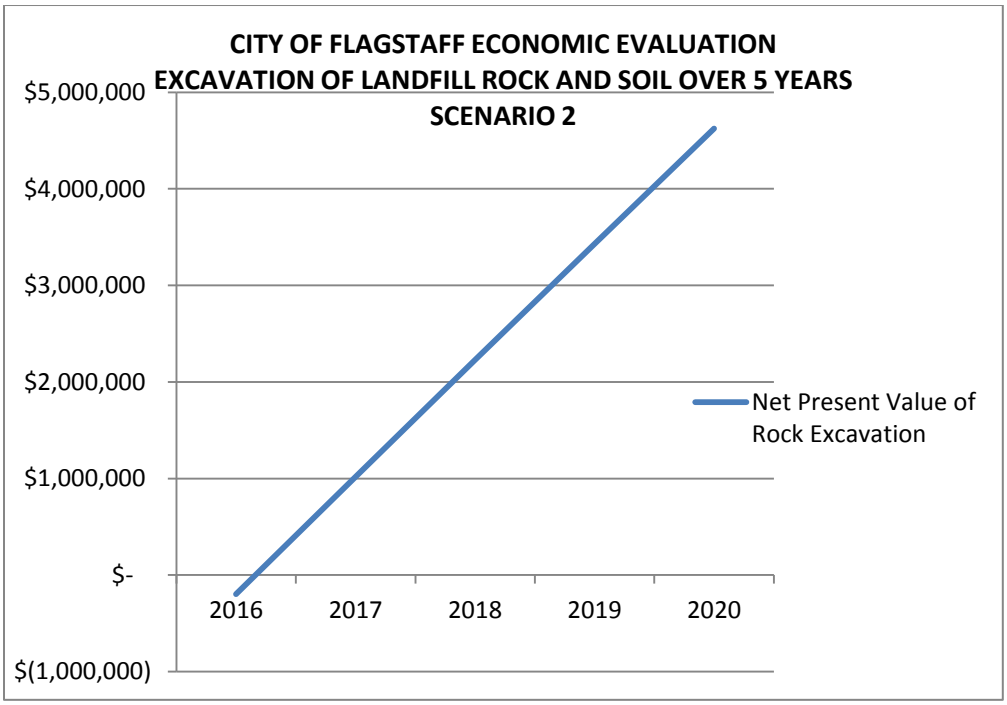
The 10 year outlook for the Solid Waste Program is drastically affected by the landfill mining project (see figure below). However, subsequent to the project we expect to see the fund balance return to more traditional levels. If the project is to be successful, it will require staff to assure that the variables (previously discussed) be kept as low as possible throughout the ten year projected timeline.

FIGURE 17-10 YEAR PROJECTION OF SOLID WASTE FUND BALANCE (EXISTING) AND THE FUND BALANCE WITH LANDFILL MINING



The rock excavation project is likely to act as a stand-alone outside of the existing Solid Waste program. The figure below clearly demonstrates that the project has the potential to be financially solvent given the existing constraints. The success of the project will likely be determined in the negotiations between the successful bidder and the City. One of the key factors will pertain to the City royalty (assumed $2/ton) and the rate at which a successful bidder can sell the rock.

FIGURE 18-PROJECTIONS FOR ROCK EXCAVATION PROJECT



SUMMARY AND RECOMMENDATIONS

This report assists in (i) identifying the City priorities, (ii) reviewing the advantages and disadvantages to excavating MSW and soil from the site; (iii) identifying the necessary resources; (iv) analyzing the economic factors; (v) and determining the best case scenario to consider for project implementation. The Team was able to ascertain that there are clear advantages to gaining additional airspace and cover material.

The City currently does not own to the equipment necessary for excavation and processing of MSW and soil. Investing in a fleet of heavy equipment poses a relatively high risk to the City. The high expenditures in capital and equipment are not likely to provide the necessary returns in a reasonable time period to keep the project and the Solid Waste program financially solvent. The CBA concludes that outsourcing portions of the project to a qualified successful bidder and construction administrator will likely carry less risk to the City.

The project should be approached in concurrent phases. For instance it is to the City's advantage to excavate MSW in Phase IB in concert with the excavation of rock in Phase IA. Recovered fines from both operations can be used as ADC either instantaneously or stockpiled over time. Phase IA will also allow the successful bidder to immediately begin excavation in Cell D and increase the chances for successful export of rock. Meanwhile another successful bidder can be working in Phase IB to open up the limits of a redesigned Cell D.

The annual projected cost for landfill mining is estimated at $12.83 per yd^3. This equates to an annual cost of $2.8 million in excavation and mining of MSW. The CBA for landfill is unfavorable at 0.05. However, the limits of rock excavation and the re-capture of airspace will be hampered if we do not mine the MSW from portions of CLL.

The annual projected costs for rock excavation are more vary between $300,000 and $600,000 over a ten year period (mostly to pay capital expenditures). However with annual returns ranging from $1.2 million (year 2) to $3.6 million (year 10), we see a much more favorable CBA of 3.38. The most important factor will pertain to assuring the contract for this project protects City's financial interests.

RECOMMENDATIONS

GEOTECHNICAL EXPLORATION

Successful rock excavation will depend both on the contractor's expertise and the market demands for the resource. While the 2012 drill samples revealed the quality of rock in Cell D meets specifications for roadway materials, the samples only provide a glimpse into discrete points within the sub-surface. Therefore it would be in the best interest of the City to perform a series of geophysical surveys over portions of Cells A, C, D, and E. A comprehensive geophysical survey would help identify where pockets of dense rock lie in the sub surface of Cells A and E. It would also assure the perspective bidders that the City has done due diligence in providing marketable quantity of rock.

A portion of the geophysical survey involves placement of seismic refraction lines across portions of Cells D and E. The procedure measures the time for a compressional wave (P-wave) to travel from a source point (shotpoint) to one or more co-linear sensors (geophones) (Woodward Clyde, 1996). The time and distance of the wave are measured to determine changes in velocity in the subsurface. In the Case of Cells D and E, the data would be interpreted by specialists to provide profiles showing the interface between weathered cinders and basalt. In addition the method known as refraction microtremor (ReMi) would be run along the proposed seismic refraction lines. The ReMi method allows us to determine the thickness of the pockets of basalt to depths of 200 feet. The deepest point in the revised excavation plan occurs in the center of Cell E (Appendix D) at approximately 146 feet below ground surface. Ultimately the survey would assist the City in providing a more detailed analysis of the subsurface characteristics and provide the optimum locations to drill and core for samples of in-situ rock.

Seismic refraction would also allow staff to approximate the true depth of trash in portions of Cell A and C and thereby improve our estimation of the volumes of buried MSW.

In order to maintain third party verification of our work, it will be necessary for a qualified geotechnical consultant to conduct the necessary geophysical survey and report. We anticipate the survey and reporting will cost approximately $75,000. Seismic refraction cannot be done where there is frozen ground. Therefore staff recommends completing this project prior to November, 2015. Subsequent to the geophysical survey, staff will use recommendations from the report to propose a soil drill/sample pattern. The drilling and sampling will allow us to test samples of the rock and verify that it meets engineering specifications.

PILOT STUDY FOR LANDFILL MINING

Previous studies indicate that mining a landfill can have highly variable costs associated directly to the type of material and how many times it is handled. In an effort to gain much needed airspace over a relatively quick period of time, staff is recommending a pilot study to excavate approximately 525,000 million yd^3 of buried MSW in Cell A. The timeline of the project is expected to be 2 years. Staffs' understanding is that the buried MSW consists mostly of MSW. We also know that the Cell was constructed mostly with a drag line, and large volumes of soil could be re-captured throughout the Cell. The anticipated costs for this project are as follows:

Mining 525,000 cubic yards of MSW and soil-$6.7 million

Consulting (Includes reports and plans)-$55,000

Permitting (ADEQ)-$30,000

Health/Safety and Environmental Oversight-$60,000

Total Costs-$6,845,000 Over Two Years

LANDFILL RE-DEVELOPMENT PLAN

In an effort to put all this planning into action, the Team is recommending a Re-Development Plan be drafted. Staff does not have the resources necessary to compile a comprehensive proposal in house. Therefore we are recommending that a qualified third party consultant be contracted with the City to complete the following tasks:

- Obtain approval from ADEQ to mine portions of the existing footprint, propose lower design depths, and realign the existing footprint in expansion areas. The scope of work will include:
    - Provide a plan for recovery of portions of excavated, degraded MSW
        - Obtain permits for the use of fine grained materials to be repurposed as ADC
    - Proposal to access to additional cover materials, mineral aggregate resources and airspace beneath existing MSW
        - Lower design depth elevation in mined and expansion areas to access additional cover materials, aggregate resources, and airspace
        - Process excavated bedrock to develop stormwater rip-rap, aggregate base and additional cover materials
    - Provide conceptual design for upgrades in existing infrastructure to support mining operations, process cover and aggregate materials and improve landfill operational efficiency. High priority infrastructure needs include:
        - Water Development Plan
        - On Site Fuel Station Construction (Budgeted for FY16)
        - Residential Dropoff Center Development Plan
        - Landfill Road Development Plan

- Submit for a Type IV change to the Facility Plan
    - ADEQ notification and Facility Plan review
    - Public notification and comment period
    - Possible demonstration of proposed changes through a pilot project
    - ADEQ approval of changes made to the Facility Plan

Other considerations include:

- 3 Phase power design and construction
- Landfill Entry/Exit redesign with added scales for efficiency

The budget for this project (FY 16) is $200,000.

The timeline for this project is anticipated to be 8 months.

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APPENDIX

APPENDIX A-EXISTING LANDFILL CLOSURE AND SOIL DEFICIT PROJECTIONS

EXISTING DESIGN-CLOSURE OF CINDER LAKE LANDFILL WITH 1500LB/CY

	In-Place Density	ton/cu.yd =	0.68
	Revised Density (1/2014)	ton/cu.yd =	0.75
All disposal rates up to 2006 were taken from the documented disposal rates taken from "Estimate of in place MSW.xls"	Refuse/Soil Ratio		0.75
	Refuse Growth Rate	%/year =	3.00%
Estimated remaining Landfill-Fill Capacity (After 12/31/2013)		20,521,099	(Cu. Yd)
Estimated remaining Landfill-Refuse Capacity (After 12/31/2013)		15,390,824	(Cu. Yd)

Year	Disposal Tonnage (Tons)[1]	Compacted Disposal Volume (Cu. Yd)[1]	ADC (Tons)	ADC (Cu.Yd.)	Tonnage After ADC (Tons)	Colume After ADC (Cu.Yd.)[2]	Total Remaining Capacity (Tons)[3]	Remaining Airspace-Existing Design (Cu. Yd)	Remaining Refuse Capacity (Tons)[2]	Remaining Refuse Capacity (Cu. Yd)[2]
1997							17,048,280	25,256,711	12,786,210	18,942,533
1998	139,477	206,633	6,636	9,831	132,841	196,801	16,871,159	24,994,309	12,653,369	18,745,732
1999	140,502	208,151	29,589	43,836	110,913	164,316	16,723,275	24,775,222	12,542,456	18,581,416
2000	117,597	174,218	26,727	39,596	90,870	134,622	16,602,115	24,595,725	12,451,586	18,446,794
2001	109,835	162,719	28,739	42,576	81,096	120,142	16,493,987	24,435,536	12,370,490	18,326,652
2002	126,650	187,630	28,686	42,498	97,964	145,132	16,363,368	24,242,027	12,272,526	18,181,520
2003	117,880	174,637	28,267	41,877	89,613	132,760	16,243,884	24,065,013	12,182,913	18,048,760
2004	134,367	199,062	32,332	47,899	102,035	151,163	16,107,837	23,863,463	12,080,878	17,897,597
2005	136,947	202,884	35,402	52,447	101,545	150,437	15,972,444	23,662,880	11,979,333	17,747,160
2006	152,234	225,532	34,960	66,400	117,274	159,132	15,829,225	23,450,704	11,871,919	17,588,028
2007	157,408	233,197	32,380	61,027	125,028	172,171	15,674,272	23,221,143	11,755,704	17,415,858
2008	155,470	230,326	34,975	64,769	120,495	165,557	14,580,921	21,601,365	10,935,691	16,201,024
2009	126,990	188,133	24,409	48,020	102,581	140,113	14,454,819	21,414,547	10,841,115	16,060,910
2010	135,162	200,240	19,841	37,685	115,321	162,555	14,308,520	21,197,807	10,731,390	15,898,355
2011	134,743	199,619	21,781	41,370	112,962	158,249	14,057,982	20,826,640	10,543,487	15,619,980
2012	136,947	202,884	25,490	48,415	111457	154,469	13,918,960	20,620,681	10,439,220	15,465,511
2013	141,055	188,074	18,421	45,497	122,634	142,577	13,851,742	20,521,099	11,543,118	15,390,824
2014	145,287	193,716	18,718	46,230	126,569	147,486	13,719,004	20,324,451	10,289,253	15,243,338
2015	149,646	199,528	27,545	40,807	122,101	158,720	13,576,156	20,112,824	10,182,117	15,084,618
2016	154,135	205,513	29,084	43,087	125,051	162,427	13,429,972	19,896,255	10,072,479	14,922,191
2017	158,759	211,679	29,084	43,087	129,675	168,592	13,278,239	19,671,466	9,958,679	14,753,599
2018	163,522	218,029	29,084	43,087	134,438	174,942	13,120,791	19,438,209	9,840,593	14,578,657
2019	168,428	224,570	29,084	43,087	139,344	181,483	12,957,456	19,196,232	9,718,092	14,397,174
2020	173,480	231,307	29,084	43,087	144,397	188,220	12,788,058	18,945,271	9,591,044	14,208,953
2021	178,685	238,246	29,084	43,087	149,601	195,160	12,612,415	18,685,059	9,459,311	14,013,794
2022	184,045	245,394	29,084	43,087	154,962	202,307	12,430,338	18,415,316	9,322,754	13,811,487
2023	189,567	252,756	29,084	43,087	160,483	209,669	12,241,636	18,135,758	9,181,227	13,601,818
2024	195,254	260,338	29,084	43,087	166,170	217,251	12,046,110	17,846,089	9,034,583	13,384,567
2025	201,111	268,148	29,084	43,087	172,028	225,062	11,843,555	17,546,007	8,882,666	13,159,505
2026	207,145	276,193	29,084	43,087	178,061	233,106	11,633,759	17,235,199	8,725,320	12,926,399
2027	213,359	284,479	29,084	43,087	184,275	241,392	11,416,507	16,913,344	8,562,380	12,685,008
2028	219,760	293,013	29,084	43,087	190,676	249,926	11,191,573	16,580,109	8,393,680	12,435,082
2029	226,353	301,803	29,084	43,087	197,269	258,717	10,958,729	16,235,153	8,219,046	12,176,365
2030	233,143	310,857	29,084	43,087	204,059	267,771	10,717,735	15,878,126	8,038,301	11,908,594
2031	240,137	320,183	29,084	43,087	211,054	277,096	10,468,348	15,508,664	7,851,261	11,631,498
2032	247,342	329,789	29,084	43,087	218,258	286,702	10,210,317	15,126,395	7,657,738	11,344,796
2033	254,762	339,682	29,084	43,087	225,678	296,595	9,943,381	14,730,934	7,457,536	11,048,201
2034	262,405	349,873	29,084	43,087	233,321	306,786	9,667,273	14,321,886	7,250,455	10,741,415

2035	270,277	360,369	29,084	43,087	241,193	317,282	9,381,719	13,898,844	7,036,290	10,424,133
2036	278,385	371,180	29,084	43,087	249,301	328,093	9,086,436	13,461,386	6,814,827	10,096,040
2037	286,737	382,315	29,084	43,087	257,653	339,229	8,781,130	13,009,081	6,585,847	9,756,811
2038	295,339	393,785	29,084	43,087	266,255	350,698	8,465,502	12,541,484	6,349,126	9,406,113
2039	304,199	405,598	29,084	43,087	275,115	362,512	8,139,241	12,058,135	6,104,431	9,043,601
2040	313,325	417,766	29,084	43,087	284,241	374,680	7,802,029	11,558,562	5,851,522	8,668,922
2041	322,725	430,299	29,084	43,087	293,641	387,213	7,453,538	11,042,279	5,590,154	8,281,709
2042	332,406	443,208	29,084	43,087	303,323	400,122	7,093,429	10,508,783	5,320,072	7,881,587
2043	342,379	456,505	29,084	43,087	313,295	413,418	6,721,353	9,957,560	5,041,015	7,468,170
2044	352,650	470,200	29,084	43,087	323,566	427,113	6,336,951	9,388,076	4,752,713	7,041,057
2045	363,229	484,306	29,084	43,087	334,146	441,219	5,939,854	8,799,784	4,454,891	6,599,838
2046	374,126	498,835	29,084	43,087	345,043	455,748	5,529,681	8,192,120	4,147,261	6,144,090
2047	385,350	513,800	29,084	43,087	356,266	470,713	5,106,039	7,564,502	3,829,529	5,673,377
2048	396,911	529,214	29,084	43,087	367,827	486,127	4,668,524	6,916,332	3,501,393	5,187,249
2049	408,818	545,090	29,084	43,087	379,734	502,004	4,216,721	6,246,994	3,162,541	4,685,246
2050	421,082	561,443	29,084	43,087	391,999	518,356	3,750,201	5,555,853	2,812,650	4,166,889
2051	433,715	578,286	29,084	43,087	404,631	535,200	3,268,521	4,842,253	2,451,391	3,631,690
2052	446,726	595,635	29,084	43,087	417,643	552,548	2,771,227	4,105,522	2,078,421	3,079,142
2053	460,128	613,504	29,084	43,087	431,044	570,417	2,257,852	3,344,966	1,693,389	2,508,724
2054	473,932	631,909	29,084	43,087	444,848	588,822	1,727,912	2,559,869	1,295,934	1,919,902
2055	488,150	723,185	29,084	43,087	459,066	680,098	1,115,824	1,653,072	836,868	1,239,804
2056	502,794	744,881	29,084	43,087	473,711	701,794	484,209	717,347	363,157	538,010
2057	517,878	767,227	29,084	43,087	488,795	724,140	-167,517	-248,173	-125,638	-186,130

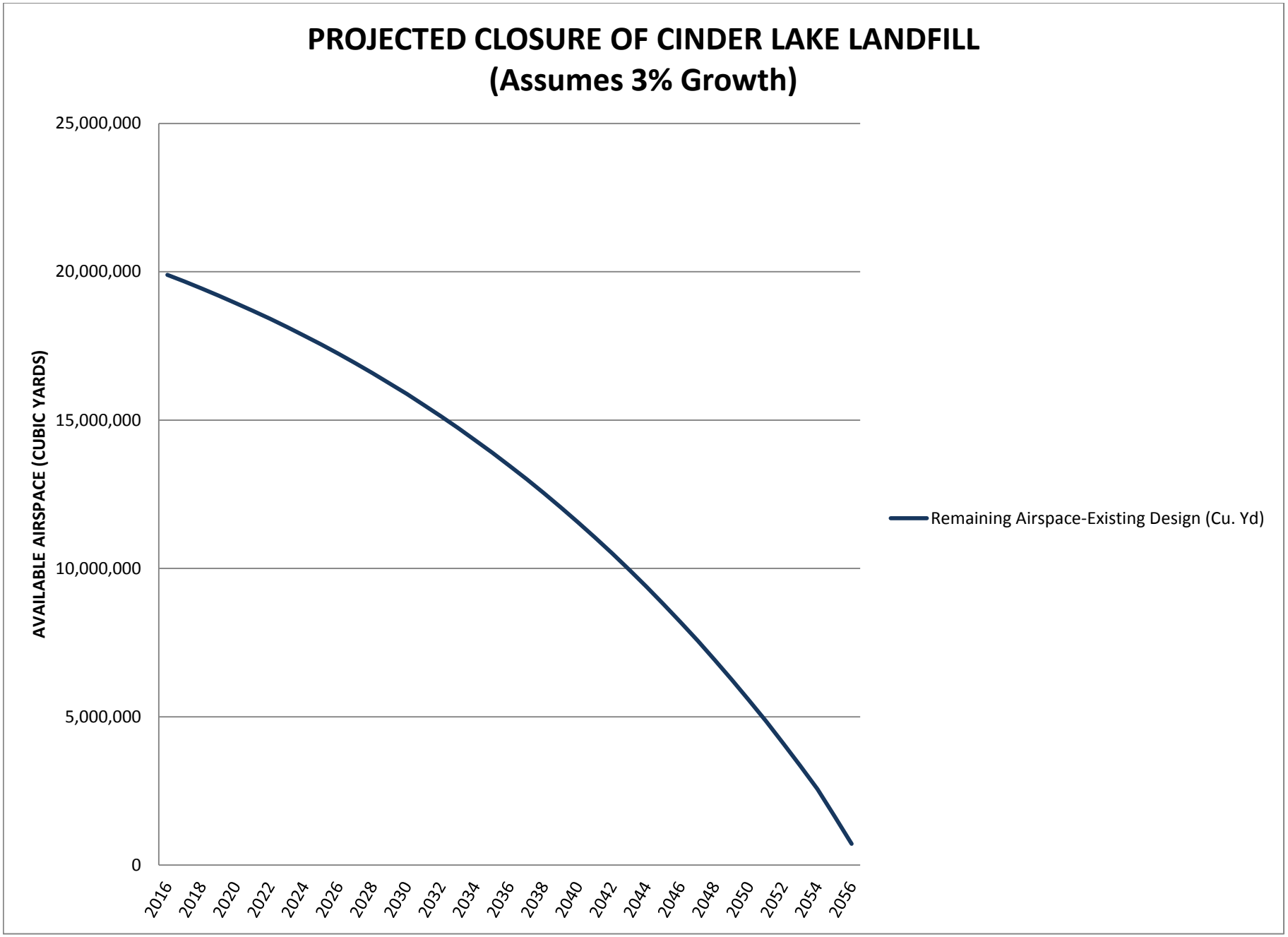
(1) Actual values are from 1999-2011. Projected values are from 2008 thru 2056

(2) Assume an in-place density for solid waste of 1,053 lb/cy (updated 2/2013) and a waste to soil cover ratio of 3:1.

(3) Combined waste and cover material capacity.

