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Project Compass 2.0: A Preliminary Analysis

An Arek'Jaalan Project

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A Multidisciplinary Division Research Initiative

Project Compass 2.0 Preliminary Analysis

Abstract

Data collected for the revamped Project Compass[1] have been used to tentatively locate Anoikis space in relation to New Eden. According to the data collected, Anoikis space is located approximately 1250-1350 light years from the center of the New Eden cluster, roughly galactic southeast from New Eden, in a plane roughly even with New Eden. To date, all Anoikis systems surveyed have been found within 100 light years of each other, roughly matching New Eden's own size. Data were collected through locator services found in all control towers. Using the principles of trilateration, Project Compass members were able to locate 294 Anoikis systems to within a few light years of accuracy. The data and this report have been forwarded to Dr. Hilen Tukoss and Eifyr and Co. for their review and commentary, though given Dr. Tukoss's recent absence, it is unknown if official commentary will be forthcoming.

Overview

Anoikis space has been accessible from New Eden since YC 111, when the Seyllin and related main sequence stellar events somehow marked the opening of unstable wormholes.[2] Since then, there have been extensive attempts to understand the fundamentals of Anoikis, yet many mysteries about even fundamental aspects remain. Project Compass is an attempt to lay the foundations of further understanding of Anoikis.

Project Compass attempts to answer the key question of where Anoikis is located compared to New Eden. Is it located in the same galaxy? The same part of the galaxy? Or across the universe entirely? Are Anoikis systems even near each other? The revamped Project Compass was proposed to answer these fundamental questions. The Project was conceived after the Authors discovered a method by which control towers could be used to determine basic relations between Anoikis and New Eden, through a process known as trilateration. By using this method, Project Compass set out to determine the three-dimensional location of Anoikis systems in relation to New Eden.

Methodology

To make logistics easier for corporations, control tower manufacturers have long included a little known function to their basic control tower designs: the ability to determine, down to 1/10th of a light year, the distance to all other anchored control towers owned by a corporation. No other information is given by this feature. By using a process analogous to that used by scanner probes to locate certain sites or ships within a solar system, Project Compass utilized this locator function to determine, as much as possible, the location of Anoikis systems in relation to the New Eden cluster.

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[1] The basic project portal is available here.
[2] A full review of the events of the Seyllin Incident is available here.

In order to locate any point in a three-dimensional system, certain amounts of data are necessary. One version, called trilateration, requires the coordinates of four reference points, as well as the distance measurements from those reference points to the location in question. Using these data, the intersection point of the four spheres (with centers on the reference points, and the measured distances as radii) can be calculated. There will only be one point where the surfaces of all four spheres intersect, marking the three-dimensional coordinates of the location in question.[3]

In order to utilize trilateration, Project Compass anchored four control towers throughout New Eden to serve as reference points. The systems within which these control towers were anchored (so-called Control Systems) were then cross-referenced with CONCORD databases that provide the exact location of all New Eden systems within a common reference grid.[4] With the Control Systems established, researchers were then able to utilize the locator functions of a fifth control tower in every surveyed Anoikis system to measure distances back to the Control Systems. Each distance measurement to the Control Systems acts as the radius of one of the four spheres described above. The intersection point of these four spheres can then be calculated, as described in Appendix A.

Systems were identified and surveyed as they were discovered, and chains to other Anoikis systems were followed as far as possible. Once collected, the data were entered into a spreadsheet created to perform the calculations needed to derive the locations of the Anoikis systems. A completely separate control tower network was also used to collect a second set of data. Data were collected until CONCORD removed the functionality on March 13, YC 114.[5]

Potential Methodological Issues

Two primary problems present themselves in relation to the methodology of this Project. The first revolves around the soundness of the underlying data. Simply put, it is unclear how the locator function in the control towers works. Project Compass members have been unable to determine the process control towers use to almost instantaneously calculate the distance between themselves and their sister towers, despite apparently being over a thousand light years away. However, it should be noted that the control towers are accurate within New Eden itself (and thus can be externally verified utilizing the aforementioned CONCORD databases), lending at least some credibility to the data. Furthermore, the data itself has been remarkably consistent, lending further credibility to the data. As discussed below, there is remarkable clustering of Anoikis systems, showing that at least if the long-distance measurements of the control towers are in error, all data are probably in error by roughly the same amount, meaning that at least some parts of the data are still usable. Given these two reasons, the authors believe that the analysis of the data is certainly worthwhile to present, as long as this caveat is kept in mind.

[3] A full overview of the math involved is available in Appendix A.

