May 2, 2002
Job No. 2-817-003935

Dakota Homes, Inc.
860 East 4500 South, #303
Salt Lake City, Utah 84107

Attention: Mr. Craig Nielsen, President

Gentlemen:

Re: Report
Supplemental Geotechnical Study
The Cedars at Cedar Hills, Plat E Phases 1 - 5
East of State Road 146 at Approximately 10500 North
Cedar Hills, Utah

1. INTRODUCTION

This report presents the results of our supplemental geotechnical study performed at the proposed The Cedars at Cedar Hills, Plat E Phases 1 - 5 site which is located east of State Road 146 at approximately 10500 North in Cedar Hills, Utah. This service was requested by Mr. Craig Nielsen of Dakota Homes, Inc. and coordinated through Mr. Nielsen and Messrs. Ken Watson and Ron Paul of Stantec Consulting, Inc. Authorization was provided by Mr. Craig Nielsen.

2. BACKGROUND

The proposed development is to consist of numerous two to four-unit three-level townhouse structures and extensive roadways and drainages. Portions of the lower level of each structure will be garages. Below grade, the structure will be of reinforced concrete construction. Above grade, the structures will be of wood-frame construction with some stone, stucco, wood, or brick veneer. Structural loads will be transmitted down through bearing walls and columns to the supporting foundations. At this time, we project that the maximum wall and column loads will be on the order of 3 to 5 kips per lineal foot and 50 to 70 kips, respectively. Floor slab loads will be light.

Site development will require a massive amount of earthwork in the form of cutting and filling. Maximum cuts will be as much as 20 to 22 feet. Maximum fills will be 15 to 20 feet. As presently proposed, the cut and fill slopes are to be constructed at two horizontal to one vertical. Because

AMEC Earth & Environmental, Inc.
4137 South 500 West
Salt Lake City, Utah 84123
Tel +1(801) 266-0720
Fax +1(801) 266-0727
www.amec.com

of the bench/foothill terrain, very positive surface drainage including rip-raped ditches have been proposed especially on the up-gradient side of the far easterly-most units. These units are on the very upper portion of the bench and just a few feet west of the toe of the steeper foothill terrain.

Structures will be supported upon conventional spread and continuous wall foundations designed to impose a maximum real net loading pressure of 2,300 pounds per square foot. Footings are to be established upon suitable natural granular soils or granular structural fill extending to suitable natural soils. Detailed earthwork, foundation, and pavement recommendations were presented in a geotechnical study report by Earthtec Testing & Engineering, PC dated January 26, 2000[1].

Primarily because of the small slide/slump which occurred in 1983 at the southern end of the northern ancient slide mass which is in near proximity to Building No. 4, AMEC Earth & Environmental, Inc. (AMEC) was asked to perform this supplemental study. In addition to reviewing and observing this particular slide, the general stability of the natural slopes in the area, the proposed final cut and fill slope recommendations, and surface drainage criteria were also reviewed.

3. FIELD PROGRAM

The site was visited on three occasions by Bill Gordon of AMEC. The first site visit was directed towards developing a "feel" for the locations of proposed roadways and structures with regard to existing terrain and a general understanding of the slopes in the eastern portion of the site. During this first visit, it was obvious that because of the massiveness of the site and the lack of layout or survey markers, it was impossible to accurately determine the relationships of the proposed structures to the terrain. It was, therefore, requested that Stantec flag in the field the back corners of most of the easterly-most units.

Following the field staking, a second site visit was performed. In conjunction with the second visit, it was determined that: 1) the back center of Building 4 was within five to six feet of the toe of the 1983 slide/slump mass; 2) there were variations between the topography indicated on the site development drawings and actual site conditions; and 3) there were significant drainages down the natural slopes not indicated by the topography presented on the site development drawings. During the second site visit, a detailed observation of the lower portion of the 1983 slide/slump mass was also performed.

Based upon data obtained from the second site visit, means of increasing the stability of the presently stable 1983 slide/slump mass and improving the drainage in the slide/slump mass area were presented. It is essential that these recommendations be followed if Building 4 is to be constructed at the proposed location. During the later portion of this meeting, the owner and other members of the design team concluded that it would be cost effective to make the proposed

[1] "Geotechnical Study, Loan Peak Residential Development, 10700 North State Road 146 (Canyon Road), Cedar Hills, Utah," Earthtec Job No. 99E-400.

earthwork and drainage modifications. These recommendations are presented in detail in the following sections.