(4) Paper Sludge Average of 30,549 tons was taken from 1999 thru 2006

(5) Calculation of available airspace performed with CAD using existing contours and WWC final design contours for 2008


PROJECTED CLOSURE OF CINDER LAKE LANDFILL
(Assumes 3% Growth)
AVAILABLE AIRSPACE (CUBIC YARDS)
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
2054
2056
Remaining Airspace-Existing Design (Cu. Yd)

APPENDIX B-ESTIMATED LANDFILL CLOSURE AND SOIL PROJECTIONS WITH REDESIGN

REDESIGN OF SEQUENCE A AND D- WITH 1500 LB/CY

In-Place Density	ton/cu.yd =	0.68
Revised Density (1/2014) [6]	ton/cu.yd =	0.75
Refuse/Soil Ratio		0.75

All disposal rates up to 2006 were taken from the documented disposal rates taken from "Estimate of in place MSW.xls"

Refuse Growth Rate %/year = **3.00%**

Estimated remaining Cell Capacity of Cells A, B, & C-Fill Capacity (After 12/31/2013) 20,521,099 (Cu. Yd)

Estimated remaining Cell Capacity of Cells A, B, & C-Refuse Capacity (After 12/31/2013) 15,390,824 (Cu. Yd)

Year	Disposal Tonnage (Tons)[1]	Disposal Volume (Cu Yd)[1]	ADC[4] (Tons)	ADC (Cu Yd)	Tonnage After ADC (Tons)	Volume After ADC (Cu.Yd.)[2]	Added Airspace[5]	Total Remaining Capacity (Tons)[3]	Airspace Added (Cu. Yd)	Remaining Refuse Capacity (Tons)[2]	Remaining Refuse Capacity (Cu. Yd)[2]
2016	154,135	205,513	29,084	43,087	125,051	162,427		13,429,972	19,896,255	11,191,643	14,922,191
2017	158,759	211,679	29,084	43,087	129,675	168,592	188,300	13,405,342	19,859,766	11,171,118	14,894,824
2018	163,522	218,029	29,084	43,087	134,438	174,942	188,300	13,374,996	19,814,810	11,145,830	14,861,107
2019	168,428	224,570	29,084	43,087	139,344	181,483	188,300	13,338,764	19,761,132	11,115,637	14,820,849
2020	173,480	231,307	29,084	43,087	144,397	188,220	188,300	13,296,469	19,698,472	11,080,390	14,773,854
2021	178,685	238,246	29,084	43,087	149,601	195,160	188,300	13,247,928	19,626,559	11,039,940	14,719,920
2022	184,045	245,394	29,084	43,087	154,962	202,307	188,300	13,192,954	19,545,117	10,994,128	14,658,838
2023	189,567	252,756	29,084	43,087	160,483	209,669	188,300	13,131,355	19,453,859	10,942,796	14,590,394
2024	195,254	260,338	29,084	43,087	166,170	217,251	279,425	13,124,441	19,443,616	10,937,034	14,582,712
2025	201,111	268,148	29,084	43,087	172,028	225,062	279,425	13,110,498	19,422,959	10,925,415	14,567,219
2026	207,145	276,193	29,084	43,087	178,061	233,106	279,425	13,089,314	19,391,577	10,907,762	14,543,683
2027	213,359	284,479	29,084	43,087	184,275	241,392	279,425	13,060,674	19,349,147	10,883,895	14,511,860
2028	219,760	293,013	29,084	43,087	190,676	249,926	219,205	12,983,704	19,235,116	10,819,753	14,426,337
2029	226,353	301,803	29,084	43,087	197,269	258,717	197,842	12,884,402	19,088,003	10,737,002	14,316,002
2030	233,143	310,857	29,084	43,087	204,059	267,771	197,842	12,776,952	18,928,818	10,647,460	14,196,614
2031	240,137	320,183	29,084	43,087	211,054	277,096		12,527,565	18,559,356	10,439,638	13,919,517
2032	247,342	329,789	29,084	43,087	218,258	286,702		12,269,534	18,177,087	10,224,612	13,632,815
2033	254,762	339,682	29,084	43,087	225,678	296,595		12,002,598	17,781,627	10,002,165	13,336,220
2034	262,405	349,873	29,084	43,087	233,321	306,786		11,726,491	17,372,579	9,772,075	13,029,434
2035	270,277	360,369	29,084	43,087	241,193	317,282		11,440,937	16,949,536	9,534,114	12,712,152
2036	278,385	371,180	29,084	43,087	249,301	328,093		11,145,653	16,512,078	9,288,044	12,384,059
2037	286,737	382,315	29,084	43,087	257,653	339,229		10,840,347	16,059,773	9,033,622	12,044,830
2038	295,339	393,785	29,084	43,087	266,255	350,698		10,524,719	15,592,176	8,770,599	11,694,132
2039	304,199	405,598	29,084	43,087	275,115	362,512		10,198,458	15,108,827	8,498,715	11,331,620
2040	313,325	417,766	29,084	43,087	284,241	374,680		9,861,247	14,609,254	8,217,706	10,956,941
2041	322,725	430,299	29,084	43,087	293,641	387,213		9,512,755	14,092,971	7,927,296	10,569,728
2042	332,406	443,208	29,084	43,087	303,323	400,122		9,152,646	13,559,475	7,627,205	10,169,607
2043	342,379	456,505	29,084	43,087	313,295	413,418		8,780,570	13,008,252	7,317,142	9,756,189
2044	352,650	470,200	29,084	43,087	323,566	427,113		8,396,168	12,438,768	6,996,807	9,329,076
2045	363,229	484,306	29,084	43,087	334,146	441,219		7,999,071	11,850,476	6,665,893	8,887,857
2046	374,126	498,835	29,084	43,087	345,043	455,748		7,588,898	11,242,812	6,324,082	8,432,109
2047	385,350	513,800	29,084	43,087	356,266	470,713		7,165,256	10,615,194	5,971,047	7,961,396
2048	396,911	529,214	29,084	43,087	367,827	486,127		6,727,742	9,967,025	5,606,451	7,475,268
2049	408,818	545,090	29,084	43,087	379,734	502,004		6,275,938	9,297,686	5,229,949	6,973,265
2050	421,082	561,443	29,084	43,087	391,999	518,356		5,809,418	8,606,545	4,841,181	6,454,909
2051	433,715	578,286	29,084	43,087	404,631	535,200		5,327,738	7,892,945	4,439,782	5,919,709
2052	446,726	595,635	29,084	43,087	417,643	552,548		4,830,445	7,156,214	4,025,371	5,367,161
2053	460,128	613,504	29,084	43,087	431,044	570,417		4,317,069	6,395,658	3,597,558	4,796,744
2054	473,932	631,909	29,084	43,087	444,848	588,822		3,787,129	5,610,562	3,155,941	4,207,921
2055	488,150	650,867	29,084	43,087	459,066	607,780		3,240,127	4,800,189	2,700,106	3,600,141

2056	502,794	670,392	29,084	43,087	473,711	627,306	2,675,552	3,963,781	2,229,627	2,972,836
2057	517,878	690,504	29,084	43,087	488,795	647,417	2,092,877	3,100,558	1,744,064	2,325,418
2058	533,415	711,219	29,084	43,087	504,331	668,133	1,491,557	2,209,715	1,242,964	1,657,286
2059	549,417	732,556	29,084	43,087	520,333	689,469	871,035	1,290,422	725,863	967,817
2060	565,899	754,533	29,084	43,087	536,816	711,446	230,734	341,828	192,278	256,371
2061	582,876	777,169	29,084	43,087	553,793	734,082	-429,940	-636,948	-358,283	-477,711

(1) Actual values are from 1999-2014. Projected values are from 2008 thru 2060. Includes portion (60%)of mined landfill (0.9 tons/cy)

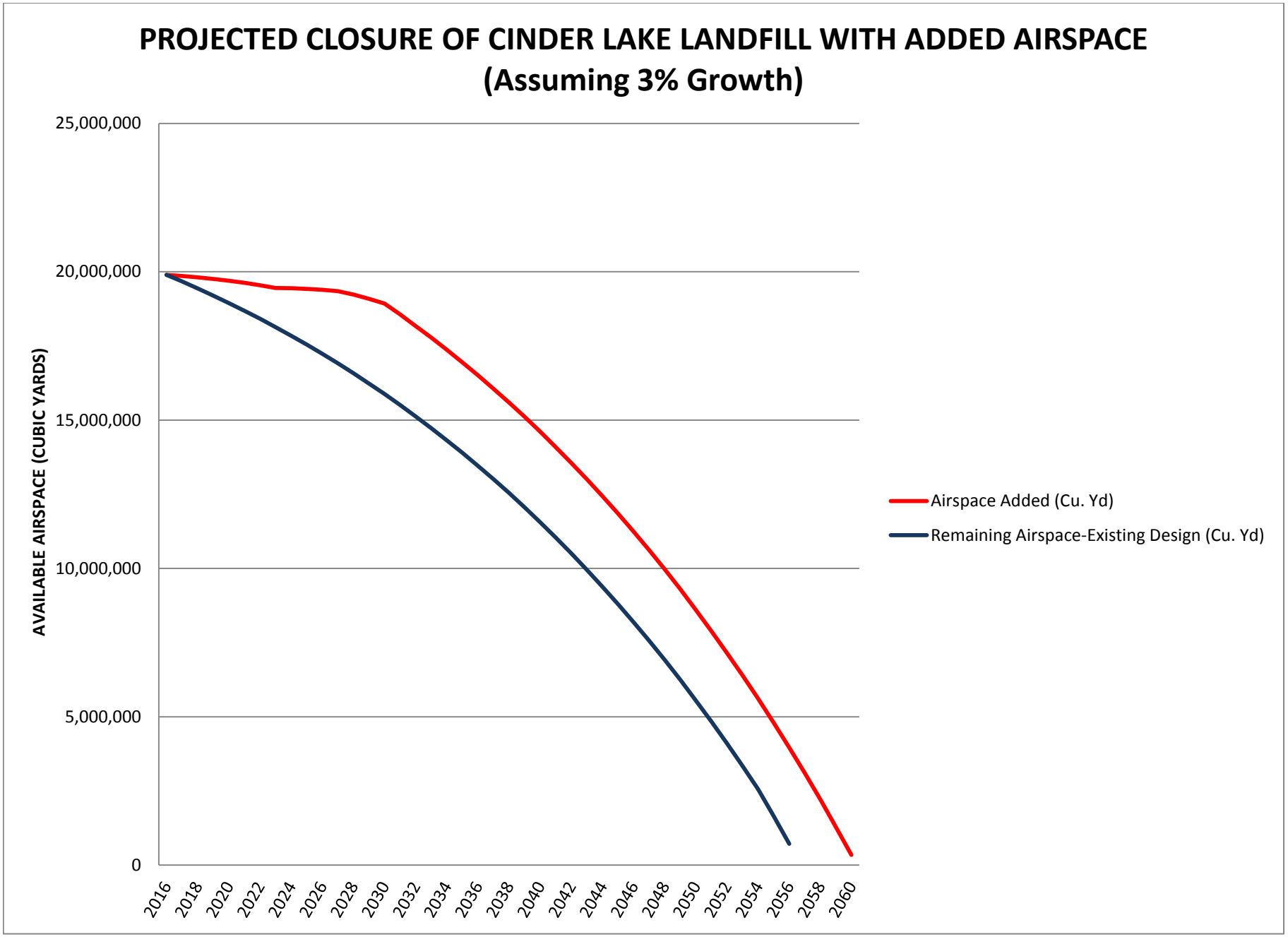
(2) Assume an in-place density for solid waste of 1,053 lb/cy (updated 2/2013) and a waste to soil cover ratio of 3:1.

(3) Combined waste and cover material capacity.

(4) Paper Millings Average of 30,549 tons was taken from 1999 thru 2006

(5) Assumes only 60% of mined waste will be disposed in the landfill. Remaining 40% is accounted for as ADC

(6) Revised density from annual airspace calculation from GPS equipment


PROJECTED CLOSURE OF CINDER LAKE LANDFILL WITH ADDED AIRSPACE
(Assuming 3% Growth)
AVAILABLE AIRSPACE (CUBIC YARDS)
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
2054
2056
2058
2060
Airspace Added (Cu. Yd)
Remaining Airspace-Existing Design (Cu. Yd)

APPENDIX C-COST ESTIMATES PROVIDED BY SDB, INC.

Direct Cost Report

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 1000											
Description =	Mobilization				Unit =	EA	Takeoff Quan:	1.000	Engr Quan:		1.000
01-505	**MOBILIZATION**				**Quan:**	**200.00 HR**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
ZMOB	HBC Equipment Mob			200.00	CH	**Prod:**	**200.0000 CH**	Lab Pcs:	3.00	Eqp Pcs:	1.00
	TRANSPORT	1.00	200.00	HR	188.320				37,664		37,664
	GENERAL LABOR	1.00	200.00	MH	24.630	4,926					4,926
	UNIVERSAL OPERATOR	1.00	200.00	MH	37.507	7,502					7,502
	TEAMSTER-TRANSPOR	1.00	200.00	MH	30.425	6,085					6,085
$56,176.63	3.0000 MH/HR		600.00	MH	[63.087]	18,513			37,664		56,177
=====> Item Totals:	**1000**	**- Mobilization**									
$56,176.63	600.0000 MH/EA		600.00	MH	[12617.44]	18,513			37,664		**56,177**
56,176.630	1 EA					18,512.64			37,663.99		56,176.63
BID ITEM = 2000											
Description =	Construction Water				Unit =	MO	Takeoff Quan:	1.000	Engr Quan:		1.000
01-332	**CONSTUCTION WATER**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	CONSTRUCTION WATE	1.00	1,408.00	MGAL	5.885		8,286				8,286
	==> KLEIN TANK	1.00	176.00	HR	8.745				1,539		1,539
$9,825.21					[ ]		8,286		1,539		9,825
=====> Item Totals:	**2000**	**- Construction Water**									
$9,825.21					[ ]		8,286		1,539		**9,825**
9,825.210	1 MO						8,286.08		1,539.13		9,825.21
BID ITEM = 3000											
Description =	General Conditions Management				Unit =	MO	Takeoff Quan:	1.000	Engr Quan:		1.000
01-020	**SUPERINTENDENT**				**Quan:**	**22.00 DA**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	==> PICK UP	1.00	176.00	HR	13.123				2,310		2,310
	==> SUPERINTENDENT	1.00	176.00	MH	75.073	13,213					13,213
$15,522.72	8.0000 MH/DA		176.00	MH	[376.64]	13,213			2,310		15,523
01-652	**JOB SERVICE**				**Quan:**	**22.00 DA**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	JOB SERVICE	1.00	88.00	HR	76.505					6,732	6,732
01-030	**SAFETY ENGINEER**				**Quan:**	**22.00 DA**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5606**	
	==> PICK UP	1.00	176.00	HR	13.123				2,310		2,310
	==> PROJECT ENGINEER	1.00	176.00	MH	61.521	10,828					10,828
$13,137.53	8.0000 MH/DA		176.00	MH	[310.728]	10,828			2,310		13,138
01-310	**JOB TRAILER**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	OFFICE SETUP	1.00	1.00	LUMP	294.250			294			294
	OFFICE SUPPLIES	1.00	1.00	MONT	176.550			177			177
	OFFICE TRAILER	1.00	1.00	MONT	529.650			530			530
	OFFICE UTILITIES	1.00	1.00	MONT	1,177.000			1,177			1,177
$2,177.45					[ ]			2,177			2,177

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 3000											
Description =	General Conditions Management				Unit =	MO	Takeoff Quan:	1.000	Engr Quan:		1.000
01-031	**PROJECT MANAGER**				**Quan:**	**22.00 DA**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5606**	
	==> PICK UP	1.00	176.00	HR	13.123				2,310		2,310
	==> PROJECT MANAGE	1.00	176.00	MH	90.662	15,957					15,957
$18,266.40	8.0000 MH/DA		176.00	MH	[451.968]	15,957			2,310		18,266
01-312	**STORAGE CONTAINR**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	STORAGE CONTAINER	1.00	1.00	MONT	129.470			129			129
01-320	**J-JON**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	J-JON	1.00	2.00	MONT	176.550			353			353
01-340	**MOBILE PHONE**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	MOBILE PHONE	1.00	4.00	MONT	294.250			1,177			1,177
25-104	**BARRICADES**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	TRAFFIC CONTROL	1.00	1.00	LS	588.500					589	589
01-280	**Progress Photos**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	VIDEO	1.00	1.00	EACH	1,177.000			1,177			1,177
01-200	**SWPP PERMIT & REPORTS**				**Quan:**	**0.83 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
	PERMITS	1.00	1.00	LUMP	1,765.500			1,766			1,766
25-911	**SURVEY**				**Quan:**	**1.00 LS**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: AZ5506**	
ZGPS	Survey Crew		80.00	CH	**Prod:**	**10.0000 S**	Lab Pcs:	2.00	Eqp Pcs:		2.00
	GPS Equipment	1.00	80.00	HR	25.894				2,072		2,072
	PICK UP	1.00	80.00	HR	13.123				1,050		1,050
	GENERAL LABOR	1.00	80.00	MH	24.630	1,970					1,970
	GPS/AGTEK OPERATOR	1.00	80.00	MH	50.385	4,031					4,031
$9,122.63	160.0000 MH/LS		160.00	MH	[4143.04]	6,001			3,121		9,123
=====> **Item Totals:**	**3000**			**- General Conditions Management**							
$70,149.74	688.0000 MH/MO		688.00	MH	[29208.43]	45,999		6,780	10,051	7,321	**70,150**
70,149.740	1 MO					45,998.69		6,779.52	10,050.59	7,320.94	70,149.74
BID ITEM = 4000											
Description =	Haul road Maint				Unit =	MO	Takeoff Quan:	1.000	Engr Quan:		1.000
02-208	**MAINTAIN HAUL ROAD**				**Quan:**	**1.00 MO**	**Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: 5506**	
EXMHR	Maintain Haul Road		176.00	CH	**Prod:**	**22.0000 S**	Lab Pcs:	1.50	Eqp Pcs:		1.50
	140G MOTOR GRADER	1.00	176.00	HR	93.041				16,375		16,375
	WATER TRUCK-3800 GA	0.50	88.00	HR	50.057				4,405		4,405
	BLADE OPERATOR	1.00	176.00	MH	39.450	6,943					6,943
	TEAMSTER-3800GL WTR	0.50	88.00	MH	31.329	2,757					2,757
$30,480.67	264.0000 MH/MO		264.00	MH	[6628.85]	9,700			20,780		30,481
=====> **Item Totals:**	**4000**			**- Haul road Maint**							

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 4000											
Description =	Haul road Maint				Unit =	MO	Takeoff Quan:		1.000	Engr Quan:	1.000
$30,480.67	264.0000 MH/MO		264.00	MH		[6628.85]	9,700		20,780		**30,481**
30,480.670	1 MO						9,700.26		20,780.41		30,480.67
BID ITEM = 6000											
Description =	Cell D Ph 1BTrash Exc & Screen				Unit =	CY	Takeoff Quan:	2,400,000.000		Engr Quan:	2,400,000.000
02-160	**Exc & Screen trash**				**Quan:**	**2,400,000.00**	**CY Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: 5506**	
EXCB	Exc Catch Basin			24,000.00	CH	**Prod:**	**800.0000 US**	Lab Pcs:	4.50	Eqp Pcs:	5.50
	CAT 345B	1.00	24,000.00	HR		170.665			4,095,960		4,095,960
	CAT 966 LOADER	1.00	24,000.00	HR		121.407			2,913,781		2,913,781
	D9 DOZER	0.50	12,000.00	HR		275.053			3,300,638		3,300,638
	WATER TRUCK-3800 GA	1.00	24,000.00	HR		50.057			1,201,387		1,201,387
	TROMMEL SCREEN	1.00	24,000.00	HR		191.703			4,600,893		4,600,893
	PICK UP	1.00	24,000.00	HR		13.123			314,965		314,965
	BACKHOE OPERATOR	1.00	24,000.00	MH		36.202	868,849				868,849
	DOZER OPERATOR	0.50	12,000.00	MH		34.577	414,935				414,935
	OILER	1.00	24,000.00	MH		29.705	712,932				712,932
	LOADER OPERATOR	1.00	24,000.00	MH		34.577	829,870				829,870
	TEAMSTER-3800GL WTR	1.00	24,000.00	MH		31.329	751,911				751,911
$20,006,120.58	0.0450 MH/CY		108,000.00	MH		[1.012]	3,578,496		16,427,624		20,006,121
02-165	**Load & Haul trash**				**Quan:**	**1,008,000.00**	**CY Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: 5506**	
RET	RW Exc to Trucks - Loader			5,600.00	CH	**Prod:**	**180.0000 UH**	Lab Pcs:	5.00	Eqp Pcs:	5.00
	CAT 966 LOADER	1.00	5,600.00	HR		121.407			679,882		679,882
	WATER TRUCK-3800 GA	1.00	5,600.00	HR		50.057			280,324		280,324
	CAT 735 -35 TON TRUCK	3.00	16,800.00	HR		166.110			2,790,648		2,790,648
	LOADER OPERATOR	1.00	5,600.00	MH		34.577	193,636				193,636
	TEAMSTER-3800GL WTR	1.00	5,600.00	MH		31.329	175,446				175,446
	TEAMSTER-WTR WGN	3.00	16,800.00	MH		34.577	580,909				580,909
$4,700,845.14	0.0277 MH/CY		28,000.00	MH		[0.641]	949,991		3,750,854		4,700,845
02-170	**Load & Haul Ferris metals**				**Quan:**	**192,000.00**	**CY Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: 5506**	
RET	RW Exc to Trucks - Loader			1,200.00	CH	**Prod:**	**160.0000 UH**	Lab Pcs:	6.00	Eqp Pcs:	5.00
	CAT 966 LOADER	1.00	1,200.00	HR		121.407			145,689		145,689
	WATER TRUCK-3800 GA	1.00	1,200.00	HR		50.057			60,069		60,069
	CAT 735 -35 TON TRUCK	3.00	3,600.00	HR		166.110			597,996		597,996
	GRADE CHECKER	1.00	1,200.00	MH		34.577	41,493				41,493
	LOADER OPERATOR	1.00	1,200.00	MH		34.577	41,493				41,493
	TEAMSTER-3800GL WTR	1.00	1,200.00	MH		31.329	37,596				37,596
	TEAMSTER-WTR WGN	3.00	3,600.00	MH		34.577	124,480				124,480
$1,048,817.45	0.0375 MH/CY		7,200.00	MH		[0.868]	245,063		803,754		1,048,817
02-180	**Load & Haul Soil**				**Quan:**	**1,200,000.00**	**CY Hrs/Shft:**	**8.00**	**Cal: 508**	**WC: 5506**	
RET	RW Exc to Trucks - Loader			6,000.00	CH	**Prod:**	**200.0000 UH**	Lab Pcs:	5.00	Eqp Pcs:	5.00
	CAT 966 LOADER	1.00	6,000.00	HR		121.407			728,445		728,445
	WATER TRUCK-3800 GA	1.00	6,000.00	HR		50.057			300,347		300,347
	CAT 735 -35 TON TRUCK	3.00	18,000.00	HR		166.110			2,989,980		2,989,980
	LOADER OPERATOR	1.00	6,000.00	MH		34.577	207,467				207,467
	TEAMSTER-3800GL WTR	1.00	6,000.00	MH		31.329	187,978				187,978
	TEAMSTER-WTR WGN	3.00	18,000.00	MH		34.577	622,402				622,402
$5,036,619.82	0.0250 MH/CY		30,000.00	MH		[0.577]	1,017,847		4,018,772		5,036,620

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 6000											
Description =	Cell D Ph 1BTrash Exc & Screen				Unit =	CY	Takeoff Quan:	2,400,000.000		Engr Quan:	2,400,000.000
=====> Item Totals:	**6000 - Cell D Ph 1BTrash Exc & Screen**										
$30,792,402.99	0.0721 MH/CY		173,200.00	MH	[1.639]	5,791,398			25,001,005		**30,792,403**
12.830		2400000 CY				2.41			10.42		12.83
BID ITEM = 6500	CLIENT# = 520										
Description =	Cell D Ph 1B Soil & DR Exc				Unit =	CY	Takeoff Quan:	21,640.000		Engr Quan:	21,640.000
02-190	**Exc & Haul Soil**				**Quan: 10,820.00 CY**		**Hrs/Shft: 8.00 Cal: 508 WC: 5506**				
EXS	Structural Exc			56.00	CH	**Prod:**	**193.2143 UH**	Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	56.00	HR	245.110				13,726		13,726
	D9 DOZER	1.00	56.00	HR	275.053				15,403		15,403
	WATER TRUCK-3800 GA	1.00	56.00	HR	50.057				2,803		2,803
	PICK UP	1.00	56.00	HR	13.123				735		735
	CAT 735 -35 TON TRUCK	3.00	168.00	HR	166.110				27,906		27,906
	BACKHOE OPERATOR	1.00	56.00	MH	36.202	2,027					2,027
	DOZER OPERATOR	1.00	56.00	MH	34.577	1,936					1,936
	GRADE CHECKER	1.00	56.00	MH	34.577	1,936					1,936
	TEAMSTER-3800GL WTR	1.00	56.00	MH	31.329	1,754					1,754
	TEAMSTER-WTR WGN	3.00	168.00	MH	34.577	5,809					5,809
$74,037.25	0.0362 MH/CY		392.00	MH	[0.847]	13,464			60,574		74,037
02-190DR	**Exc & Haul Decomposed Rock**				**Quan: 10,820.00 CY**		**Hrs/Shft: 8.00 Cal: 508 WC: 5506**				
EXS	Structural Exc			64.00	CH	**Prod:**	**169.0625 UH**	Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	64.00	HR	245.110				15,687		15,687
	D9 DOZER	1.00	64.00	HR	275.053				17,603		17,603
	WATER TRUCK-3800 GA	1.00	64.00	HR	50.057				3,204		3,204
	PICK UP	1.00	64.00	HR	13.123				840		840
	CAT 735 -35 TON TRUCK	3.00	192.00	HR	166.110				31,893		31,893
	BACKHOE OPERATOR	1.00	64.00	MH	36.202	2,317					2,317
	DOZER OPERATOR	1.00	64.00	MH	34.578	2,213					2,213
	GRADE CHECKER	1.00	64.00	MH	34.578	2,213					2,213
	TEAMSTER-3800GL WTR	1.00	64.00	MH	31.329	2,005					2,005
	TEAMSTER-WTR WGN	3.00	192.00	MH	34.577	6,639					6,639
$84,614.10	0.0414 MH/CY		448.00	MH	[0.968]	15,387			69,227		84,614
=====> Item Totals:	**6500 - Cell D Ph 1B Soil & DR Exc**										
$158,651.35	0.0388 MH/CY		840.00	MH	[0.907]	28,851			129,801		**158,651**
7.331		21640 CY				1.33			6.00		7.33
BID ITEM = 7000	CLIENT# = 550										
Description =	Cell D Ph 1B Weathered Basalt Exc				Unit =	CY	Takeoff Quan:	28,853.000		Engr Quan:	28,853.000
02-190R	**Exc Haul Weatherd Basalt Blasted**				**Quan: 28,853.00 CY**		**Hrs/Shft: 8.00 Cal: 508 WC: 5506**				
EXS	Structural Exc			176.00	CH	**Prod:**	**163.9375 UH**	Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	176.00	HR	245.110				43,139		43,139
	D9 DOZER	1.00	176.00	HR	275.053				48,409		48,409
	WATER TRUCK-3800 GA	1.00	176.00	HR	50.057				8,810		8,810
	PICK UP	1.00	176.00	HR	13.123				2,310		2,310
	CAT 735 -35 TON TRUCK	2.00	352.00	HR	166.110				58,471		58,471
	BACKHOE OPERATOR	1.00	176.00	MH	36.202	6,372					6,372
	DOZER OPERATOR	1.00	176.00	MH	34.577	6,086					6,086