[4] A link to the database used is available here. ((Please note that the static data dump was only used to verify positions of New Eden systems, as the Project Leads deemed this as something that would be widely available. Though Anoikis system locations are also contained within the database, they were not utilized for the purposes of Project Compass. All data analyzed in this report derives solely from data collected from control towers.))

[5] CONCORD apparently only became aware of the locator function's utility in Anoikis after inquiries by Project Compass members. After these inquiries, CONCORD announced that they intended to require all control tower manufacturers to remove the locator function, or at least disable its use in Anoikis. The reasons behind this announcement are unknown.

The second methodological issue is much more practical in nature, and derives from trilateration itself and the geometry of New Eden. In order to be able to most accurately derive the positions of Anoikis systems, the Control Systems need as much distance between them as possible along the x, y, and z axes. A smaller differential means that measurement errors become more significant, especially along that axis. Due to New Eden's geometry, this problem becomes most notable along the y axis. Balancing concerns for security with the needs for maximum distance yielded four systems suitable as Control Systems for Project Compass's official towers, located in Adacyne, Balle, Hemouner, and Kattegaud (Maximum differentials for x, y, and z axes, respectively, in light-years: 30, 10, 28), with a second set of control towers established in Gateway, Hemouner (at a separate control tower from Set 1), Horkkisen, and Sakulda (Maximum differentials for x, y, and z axes, respectively, in light-years: 27, 14, 32), with Set 2 towers being placed entirely in low security space. Notably, due to New Eden's fairly flat distribution, Project Compass could only achieve a differential of 10 to 14 light years on the y axis. This smaller differential could lead to substantial errors in certain system measurements. However, this concern is balanced by the sheer size of the sample systems (see analysis, below, for some effects). While individual systems may have an actual y-axis coordinate up to a few light years different from the estimated coordinate, these errors should smooth out over the aggregate. Indeed, the clustering of data (again, discussed below) again demonstrates the overall soundness of the data. Individual data points may be slightly inaccurate, but overall trends can still be analyzed. Furthermore, the existence of a second data set, even if similarly limited by New Eden's geographical limitations, helps to establish the data's validity.

A third, more minor, methodological issue also presents itself in the form of potential selection bias. Anoikis systems were selected at random as wormholes to these systems presented themselves to the Project. Although wormhole topology was assumed fairly random for the purposes of this Project,[6] as-of-yet unidentified patterns may be of significance. Although only roughly ten-percent of Anoikis systems were analyzed (out of the 2,498 known locus signatures), all classes of Anoikis were surveyed and hopefully allay fears of selection bias. Adding to this is the fact that no significant outliers were found from the core cluster of Anoikis that would suggest the existence of a second cluster of Anoikis space that simply was not found. That does not indicate the lack of a second cluster, only that it was not found in Project Compass's surveys.

Experimental Data

Data were obtained from 294 Anoikis systems. Selected data is available in Appendix B while the full data is available here. Each project member collected a variety of data on each system surveyed. Beyond the distances to either the primary or secondary set of Control Systems (via a control tower in each Anoikis system surveyed), the classification of each system as well as any nearby stellar phenomena were also recorded. The general direction of most phenomenon was also recorded from galactic north. All data is then entered into a spreadsheet to perform the necessary calculations. These calculations derive the x, y, and z coordinates of each surveyed Anoikis systems in light years from the (0, 0, 0) coordinates used by CONCORD. From there, calculations are performed to find the distance from (0, 0, 0) as well as entered into a graphical representation of the Anoikis cluster. A listing of the raw data are located in Appendix B.

[6] Further research along these lines is ongoing under the auspices of Project Atlas. Details of the research is available here.