A third site visit was performed. Mr. Ron Paul of Stantec was present during a portion of the visit. During this visit, the overall grading plan for the lower portion of the slide mass and the installation of rip-raped drainage channels were visualized and discussed. The alignment of the channels were also staked.

4. 1983 SLIDE MASS

The 1983 slide/slump consists of two primary components. The first component occurred much further upslope and consisted of minor to fairly significant shallow slump failures. The minor slumps had crest movements of two to three feet and occupied areas of approximately 40-feet by 50-feet. The runout of the lower portion of the slump was about two feet above existing grade. These minor slumps have subsequently totally revegetated and are stable. A more significant slump failure occurred above the drainages that run northeast-to-southwest, south of the proposed location of Building 4. It appears that subsequent to the slump, a dozer had been brought up to the site to regrade the area. The exposed soils are light tan in color and contain gravels and cobbles in a matrix of clayey silts. Revegetation of this slump material is minimal and consists of only some scattered grasses and weeds. A very interesting thing about this more major slump is that none of the material appears to have entered the upper portion of the previously referenced drainage. Instead the slump materials spread downslope along a bench area somewhat further to the north and dissipated on the moderate slope before it reached any steeper terrain especially associated with drainages.

The second component of the overall 1983 slide/slump occurred just northeast of the proposed Building 4 location and in our opinion was triggered by extensive erosion/undercutting of the steep southeast-facing slope of the drainage. This slope consisted of the ancient landslide materials. The other side of the drainage is dominated by bedrock which is exposed in the channel. During the periods of excessively high rainfall, we not only had the undercutting of the old landslide deposits but saturation of these deposits. This lead to the slide/slump which essentially terminated about six feet up-gradient of the east-center portion of proposed Building 4. As typical of these slide masses, the area near the crest is hummocky with numerous depressions which do not allow for fast and efficient pass through of runoff waters down the drainage. Although there is no evidence of any significant movement since 1983, ponding of water in these depressions above the runout point is not beneficial to the overall stability of the runout soil mass.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 1983 SLIDE MASS

Based upon results of this supplemental study, it is our opinion that by proper grading and drainage improvements, the stability of the presently stable lower 1983 slide mass can be increased sufficiently to allow for the construction of Building 4. Remediation efforts that will be required must consist of:

1. The improvement of the drainage within the lower slide/slump mass by regarding the closed depressions so that ponding of water in the slide/slump mass does not occur

2. Facilitate and rapidly discharge surface water down the natural drainage in a manner that it will not undercut the steep southeast-facing slope forming the northwest boundary of slide/slump mass. Specifically, the primary drainage channel will be along the southern portion of the slide/slump mass against the natural bedrock slope. A secondary rip-raped ditch will be constructed in a generally northwest-to-southeast direction through a depression in the middle of the slide/slump mass. The drainage will discharge to the previously discussed primary ditch. A sketch of this concept is attached. In conjunction with installation of the rip-raped ditches, regrading will take place as to minimize any closed depressions and facilitating fast runoff of any surface water to the ditches. The primary purpose of this drainage improvement is to reduce the possibility of water infiltration in the lower portion of the slide mass.

3. Cut the toe of the slide/slump mass back at a slope no steeper than two and one-half horizontal to one vertical. The toe of the final slope should be at least 8 to 10 feet back of Building 4. The present slope in areas is approximately one and one-half horizontal to one vertical and during periods of extremely heavy precipitation could be susceptible to fairly shallow slumping and/or mud flow type failure. The excavated materials can be re-utilized as structural site grading fill in the mass grading operations.

When the above operations have been completed, it essential that the surface soil in the regraded slide/slump mass be appropriately revegetated or otherwise protected against erosion.

5.2 SURFACE DRAINAGE

In conjunction with our site observations, one or more minor but significant drainages not shown on the original topography were observed. The discharge points of these drainage areas were just up-gradient of proposed structures. These drainages were brought to the attention of a representative of Stantec who mapped them and will make appropriate changes in the grading

plans. In some cases, more positive surface drainage ditches and even rip-raped ditches will be added.