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 7000	CLIENT# = 550										
Description =	Cell D Ph 1B Weathered Basalt Exc				Unit = CY	Takeoff Quan:		28,853.000	Engr Quan:		28,853.000
	GRADE CHECKER	1.00	176.00	MH	34.577	6,086					6,086
	TEAMSTER-3800GL WTR	1.00	176.00	MH	31.329	5,514					5,514
	TEAMSTER-WTR WGN	2.00	352.00	MH	34.577	12,171					12,171
$197,367.71	0.0365 MH/CY		1,056.00	MH	[0.854]	36,228			161,139		197,368
=====> Item Totals:	**7000 - Cell D Ph 1B Weathered Basalt Exc**										
$197,367.71	0.0365 MH/CY		1,056.00	MH	[0.854]	36,228			161,139		**197,368**
6.840	28853 CY					1.26			5.58		6.84
BID ITEM = 7500	CLIENT# = 560										
Description =	Cell D Ph 1A Basalt Exc				Unit = CY	Takeoff Quan:		21,640.000	Engr Quan:		21,640.000
02-190R	**Exc & Haul Blasted Basalt to crusher**				**Quan: 21,640.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc		144.00	CH	**Prod: 150.2778 UH**			Lab Pcs: 6.00		Eqp Pcs: 6.00	
	CAT 365	1.00	144.00	HR	245.110				35,296		35,296
	D9 DOZER	1.00	144.00	HR	275.053				39,608		39,608
	WATER TRUCK-3800 GA	1.00	144.00	HR	50.057				7,208		7,208
	PICK UP	1.00	144.00	HR	13.123				1,890		1,890
	CAT 735 -35 TON TRUCK	2.00	288.00	HR	166.110				47,840		47,840
	BACKHOE OPERATOR	1.00	144.00	MH	36.202	5,213					5,213
	DOZER OPERATOR	1.00	144.00	MH	34.578	4,979					4,979
	GRADE CHECKER	1.00	144.00	MH	34.578	4,979					4,979
	TEAMSTER-3800GL WTR	1.00	144.00	MH	31.329	4,511					4,511
	TEAMSTER-WTR WGN	2.00	288.00	MH	34.577	9,958					9,958
$161,482.69	0.0399 MH/CY		864.00	MH	[0.932]	29,641			131,841		161,483
=====> Item Totals:	**7500 - Cell D Ph 1A Basalt Exc**										
$161,482.69	0.0399 MH/CY		864.00	MH	[0.932]	29,641			131,841		**161,483**
7.462	21640 CY					1.37			6.09		7.46
BID ITEM = 8000											
Description =	Cell D Ph 1A Soil & DR Exc				Unit = CY	Takeoff Quan:		150,369.000	Engr Quan:		150,369.000
02-190	**Exc & Haul Soil**				**Quan: 60,148.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc		312.00	CH	**Prod: 192.7821 UH**			Lab Pcs: 7.00		Eqp Pcs: 7.00	
	CAT 365	1.00	312.00	HR	245.110				76,474		76,474
	D9 DOZER	1.00	312.00	HR	275.053				85,817		85,817
	WATER TRUCK-3800 GA	1.00	312.00	HR	50.057				15,618		15,618
	PICK UP	1.00	312.00	HR	13.123				4,095		4,095
	CAT 735 -35 TON TRUCK	3.00	936.00	HR	166.110				155,479		155,479
	BACKHOE OPERATOR	1.00	312.00	MH	36.202	11,295					11,295
	DOZER OPERATOR	1.00	312.00	MH	34.577	10,788					10,788
	GRADE CHECKER	1.00	312.00	MH	34.577	10,788					10,788
	TEAMSTER-3800GL WTR	1.00	312.00	MH	31.329	9,775					9,775
	TEAMSTER-WTR WGN	3.00	936.00	MH	34.577	32,365					32,365
$412,493.85	0.0363 MH/CY		2,184.00	MH	[0.849]	75,011			337,482		412,494
02-190DR	**Exc & Haul Decomposed Rock**				**Quan: 90,221.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc		528.00	CH	**Prod: 170.8731 UH**			Lab Pcs: 7.00		Eqp Pcs: 7.00	
	CAT 365	1.00	528.00	HR	245.110				129,418		129,418
	D9 DOZER	1.00	528.00	HR	275.053				145,228		145,228

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 8000											
Description =	Cell D Ph 1A Soil & DR Exc				Unit = CY	Takeoff Quan:		150,369.000	Engr Quan:		150,369.000
	WATER TRUCK-3800 GA	1.00	528.00	HR	50.057				26,431		26,431
	PICK UP	1.00	528.00	HR	13.123				6,929		6,929
	CAT 735 -35 TON TRUCK	3.00	1,584.00	HR	166.110				263,118		263,118
	BACKHOE OPERATOR	1.00	528.00	MH	36.202	19,115					19,115
	DOZER OPERATOR	1.00	528.00	MH	34.577	18,257					18,257
	GRADE CHECKER	1.00	528.00	MH	34.577	18,257					18,257
	TEAMSTER-3800GL WTR	1.00	528.00	MH	31.329	16,542					16,542
	TEAMSTER-WTR WGN	3.00	1,584.00	MH	34.577	54,771					54,771
$698,066.58	0.0409 MH/CY		3,696.00	MH	[0.957]	126,942			571,124		698,067
=====> Item Totals:	**8000 - Cell D Ph 1A Soil & DR Exc**										
$1,110,560.43	0.0391 MH/CY		5,880.00	MH	[0.914]	201,954			908,607		**1,110,560**
7.386	150369 CY					1.34			6.04		7.39
BID ITEM = 8500	CLIENT# = 700										
Description =	Cell D Ph 1A Weathered Basalt Exc				Unit = CY	Takeoff Quan:		90,221.000	Engr Quan:		90,221.000
02-190R	**Exc Haul Weatherd Basalt Blasted**				**Quan: 90,221.00 CY**	**Hrs/Shft:**		**8.00**	**Cal: 508**	**WC: 5506**	
EXS	Structural Exc		552.00	CH	**Prod:**	**163.4438 UH**		Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	552.00	HR	245.110				135,301		135,301
	D9 DOZER	1.00	552.00	HR	275.053				151,829		151,829
	WATER TRUCK-3800 GA	1.00	552.00	HR	50.057				27,632		27,632
	PICK UP	1.00	552.00	HR	13.123				7,244		7,244
	CAT 735 -35 TON TRUCK	2.00	1,104.00	HR	166.110				183,385		183,385
	BACKHOE OPERATOR	1.00	552.00	MH	36.202	19,984					19,984
	DOZER OPERATOR	1.00	552.00	MH	34.577	19,087					19,087
	GRADE CHECKER	1.00	552.00	MH	34.577	19,087					19,087
	TEAMSTER-3800GL WTR	1.00	552.00	MH	31.329	17,294					17,294
	TEAMSTER-WTR WGN	2.00	1,104.00	MH	34.577	38,174					38,174
$619,017.19	0.0367 MH/CY		3,312.00	MH	[0.857]	113,626			505,392		619,017
=====> Item Totals:	**8500 - Cell D Ph 1A Weathered Basalt Exc**										
$619,017.19	0.0367 MH/CY		3,312.00	MH	[0.857]	113,626			505,392		**619,017**
6.861	90221 CY					1.26			5.60		6.86
BID ITEM = 9000											
Description =	Cell D Ph 1A Basalt Exc				Unit = CY	Takeoff Quan:		360,885.000	Engr Quan:		360,885.000
02-190R	**Exc & Haul Blasted Basalt to crusher**				**Quan: 360,885.00 CY**	**Hrs/Shft:**		**8.00**	**Cal: 508**	**WC: 5506**	
EXS	Structural Exc		2,400.00	CH	**Prod:**	**150.3688 UH**		Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	2,400.00	HR	245.110				588,265		588,265
	D9 DOZER	1.00	2,400.00	HR	275.053				660,128		660,128
	WATER TRUCK-3800 GA	1.00	2,400.00	HR	50.057				120,139		120,139
	PICK UP	1.00	2,400.00	HR	13.123				31,497		31,497
	CAT 735 -35 TON TRUCK	2.00	4,800.00	HR	166.110				797,328		797,328
	BACKHOE OPERATOR	1.00	2,400.00	MH	36.202	86,885					86,885
	DOZER OPERATOR	1.00	2,400.00	MH	34.577	82,987					82,987
	GRADE CHECKER	1.00	2,400.00	MH	34.577	82,987					82,987
	TEAMSTER-3800GL WTR	1.00	2,400.00	MH	31.329	75,191					75,191
	TEAMSTER-WTR WGN	2.00	4,800.00	MH	34.577	165,974					165,974
$2,691,379.31	0.0399 MH/CY		14,400.00	MH	[0.931]	494,024			2,197,355		2,691,379

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total

BID ITEM = 9000
Description = Cell D Ph 1A Basalt Exc Unit = CY Takeoff Quan: 360,885.000 Engr Quan: 360,885.000

=====> Item Totals: 9000 - Cell D Ph 1A Basalt Exc

$2,691,379.31	0.0399 MH/CY		14,400.00	MH	[0.931]	494,024		2,197,355	**2,691,379**
7.458	360885 CY					1.37		6.09	7.46

BID ITEM = 14000
Description = Cell D PH 2 Soil & DR Exc Unit = CY Takeoff Quan: 241,348.000 Engr Quan: 241,348.000

02-190 Exc & Haul Soil **Quan: 96,539.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**

EXS	Structural Exc			496.00	CH	**Prod:**	**194.6351 UH**	Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	496.00	HR	245.110				121,575		121,575
	D9 DOZER	1.00	496.00	HR	275.053				136,426		136,426
	WATER TRUCK-3800 GA	1.00	496.00	HR	50.057				24,829		24,829
	PICK UP	1.00	496.00	HR	13.123				6,509		6,509
	CAT 735 -35 TON TRUCK	3.00	1,488.00	HR	166.110				247,172		247,172
	BACKHOE OPERATOR	1.00	496.00	MH	36.202	17,956					17,956
	DOZER OPERATOR	1.00	496.00	MH	34.577	17,151					17,151
	GRADE CHECKER	1.00	496.00	MH	34.577	17,151					17,151
	TEAMSTER-3800GL WTR	1.00	496.00	MH	31.329	15,540					15,540
	TEAMSTER-WTR WGN	3.00	1,488.00	MH	34.577	51,452					51,452
$655,759.50	0.0359 MH/CY		3,472.00	MH	[0.841]	119,249			536,511		655,760

02-190DR Exc & Haul Decomposed Rock **Quan: 144,809.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**

EXS	Structural Exc			856.00	CH	**Prod:**	**169.1694 UH**	Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	856.00	HR	245.110				209,814		209,814
	D9 DOZER	1.00	856.00	HR	275.053				235,445		235,445
	WATER TRUCK-3800 GA	1.00	856.00	HR	50.057				42,849		42,849
	PICK UP	1.00	856.00	HR	13.123				11,234		11,234
	CAT 735 -35 TON TRUCK	3.00	2,568.00	HR	166.110				426,570		426,570
	BACKHOE OPERATOR	1.00	856.00	MH	36.202	30,989					30,989
	DOZER OPERATOR	1.00	856.00	MH	34.577	29,599					29,599
	GRADE CHECKER	1.00	856.00	MH	34.577	29,599					29,599
	TEAMSTER-3800GL WTR	1.00	856.00	MH	31.329	26,818					26,818
	TEAMSTER-WTR WGN	3.00	2,568.00	MH	34.577	88,796					88,796
$1,131,714.04	0.0413 MH/CY		5,992.00	MH	[0.967]	205,801			925,914		1,131,714

=====> Item Totals: 14000 - Cell D PH 2 Soil & DR Exc

$1,787,473.54	0.0392 MH/CY		9,464.00	MH	[0.916]	325,049		1,462,424	**1,787,474**
7.406	241348 CY					1.35		6.06	7.41

BID ITEM = 14500 CLIENT# = 1000
Description = Cell D PH 2 Weathered BASALT Exc Unit = CY Takeoff Quan: 144,809.000 Engr Quan: 144,809.000

02-190R Exc Haul Weathered Basalt Blasted **Quan: 144,809.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**

EXS	Structural Exc			880.00	CH	**Prod:**	**164.5557 UH**	Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	880.00	HR	245.110				215,697		215,697
	D9 DOZER	1.00	880.00	HR	275.053				242,047		242,047
	WATER TRUCK-3800 GA	1.00	880.00	HR	50.057				44,051		44,051
	PICK UP	1.00	880.00	HR	13.123				11,549		11,549
	CAT 735 -35 TON TRUCK	2.00	1,760.00	HR	166.110				292,354		292,354
	BACKHOE OPERATOR	1.00	880.00	MH	36.202	31,858					31,858
	DOZER OPERATOR	1.00	880.00	MH	34.577	30,429					30,429

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 14500	CLIENT# = 1000										
Description =	Cell D PH 2 Weathered BASALT Exc				Unit = CY	Takeoff Quan:		144,809.000	Engr Quan:		144,809.000
	GRADE CHECKER	1.00	880.00	MH	34.577	30,429					30,429
	TEAMSTER-3800GL WTR	1.00	880.00	MH	31.329	27,570					27,570
	TEAMSTER-WTR WGN	2.00	1,760.00	MH	34.577	60,857					60,857
$986,839.07	0.0364 MH/CY		5,280.00	MH	[0.851]	181,142			805,697		986,839
=====> Item Totals:	**14500 - Cell D PH 2 Weathered BASALT Exc**										
$986,839.07	0.0364 MH/CY		5,280.00	MH	[0.851]	181,142			805,697		**986,839**
6.815	144809 CY					1.25			5.56		6.81
BID ITEM = 15000											
Description =	Cell D PH 2 BASALT Exc				Unit = CY	Takeoff Quan:		579,235.000	Engr Quan:		579,235.000
02-190R	**Exc & Haul Blasted Basalt to crusher**				**Quan: 579,235.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc			3,840.00	CH **Prod: 150.8424 UH**			Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	3,840.00	HR	245.110				941,223		941,223
	D9 DOZER	1.00	3,840.00	HR	275.053				1,056,204		1,056,204
	WATER TRUCK-3800 GA	1.00	3,840.00	HR	50.057				192,222		192,222
	PICK UP	1.00	3,840.00	HR	13.123				50,394		50,394
	CAT 735 -35 TON TRUCK	2.00	7,680.00	HR	166.110				1,275,725		1,275,725
	BACKHOE OPERATOR	1.00	3,840.00	MH	36.202	139,016					139,016
	DOZER OPERATOR	1.00	3,840.00	MH	34.577	132,779					132,779
	GRADE CHECKER	1.00	3,840.00	MH	34.577	132,779					132,779
	TEAMSTER-3800GL WTR	1.00	3,840.00	MH	31.329	120,306					120,306
	TEAMSTER-WTR WGN	2.00	7,680.00	MH	34.577	265,558					265,558
$4,306,206.89	0.0397 MH/CY		23,040.00	MH	[0.929]	790,438			3,515,769		4,306,207
=====> Item Totals:	**15000 - Cell D PH 2 BASALT Exc**										
$4,306,206.89	0.0397 MH/CY		23,040.00	MH	[0.929]	790,438			3,515,769		**4,306,207**
7.434	579235 CY					1.36			6.07		7.43
BID ITEM = 18000											
Description =	Cell D Blast Basalt				Unit = CY	Takeoff Quan:		1,225,643.000	Engr Quan:		1,225,643.000
25-410	**BLASTING**				**Quan: 1,225,643.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
	BLAST	1.00	1,225,643.00	CY	5.885					7,212,909	7,212,909
BID ITEM = 22000											
Description =	Cell A PH 2 Soil & DR Exc				Unit = CY	Takeoff Quan:		154,337.000	Engr Quan:		154,337.000
02-190	**Exc & Haul Soil**				**Quan: 61,735.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc			303.07	CH **Prod: 203.6932 UH**			Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	303.08	HR	245.110				74,288		74,288
	D9 DOZER	1.00	303.08	HR	275.053				83,363		83,363
	WATER TRUCK-3800 GA	1.00	303.08	HR	50.057				15,172		15,172
	PICK UP	1.00	303.08	HR	13.123				3,977		3,977
	CAT 735 -35 TON TRUCK	3.00	909.24	HR	166.110				151,034		151,034
	BACKHOE OPERATOR	1.00	303.08	MH	36.202	10,972					10,972
	DOZER OPERATOR	1.00	303.08	MH	34.577	10,480					10,480

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 22000											
Description =	Cell A PH 2 Soil & DR Exc				Unit = CY	Takeoff Quan:	154,337.000		Engr Quan:		154,337.000
	GRADE CHECKER	1.00	303.08	MH	34.577	10,480					10,480
	TEAMSTER-3800GL WTR	1.00	303.08	MH	31.329	9,495					9,495
	TEAMSTER-WTR WGN	3.00	909.24	MH	34.577	31,440					31,440
$400,700.76	0.0343 MH/CY		2,121.56	MH	[0.803]	72,867			327,834		400,701
02-190DR	**Exc & Haul Decomposed Rock**				**Quan: 92,602.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc			544.00	CH **Prod: 170.2243 UH**			Lab Pcs:	7.00	Eqp Pcs:	7.00
	CAT 365	1.00	544.00	HR	245.110				133,340		133,340
	D9 DOZER	1.00	544.00	HR	275.053				149,629		149,629
	WATER TRUCK-3800 GA	1.00	544.00	HR	50.057				27,231		27,231
	PICK UP	1.00	544.00	HR	13.123				7,139		7,139
	CAT 735 -35 TON TRUCK	3.00	1,632.00	HR	166.110				271,092		271,092
	BACKHOE OPERATOR	1.00	544.00	MH	36.202	19,694					19,694
	DOZER OPERATOR	1.00	544.00	MH	34.577	18,810					18,810
	GRADE CHECKER	1.00	544.00	MH	34.577	18,810					18,810
	TEAMSTER-3800GL WTR	1.00	544.00	MH	31.329	17,043					17,043
	TEAMSTER-WTR WGN	3.00	1,632.00	MH	34.577	56,431					56,431
$719,220.15	0.0411 MH/CY		3,808.00	MH	[0.961]	130,789			588,431		719,220
=====> Item Totals: 22000 - Cell A PH 2 Soil & DR Exc											
$1,119,920.91	0.0384 MH/CY		5,929.56	MH	[0.898]	203,656			916,265		**1,119,921**
7.256	154337 CY					1.32			5.94		7.26
BID ITEM = 23000	CLIENT# = 1300										
Description =	Cell A PH 2 Weathered BASALT Exc				Unit = CY	Takeoff Quan:	92,602.000		Engr Quan:		92,602.000
02-190R	**Exc Haul Weathered Basalt Blasted**				**Quan: 92,602.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc			568.00	CH **Prod: 163.0317 UH**			Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	568.00	HR	245.110				139,223		139,223
	D9 DOZER	1.00	568.00	HR	275.053				156,230		156,230
	WATER TRUCK-3800 GA	1.00	568.00	HR	50.057				28,433		28,433
	PICK UP	1.00	568.00	HR	13.123				7,454		7,454
	CAT 735 -35 TON TRUCK	2.00	1,136.00	HR	166.110				188,701		188,701
	BACKHOE OPERATOR	1.00	568.00	MH	36.202	20,563					20,563
	DOZER OPERATOR	1.00	568.00	MH	34.577	19,640					19,640
	GRADE CHECKER	1.00	568.00	MH	34.577	19,640					19,640
	TEAMSTER-3800GL WTR	1.00	568.00	MH	31.329	17,795					17,795
	TEAMSTER-WTR WGN	2.00	1,136.00	MH	34.577	39,280					39,280
$636,959.68	0.0368 MH/CY		3,408.00	MH	[0.859]	116,919			520,041		636,960
=====> Item Totals: 23000 - Cell A PH 2 Weathered BASALT Exc											
$636,959.68	0.0368 MH/CY		3,408.00	MH	[0.859]	116,919			520,041		**636,960**
6.878	92602 CY					1.26			5.62		6.88
BID ITEM = 24000											
Description =	Cell A PH 2 BASALT Exc				Unit = CY	Takeoff Quan:	370,407.000		Engr Quan:		370,407.000
02-190R	**Exc & Haul Blasted Rock-to crusher**				**Quan: 370,407.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
EXS	Structural Exc			2,440.00	CH **Prod: 151.8061 UH**			Lab Pcs:	6.00	Eqp Pcs:	6.00
	CAT 365	1.00	2,440.00	HR	245.110				598,069		598,069
	D9 DOZER	1.00	2,440.00	HR	275.053				671,130		671,130

Activity Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 24000											
Description =	Cell A PH 2 BASALT Exc				Unit = CY	Takeoff Quan:		370,407.000	Engr Quan:		370,407.000
	WATER TRUCK-3800 GA	1.00	2,440.00	HR	50.057				122,141		122,141
	PICK UP	1.00	2,440.00	HR	13.123				32,021		32,021
	CAT 735 -35 TON TRUCK	2.00	4,880.00	HR	166.110				810,617		810,617
	BACKHOE OPERATOR	1.00	2,440.00	MH	36.202	88,333					88,333
	DOZER OPERATOR	1.00	2,440.00	MH	34.577	84,370					84,370
	GRADE CHECKER	1.00	2,440.00	MH	34.577	84,370					84,370
	TEAMSTER-3800GL WTR	1.00	2,440.00	MH	31.329	76,444					76,444
	TEAMSTER-WTR WGN	2.00	4,880.00	MH	34.577	168,740					168,740
$2,736,235.62	0.0395 MH/CY		14,640.00	MH	[0.923]	502,258			2,233,978		2,736,236
=====> Item Totals:	**24000**		**- Cell A PH 2 BASALT Exc**								
$2,736,235.62	0.0395 MH/CY		14,640.00	MH	[0.923]	502,258			2,233,978		**2,736,236**
7.387	370407 CY					1.36			6.03		7.39
BID ITEM = 25000											
Description =	Cell A Blast Basalt				Unit = CY	Takeoff Quan:		463,009.000	Engr Quan:		463,009.000
25-410	**BLASTING**				**Quan: 463,009.00 CY Hrs/Shft: 8.00 Cal: 508 WC: 5506**						
	BLAST	1.00	463,009.00	CY	5.885				2,724,808		2,724,808
$57,408,846.66	***** Report Totals *****		262,865.56	MH		8,889,395	8,286	6,780	38,559,348	9,945,038	**57,408,847**

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Actual Unit Cost is used, which includes taxes, escalation, etc.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

508	**5 X 8 HR WEEK (Default Calendar)**
510	5 X 10 HR WEEK
610	6 X 10 HR WEEK
WK	WEEKEND WORK