Analysis

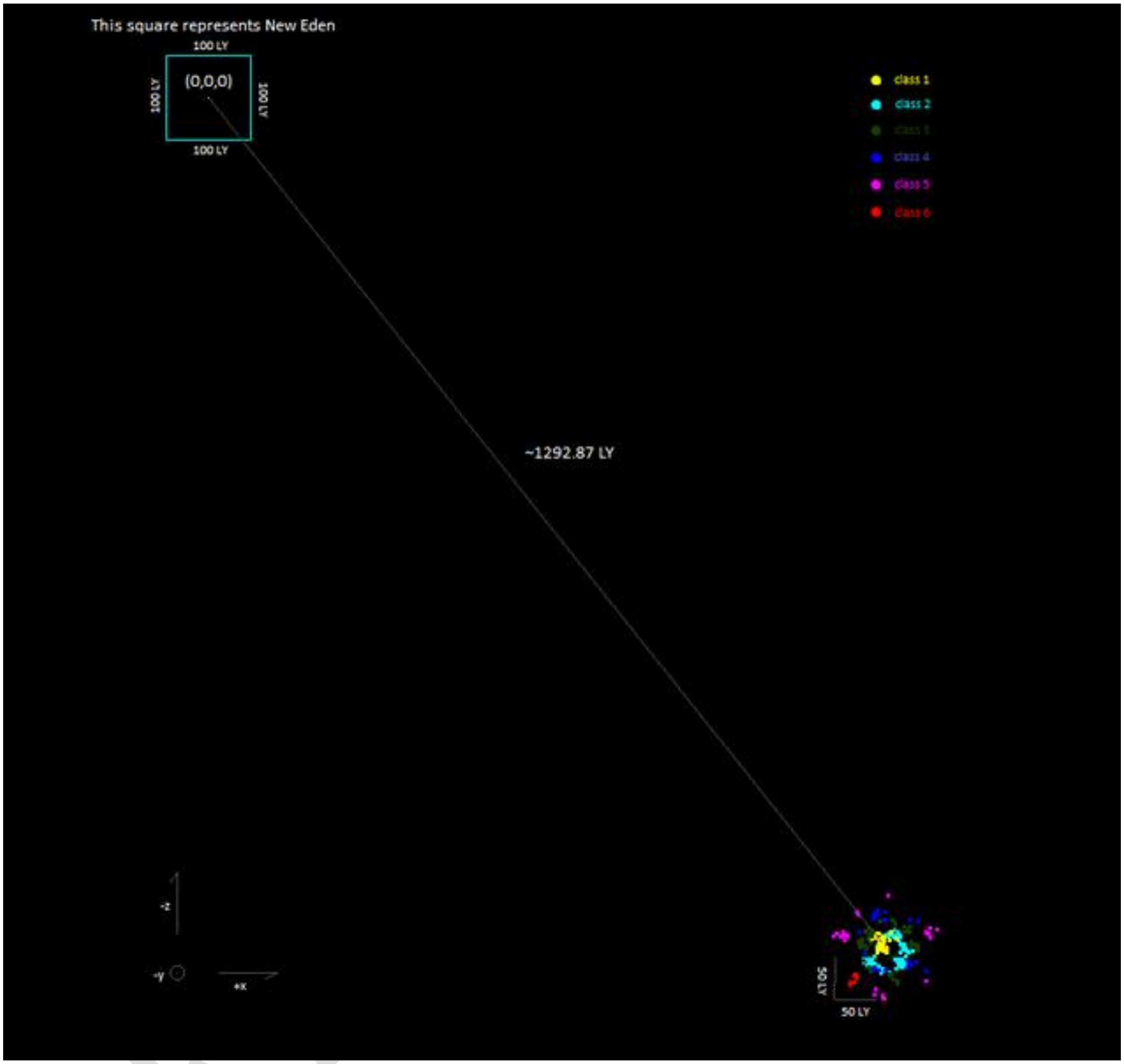

Figure 1: Measured Anoikis systems in relation to New Eden.

According to the calculations summarized above and described in full form in Appendix A, all surveyed Anoikis systems are located in a cluster roughly to the galactic south east of New Eden, in roughly the same plane, as seen from above in Figure 1. Distances from (0,0,0) range from a minimum of 1235.5 light years in locus signature J103701 to a maximum of 1347.5 light years in locus signature J113712. The average distance to measured stars was 1288.9 light-years.