5.3 EARTHWORK

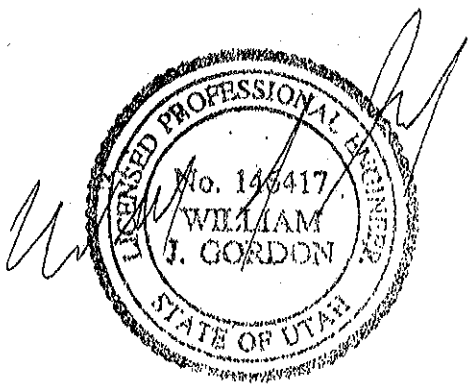
In the January 26, 2000 report, it was recommended that structural fills placed below foundations, flatwork, and pavements be compacted to at least 95 percent of the maximum dry density as determined by the ASTM[2] D-1557 criteria. As previously discussed, the present site grading plan is to include structural fills beneath the proposed residential units in excess of 5 to 10 feet in thickness. It has been our experience that deep structural fills compacted to 95 percent will experience areal settlement which could be detrimental to the structures especially if a portion of the structure is established over the deep structural fills and other portions upon cut natural soils. We, therefore, strongly recommend that structural fills in excess of 7 feet in thickness beneath the structure be compacted to at least 98 percent of the previously defined compaction criteria. This will significantly reduce potential damaging differential settlements. It will also be beneficial to construct the fill sequences as far in advance of the construction of the structures as possible.

The proposed two horizontal to one vertical final cut and fill slopes in the natural and structural areas will be susceptible to erosion. Therefore, appropriate final grading and relegation or other means of erosional control must be part of the mass excavation operations.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

AMEC Earth & Environmental, Inc.