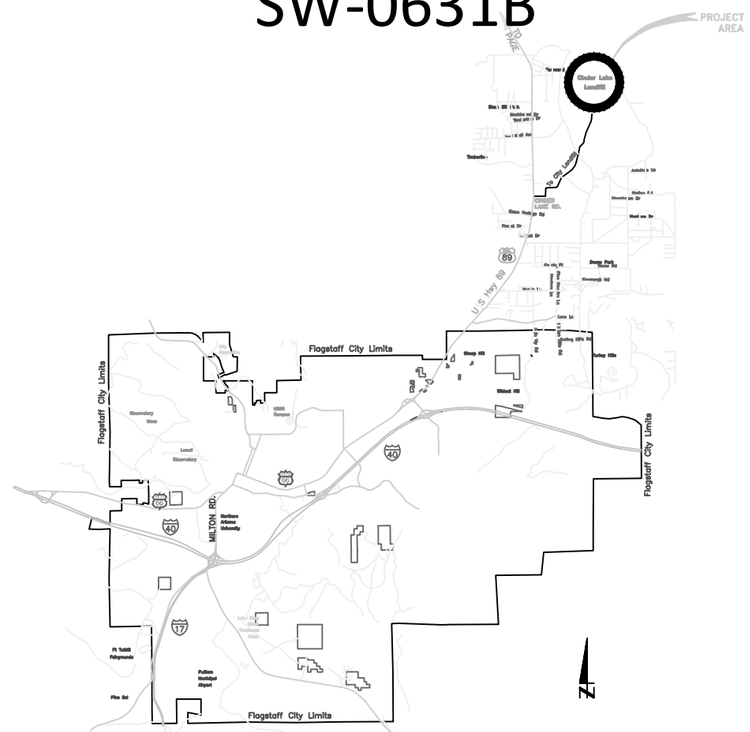
City of Flagstaff
Cinder Lake Landfill
Revised Excavation Quanties

Biditem	Description	Bid Quantity	Unit	Unit Price	Total
100	Mobilization	1	EA	$ 56,177.00	$ 56,177.00
200	Construction Water	1	MO	$ 9,825.00	$ 9,825.00
300	General Conditions Management	1	MO	$ 70,150.00	$ 70,150.00
400	Haul Road Maintain	1	Mo	$ 30,480.00	$ 30,480.00
500	Cell D Ph 1B Trash Exc & Screen	2,400,000	CY	$ 12.83	$ 30,792,000.00
	Cell D Ph 1B Soil & DR Exc	21,640	CY	$ 7.33	$ 158,621.20
	Cell D PH 1B WEATHERED BASALT EXC	28,853	CY	$ 6.84	$ 197,354.52
	Cell D PH 1B Basalt	21,640	CY	$ 7.46	$ 161,434.40
600	Cell D PH 1A Soil & DR Exc	150,369	CY	$ 7.39	$ 1,111,226.91
700	Cell D PH 1A WEATHERED BASALT Exc	90,221	CY	$ 6.86	$ 618,916.06
800	Cell D PH 1A BASALT Exc	360,885	CY	$ 7.46	$ 2,692,202.10
900	Cell D PH 2 Soil & DR Exc	241,348	CY	$ 7.41	$ 1,788,388.68
1000	Cell D PH 2 WEATHERED BASALT Exc	144,809	CY	$ 6.81	$ 986,149.29
1100	Cell D PH 2 BASALT Exc	579,235	CY	$ 7.43	$ 4,303,716.05
1200	Cell A PH 2 Soil & DR Exc	154,337	CY	$ 7.26	$ 1,120,486.62
1300	Cell A PH 2 WEATHERED BASALT Exc	92,602	CY	$ 6.88	$ 637,101.76
1400	Cell A PH 2 BASALT Exc	370,407	CY	$ 7.39	$ 2,737,307.73
1500	Cell D Blast Basalt	1,225,643	CY	$ 5.89	$ 7,219,037.27
1600	Cell A Blast Basalt	463,009	CY	$ 5.89	$ 2,727,123.01
	Subtotal				$ 57,417,697.60
	Sales Tax			5.8182%	$ 3,340,676.48
	Total Cost				$ 60,758,374.08

APPENDIX D-EXISTING LANDFILL DESIGN AND PROPOSED REDESIGN

CITY OF FLAGSTAFF, ARIZONA

PUBLIC WORKS DEPARTMENT
SOLID WASTE SECTION
CINDER LAKE LANDFILL
SEQ-D-REDESIGN
SW-0631B



VICINITY MAP

N.T.S.

REVISIONS:	COMMENTS:
NA	.

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: Custom
DATE: 9/1/2015
SHEET NO: iof ##

DESIGN BY: MM
DRAFTED BY: DC
CHECKED BY: MM

SHEET TITLE: COF-COVERSHEET

DATE SUBMITTED: 9/1/15

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

FILE NO: MOYRXXXXX-##

PROJECT NO: SW-0631_

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CINDER LAKE LANDFILL
REDESIGN OF SEQUENCE D
EXISTING TOPOGRAPHY

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6550	6578	
2	6578	6606	
3	6606	6634	
4	6634	6662	
5	6662	6691	
6	6691	6719	
7	6719	6747	
8	6747	6775	
9	6775	6803	
10	6803	6831	
11	6831	6859	
12	6859	6888	
13	6888	6916	
14	6916	6944	
15	6944	6972	
16	6972	7000	

PROJECT NO: 20-431-03

FILE NO: SW-0631B

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD, FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

SHEET TITLE: EXISTING TOPOGRAPHY

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1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD, FLAGSTAFF, ARIZONA
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:300
DATE: 7/20/14
SHEET NO: 1 of 14

DESIGNED: JMV
DRAWN: JMV
CHECKED: JMV

S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CAD\MASTER\MONTHLYS\04-14\REFERENCE\EXISTING

CINDER LAKE LANDFILL
EXISTING DESIGN OF SEQUENCE D

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6596	6623	
2	6623	6635	
3	6635	6648	
4	6648	6663	
5	6663	6680	
6	6680	6688	
7	6688	6693	
8	6693	6698	

Cut/Fill Summary

Name	Cut Volume	Fill Volume	Net Volume	Cut	Fill	Net
Sequence D-EXISTING GRD	0.000	0.000	0.000	2004447.36 Cu. Yd.	1438231.38 Cu. Yd.	566215.97 Cu. Yd. (CUT)
Totals				2004447.36 Cu. Yd.	1438231.38 Cu. Yd.	566215.97 Cu. Yd. (CUT)

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL COVERAGE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1":300'
DATE: 7/20/14
SHEET NO: 2 of 14

DRAWN BY: MM
DESIGNED BY: MM
CHECKED BY: MM

PROJECT NO: 20-431-03
FILE NO: SW-0631B
CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123
DATE SUBMITTED: 9/1/15
SHEET TITLE: SEQD-EX-DESIGN

FILE NAME S:\Public Works\Environmental Services\Engineering and Compliance\Services\RCA\DRAFTS\SEQUENCE\SEQUENCE-D\REFERENCE\SEQD-EX-DESIGN.dwg

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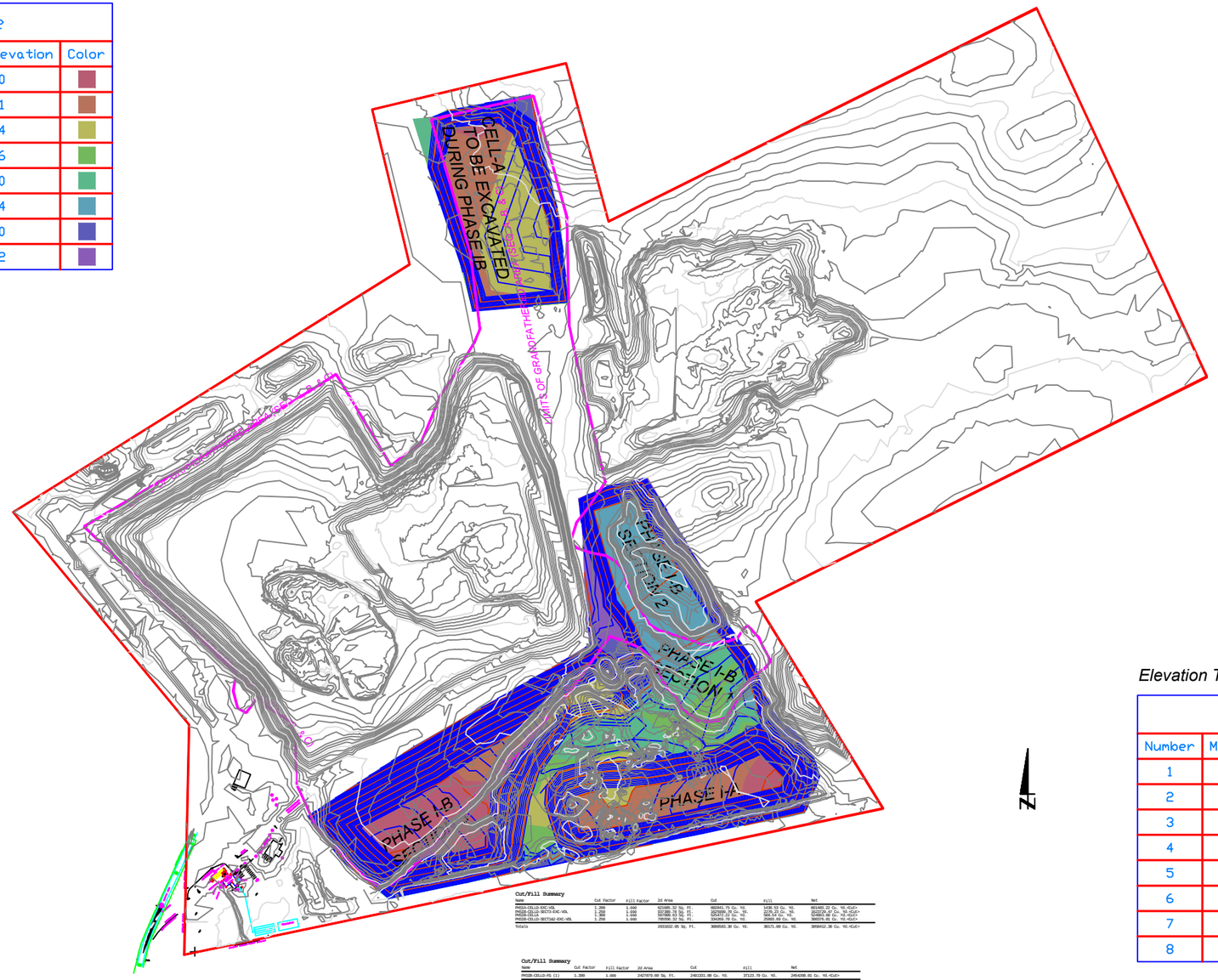
CONCEPTUAL PHASES OF EXCAVATIONS WITHIN SEQUENCE D (ALL VOLUMES APPROXIMATE)

Elevation Table for Cell A

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6630	6630	
2	6630	6631	
3	6631	6654	
4	6654	6656	
5	6656	6660	
6	6660	6664	
7	6664	6670	
8	6670	6672	



Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
PHSIA-CELLD-EXC-VOL	1.000	1.000	615985.32 Sq. Ft.	682941.79 Cu. Yd.	1438.53 Cu. Yd.	681503.22 Cu. Yd.<Cut>
PHSIB-CELLD-RECTA-EXC-VOL	1.000	1.000	321885.25 Sq. Ft.	202797.74 Cu. Yd.	22767.27 Cu. Yd.	180030.47 Cu. Yd.<Cut>
PHSIB-CELLD-EXC-VOL	1.000	1.000	1125000.00 Sq. Ft.	1000000.00 Cu. Yd.	0.00 Cu. Yd.	1000000.00 Cu. Yd.<Cut>
PHSIB-CELLD-SECTA2-EXC-VOL	1.250	1.000	789956.32 Sq. Ft.	334269.79 Cu. Yd.	25992.69 Cu. Yd.	308276.81 Cu. Yd.<Cut>
Totals			2852826.89 Sq. Ft.	3000008.38 Cu. Yd.	38171.09 Cu. Yd.	3056412.38 Cu. Yd.<Cut>

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
PHSIB-CELLD-PE (1)	1.000	1.000	2427879.00 Sq. Ft.	2401101.00 Cu. Yd.	37123.79 Cu. Yd.	2364208.81 Cu. Yd.<Cut>
Totals			2427879.00 Sq. Ft.	2401101.00 Cu. Yd.	37123.79 Cu. Yd.	2364208.81 Cu. Yd.<Cut>

Elevation Table for Cell D phase IA AND IB

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6559	6571	
2	6571	6580	
3	6580	6613	
4	6613	6615	
5	6615	6618	
6	6618	6622	
7	6622	6643	
8	6643	6654	

PROJECT NO: 20-431-03
FILE NO: SW-0631B
CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123
DATE SUBMITTED: 9/1/15
SHEET TITLE: PHS-IA&IB-EXC-PLAN

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 EAST LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1"=300'
DATE: 9/1/15
SHEET NO: 3 of 14

DRAWN BY: MM
DESIGNED BY: MM
CHECKED BY: MM

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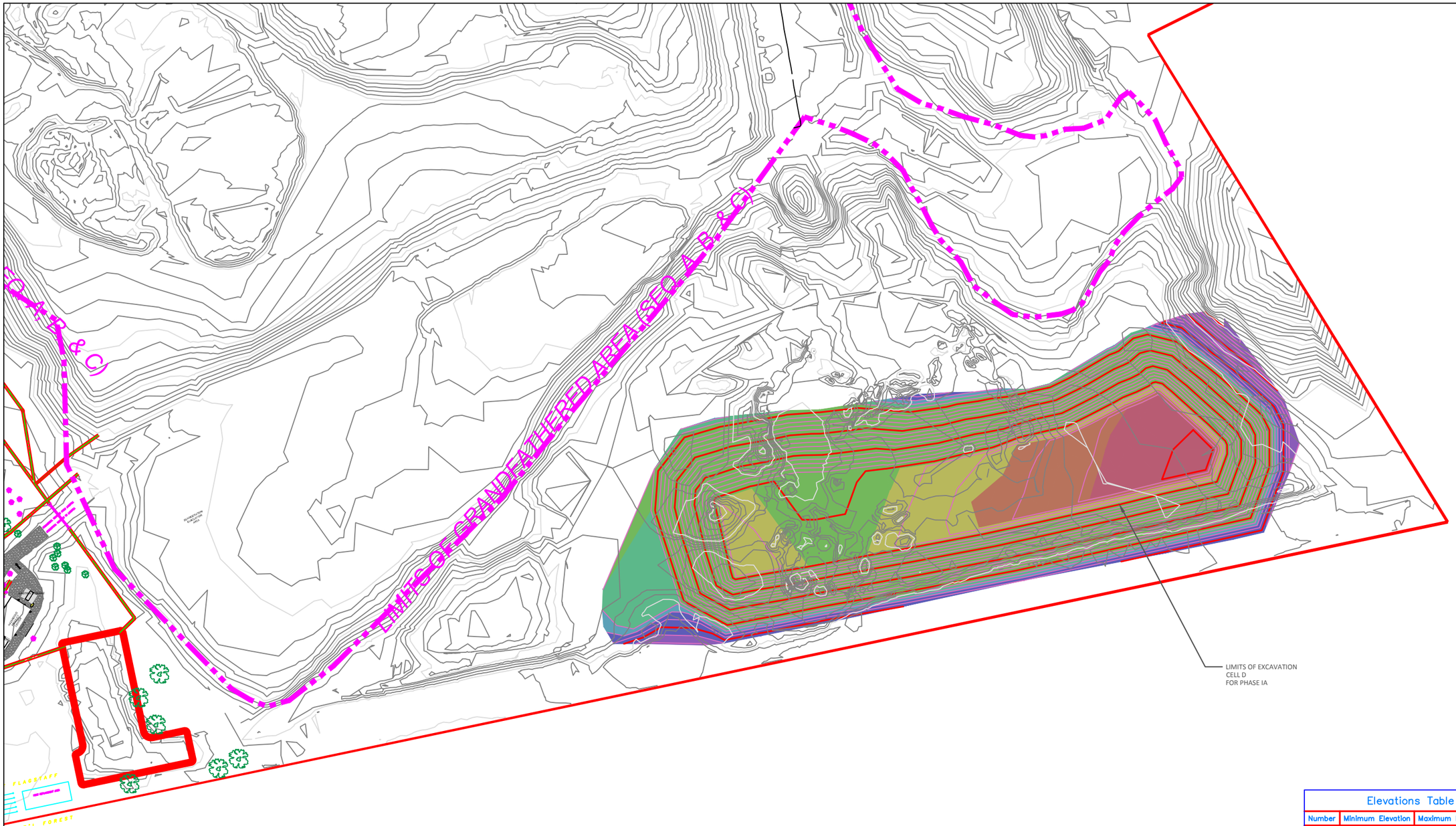

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-D-V-VERSION-III	1.200	0.950	621685.32 Sq. Ft.	602841.75 Cu. Yd.	1366.61 Cu. Yd.	601475.15 Cu. Yd.<Cut>
Totals			621685.32 Sq. Ft.	602841.75 Cu. Yd.	1366.61 Cu. Yd.	601475.15 Cu. Yd.<Cut>

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	6570	6572	
2	6572	6575	
3	6575	6579	
4	6579	6612	
5	6612	6614	
6	6614	6616	
7	6616	6622	
8	6622	6640	

N

PROJECT NO: SW-0631B

FILE NO: 20-431-03

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

SHEET TITLE: PHSIA-CELL-D

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1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
DEC 2014	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100.2691
DATE: 9/1/2015
SHEET NO: 4 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

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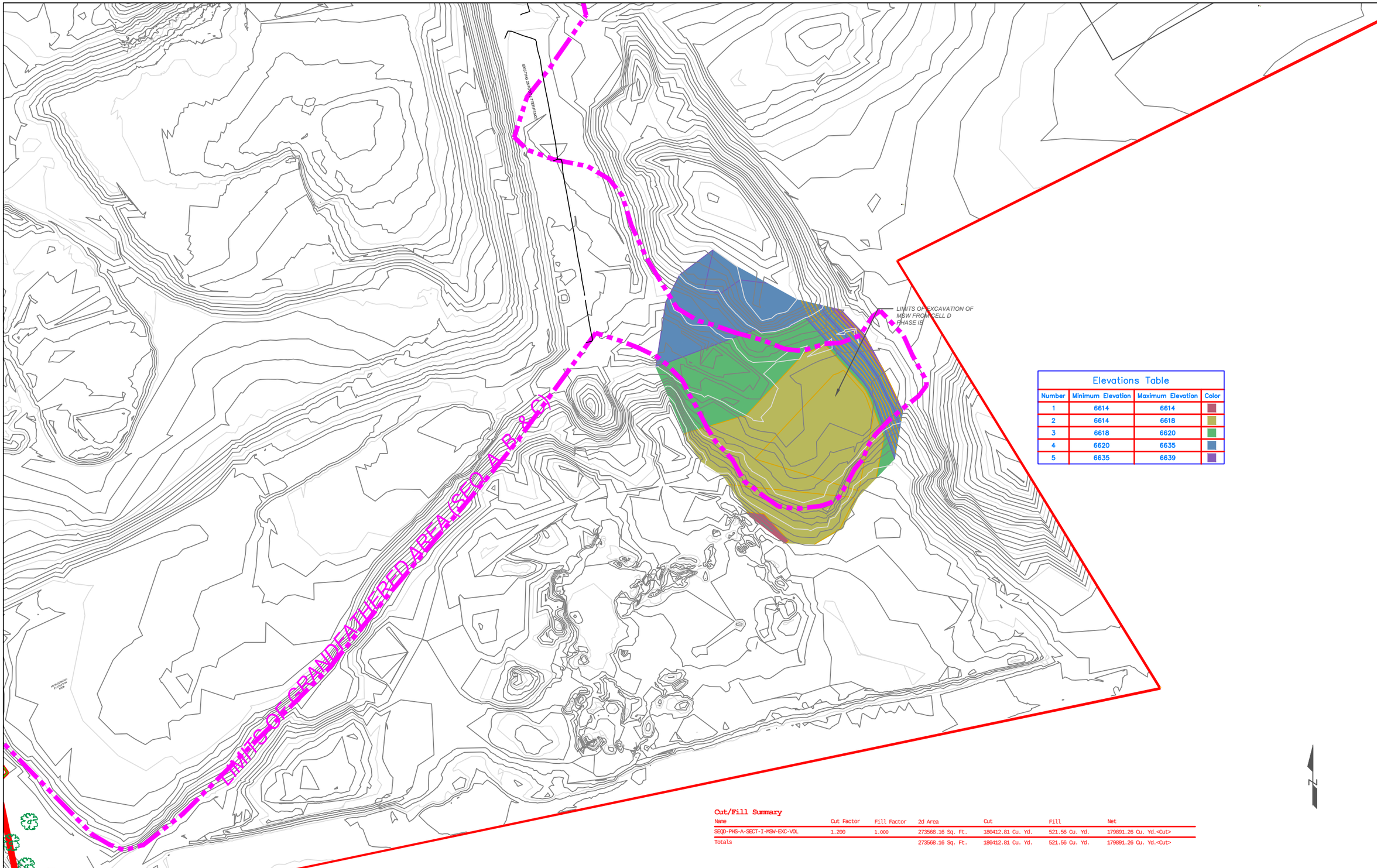

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQD-PHS-A-SECT-I-MSW-EXC-VOL	1.200	1.000	273568.16 Sq. Ft.	180412.81 Cu. Yd.	521.56 Cu. Yd.	179891.26 Cu. Yd.<Cut>
Totals			273568.16 Sq. Ft.	180412.81 Cu. Yd.	521.56 Cu. Yd.	179891.26 Cu. Yd.<Cut>

CALL TWO WORKING DAYS BEFORE YOU DIG
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(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
NA	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100
DATE: 9/1/2015
SHEET NO: 5 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

SHEET TITLE: *PHSIB-CELL-D-SECTION1-MSW-EXC*

FILE NO: *MOYRXXXXX-##*

PROJECT NO: *SW-0631_*

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: *9/1/15*

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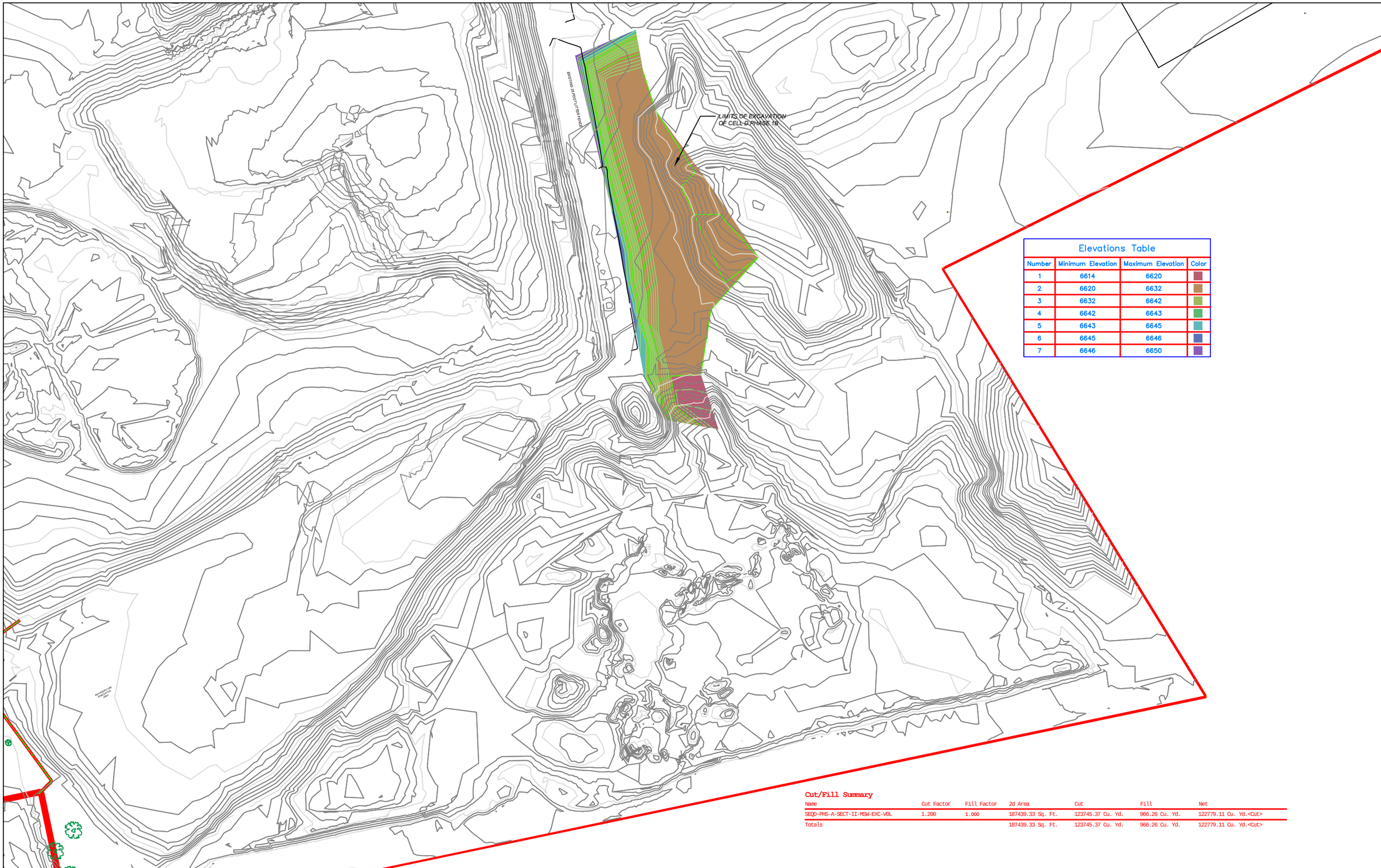