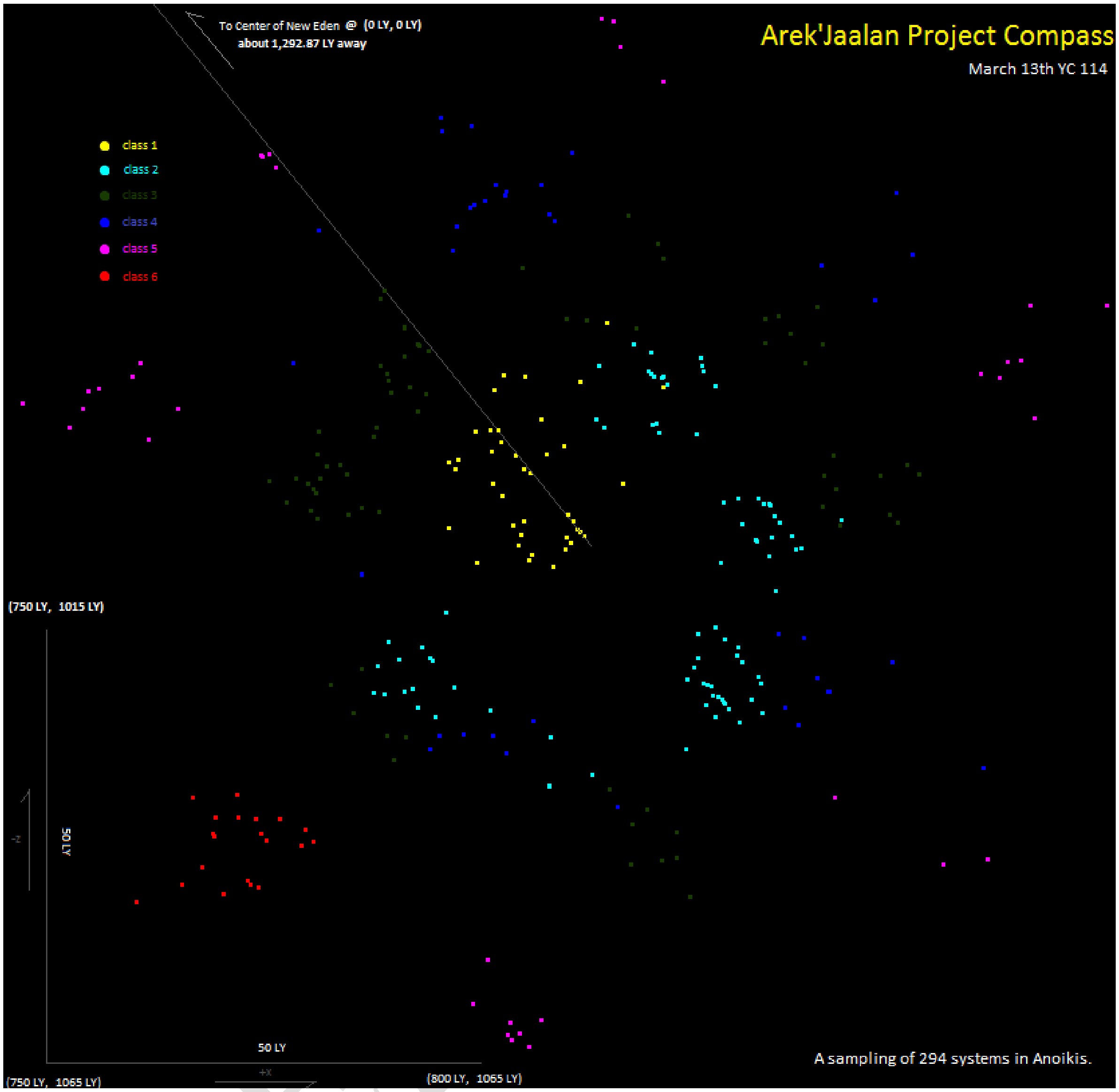

Figure 2: All measured stars, colored by class.

As can be seen above, in Figure 2, Anoikis appears clustered within a disk roughly 125 light-years across, roughly the same size and shape as the New Eden Cluster. Perhaps more significantly, there appears to be a significant clustering of Anoikis systems according to class. Classification of a system appears to be principally based on the sophistication of Sleeper defenses, with Class 1 systems having fairly light defenses, while Class 6 systems having very heavy defenses.[7] With Class 1 systems located exclusively in the interior of Anoikis and higher classes distributed outwards, a fairly striated appearance becomes evident.

This might suggest that the Sleeper civilization considered the inner areas of the cluster to be fairly safe, needing little protection from outside enemies, while the outer rim systems needed more formidable protection to maintain Sleeper control. This, however, does not fit with known Sleeper site naming patterns. Lower class systems often have sites such as a “Perimeter Camp”

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[7] More information is available here.

or a "Perimeter Hanger," while higher class systems might have a "Core Citadel" or a "Core Bastion."[8] These names, at least, suggest precisely the opposite: that Sleepers considered Class-6 systems to be strongholds while Class 1 systems were considered to be frontier territory. It is also notable that unlike the other higher classes of wormhole space, Class 6 wormhole systems are clustered in one area, which raises further questions about the development of Sleeper civilization (especially given the propensity of Talocan relics to be found in higher classes of Anoikis).

Another potential theory is that the physical locations of systems should be ignored when analyzing Sleeper site distributions in favor of examining connections through wormholes. In that sense, it is notable that Classes 1-3 of Anoikis are easily accessible from New Eden (thus more easily being considered to be "frontier" or "perimeter" systems if wormholes to New Eden are considered the frontier), while Classes 4-6 are only very rarely, if ever, accessible from New Eden. Instead, these higher class systems are generally only accessible through other Anoikis systems, perhaps lending themselves more easily to being called "core" systems. This explanation yields even more questions, such as what shut down the original wormhole networks. Whatever the reason, Sleeper astrocartography certainly warrants further investigation.