William J. Gordon, State of Utah No. 146417
Professional Engineer

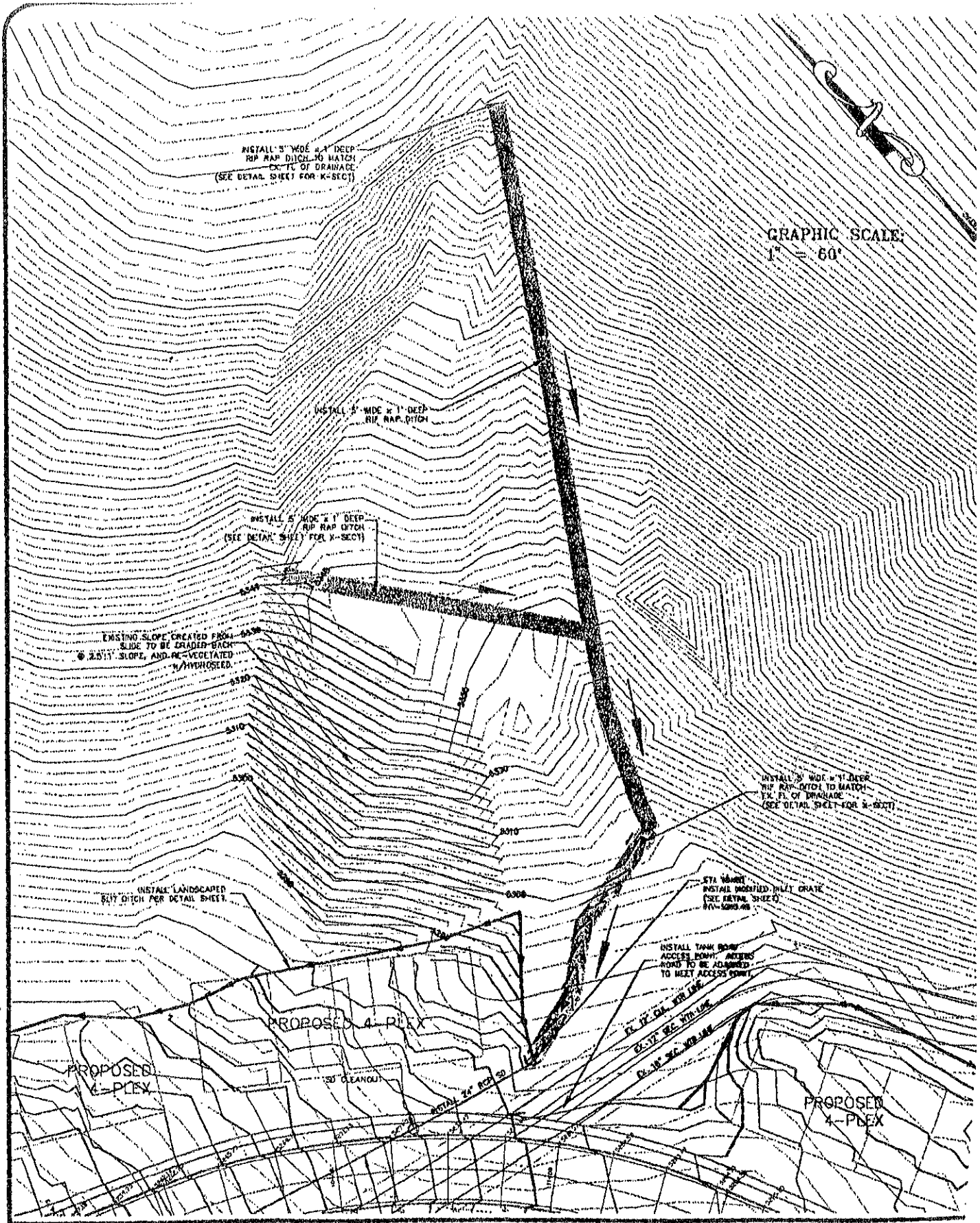
WJG/sn

Encl. Stantec Drawings

Addressee (3)
c: Mr. Ron Paul (1)
Stantec Consulting, Inc.
3995 South 700 East
Salt Lake City, Utah 84107

Mr. Ken Watson (1)
Stantec Consulting, Inc.
3995 South 700 East
Salt Lake City, Utah 84107

[2] American Society for Testing and Materials

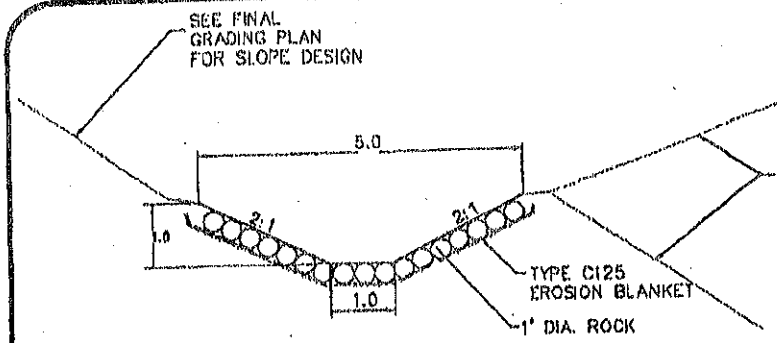


GRAPHIC SCALE:
1" = 60'

Stantec Consulting Inc.
3995 S 700 E Ste. 300
Salt Lake City, UT
84107-2540
Tel. 801.261.0090
Fax. 801.266.1874
www.stantec.com

THE CEDARS TOWNHOMES LANDSLIDE MITIGATION PL

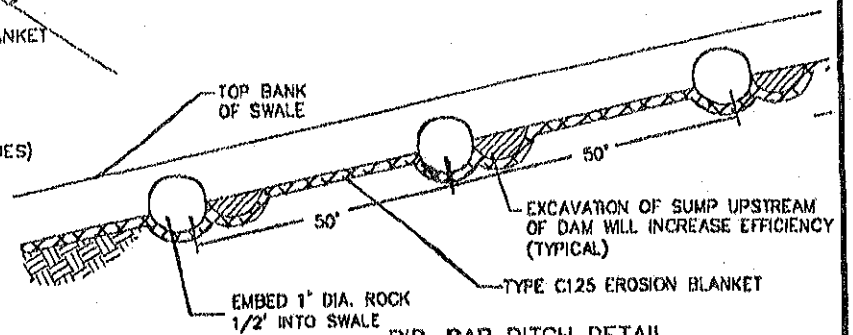
SHEET 1 of 2



RIP. RAP DITCH DETAIL

(SEE FINAL GRADING PLAN FOR DESIGNED LOCATION & GRADES)