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	6614	6620	
2	6620	6632	
3	6632	6642	
4	6642	6643	
5	6643	6645	
6	6645	6646	
7	6646	6650	

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQD-PHS-A-SECT-II-MSW-EXC-VOL	1.200	1.000	187439.33 Sq. Ft.	123745.37 Cu. Yd.	966.26 Cu. Yd.	122779.11 Cu. Yd.<Cut>
Totals			187439.33 Sq. Ft.	123745.37 Cu. Yd.	966.26 Cu. Yd.	122779.11 Cu. Yd.<Cut>

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
NA	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100
DATE: 9/1/2015
SHEET NO: 6 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

SHEET TITLE: *PHSIB-CELL-D-SECTION2-MSW-EXC*

DATE SUBMITTED: *9/1/15*

FILE NO: *MOYRXXXXX-##*

PROJECT NO: *SW-0631_*

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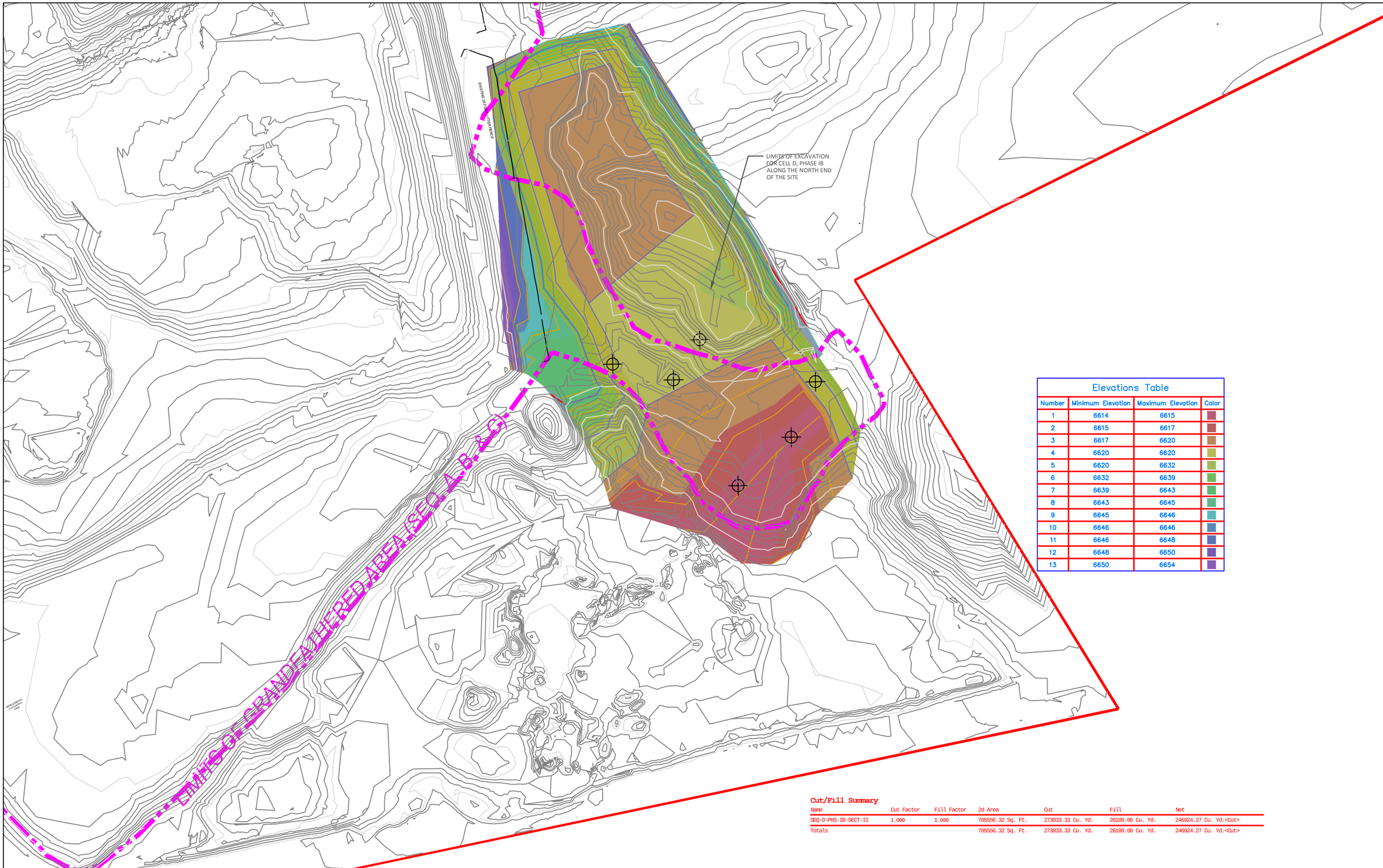


Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6614	6615	
2	6615	6617	
3	6617	6620	
4	6620	6620	
5	6620	6632	
6	6632	6639	
7	6639	6643	
8	6643	6645	
9	6645	6646	
10	6646	6646	
11	6646	6648	
12	6648	6650	
13	6650	6654	

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-D-PHS-IB-SECT-II	1.000	1.000	705556.32 Sq. Ft.	273033.33 Cu. Yd.	26109.06 Cu. Yd.	246924.27 Cu. Yd.<Cut>
Totals			705556.32 Sq. Ft.	273033.33 Cu. Yd.	26109.06 Cu. Yd.	246924.27 Cu. Yd.<Cut>

PROJECT NO: SW-0631_

FILE NO: MOYRXXXXX-##

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

SHEET TITLE: PHSIB-CELL-D-SECTION1&2

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
NA	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

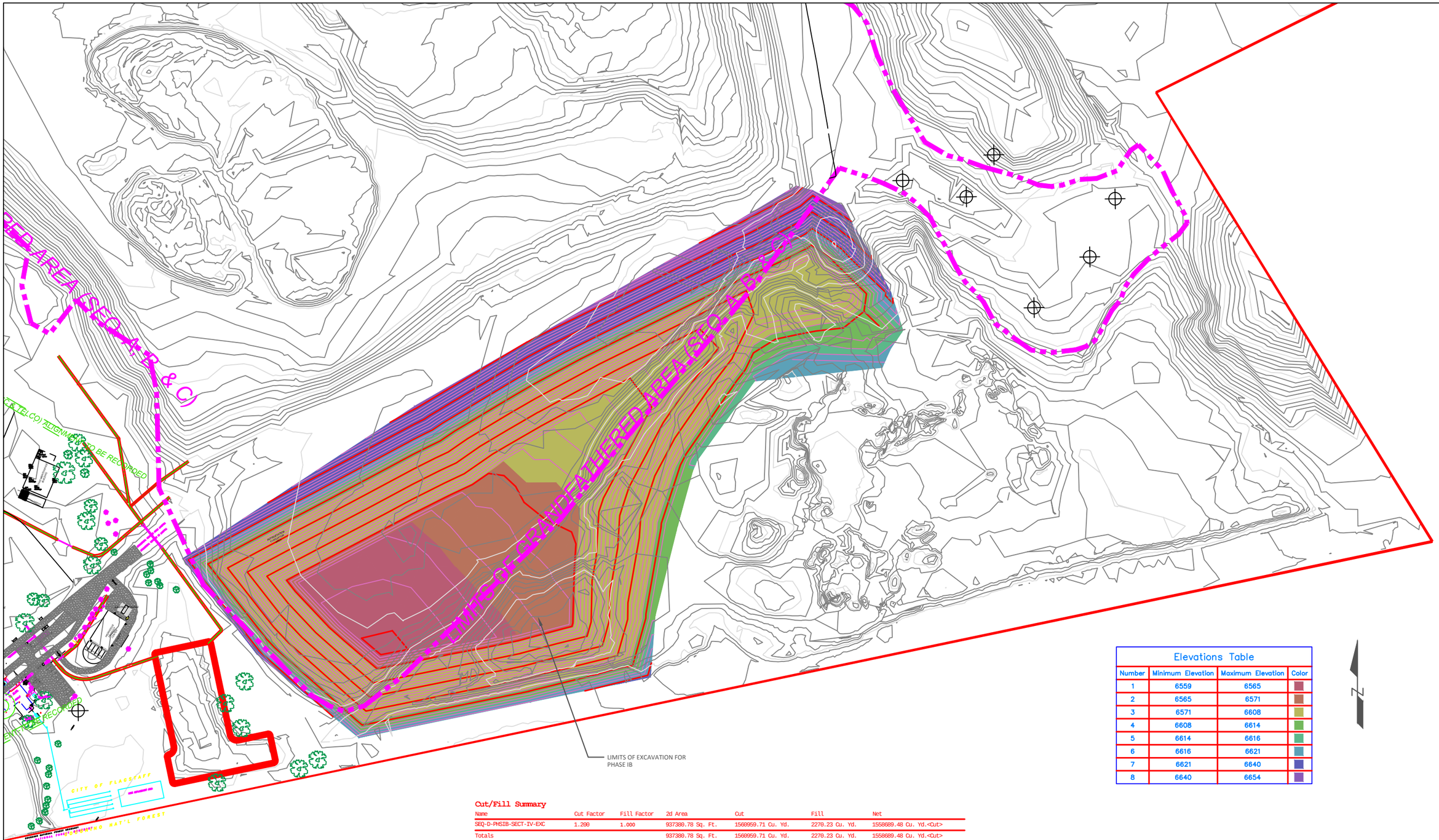
PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100
DATE: 9/1/2015
SHEET NO: 7 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CAD\MASTER\SEQUENCE\SEQUENCE-D\REFERENCE\PH



Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6559	6565	
2	6565	6571	
3	6571	6608	
4	6608	6614	
5	6614	6616	
6	6616	6621	
7	6621	6640	
8	6640	6654	

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-D-PHSIB-SECT-IV-EXC	1.200	1.000	937380.78 Sq. Ft.	1560959.71 Cu. Yd.	2270.23 Cu. Yd.	1558689.48 Cu. Yd.<Cut>
Totals			937380.78 Sq. Ft.	1560959.71 Cu. Yd.	2270.23 Cu. Yd.	1558689.48 Cu. Yd.<Cut>

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
NA	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD, FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100
DATE: 9/1/2015
SHEET NO: 8 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

SHEET TITLE: *PHSIB-CELL-D-SECTION3*

DATE SUBMITTED: *9/1/15*

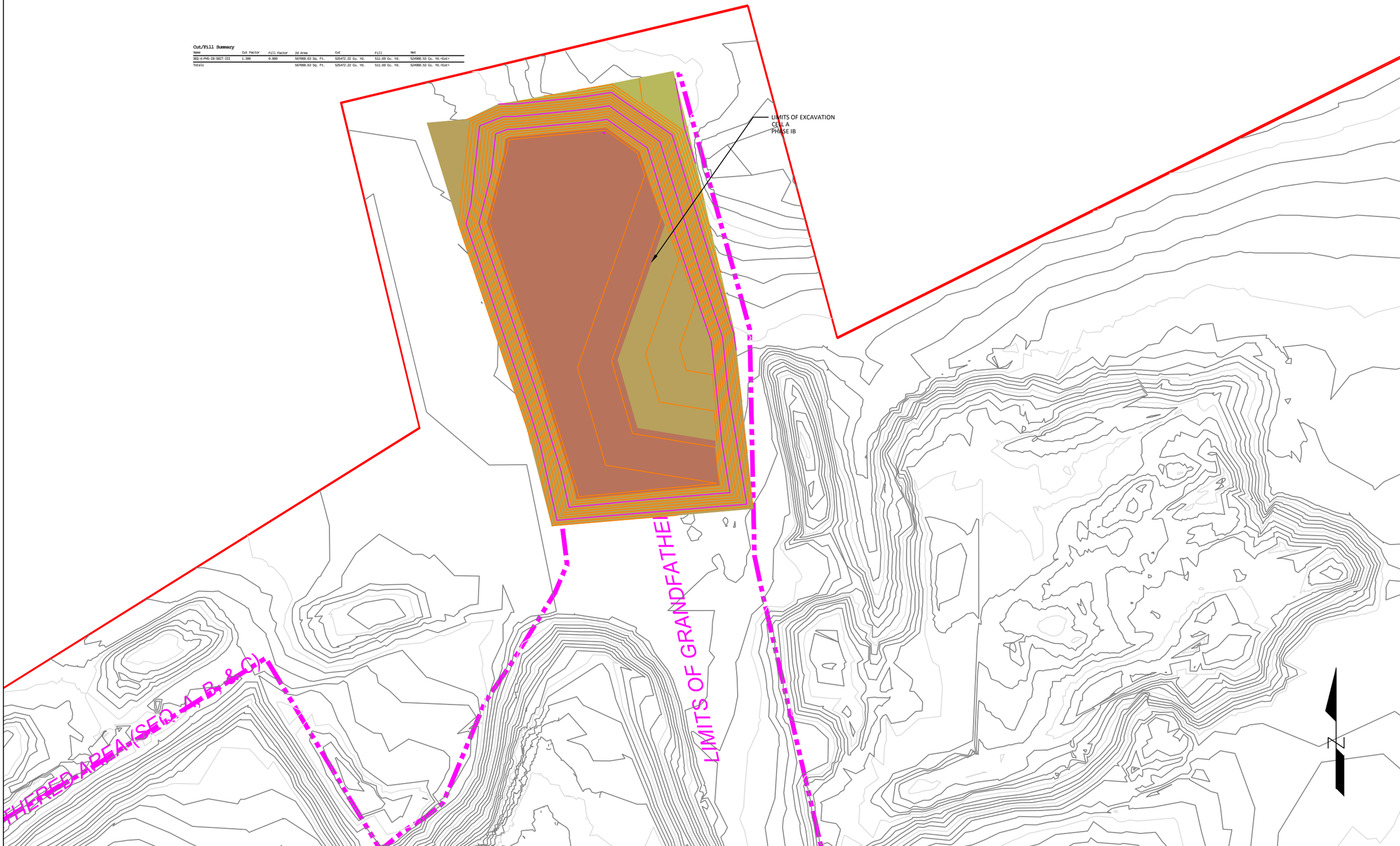
FILE NO: *MOYRXXXXX-##*

PROJECT NO: *SW-0631_*

S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CAD\MASTER\SEQUENCE\SEQUENCE-D\REFERENCE\PH

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-A-PHS-IB-SECT-III	1.300	0.900	567069.63 Sq. Ft.	525472.22 Cu. Yd.	511.69 Cu. Yd.	524960.53 Cu. Yd.<Cut>
Totals			567069.63 Sq. Ft.	525472.22 Cu. Yd.	511.69 Cu. Yd.	524960.53 Cu. Yd.<Cut>



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1-800-782-5348
(OUTSIDE MARICOPA COUNTY)

REVISIONS:	COMMENTS:
NA	.

CITY OF FLAGSTAFF
PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1:100
DATE: 9/1/2015
SHEET NO: 9 of 14

DESIGN BY: MM
DRAWN BY: DC
CHECKED BY: MM

SHEET TITLE: *PHSIB-CELL-A*

DATE SUBMITTED: *9/1/15*

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

FILE NO: *MOYRXXXXX-##*

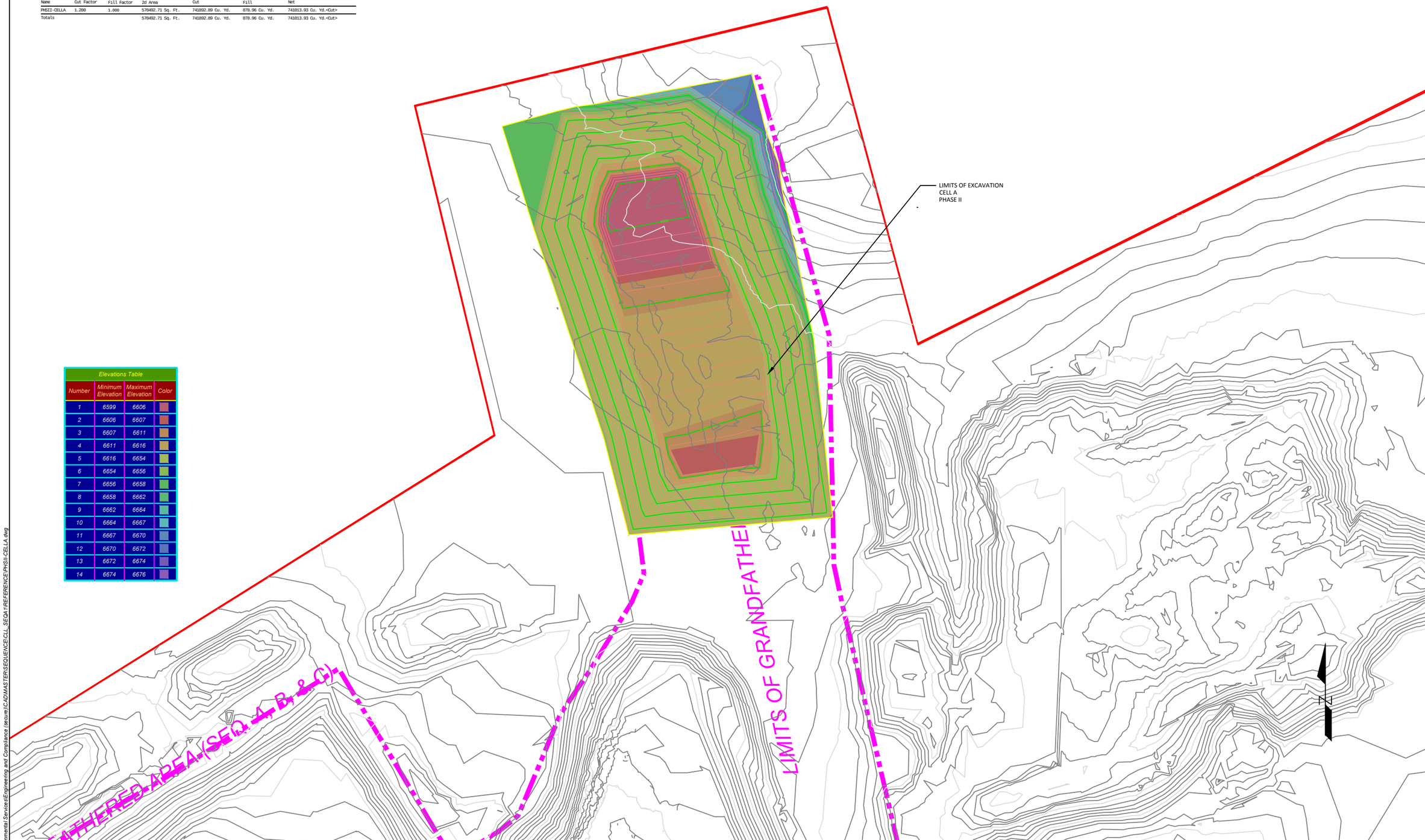
PROJECT NO: *SW-0631_*

S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CAD\MASTER\SEQUENCE\CLL_SEQA1\REFERENCE\PHSI

CINDER LAKE LANDFILL-PROJECTED SOIL VOLUMES TO BE EXTRACTED FROM CELL A-PHASE III

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
PHSII-CELLA	1.200	1.000	570492.71 Sq. Ft.	741892.89 Cu. Yd.	878.96 Cu. Yd.	741013.93 Cu. Yd.<Cut>
Totals			570492.71 Sq. Ft.	741892.89 Cu. Yd.	878.96 Cu. Yd.	741013.93 Cu. Yd.<Cut>



Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6599	6606	
2	6606	6607	
3	6607	6611	
4	6611	6616	
5	6616	6654	
6	6654	6656	
7	6656	6658	
8	6658	6662	
9	6662	6664	
10	6664	6667	
11	6667	6670	
12	6670	6672	
13	6672	6674	
14	6674	6676	

PROJECT NO: 20-431-03

FILE NO: SW-0631B

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

SHEET TITLE: PHSII-CELL-A

FILENAME: S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CAD\MASTER\SEQUENCE\CLL_SEQA1\REFERENCE\PHSII-CELLA.dwg

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REVISIONS:	COMMENTS:

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SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1" = 100'
DATE: 9/1/2015
SHEET NO: 1 OF 14

DRAWN BY: MM
DATE: 9/1/15
REVISED BY: MM
DATE:

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CINDER LAKE LANDFILL
FINAL GRADE OF SEQUENCE D WITH ROADS-PROPOSED

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6550	6578	
2	6578	6606	
3	6606	6634	
4	6634	6662	
5	6662	6691	
6	6691	6719	
7	6719	6747	
8	6747	6775	
9	6775	6803	
10	6803	6831	
11	6831	6859	
12	6859	6888	
13	6888	6916	
14	6916	6944	
15	6944	6972	
16	6972	7000	

PROJECT NO: 20-431-03

FILE NO: SW-0631B

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

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6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-213-2123

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: *1":300'*
DATE: 9/1/15
SHEET NO: 11 of 14

DRAWN BY: MM
DESIGNED BY: MM
CHECKED BY: MM

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CINDER LAKE LANDFILL-PROJECTED SOIL VOLUMES TO BE EXTRACTED FROM CELL A-PHASE II
SUMMARY INCLUDES ADDITIONAL EXCAVATION VOLUME BELOW REVISED DESIGN ELEVATION

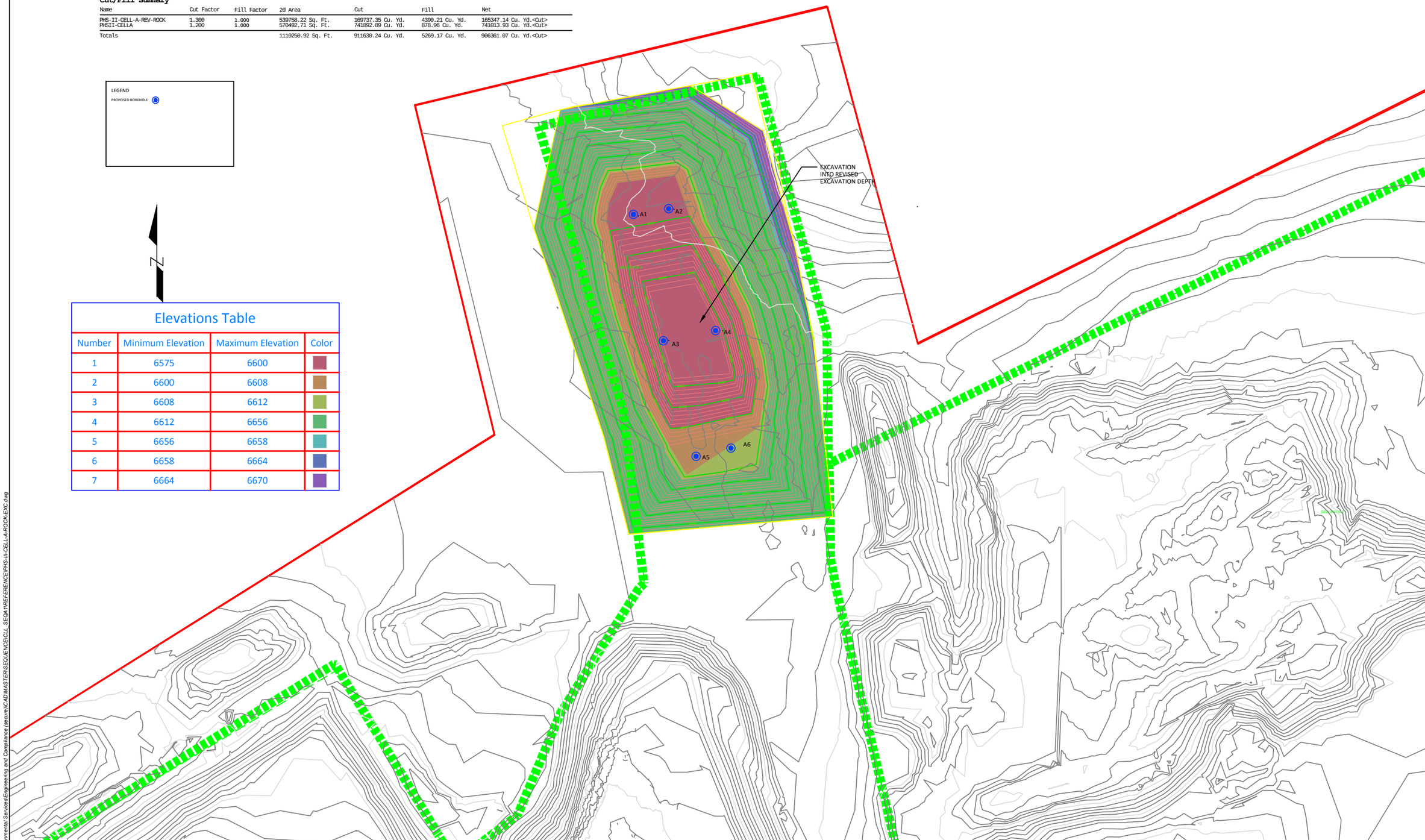
Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
PHS-II-CELL-A-REV-ROCK	1.300	1.000	539758.22 Sq. Ft.	169737.35 Cu. Yd.	4390.21 Cu. Yd.	165347.14 Cu. Yd.<Cut>
PHSII-CELLA	1.200	1.000	570492.71 Sq. Ft.	741892.89 Cu. Yd.	878.96 Cu. Yd.	741013.93 Cu. Yd.<Cut>
Totals			1110250.92 Sq. Ft.	911630.24 Cu. Yd.	5269.17 Cu. Yd.	906361.07 Cu. Yd.<Cut>