Measurement Errors

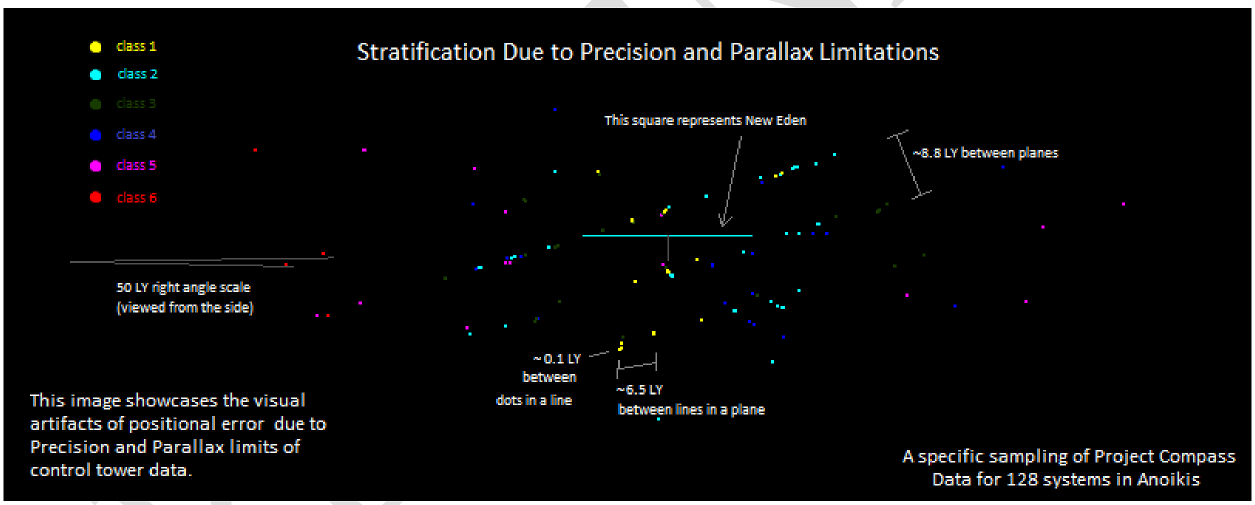

Figure 3: Selected data illustrating errors introduced in the data by limitations in the methodology.

As discussed above, measurement errors do introduce a certain level of uncertainty into Project Compass results. These errors are most easily demonstrated in the 6 systems where Sets 1 and 2 of Control Towers made measurements of the same Anoikis systems. These systems were J101307, J125023, J125833, J133128, J232441, and J232801. Sizeable differences between Sets 1 and 2 illustrate the potential sizes for measurement error. Differences in coordinate measurements for the two data sets were 10.7, 10.5, 6.9, 15.5, 7.3, and 8.8 light-years, respectively. Although small in relation to the roughly 1300 light-years measured distance between New Eden and Anoikis, they demonstrate that the calculated coordinate sets of specific Anoikis systems should not be taken as absolutes, even assuming the locator technology in and of itself is completely accurate. Indeed, the errors introduced to the data due to parallax as well

[8] A comprehensive review of classes of Anoikis sites is available here.

as the 1/10th of a light-year sensitivity of the control towers is most evident when the data set is viewed from a certain angle, as demonstrated in Figure 3, above. The errors in the Compass data sets are so significant (as compared to the data sets a capsuleer would obtain from using the same calculations while scanning the system with probes) because the spheres from each of the Control Towers meet at such acute angles. Regardless, given that Compass's purpose was only to provide a rough estimate of Anoikis's location rather than precise coordinates, the authors believe that these measurements errors do not hinder Compass's overall goals.

More troubling for the veracity of Compass's data is an examination the distribution of systems with nearby stellar phenomena. These phenomena include a host of stellar oddities, such as pulsars, black holes, and Wolf-Rayet stars, to name a few. These phenomena are often close enough to be seen easily from the affected Anoikis system, providing a rather dramatic backdrop to certain Anoikis systems. Before measurements were taken, it was theorized that Anoikis systems exhibiting similar stellar phenomena might have "clustered;" that numerous black hole systems might be found near the same black hole. However, as seen in Figure 4 below, that is clearly not the case. Various stellar phenomena can be viewed from one system that cannot be viewed from nearby systems. Indeed, in some instances, the closest system has an entirely different stellar phenomenon visible. Moreover, none of these stellar phenomenon can be viewed visually from New Eden. Although certain sources, such as neutron stars, may not be immediately viewable, a standard red giant has enough surface brightness that it should be easily visible from New Eden. Despite that, New Eden astronomers have yet to be able to match any known Anoikis stars to anything in New Eden's sky.