-NTS-



RIP. RAP DITCH DETAIL

(SIDE VIEW)

(SEE FINAL GRADING PLAN FOR DESIGNED LOCATION & GRADES)

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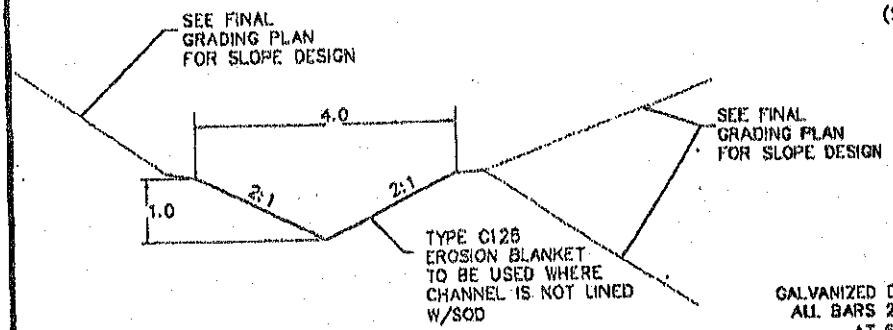

LANDSCAPED SLIT DITCH

(SEE FINAL GRADING PLAN FOR DESIGNED LOCATION & GRADES)

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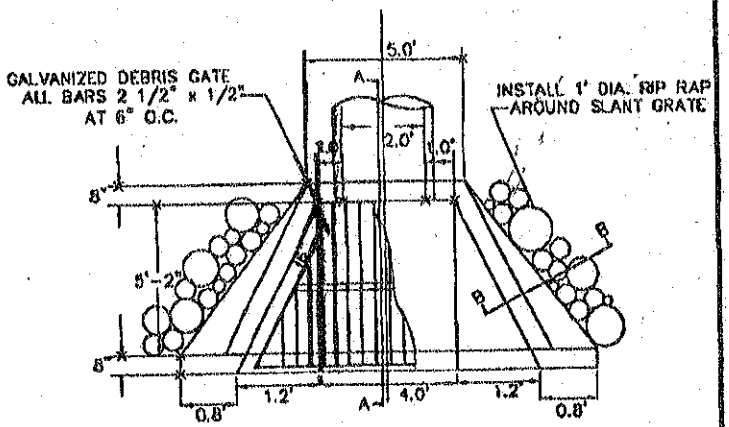
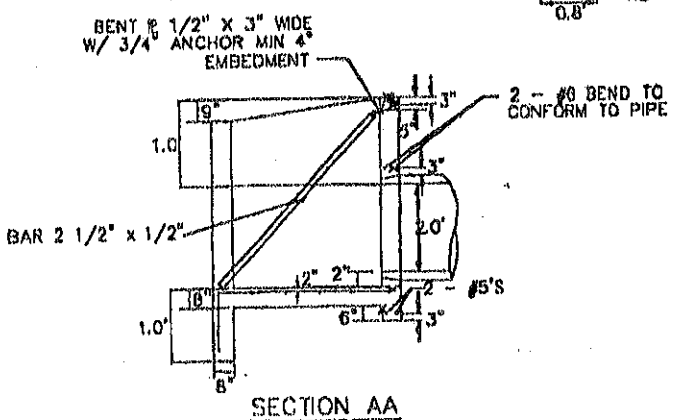
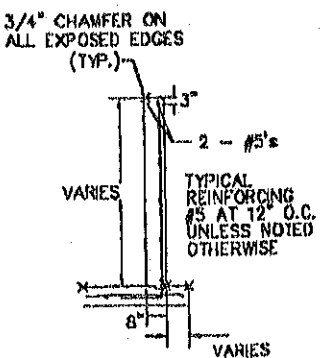




SECTION AA



SECTION BB

NOT TO SCALE

MODIFIED INLET GRATE

-NTS-

Stantec Consulting Inc.
3995 S 700 E Ste. 300
Salt Lake City, UT
84107-2340
Tel. 801.261.0090
Fax. 801.355.1971
www.stantec.com

THE CEDARS TOWNHOMES
LANDSLIDE MITIGATION PLAN
DETAIL SHEET

SHEET 2 of 2