LEGEND
PROPOSED BOREHOLE

N

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6575	6600	
2	6600	6608	
3	6608	6612	
4	6612	6656	
5	6656	6658	
6	6658	6664	
7	6664	6670	



FILE NAME S:\Public Works\Environmental Services\Engineering and Compliance (secure)\CADMASTER\SEQUENCE\CLL_SEQA1\REFERENCE\PHS-III-CELL-A-ROCK-EXC.dwg

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REVISIONS:	COMMENTS:

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PUBLIC WORKS
SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-527-9843

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1" = 100'
DATE: 9/1/2015
SHEET NO: 13 of 14

DESIGN BY: MM
DRAFTED BY: MM
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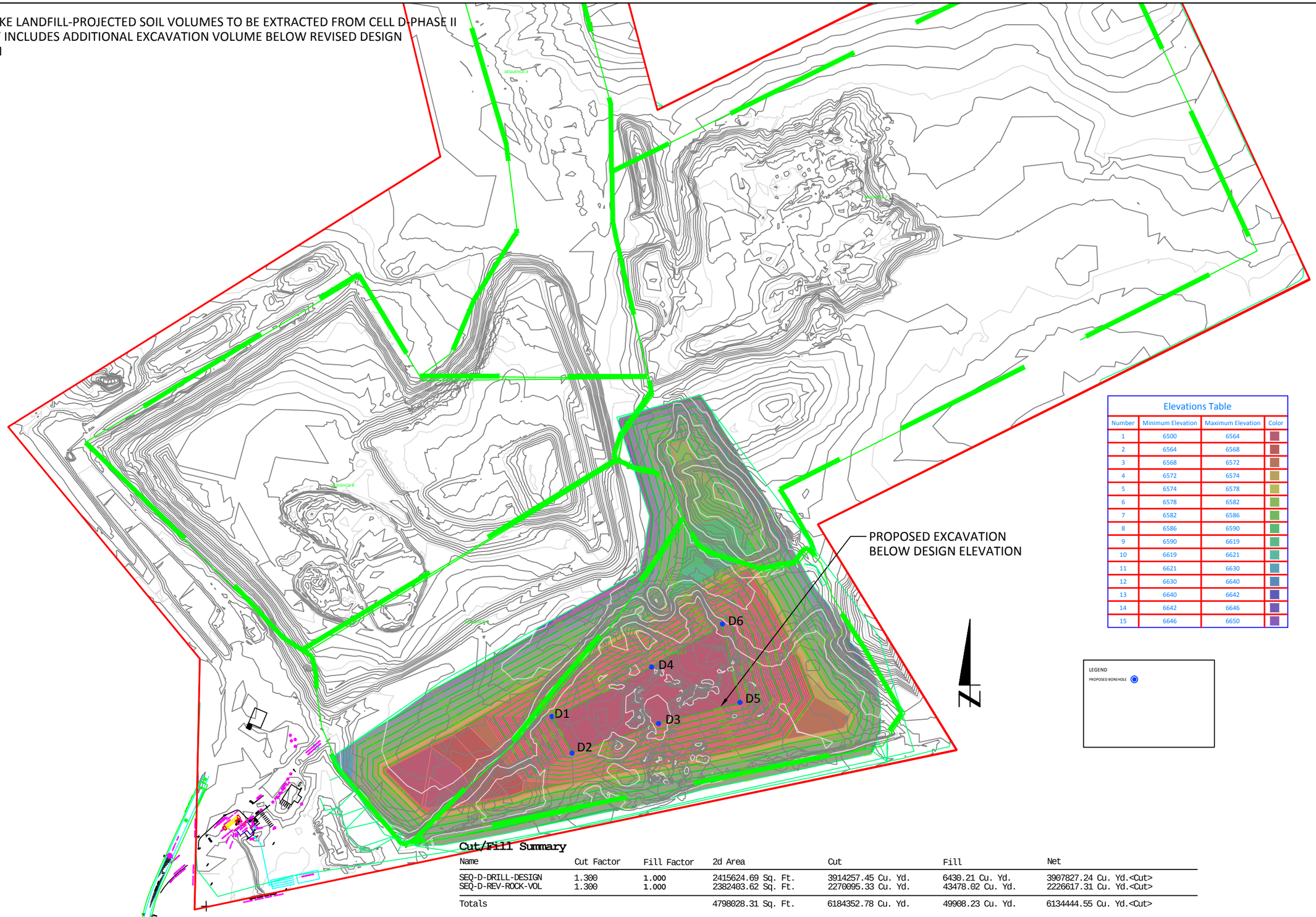
PROJECT NO: 20-431-03
FILE NO: SW-0631B
CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123
DATE SUBMITTED: 9/1/15
SHEET TITLE: PHS-III-CELL-A-ROCK EXCAVATION

CINDER LAKE LANDFILL-PROJECTED SOIL VOLUMES TO BE EXTRACTED FROM CELL D-PHASE II
SUMMARY INCLUDES ADDITIONAL EXCAVATION VOLUME BELOW REVISED DESIGN ELEVATION



Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	6500	6564	
2	6564	6568	
3	6568	6572	
4	6572	6574	
5	6574	6578	
6	6578	6582	
7	6582	6586	
8	6586	6590	
9	6590	6619	
10	6619	6621	
11	6621	6630	
12	6630	6640	
13	6640	6642	
14	6642	6646	
15	6646	6650	

LEGEND
PROPOSED BOREHOLE

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-D-DRILL-DESIGN	1.300	1.000	2415624.69 Sq. Ft.	3914257.45 Cu. Yd.	6430.21 Cu. Yd.	3907827.24 Cu. Yd.<Cut>
SEQ-D-REV-ROCK-VOL	1.300	1.000	2382403.62 Sq. Ft.	2270095.33 Cu. Yd.	43478.02 Cu. Yd.	2226617.31 Cu. Yd.<Cut>
Totals			4798028.31 Sq. Ft.	6184352.78 Cu. Yd.	49908.23 Cu. Yd.	6134444.55 Cu. Yd.<Cut>

PROJECT NO: 20-431-03

FILE NO: SW-0631B

CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123

DATE SUBMITTED: 9/1/15

SHEET TITLE: PHS-III-CELL-D-ROCK EXCAVATION

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REVISIONS:

COMMENTS:

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SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-527-9843

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

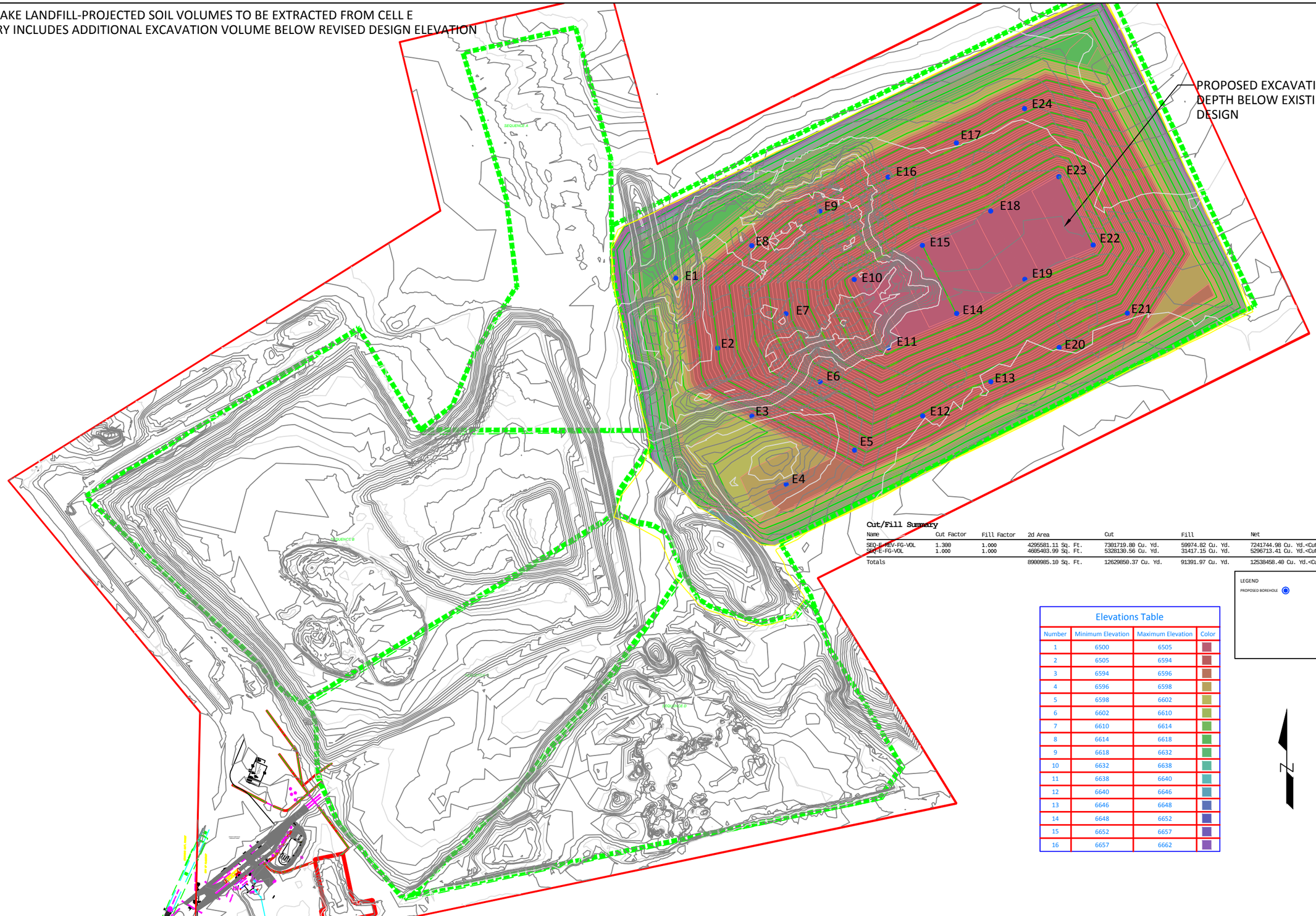
PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1"=200'
DATE: 9/1/15
SHEET NO: 12 of 14

DESIGN BY: MM
DRAFTED BY: MM
CHECKED BY: MM

FILE NAME: S:\Public Work\Environmental Services\Engineering and Compliance (Kevin)\ACADMASTER\SOLIDWOTE\GUIDANCE-DRAFTERING\PHS-III-CELL-D-ROCK EXC.dwg

CINDER LAKE LANDFILL-PROJECTED SOIL VOLUMES TO BE EXTRACTED FROM CELL E
SUMMARY INCLUDES ADDITIONAL EXCAVATION VOLUME BELOW REVISED DESIGN ELEVATION



Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
SEQ-E-REV-FG-VOL	1.300	1.000	4295581.11 Sq. Ft.	7381719.80 Cu. Yd.	59974.82 Cu. Yd.	7241744.98 Cu. Yd.<Cut>
SEQ-E-FG-VOL	1.000	1.000	4605403.99 Sq. Ft.	5328130.56 Cu. Yd.	31417.15 Cu. Yd.	5296713.41 Cu. Yd.<Cut>
Totals			8900985.10 Sq. Ft.	12629850.37 Cu. Yd.	91391.97 Cu. Yd.	12538458.40 Cu. Yd.<Cut>

LEGEND
PROPOSED BOREHOLE

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	6500	6505	
2	6505	6594	
3	6594	6596	
4	6596	6598	
5	6598	6602	
6	6602	6610	
7	6610	6614	
8	6614	6618	
9	6618	6632	
10	6632	6638	
11	6638	6640	
12	6640	6646	
13	6646	6648	
14	6648	6652	
15	6652	6657	
16	6657	6662	

PROJECT NO: 20-431-03
FILE NO: SW-0631B
CITY OF FLAGSTAFF
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004 PHONE: 928-213-2123
DATE SUBMITTED: 9/1/15
SHEET TITLE: PHS-III-CELL-E-ROCK EXCAVATION

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REVISIONS:	COMMENTS:

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SOLID WASTE SECTION
CINDER LAKE LANDFILL
6770 E LANDFILL ROAD FLAGSTAFF, AZ 86004
PHONE: 928-527-9843

PROJECT DESCRIPTION:
REDESIGN OF SEQUENCE A & D-PROPOSED EXCAVATION OF APPROXIMATELY 2 MILLION CUBIC YARDS OF TRASH AND 1.3 MILLION CUBIC YARDS OF MINERAL AGGREGATE

PROJECT PHASE:
CONCEPTUAL

HOR SCALE: 1"=200'
DATE: 9/1/2015
SHEET NO: 1 of 1

DESIGN BY: MM
DRAFTED BY: MM
CHECKED BY: MM

APPENDIX E-COST ANALYSIS FOR SCENARIO 1

Cinder Lake Landfill
Feasibility Study for Landfill
Worksheet for Potential Revenue for Aggregate
SCENARIO 1

Given

Average Unit Weight of Aggregate Base (tons/yd^3)	1.5
Average Excavation and processing volume per Day (yd^3)	334
Working days/month	20

Conditions

	Volume yd^3
Available Rock Volume in Phase IA[1]	360,885
Available Rock Volume in Phase IB[1]	21,640
Available Rock Volume in Phase II, Cell A[1]	370,407
Available Rock Volume in Phase II, Cell D[1]	579,235
Total	**1,332,167**

$ 9.00 City Payment for Exported Aggregate

		Revenue for Processed Rock and Soil			
Proposed Phases of Soil Excavation	**Fiscal year**	**Basalt Rock (yd^3)**	**Soil (yd^3)**	**Remaining Marketable Aggregate (yd^3)**	**Annual Revenue for Aggregate Base**
	2016		-		$ -
Phase IA & IB	2017	47,816	11,954	334,709.38	$ 806,889
Phase IA	2018	47,816	11,954	286,894	$ 806,889
Phase IA	2019	47,816	11,954	239,078	$ 806,889
Phase IA	2020	47,816	11,954	191,263	$ 806,889
Phase IA	2021	47,816	11,954	143,447	$ 806,889
Phase IA	2022	47,816	11,954	95,631	$ 806,889
Phase IA	2023	47,816	11,954	47,816	$ 806,889
Phase IA	2024	47,816	11,954	949,642	$ 806,889
Phase II	2025	47,482	11,871	902,160	$ 801,260
Phase II	2026	47,482	11,871	854,678	$ 801,260
Phase II	2027	47,482	11,871	807,196	$ 801,260
Phase II	2028	47,482	11,871	759,714	$ 801,260
Phase II	2029	47,482	11,871	712,232	$ 801,260
Phase II	2030	47,482	11,871	664,749	$ 801,260
Phase II	2031	47,482	11,871	617,267	$ 801,260
Phase II	2032	47,482	11,871	569,785	$ 801,260
Phase II	2033	47,482	11,871	522,303	$ 801,260
Phase II	2034	47,482	11,871	474,821	$ 801,260
Phase II	2035	47,482	11,871	427,339	$ 801,260
Phase II	2036	47,482	11,871	379,857	$ 801,260
Phase II	2037	47,482	11,871	332,375	$ 801,260
Phase II	2038	47,482	11,871	284,893	$ 801,260
Phase II	2039	47,482	11,871	237,411	$ 801,260
Phase II	2040	47,482	11,871	189,928	$ 801,260
Phase II	2041	47,482	11,871	142,446	$ 801,260
Phase II	2042	47,482	11,871	94,964	$ 801,260
Phase II	2043	47,482	11,871	47,482	$ 801,260
Phase II	2044	47,482	11,871	0	$ 801,260

1. The estimated bulk volume of Basalt in Cell A and D is approximated at 1.3 million $yd^{3.}$ The processed volume is estimated to equate to approximately 2 million yd^3

Cinder Lake Landfill
Feasibility Study for Soil
Workshet for Soil Excavation Costs
SCENARIO 1

Excavation Volumes for Each Phase

Phase 1A, Cell D[1]	**Volume (yd^3)**	**Unit Costs**	**Costs**
Soil & Decomposed Rock	150,369	$ 7.39	$ 1,111,226.91
Weathered Basalt	90,221	$ 6.86	$ 618,916.06
Basalt	360,885	$ 7.46	$ 2,692,202.10
Total Rock & Soil Volume in Phase IA, Cell D	**601,476**		**$ 4,422,345**
Phase 1B, Cell D[1]			
Soil & Decomposed Rock	21,640	$ 7.33	$ 158,621.20
Weathered Basalt	28,853	$ 6.84	$ 197,354.52
Basalt	21,640	$ 7.46	$ 161,434.40
Total Rock & Soil Volume in Phase IB, Cell D	**72,133**		**$ 517,410**
Phase 2, Cell A[1]			
Soil & Decomposed Rock	154,337	$ 7.26	$ 1,120,486.62
Weathered Basalt	92,602	$ 6.88	$ 637,101.76
Basalt	370,407	$ 7.39	$ 2,737,307.73
Rock & Soil Volume in Phase II, Cell A	**617,346**		**$ 4,494,896**
Phase 2, Cell D[1]			
Soil & Decomposed Rock	241,348	$ 7.41	$ 1,788,388.68
Weathered Basalt	144,809	$ 6.81	$ 986,149.29
Basalt	579,235	$ 7.43	$ 4,303,716.05
Rock & Soil Volume in Phase II, Cell D	**965,392**		**$ 7,078,254**

Projections

	1500	Excavation and processing volume per Day (yd^3)
	22	Working days/month
$	(7.00)	Average cost to excavate soil for the City ($/$yd^3$)[1]

	Costs to Excavate soil from old cells			
Phases of Excavation	**Fiscal Year**	**Excavation (cubic yards/year)**	**Remaining Volume of soil (cubic yards)**	**Annual Contractual Costs for Mining Rock [2]**
Phase IA	2017	112,268	561,341	$ (785,877)
Phase IA	2018	112,268	449,073	$ (785,877)
Phase IA	2019	112,268	336,805	$ (785,877)
Phase IA	2020	112,268	224,536	$ (785,877)
Phase IA	2021	112,268	112,268	$ (785,877)
Phase IA & II	2022	112,268	1,582,738	$ (785,877)
Phase IA & II	2023	197,842	1,384,896	$ (1,384,896)
Phase IA & II	2024	197,842	1,187,054	$ (1,384,896)
Phase II	2025	197,842	989,211	$ (1,384,896)
Phase II	2026	197,842	791,369	$ (1,384,896)
Phase II	2027	197,842	593,527	$ (1,384,896)
Phase II	2028	197,842	395,685	$ (1,384,896)
Phase II	2029	197,842	197,842	$ (1,384,896)
Phase II	2030	197,842	0	$ (1,384,896)

values were found in regional bid tabs and RS Means. $10.79/yd^3 for drilling and blasting, $1.40/yd^3 for excavation of blasted rock, $5/yd^3 for processing rock, and $2 for overhead and profit

2. Annual contractual costs are 0 because the contractor is assume to make revenue on the sale of rock and soil being procesed.

Cinder Lake Landfill
Feasibility Study for Landfill
Worksheet for Mining Burried MSW
SCENARIO 1

Given

Volume of Burried MSW in Cell A (yd^3)	524,904
Volume of Burried MSW in Cell D Phase IB	1,919,316
Total Volume of Burried MSW	**2,444,220**

Annual Costs for Dust Suppressant $ -

Conditions

	800	Excavation Volume of Burried MSW per Day (yd^3)
	720	Excavation Volume of Burried MSW per Day (ton)[2]
	90	Excavation Processing Rate MSW per hour (ton)
	22	Working days/month
$	(12.83)	Average cost to mine trash ($/$yd^3$)[1]

	Costs to Excavate MSW from old cells			
Phases of Excavation	**Fiscal Year**	**Cubic Yards/year**	**Remaining Volume of MSW**	**Annual Costs for Trash Mining**
Phase IB, Cells A, C, and D	2017	211,200	2,233,020	$ (2,709,696)
Phase IB, Cells A, C, and D	2018	211,200	2,021,820	$ (2,709,696)
Phase IB, Cells A and C	2019	211,200	1,810,620	$ (2,709,696)
Phase IB, Cells A and C	2020	211,200	1,599,420	$ (2,709,696)
Phase IB, Cells A and C	2021	211,200	1,388,220	$ (2,709,696)
Phase IB, Cells A and C	2022	211,200	1,177,020	$ (2,709,696)
Phase IB, Cells A and C	2023	211,200	965,820	$ (2,709,696)
Phase IB, Cells A and C	2024	226,620	739,200	$ (2,907,535)
Phase IB, Cells A and C	2025	226,620	512,580	$ (2,907,535)
Phase IB, Cells A and C	2026	226,620	285,960	$ (2,907,535)
Phase IB, Cells A and C	2027	226,620	59,340	$ (2,907,535)
Phase IB, Cells A and C	2028	59,340	0	$ (761,332)

Annual-Hazardous Disposal Tipping Fees				
Tons of Waste	**Tipping Fee**	**Subtotal**	**Tax**	**Disposal Fees**
500	$ 125	$ 62,500	$ 10,938	$ (73,438)

Annual Hazardous Transporation and Other Fees					
Transporation Fee	**Drop Fee**	**Number of Loads**	**Bin Washing**	**Subtotal for Transporation and Drop Fee**	**Total Fees**
$ 3,200	$ 2,450	42	$ 11,458	$ (11,458)	$ (84,896)

1. Based on landfill excavation costs from a recent project by Ocean County Landfill (New Jersey). Price accounts for union labor that was orginally at $14/CY.