There are, of course, potential explanations for the discrepancies, especially over the longer New Eden-Anoikis distance. Skies in Anoikis systems demonstrate significant amounts of nebulosity, as do certain New Eden skies. It's possible that such nebulosity obscures even high absolute magnitude objects such as red giants. Additionally, since New Eden and Anoikis are located in the galactic plane (discussed below), it's possible Anoikis is located in New Eden's zone of avoidance.[9] For these reasons, the authors explicitly call on all observational telescopes in New Eden to focus on the area described in this essay and to make thorough observations in all wavelengths. Infrared observations particularly should be of use if, in fact, heavy nebulosity blocks the visible spectrum, as infrared radiation is more easily able to pass through interstellar dust. Radio emissions should also prove useful, especially in identifying pulsars and black holes. Other theories have also been suggested, most notably including the theories that Anoikis exists at a different time than New Eden or even that Anoikis exists in a parallel dimension or universe.[10]

[9] The zone of avoidance is an astronomical term used to describe the plane of the galaxy when making observations. Because the galactic plane is so dense with other stars, it can be difficult, if not impossible, to find specific objects within the zone. Examples of the difficulties of such identifications can be found here and here. Indeed, some research suggests that the dimming inherent in examining objects in the Zone can be substantial. ((The Real Life paper examining the issue can be found here))

[10] The latter theory especially seems unlikely, however. At the very least, modern instruments have at least been able to identify a number of quasars from Anoikis space that match with known quasars in New Eden. If universal constants were even slightly altered in the parallel dimensions postulated by these theories, the chances of numerous quasars being identified with the same precise spectral emissions are remote, to say the least.

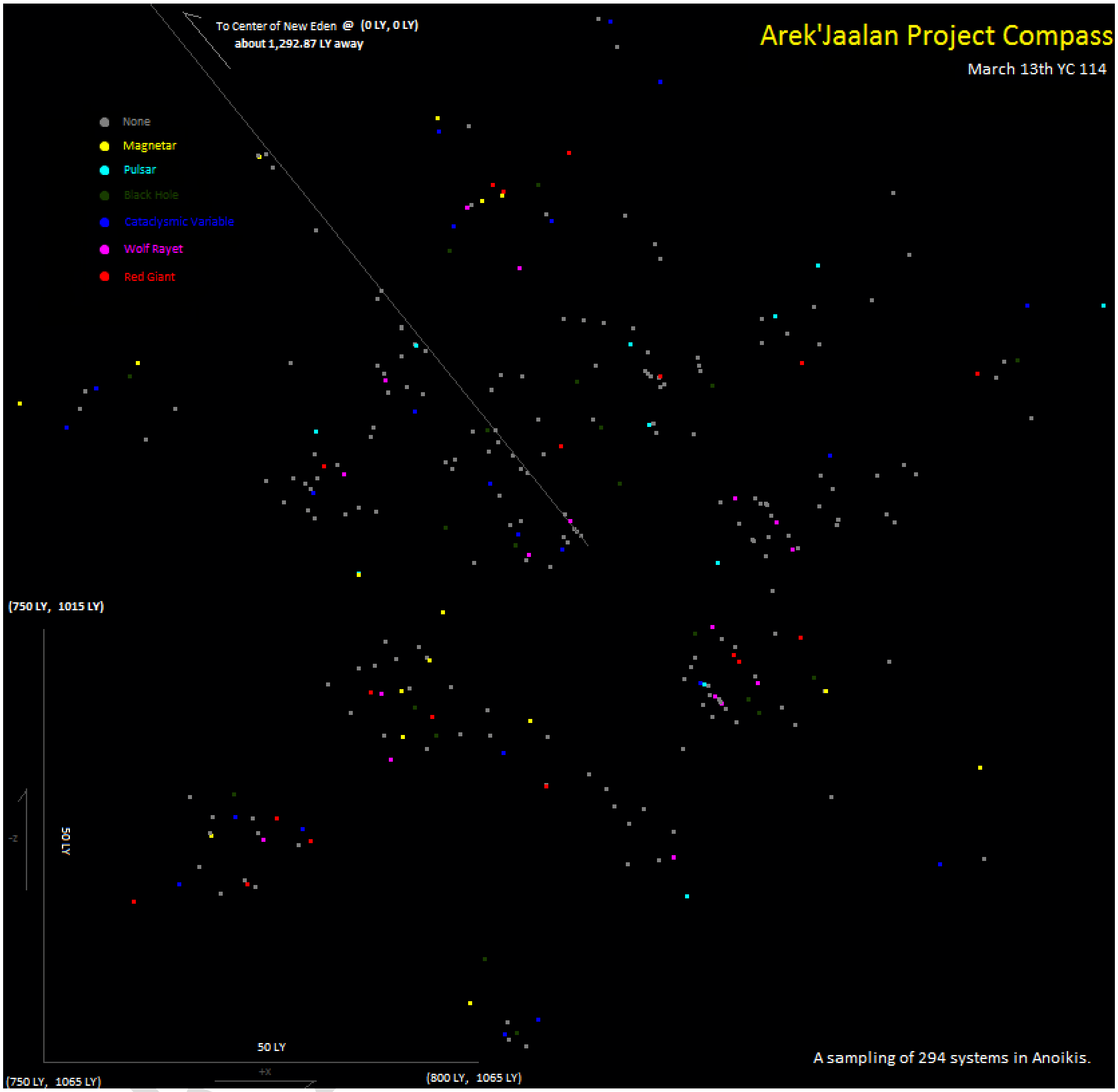

Figure 4: Measured Anoikis systems, colored by nearby celestial phenomena

More difficult to reconcile is the intra-Anoikis discrepancies. Why certain objects are only viewable from certain systems, despite relatively proximity to other systems, is completely unknown and admittedly the strongest argument against the veracity of Compass data. For example, Set 2 offers the examples of systems J111421 (Class 3) and J111603 (Class 3). Geometric calculations demonstrate that the systems are only a little over 1/2 a light-year apart from each other. However, a cataclysmic variable (consisting of a reddish larger star above a smaller blue star) is clearly visible from J111421, while being invisible from J111603. Although the distance from J111421 to the variable star is unknown, it seems unlikely that such an object would be so prominent in one system while completely invisible from only a 1/2 light-year away. It should be noted that, due to the measurement errors discussed previously, it is entirely possible that J111421 and J111603 are significantly farther apart, but these systems were chosen merely as an example.

While this certainly casts some suspicions on Compass's data, the authors truly believe that the Compass data sets are worth releasing and analyzing. Although questions certainly are raised about the data's integrity, the data could still present a boon to intrepid researchers. Furthermore, there could very well be natural explanations for the oddities observed, such as particularly thick nebulosities that could obscure even closer objects. The authors still believe in the integrity of the data, but given the potential problems with the data sets, they believe it was important to lay all issues out in this report, and let the broader scientific community make its own judgments.

Reconciling Results from Original Project Compass

The original Project Compass used a very different methodology in determining the location of Anoikis based on parallax and stellar spectroscopy.[11] Under that methodology, the author determined that Anoikis was probably located in a halo surrounding the New Eden cluster, perhaps 500 light years away from New Eden. This conclusion was based on the identification of a star cluster both in New Eden and Anoikis, nicknamed Orion. Based on changes in Orion's configuration from New Eden to Anoikis, the author concluded that the halo hypothesis was the most reasonable hypothesis.

The halo hypothesis does not precisely match the data gathered in Compass 2.0. Contrary to the halo hypothesis, the Anoikis Cluster apparently sits approximately 1300 light-years away from New Eden in a cluster of its own. The reasons for the differences are not entirely clear at this time. A number of possibilities present themselves, such as some kind of temporal differential between Anoikis and New Eden. Also, errors in either the identification of Orion or its distance from New Eden, both mentioned as possibilities in the original Project Compass report, are possible. Interpretation of the original data may also have been incorrect.

Despite the lack of agreement on why, the question still exists as to which method should be more trustworthy. On the one hand, the Original Compass methodology relies on known-world physics and concrete observations. On the other hand, the new methodology relies on actual numbers from what is seemingly an accurate method of distance determination on at least the small scale, intra-cluster tests. The authors believe that despite the unknowns in the new methodology, it is more reliable. The data have been too consistent with each other to be otherwise. While further observations confirming the 1250-1350 light-year distance would certainly be helpful, the original methodology's numbers had enough of a margin of error to end up possibly fitting the new numbers.

Some further notes on data from the original Project Compass are warranted. One of the conclusions drawn from the original data was that due to an apparent lack of banding visible in either New Eden or Anoikis, it seemed likely that both objects were located in a non-spiral galaxy. However, recent improvements to camera drone low-contrast imaging systems have revealed that, at least in New Eden, the banding (with both visible star clouds and gas clouds in such a pattern that would only reasonably be found in a spiral galaxy) expected in a spiral galaxy

[11] An overview and links to all documentation of the original methodology is available here.

Figure 5: A view of the galactic disc as viewed from New Eden.

is present. As such, the authors officially retract that particular conclusion from the Original Compass report. It is notable, however, that no such patterns are visible in Anoikis space. This is not altogether conclusive one way or another, as many, if not all Anoikis systems, are surrounded by thick layers of gas themselves, and may thus be concealing the recently-revealed band patterns. Further investigations will continue as camera drone technology continues to improve.