2. Assumes the average density of in place MSW is 1,800 lb/yd^3

Cinder Lake Landfill
Feasibility Study for Landfill Mining
Worksheet for Captital Costs
SCENARIO 1

Equipment				
Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Rock and Soil Excavation Equipment				
	CAT 345B Excavator	2	$ 350,000	$ 700,000
	CAT D9 Dozer	1	$ 900,000	$ 900,000
	CAT 966 Loader	1	$ 350,000	$ 350,000
	CAT 735 Atriculated Truck	2	$ 180,000	$ 360,000
	Portable Rock Crusher	1	$ 400,000	$ 400,000
	Portable Rock Screener	1	$ 400,000	$ 400,000
	3,800 Gal Water Truck	1	$ 65,000.00	$ 65,000.00
			Total	**$ 3,175,000**
			Contingency	**$ 3,810,000**

Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Waste Processing Equipment				
	CAT 345B Excavator	2	$ 350,000	$ 700,000
	CAT D9 Dozer	1	$ 900,000	$ 900,000
	CAT 966 Loader	1	$ 350,000	$ 350,000
	CAT 735 Aticulated Truck	2	$ 180,000	$ 360,000
	Trommel Screener	1	$ 120,000	$ 120,000
	Vibratory Screener	1	$ 400,000	$ 400,000
	Magnetic Separator	1	$ 40,000	$ 40,000
			Total	**$ 2,870,000**
			Contingency	**$ 3,444,000**

Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Haul Road Equipment				
	CAT 140 M	1	$ 300,000	$ 300,000
	CAT 621 G Water Wagon	2	$ 400,000	$ 800,000
			Total	**$ 1,100,000**
			Contingency	**$ 1,320,000**

Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Air Quality Monitoring Equipment				
	GEM2000	1	$ 10,000	$ 10,000
	MiniRAE3000	1	$ 1,200	$ 1,200
	DOCSII System ^	1	$ 2,500	$ 2,500
			Total	**$ 13,700**
			Contingency	**$ 16,440**

Total Equipment	**$ 7,158,700**
Contingency	**$ 8,590,440**

Cinder Lake Landfill
Feasibility Study for Landfill Mining
Worksheet for Captital Costs
SCENARIO 1

Capital				
Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Infrastructure				
Waterline for dust abatement and fire suppression	L.S	1	$ 315,000	$ 315,000
12,000 Gallon Water Storage Tank/Tower	LS	1	$ 55,000	$ 55,000
3 Phase Power	LS	1	$ 450,000	$ 450,000
Delineators and Segregation Blocks for stockpiled select rock	2'x2'x6'	200	$ 1,500	$ 300,000
Traffic Control Barriers	K-Rail	150	$ 1,000	$ 150,000
Used Asphalt Concrete for Permanent Roads	Asphalt Millings (square feet)	10,648	$ 10	$ 106,480
Yearly application of soil stabilizer	Geopolymer	10,648	$ 4	$ 42,592
Stormwater Management control measures	Erosion & Drainage *	1	$ 388,961	$ 388,961
Temporary Dome Structure for storage of hazardous materials	26'W x 60'L	1	$ 13,000	$ 13,000
25' High Litter Fence	1500 feet	1500	$ 150	$ 225,000
Scales with Infrastructure	LS	1	$ 150,000	$ 150,000
New Entryway Improvements at	LS	1	$ 500,000	$ 500,000
			Total	**$ 2,696,033**
			Contingency	**$ 3,235,240**

Total w-Contingency	**$ 11,825,679.60**

KEY
*Price calculated using RS Means
^DOCS price is purchasing value, not rental price per month

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF LANDFILL CELLS AND SOIL RESOURCES
SCENARIO 1

Given

2015 Landfill Tipping Fee
$44.42

Capital Improvements

Fiscal Year	Proposed Capital Expenditures- Rock Excavation	Capital Expenditures- MSW Excavation	Engineering and Design	Testing and Environmental Consulting	Permits
FY15					
FY16	$ (8,365,240)	$ (3,460,440)	$ (200,000)		
FY17			$ (50,000)	$ (50,000)	$ (20,000)
FY18			$ (50,000)	$ (50,000)	$ (20,000)
FY19			$ (50,000)	$ (50,000)	$ (20,000)
FY20			$ (50,000)	$ (50,000)	$ (20,000)
FY21			$ (50,000)	$ (50,000)	$ (20,000)
FY22			$ (50,000)	$ (50,000)	$ (20,000)
FY23			$ (50,000)	$ (50,000)	$ (20,000)
FY24			$ (50,000)	$ (50,000)	$ (20,000)
FY25			$ (50,000)	$ (50,000)	$ (20,000)
FY26			$ (50,000)	$ (50,000)	$ (20,000)
FY27	$ (8,365,240)		$ (50,000)	$ (50,000)	$ (20,000)
FY28			$ (50,000)	$ (50,000)	$ (20,000)
FY29			$ (50,000)	$ (50,000)	$ (20,000)
FY30			$ (50,000)	$ (50,000)	$ (20,000)
FY31			$ (50,000)	$ (50,000)	$ (20,000)
FY32			$ (50,000)	$ (50,000)	$ (20,000)
FY33			$ (50,000)	$ (50,000)	$ (20,000)
FY34			$ (50,000)	$ (50,000)	$ (20,000)
FY35			$ (50,000)	$ (50,000)	$ (20,000)
FY36			$ (50,000)	$ (50,000)	$ (20,000)
FY37			$ (50,000)	$ (50,000)	$ (20,000)
FY38			$ (50,000)	$ (50,000)	$ (20,000)
FY39			$ (50,000)	$ (50,000)	$ (20,000)
FY40			$ (50,000)	$ (50,000)	$ (20,000)
FY41			$ (50,000)	$ (50,000)	$ (20,000)
FY42			$ (50,000)	$ (50,000)	$ (20,000)
FY43			$ (50,000)	$ (50,000)	$ (20,000)
FY44			$ (50,000)	$ (50,000)	$ (20,000)

Discount Rate

Cost of Capital	3.0%
Inflation Rate [2]	2.38%
Inflation Adjusted Discount Rate	0.61%

Typical Values

Current Landfill Volume (yd^3) Occupied Annually [3]
178,000

Total cover soil usage for 2014 (ton)
67,612
Total ADC Usage for 2014 (ton)
18,718

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF LANDFILL CELLS AND SOIL RESOURCES
SCENARIO 1

Average cost for imported sand ($/ton)
$ 27.00
Hourly Rate for Soil Extraction
$43.86
Annual Cost to Excavate Soil with Existing Methods
$ 34,210.80
Cost to Excavate Soil with Existing Methods ($/cubic yd)
$ 0.51

Assumptions

Assumed Yearly Discounts/Fee Increases

2%	Labor rate increase per year
2.25%	Cost Increase on Commodities per year
2.0%	Increase on Revenue per year
5%	Landfill Tipping Fee Increase Every Five Years
$ 14.97	Net Revenue Per Cubic yard

1. Contractual agreements include fees for Construction Manager and Administration
2. Inflation rate (CPI) based on the 20 year average from the Bureau of Labor Statistics Table
http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-
3. Typical airspace calculation is based on the latest annual report for GPS Machine Control Surveys
4. Calculated using CAD Software to compare two Triangular Irregular Networks on a cut and fill factor of 1

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 1

CASHFLOW TABLE

		Annual Expenses								Annual Income Sources						Outcome		
Fiscal Year	Projected Annual Landfill Volume	Excavation of Soil and Rock	Capital	Engineering and Design	Soil Testing and Environmental Consulting	Other Operations Staff[1]	Perimits	Annual Costs	Present Value of Annual Costs	Aggregate Sales	Value of Regained Airspace from Landfill Excavation	Avoided Costs to Excavate Soil With Existing Methods [3]	Avoided Costs for Importation of Soil [4]	Annual Benefits	Present Value of Annual Benefits	Annual Program Balance	Present Value of Project Balance	Net Present Value
2015																		
2016				$ (200,000)		$ (63,082)		$ (200,000)	$ (198,796)					$ -	$ -	$ (200,000)	$ (198,796)	$ (198,796)
2017	158,759	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,519,607)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,506,574	$ 992,945	$ 986,968	$ 782,231
2018	163,522	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,510,459)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,491,486	$ 992,945	$ 981,027	$ 1,757,352
2019	168,428	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,501,367)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,476,489	$ 992,945	$ 975,122	$ 2,726,604
2020	173,480	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,492,330)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,461,582	$ 992,945	$ 969,252	$ 3,690,022
2021	178,685	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,483,347)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,446,765	$ 992,945	$ 963,418	$ 4,647,640
2022	184,045	$ (785,877)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (1,528,809)	$ (1,474,418)	$ 806,889	$ 1,680,654	$ 34,211		$ 2,521,754	$ 2,432,037	$ 992,945	$ 957,618	$ 5,599,494
2023	189,567	$ (1,384,896)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,127,828)	$ (2,039,773)	$ 806,889	$ 2,961,698	$ 34,211		$ 3,802,798	$ 3,645,428	$ 1,674,970	$ 1,605,656	$ 7,195,485
2024	195,254	$ (1,384,896)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,127,828)	$ (2,027,494)	$ 806,889	$ 2,961,698	$ 34,211		$ 3,802,798	$ 3,623,485	$ 1,674,970	$ 1,595,990	$ 8,781,868
2025	201,111	$ (1,384,896)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,127,828)	$ (2,015,290)	$ 801,260	$ 2,961,698	$ 34,211		$ 3,797,170	$ 3,596,343	$ 1,669,342	$ 1,581,053	$ 10,353,404
2026	207,145	$ (1,384,896)	$ (346,044)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,127,828)	$ (1,991,101)	$ 801,260	$ 2,961,698	$ 34,211		$ 3,797,170	$ 3,574,695	$ 1,669,342	$ 1,583,594	$ 11,915,481
2027	213,359	$ (1,384,896)	$ (494,349)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,276,132)	$ (2,129,876)	$ 801,260	$ 2,961,698	$ 34,211		$ 3,797,170	$ 3,553,178	$ 1,521,037	$ 1,423,301	$ 13,330,214
2028	219,760	$ (1,384,896)	$ (494,349)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,276,132)	$ (2,117,056)	$ 801,260	$ 2,961,698	$ 34,211		$ 3,797,170	$ 3,531,790	$ 1,521,037	$ 1,414,734	$ 14,736,432
2029	226,353	$ (1,384,896)	$ (494,349)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,276,132)	$ (2,104,312)	$ 801,260	$ 2,961,698	$ 34,211		$ 3,797,170	$ 3,510,530	$ 1,521,037	$ 1,406,218	$ 16,134,185
2030	233,143	$ (1,384,896)	$ (494,349)	$ (50,000)	$ (50,000)	$ (276,888)	$ (20,000)	$ (2,276,132)	$ (2,091,646)	$ 801,260	$ 2,961,698	$ 34,211	$ 1,573,716	$ 5,370,886	$ 4,935,561	$ 3,094,753	$ 2,843,915	$ 18,960,982
2031	240,137		$ (494,349)				$ (20,000)	$ (514,349)	$ (469,814)	$ 801,260		$ 34,211	$ 1,620,927	$ 2,456,399	$ 2,243,713	$ 1,942,050	$ 1,773,899	$ 20,724,203
2032	247,342		$ (494,349)				$ (20,000)	$ (514,349)	$ (466,986)	$ 801,260		$ 34,211	$ 1,669,555	$ 2,505,026	$ 2,274,357	$ 1,990,678	$ 1,807,371	$ 22,520,695
2033	254,762		$ (494,349)				$ (20,000)	$ (514,349)	$ (464,175)	$ 801,260		$ 34,211	$ 1,719,642	$ 2,555,113	$ 2,305,868	$ 2,040,765	$ 1,841,693	$ 24,351,302
2034	262,405						$ (20,000)	$ (20,000)	$ (17,940)	$ 801,260		$ 34,211	$ 1,771,231	$ 2,606,702	$ 2,338,265	$ 2,586,702	$ 2,320,324	$ 26,657,659
2035	270,277						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 1,824,368	$ 2,659,839	$ 2,371,568	$ 2,639,839	$ 2,371,568	$ 28,997,227
2036	278,385						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 1,879,099	$ 2,714,570	$ 2,405,798	$ 2,694,570	$ 2,405,798	$ 31,370,924
2037	286,737						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 1,935,472	$ 2,770,943	$ 2,440,976	$ 2,750,943	$ 2,440,976	$ 33,779,695
2038	295,339						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 1,993,536	$ 2,829,007	$ 2,477,125	$ 2,809,007	$ 2,477,125	$ 36,224,502
2039	304,199						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,342	$ 2,888,814	$ 2,514,266	$ 2,868,814	$ 2,514,266	$ 38,706,332
2040	304,200						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,349	$ 2,888,820	$ 2,499,137	$ 2,868,820	$ 2,499,137	$ 41,173,228
2041	304,201						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,356	$ 2,888,827	$ 2,484,100	$ 2,868,827	$ 2,484,100	$ 43,625,280
2042	304,202						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,363	$ 2,888,834	$ 2,469,153	$ 2,868,834	$ 2,469,153	$ 46,062,579
2043	304,203						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,369	$ 2,888,841	$ 2,454,296	$ 2,868,841	$ 2,454,296	$ 48,485,212
2044	304,204						$ (20,000)	$ (20,000)		$ 801,260		$ 34,211	$ 2,053,376	$ 2,888,847	$ 2,439,528	$ 2,868,847	$ 2,439,528	$ 50,893,268

1. Assumes City staff would consist of 1 Project Manager 1 Lead Worker, 3 Operators, and a Sales Specialist
2. Avoided Costs were based on existing method of soil extraction from the landfill borrow pit with a 627 E Scraper Auger. Assumes 40% of operation is dedicated to prepping ADC with wood chips.
3. Avoided costs are based on current costs of imported sand from Verde Valley. Current projections indicate the facility will run our of soil in 2032

Economic Considerations Over 10 Years		
Benefit	25,680,189	(Present Value)
Costs	(15,262,882)	(Present Value)
B/C	**1.68**	

CITY OF FLAGSTAFF ECONOMIC EVALUATION
MINING OF LANDFILL CELLS
SCENARIO 1

CASHFLOW TABLE

		Annual Expenses							Annual Income Sources			Outcome		
Fiscal Year	Projected Annual Landfill Volume	Processing Costs of Mined Trash	Costs to Bury Unusable Portion of MSW[1]	Capital	Engineering and Design	Soil Testing and Environmental Consulting	Annual Costs	Present Value of Annual Costs	Avoided Costs by Not having to use Paper Millings as ADC [2]	Annual Benefits	Present Value of Annual Benefits	Annual Program Balance	Present Value of Project Balance	Net Present Value
2015														
2016							$ -	$ -		$ -	$ -	$ -	$ -	$ -
2017	158,759	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,136,744)	$ 149,744	$ 149,744	$ 147,947	$ (3,005,996)	$ (2,988,798)	$ (2,969,916)
2018	163,522	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,117,863)	$ 149,744	$ 149,744	$ 147,056	$ (3,005,996)	$ (2,970,807)	$ (5,921,955)
2019	168,428	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,099,095)	$ 149,744	$ 149,744	$ 146,171	$ (3,005,996)	$ (2,952,924)	$ (8,856,225)
2020	173,480	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,080,440)	$ 149,744	$ 149,744	$ 145,291	$ (3,005,996)	$ (2,935,149)	$ (11,772,832)
2021	178,685	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,061,898)	$ 149,744	$ 149,744	$ 144,417	$ (3,005,996)	$ (2,917,481)	$ (14,671,882)
2022	184,045	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,043,467)	$ 149,744	$ 149,744	$ 143,547	$ (3,005,996)	$ (2,899,920)	$ (17,553,482)
2023	189,567	$ (2,709,696)	$ (253,440)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,155,740)	$ (3,025,147)	$ 149,744	$ 149,744	$ 142,683	$ (3,005,996)	$ (2,882,464)	$ (20,417,737)
2024	195,254	$ (2,907,535)	$ (271,944)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,353,579)	$ (3,195,448)	$ 149,744	$ 149,744	$ 141,824	$ (3,203,835)	$ (3,053,623)	$ (23,452,125)
2025	195,255	$ (2,907,535)	$ (271,944)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,353,579)	$ (3,176,213)	$ 149,744	$ 149,744	$ 140,971	$ (3,203,835)	$ (3,035,242)	$ (26,468,249)
2026	195,256	$ (2,907,535)	$ (271,944)	$ (346,044)	$ (50,000)	$ (50,000)	$ (3,353,579)	$ (3,157,094)	$ 149,744	$ 149,744	$ 140,122	$ (3,203,835)	$ (3,016,972)	$ (29,466,217)
2027	195,257	$ (2,907,535)	$ (271,944)		$ (50,000)	$ (50,000)	$ (3,007,535)	$ (2,814,282)	$ 149,744	$ 149,744	$ 139,279	$ (2,857,791)	$ (2,675,003)	$ (32,124,279)
2028	195,258	$ (761,332)	$ (71,208)		$ (50,000)	$ (50,000)	$ (861,332)	$ (801,135)	$ 149,744	$ 149,744	$ 138,440	$ (711,588)	$ (662,694)	$ (32,782,151)

1.Assumes a disposal cost of $2 per cubic yard
2. Avoided Costs were based on existing method of soil extraction from the landfill borrow pit with a 627 E Scraper Auger. Assumes 40% of operation is dedicated to prepping ADC with wood chips.

Economic Considerations Over 10 Years

Benefit	1,440,028	(Present Value)
Costs	(31,093,409)	(Present Value)
B/C	**0.05**	

APPENDIX F-COST ANALYSIS FOR SCENARIO II

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

Given

Average Unit Weight of Aggregate Base (tons/yd^3)	1.5
Average Excavation and processing volume per Day (yd^3)	334
Working days/month	20

Assumptions

	Volume yd^3
Available Rock Volume in Phase IA[1]	360,885
Available Rock Volume in Phase IB[1]	21,640
Available Rock Volume in Phase II, Cell A[1]	370,407
Available Rock Volume in Phase II, Cell D[1]	579,235
Total	**1,332,167**

$ 2.00 City Payment for Exported Aggregate

		Revenue for Processed Rock and Soil			
Proposed Phases of Soil Excavation	**Fiscal year**	**Basalt Rock (yd^3)**	**Soil (yd^3)**	**Remaining Marketable Aggregate (yd^3)**	**Annual Revenue for Aggregate Base**
	2016		-		$ -
Phase IA & IB	2017	47,816	11,954	334,709.38	$ 179,309
Phase IA	2018	47,816	11,954	286,894	$ 179,309
Phase IA	2019	47,816	11,954	239,078	$ 179,309
Phase IA	2020	47,816	11,954	191,263	$ 179,309
Phase IA	2021	47,816	11,954	143,447	$ 179,309
Phase IA	2022	47,816	11,954	95,631	$ 179,309
Phase IA	2023	47,816	11,954	47,816	$ 179,309
Phase IA	2024	47,816	11,954	949,642	$ 179,309
Phase II	2025	47,482	11,871	902,160	$ 178,058
Phase II	2026	47,482	11,871	854,678	$ 178,058
Phase II	2027	47,482	11,871	807,196	$ 178,058
Phase II	2028	47,482	11,871	759,714	$ 178,058
Phase II	2029	47,482	11,871	712,232	$ 178,058
Phase II	2030	47,482	11,871	664,749	$ 178,058
Phase II	2031	47,482	11,871	617,267	$ 178,058
Phase II	2032	47,482	11,871	569,785	$ 178,058
Phase II	2033	47,482	11,871	522,303	$ 178,058
Phase II	2034	47,482	11,871	474,821	$ 178,058
Phase II	2035	47,482	11,871	427,339	$ 178,058
Phase II	2036	47,482	11,871	379,857	$ 178,058
Phase II	2037	47,482	11,871	332,375	$ 178,058
Phase II	2038	47,482	11,871	284,893	$ 178,058
Phase II	2039	47,482	11,871	237,411	$ 178,058
Phase II	2040	47,482	11,871	189,928	$ 178,058
Phase II	2041	47,482	11,871	142,446	$ 178,058
Phase II	2042	47,482	11,871	94,964	$ 178,058
Phase II	2043	47,482	11,871	47,482	$ 178,058
Phase II	2044	47,482	11,871	0	$ 178,058

1. The estimated bulk volume of Basalt in Cell A and D is approximated at 1.3 million $yd^{3.}$ The processed volume is estimated to equate to approximately 2 million yd^3

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

Excavation Volumes for Each Phase

Phase 1A, Cell D[1]	**Volume (yd^3)**	**Unit Costs**	**Costs**
Soil & Decomposed Rock	150,369	$ 7.39	$ 1,111,226.91
Weathered Basalt	90,221	$ 6.86	$ 618,916.06
Basalt	360,885	$ 7.46	$ 2,692,202.10
Total Rock & Soil Volume in Phase IA, Cell D	**601,476**		**$ 4,422,345**
Phase 1B, Cell D[1]			
Soil & Decomposed Rock	21,640	$ 7.33	$ 158,621.20
Weathered Basalt	28,853	$ 6.84	$ 197,354.52
Basalt	21,640	$ 7.46	$ 161,434.40
Total Rock & Soil Volume in Phase IB, Cell D	**72,133**		**$ 517,410**
Phase 2, Cell A[1]			
Soil & Decomposed Rock	154,337	$ 7.26	$ 1,120,486.62
Weathered Basalt	92,602	$ 6.88	$ 637,101.76
Basalt	370,407	$ 7.39	$ 2,737,307.73
Rock & Soil Volume in Phase II, Cell A	**617,346**		**$ 4,494,896**
Phase 2, Cell D[1]			
Soil & Decomposed Rock	241,348	$ 7.41	$ 1,788,388.68
Weathered Basalt	144,809	$ 6.81	$ 986,149.29
Basalt	579,235	$ 7.43	$ 4,303,716.05
Rock & Soil Volume in Phase II, Cell D	**965,392**		**$ 7,078,254**
Total Excavation Volume	**2,256,347**		

Projections

1500 Excavation and processing volume per Day (yd^3)
22 Working days/month
$ - Average cost to excavate soil for the City ($/$yd^3$)[1]

	Costs to Excavate soil from old cells			
Phases of Excavation	**Fiscal Year**	**Excavation (cubic yards/year)**	**Remaining Volume of soil (cubic yards)**	**Annual Contractual Costs for Mining Rock**
Phase IA	2017	112,268	561,341	$ -
Phase IA	2018	112,268	449,073	$ -
Phase IA	2019	112,268	336,805	$ -
Phase IA	2020	112,268	224,536	$ -
Phase IA	2021	112,268	112,268	$ -
Phase IA & II	2022	112,268	1,582,738	$ -
Phase IA	2023	197,842	1,384,896	$ -
Phase IA	2024	197,842	1,187,054	$ -
Phase II	2025	197,842	989,211	$ -
Phase II	2026	197,842	791,369	$ -
Phase II	2027	197,842	593,527	$ -
Phase II	2028	197,842	395,685	$ -
Phase II	2029	197,842	197,842	$ -
Phase II	2030	197,842	0	$ -

1 Excavation Costs were not assumed since it would be negated by the avoided costs to prep the cell.

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

Given

Volume of Burried MSW in Cell A (yd^3)	524,904
Volume of Burried MSW in Cell D Phase IB	1,919,316
Total Volume of Burried MSW	**2,444,220**

Annual Costs for Dust Suppressant $ -

Conditions

	800	Excavation Volume of Burried MSW per Day (yd^3)
	720	Excavation Volume of Burried MSW per Day (ton)[2]
	90	Excavation Processing Rate MSW per hour (ton)
	22	Working days/month
$	(12.83)	Average cost to mine trash ($/$yd^3$)[1]

	Costs to Excavate MSW from old cells			
Phases of Excavation	**Fiscal Year**	**Cubic Yards/year**	**Remaining Volume of MSW**	**Annual Costs for Trash Mining**
Phase IB, Cells A, C, and D	2017	211,200	2,233,020	$ (2,709,696)
Phase IB, Cells A, C, and D	2018	211,200	2,021,820	$ (2,709,696)
Phase IB, Cells A and C	2019	211,200	1,810,620	$ (2,709,696)
Phase IB, Cells A and C	2020	211,200	1,599,420	$ (2,709,696)
Phase IB, Cells A and C	2021	211,200	1,388,220	$ (2,709,696)
Phase IB, Cells A and C	2022	211,200	1,177,020	$ (2,709,696)
Phase IB, Cells A and C	2023	211,200	965,820	$ (2,709,696)
Phase IB, Cells A and C	2024	226,620	739,200	$ (2,907,535)
Phase IB, Cells A and C	2025	226,620	512,580	$ (2,907,535)
Phase IB, Cells A and C	2026	226,620	285,960	$ (2,907,535)
Phase IB, Cells A and C	2027	226,620	59,340	$ (2,907,535)
Phase IB, Cells A and C	2028	59,340	0	$ (761,332)

Annual-Hazardous Disposal Tipping Fees				
Tons of Waste	**Tipping Fee**	**Subtotal**	**Tax**	**Disposal Fees**
500	$ 125	$ 62,500	$ 10,938	$ (73,438)

Annual Hazardous Transporation and Other Fees					
Transporation Fee	**Drop Fee**	**Number of Loads**	**Bin Washing**	**Subtotal for Transporation and Drop Fee**	**Total Fees**
$ 3,200	$ 2,450	42	$ 11,458	$ (11,458)	$ (84,896)

1. Based on landfill excavation costs from a recent project by Ocean County Landfill (New Jersey). Price accounts for union labor that was orginally at $14/CY.

2. Assumes the average density of in place MSW is 1,800 lb/yd^3

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

Capital				
Category	**Type**	**# of Units**	**Price Per Unit ($)**	**Total Price ($)**
Waterline for dust abatement and fire suppression	L.S			$ 315,000
12,000 Gallon Water Storage Tank/Tower	LS	1	$ 55,000	$ 55,000
3 Phase Power	LS	1	$ 450,000	$ 450,000
Delineators and Segregation Blocks for stockpiled select rock	2'x2'x6'	200	$ 1,500	
Traffic Control Barriers	K-Rail	150	$ 1,000	
Used Asphalt Concrete for Permanent	Asphalt Millings (square feet)	10,648	$ 10	$ 106,480
Yearly application of soil stabilizer	Geopolymer	10,648	$ 4	$ 42,592
Stormwater Management control measures	Erosion & Drainage *	1	$ 388,961	$ 388,961
Temporary Dome Structure for storage of hazardous materials	26'W x 60'L	1	$ 13,000	$ 13,000
25' High Litter Fence	1500 feet	1500	$ 150	$ 225,000
Scales with Infrastructure	LS	1	$ 150,000	$ 150,000
New Entryway Improvements at Landfill Entrance	LS	1	$ 500,000	$ 500,000
			Total	**$ 2,246,033**
			Contingency	**$ 2,695,239.60**

KEY
*Price calculated using RS Means
^DOCS price is purchasing value, not rental price per month

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

Given

2015 Landfill Tipping Fee

$44.42

Capital Improvements

Fiscal Year	Capital Expenditures	Engineering and Design	Environmental Consulting	Permits	Administration and Contractual1
FY15					
FY16	$ (2,695,240)	$ (200,000)			
FY17		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY18		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY19		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY20		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY21		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY22		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY23		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY24		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY25		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY26		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY27	$ (2,695,240)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY28		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY29		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY30		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY31		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY32		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY33		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY34		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY35		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY36		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY37		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY38		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY39		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY40		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY41		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY42		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY43		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)
FY44		$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)

Discount Rate

Cost of Capital	3.0%
Inflation Rate [2]	2.38%
Inflation Adjusted Discount Rate	0.61%

Typical Values

Current Landfill Volume (yd^3) Occupied Annually [3]
178,000

Total cover soil usage for 2014 (ton)
67,612

Total ADC Usage for 2014 (ton)
18,718

Average cost for imported sand ($/ton)
$ 27.00

Hourly Rate for Soil Extraction
$43.86

Annual Cost to Excavate Soil with Existing Methods
$ 34,210.80

Cost to Excavate Soil with Existing Methods ($/cubic yd)
$ 0.51

Assumptions

Assumed Yearly Discounts/Fee Increases

2% Labor rate increase per year
2.25% Cost Increase on Commodities per year
2.0% Increase on Revenue per year

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

5% Landfill Tipping Fee Increase Every Five Years
$ 14.97 Net Revenue Per Cubic yard

1. Contractual agreements include fees for Construction Manager and Administration
2. Inflation rate (CPI) based on the 20 year average from the Bureau of Labor Statistics Table
http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/
3. Typical airspace calculation is based on the latest annual report for GPS Machine Control Surveys
4. Calculated using CAD Software to compare two Triangular Irregular Networks on a cut and fill factor of 1

CITY OF FLAGSTAFF ECONOMIC EVALUATION
EXCAVATION OF ROCK AND SOIL RESOURCES
SCENARIO 2

CASHFLOW TABLE

	Annual Expenses									Annual Income Sources						Outcome		
Fiscal Year	Projected Annual Landfill Volume	Capital	Engineering and Design	Soil Testing and Environmental Consulting	Permiting	Contractual Agreements [1]	City Staff[2]	Tota lAnnual Costs	Present Value of Annual Costs	Aggregate Sales	Value of Regained Airspace from Landfill Excavation	Avoided Costs to Excavate Soil With Existing Methods [3]	Avoided Costs for Importation of Soil [4]	Toral Annual Benefits	Present Value of Annual Benefits	Annual Program Balance	Present Value of Project Balance	Net Present Value of Rock Excavation
2015																		
2016			$ (200,000)				$ (31,541)	$ (200,000)	$ (198,796)					$ -	$ -	$ (200,000)	$ (198,796)	$ (198,796)
2017	158,759	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (645,614)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,882,772	$ 1,244,650	$ 1,237,158	$ 1,030,915
2018	163,522	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (641,728)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,871,439	$ 1,244,650	$ 1,229,711	$ 2,253,223
2019	168,428	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (637,865)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,860,174	$ 1,244,650	$ 1,222,309	$ 3,468,175
2020	173,480	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (634,026)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,848,977	$ 1,244,650	$ 1,214,951	$ 4,675,812
2021	178,685	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (630,209)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,837,847	$ 1,244,650	$ 1,207,638	$ 5,876,181
2022	184,045	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (626,416)	$ 179,309	$ 1,680,654	$ 34,211		$ 1,894,174	$ 1,826,784	$ 1,244,650	$ 1,200,369	$ 7,069,324
2023	189,567	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (622,645)	$ 179,309	$ 2,961,698	$ 34,211		$ 3,175,218	$ 3,043,819	$ 2,525,694	$ 2,421,174	$ 9,475,924
2024	195,254	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (618,897)	$ 179,309	$ 2,961,698	$ 34,211		$ 3,175,218	$ 3,025,497	$ 2,525,694	$ 2,406,600	$ 11,868,038
2025	201,111	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (615,172)	$ 178,058	$ 2,961,698	$ 34,211		$ 3,173,967	$ 3,006,101	$ 2,524,443	$ 2,390,929	$ 14,244,575
2026	207,145	$ (269,524)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (649,524)	$ (611,469)	$ 178,058	$ 2,961,698	$ 34,211		$ 3,173,967	$ 2,988,006	$ 2,524,443	$ 2,376,537	$ 16,606,807
2027	213,359	$ (385,034)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (765,034)	$ (715,876)	$ 178,058	$ 2,961,698	$ 34,211		$ 3,173,967	$ 2,970,020	$ 2,408,933	$ 2,254,144	$ 18,847,382
2028	219,760	$ (385,034)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (765,034)	$ (711,567)	$ 178,058	$ 2,961,698	$ 34,211		$ 3,173,967	$ 2,952,142	$ 2,408,933	$ 2,240,575	$ 21,074,470
2029	226,353	$ (385,034)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (765,034)	$ (707,284)	$ 178,058	$ 2,961,698	$ 34,211		$ 3,173,967	$ 2,934,372	$ 2,408,933	$ 2,227,088	$ 23,288,152
2030	233,143	$ (385,034)	$ (30,000)	$ (30,000)	$ (20,000)	$ (300,000)	$ (31,541)	$ (765,034)	$ (703,026)	$ 178,058	$ 2,961,698	$ 34,211	$ 1,573,716	$ 4,747,683	$ 4,362,871	$ 3,982,649	$ 3,659,844	$ 26,925,967
2031	240,137	$ (385,034)			$ (20,000)		$ (31,541)	$ (405,034)	$ (369,965)	$ 178,058		$ 34,211	$ 1,620,927	$ 1,833,196	$ 1,674,470	$ 1,428,162	$ 1,304,506	$ 28,222,620
2032	247,342	$ (385,034)			$ (20,000)		$ (31,541)	$ (405,034)	$ (367,738)	$ 178,058		$ 34,211	$ 1,669,555	$ 1,881,824	$ 1,708,541	$ 1,476,790	$ 1,340,803	$ 29,555,352
2033	254,762	$ (385,034)			$ (20,000)		$ (31,541)	$ (405,034)	$ (365,524)	$ 178,058		$ 34,211	$ 1,719,642	$ 1,931,911	$ 1,743,457	$ 1,526,876	$ 1,377,933	$ 30,924,991
2034	262,405				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,940)	$ 178,058		$ 34,211	$ 1,771,231	$ 1,983,500	$ 1,779,239	$ 1,963,500	$ 1,761,299	$ 32,675,688
2035	270,277				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,832)	$ 178,058		$ 34,211	$ 1,824,368	$ 2,036,637	$ 1,815,907	$ 2,016,637	$ 1,798,075	$ 34,462,940
2036	278,385				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,725)	$ 178,058		$ 34,211	$ 1,879,099	$ 2,091,368	$ 1,853,482	$ 2,071,368	$ 1,835,757	$ 36,287,647
2037	286,737				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,618)	$ 178,058		$ 34,211	$ 1,935,472	$ 2,147,741	$ 1,891,985	$ 2,127,741	$ 1,874,367	$ 38,150,731
2038	295,339				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,512)	$ 178,058		$ 34,211	$ 1,993,536	$ 2,205,805	$ 1,931,439	$ 2,185,805	$ 1,913,926	$ 40,053,137
2039	304,199				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,407)	$ 178,058		$ 34,211	$ 2,053,342	$ 2,265,611	$ 1,971,864	$ 2,245,611	$ 1,954,458	$ 41,995,830
2040	304,200				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,302)	$ 178,058		$ 34,211	$ 2,053,349	$ 2,265,618	$ 1,960,001	$ 2,245,618	$ 1,942,699	$ 43,926,834
2041	304,201				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,198)	$ 178,058		$ 34,211	$ 2,053,356	$ 2,265,625	$ 1,948,209	$ 2,245,625	$ 1,931,011	$ 45,846,221
2042	304,202				$ (20,000)		$ (31,541)	$ (20,000)	$ (17,094)	$ 178,058		$ 34,211	$ 2,053,363	$ 2,265,631	$ 1,936,487	$ 2,245,631	$ 1,919,393	$ 47,754,060
2043	304,203				$ (20,000)		$ (31,541)	$ (20,000)	$ (16,992)	$ 178,058		$ 34,211	$ 2,053,369	$ 2,265,638	$ 1,924,836	$ 2,245,638	$ 1,907,845	$ 49,650,421
2044	304,204				$ (20,000)		$ (31,541)	$ (20,000)	$ (16,889)	$ 178,058		$ 34,211	$ 2,053,376	$ 2,265,645	$ 1,913,256	$ 2,245,645	$ 1,896,366	$ 51,535,373

1. Contractual agreements include fees for Construction Manager and Administration
2. Assumes City staff would consist of 1/2 Project Manager dedicated to the project throughout the year.
3. Additional Airspace assumes Cell A to be occupied after excavation. Additional airspace calculated with CAD by comparing the triangular irregular networks of the proposed Cell A re-design with existing topography.
4. Avoided Costs were based on existing method of soil extraction from the landfill borrow pit with a 627 E Scraper Auger. Assumes 40% of operation is dedicated to prepping ADC with wood chips.
5. Avoided costs are based on current costs of imported sand from Verde Valley. Current projections indicate the facility will run our of soil in 2032

Economic Considerations Over 10 Years		
Benefit	20,203,409	(Present Value)
Costs	(5,871,367)	(Present Value)
B/C	**3.44**	

CITY OF FLAGSTAFF ECONOMIC EVALUATION
MINING OF LANDFILL CELLS
SCENARIO 2

CASHFLOW TABLE

		Annual Expenses						Annual Income Sources			Outcome		
Fiscal Year	Projected Annual Landfill Volume	Processing Costs of Mined Trash	Costs to Bury Unusable Portion of MSW[1]	Engineering and Design	Soil Testing and Environmental Consulting	Annual Costs	Present Value of Annual Costs	Avoided Costs by Not having to use Paper Millings as ADC [2]	Annual Benefits	Present Value of Annual Benefits	Annual Program Balance	Present Value of Project Balance	Net Present Value
2015													
2016						$ -	$ -		$ -	$ -	$ -	$ -	$ -
2017	158,759	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,878,981)	$ 149,744	$ 149,744	$ 147,947	$ (2,746,672)	$ (2,731,035)	$ (2,713,705)
2018	163,522	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,861,651)	$ 149,744	$ 149,744	$ 147,056	$ (2,746,672)	$ (2,714,595)	$ (5,411,075)
2019	168,428	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,844,426)	$ 149,744	$ 149,744	$ 146,171	$ (2,746,672)	$ (2,698,255)	$ (8,092,208)
2020	173,480	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,827,304)	$ 149,744	$ 149,744	$ 145,291	$ (2,746,672)	$ (2,682,013)	$ (10,757,202)
2021	178,685	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,810,285)	$ 149,744	$ 149,744	$ 144,417	$ (2,746,672)	$ (2,665,869)	$ (13,406,155)
2022	184,045	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,793,369)	$ 149,744	$ 149,744	$ 143,547	$ (2,746,672)	$ (2,649,822)	$ (16,039,163)
2023	189,567	$ (2,709,696)	$ (126,720)	$ (30,000)	$ (30,000)	$ (2,896,416)	$ (2,776,555)	$ 149,744	$ 149,744	$ 142,683	$ (2,746,672)	$ (2,633,872)	$ (18,656,321)
2024	195,254	$ (2,907,535)	$ (135,972)	$ (30,000)	$ (30,000)	$ (3,103,507)	$ (2,957,167)	$ 149,744	$ 149,744	$ 141,824	$ (2,953,763)	$ (2,815,343)	$ (21,453,863)
2025	195,255	$ (2,907,535)	$ (135,972)	$ (30,000)	$ (30,000)	$ (3,103,507)	$ (2,939,367)	$ 149,744	$ 149,744	$ 140,971	$ (2,953,763)	$ (2,798,396)	$ (24,234,566)
2026	195,256	$ (2,907,535)	$ (135,972)	$ (30,000)	$ (30,000)	$ (3,103,507)	$ (2,921,673)	$ 149,744	$ 149,744	$ 140,122	$ (2,953,763)	$ (2,781,551)	$ (26,998,531)
2027	195,257	$ (2,907,535)	$ (135,972)	$ (30,000)	$ (30,000)	$ (3,103,507)	$ (2,904,087)	$ 149,744	$ 149,744	$ 139,279	$ (2,953,763)	$ (2,764,808)	$ (29,745,858)
2028	195,258	$ (761,332)	$ (35,604)	$ (30,000)	$ (30,000)	$ (856,936)	$ (797,046)	$ 149,744	$ 149,744	$ 138,440	$ (707,192)	$ (658,606)	$ (30,399,666)

1.Assumes a disposal cost of $2 per cubic yard
2. Avoided Costs were based on existing method of soil extraction from the landfill borrow pit with a 627 E Scraper Auger. Assumes 40% of operation is dedicated to prepping ADC with wood chips.

Economic Considerations Over 10 Years

Benefit	1,440,028	(Present Value)
Costs	(28,610,780)	(Present Value)
B/C	**0.05**	

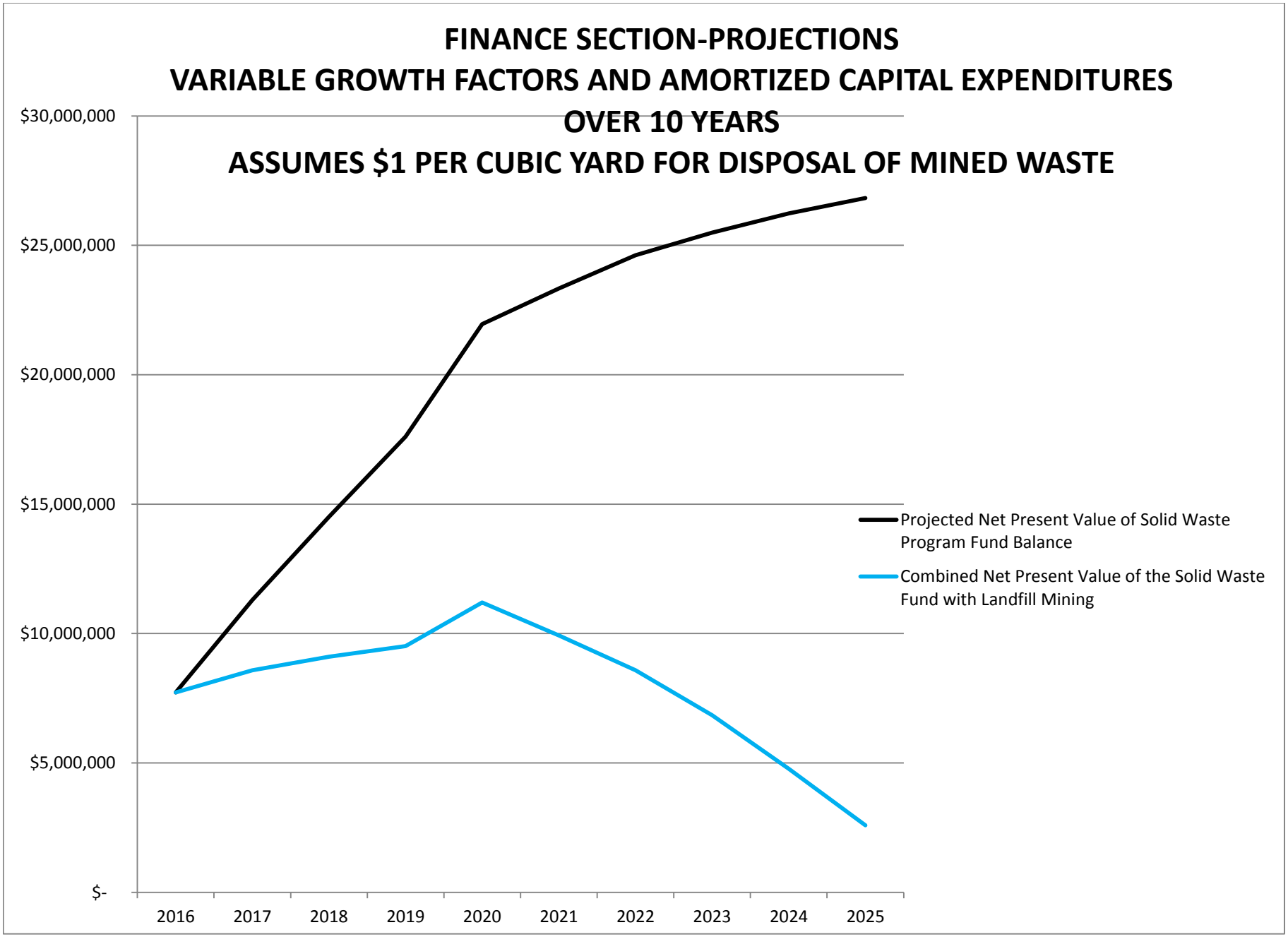
SOLID WASTE PROGRAM ECONOMIC ANALYSIS-LANDFILL MINING
BASED ON FINANCE-SECTION PROJECTIONS (PUBLISHED IN FY 15 BUDGET)
VARIABLE GROWTH FACTORS (SEE ASSUMPTIONS)
AMORTIZED CAPITAL EXPENDITURES OVER 10 YEARS
SCENARIO 2

	Balance Sheet																
	Annual Expenses				Annual Revenue				Outcome								
	Solid Waste		Landfill Mining Project		Solid Waste		Landfill Mining Project		Solid Waste		Landfill Mining Project		Program Results		Solid Waste	Landfill Mining Project	Program Results
Fiscal Year	Projected Solid Waste Program Costs	Present Value of Projected Annual Solid Waste Costs [1]	Project Costs	Present Value of Project Costs [2]	Projected Solid Waste Program Revenues	Present Value of Projected Annual Solid Waste Revenues [1]	Project Revenue	Present value of Project Revenue [2]	Solid Waste Program Annual Gains/Losses	Present Value of Annual Gains/Losses [2]	Project Annual Gains/Losses	Present Value of Annual Gains/Losses [2]	Combined Gains/Losses	Combined Present Value of Gains/Losses	Projected Net Present Value of Solid Waste Program Fund Balance	Net Present Value of Project [2]	Combined Net Present Value of the Solid Waste Fund with Landfill Mining
2015																	$ 7,421,880
2016	$ (15,476,095)	$ (15,116,327)	$ -	$ -	$ 15,785,212	$ 15,418,257	$ -	$ -	$ 309,117	$ 301,931	$ -	$ -	$ 309,117	$ 301,931	$ 7,723,811	$ -	$ 7,723,811
2017	$ (8,443,152)	$ (8,055,163)	$ (2,896,416)	$ (2,878,981)	$ 12,187,588	$ 11,627,531	$ 149,744	$ 147,947	$ 3,744,436	$ 3,572,368	$ (2,746,672)	$ (2,731,035)	$ 997,764	$ 841,333	$ 11,296,179	$ (2,713,705)	$ 8,582,474
2018	$ (8,818,643)	$ (8,217,815)	$ (2,896,416)	$ (2,861,651)	$ 12,270,956	$ 11,434,917	$ 149,744	$ 147,056	$ 3,452,313	$ 3,217,102	$ (2,746,672)	$ (2,714,595)	$ 705,641	$ 502,506	$ 14,513,280	$ (5,411,075)	$ 9,102,206
2019	$ (8,953,410)	$ (8,149,443)	$ (2,896,416)	$ (2,844,426)	$ 12,354,997	$ 11,245,587	$ 149,744	$ 146,171	$ 3,401,587	$ 3,096,144	$ (2,746,672)	$ (2,698,255)	$ 654,915	$ 397,889	$ 17,609,424	$ (8,092,208)	$ 9,517,216
2020	$ (10,553,543)	$ (9,382,589)	$ (2,896,416)	$ (2,827,304)	$ 15,439,719	$ 13,726,625	$ 149,744	$ 145,291	$ 4,886,176	$ 4,344,037	$ (2,746,672)	$ (2,682,013)	$ 2,139,504	$ 1,662,024	$ 21,953,461	$ (10,757,202)	$ 11,196,259
2021	$ (10,935,093)	$ (9,495,804)	$ (2,896,416)	$ (2,810,285)	$ 12,525,129	$ 10,876,557	$ 149,744	$ 144,417	$ 1,590,036	$ 1,380,753	$ (2,746,672)	$ (2,665,869)	$ (1,156,636)	$ (1,285,116)	$ 23,334,214	$ (13,406,155)	$ 9,928,059
2022	$ (11,092,157)	$ (9,408,278)	$ (2,896,416)	$ (2,793,369)	$ 12,611,231	$ 10,696,744	$ 149,744	$ 143,547	$ 1,519,075	$ 1,288,467	$ (2,746,672)	$ (2,649,822)	$ (1,227,597)	$ (1,361,355)	$ 24,622,681	$ (16,039,163)	$ 8,583,518
2023	$ (11,643,997)	$ (9,646,752)	$ (2,896,416)	$ (2,776,555)	$ 12,698,033	$ 10,519,993	$ 149,744	$ 142,683	$ 1,054,036	$ 873,241	$ (2,746,672)	$ (2,633,872)	$ (1,692,636)	$ (1,760,630)	$ 25,495,922	$ (18,656,321)	$ 6,839,601
2024	$ (11,877,933)	$ (9,611,800)	$ (3,103,507)	$ (2,957,167)	$ 12,785,544	$ 10,346,252	$ 149,744	$ 141,824	$ 907,610	$ 734,452	$ (2,953,763)	$ (2,815,343)	$ (2,046,152)	$ (2,080,891)	$ 26,230,374	$ (21,453,863)	$ 4,776,511
2025	$ (12,117,597)	$ (9,577,789)	$ (3,103,507)	$ (2,939,367)	$ 12,873,766	$ 10,175,467	$ 149,744	$ 140,971	$ 756,169	$ 597,679	$ (2,953,763)	$ (2,798,396)	$ (2,197,593)	$ (2,200,717)	$ 26,828,053	$ (24,234,566)	$ 2,593,487

Economic Considerations Over 10 Years

Benefit	117,367,839	(Present Value)
Costs	(122,350,866)	(Present Value)
B/C	**0.96**	

1. Based on CPI
2. See details and assumptions for the excavation project on sheet 1 and 2 of Appendix F


FINANCE SECTION-PROJECTIONS
VARIABLE GROWTH FACTORS AND AMORTIZED CAPITAL EXPENDITURES
OVER 10 YEARS
ASSUMES $1 PER CUBIC YARD FOR DISPOSAL OF MINED WASTE
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$-
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Projected Net Present Value of Solid Waste Program Fund Balance
Combined Net Present Value of the Solid Waste Fund with Landfill Mining