Conclusion

Overall, then, the new Project Compass met the goals laid out in the experimental outline. Although questions remain about the validity and precision of the data from control tower locator functions, the data remain too cohesive to not be at least somewhat reliable. Even if the overall 1250-1350 light year distance to New Eden is incorrect due to some unknown error in the locator function, the fact that the data points are in such close relation to each other suggests that Anoikis in fact exists as a cluster. Even this revelation alone should provide fascinating insights into the development of Sleeper and Talocan historical narratives, and hopefully help solve some of the mysteries of Anoikis.

The data collected during the Project Compass survey was extensive. Although this paper should be deemed the primary report for Project Compass, the data collected can use further analysis, especially in the data deemed more secondary in nature (such as the nearby stellar phenomena, Sleeper and Talocan structures discovered, and the distribution of classes of Anoikis space). Although the primary purpose of Project Compass – attempting to locate Anoikis in relation to New Eden – has for now been completed, the rich data sets collected for this project should prove of use to researchers for some time to come.

Appendix A

The following is a review of the math used to determine the location of Anoikis systems via trilateration. The math is also found here. All questions and comments on the math used should be directed to co-Project Lead Faulx.

Set up

We start with 4 systems in known space at the points A(xa, ya, za), B(xb, yb, zb), C(xc, yc, zc), and D(xd, yd, zd). A 5th point, R(x, y z), represents the distant unknown solar system. The distances measured from R to A, B, C, and D are da, db, dc, and dd respectively. Using these distances as the radii for 4 spheres centered at A, B, C, and D, we generate 4 equations, which we will then expand and solve with standard addition/multiplication of equations:
$(x-xa)^2 + (y-ya)^2 + (z-za)^2 = da^2$
$(x-xb)^2 + (y-yb)^2 + (z-zb)^2 = db^2$
$(x-xc)^2 + (y-yc)^2 + (z-zc)^2 = dc^2$
$(x-xd)^2 + (y-yd)^2 + (z-zd)^2 = dd^2$
where,

- (x, y, z) is the coordinate position of the star system being measured and is the unknown for which we are solving.
- (xa, ya, za) is the coordinate position of reference system A
- (xb, yb, zb) is the coordinate position of reference system B
- (xc, yc, zc) is the coordinate position of reference system C
- (xd, yd, zd) is the coordinate position of reference system D
- "da", is the measured distance from (x, y, z) to (xa, ya, za)
- "db", is the measured distance from (x, y, z) to (xb, yb, zb)
- "dc", is the measured distance from (x, y, z) to (xc, yc, zc)
- "dd", is the measured distance from (x, y, z) to (xd, yd, zd)

Work

We begin by expanding the quadratic terms:
$(x^2 - 2xa*x + xa^2) + (y^2 - 2ya*y + ya^2) + (z^2 - 2za*z + za^2) = da^2$
$(x^2 - 2xb*x + xb^2) + (y^2 - 2yb*y + yb^2) + (z^2 - 2zb*z + zb^2) = db^2$
$(x^2 - 2xc*x + xc^2) + (y^2 - 2yc*y + yc^2) + (z^2 - 2zc*z + zc^2) = dc^2$
$(x^2 - 2xd*x + xd^2) + (y^2 - 2yd*y + yd^2) + (z^2 - 2zd*z + zd^2) = dd^2$

Next, we subtract the first row from the other three:
$(x^2 - 2xa*x + xa^2) + (y^2 - 2ya*y + ya^2) + (z^2 - 2za*z + za^2) = da*da$
$(x^2 - 2xb*x + xb^2) + (y^2 - 2yb*y + yb^2) + (z^2 - 2zb*z + zb^2) + (-x^2 + 2xa*x - xa^2) + (-y^2 + 2ya*y - ya^2) + (-z^2 + 2za*z - za^2) = db*db - da*da$
$(x^2 - 2xc*x + xc^2) + (y^2 - 2yc*y + yc^2) + (z^2 - 2zc*z + zc^2) + (-x^2 + 2xa*x - xa^2) + (-y^2 + 2ya*y - ya^2) + (-z^2 + 2za*z - za^2) = dc*dc - da*da$
$(x^2 - 2xd*x + xd^2) + (y^2 - 2yd*y + yd^2) + (z^2 - 2zd*z + zd^2) + (-x^2 + 2xa*x - xa^2) + (-y^2 + 2ya*y - ya^2) + (-z^2 + 2za*z - za^2) = dd*dd - da*da$

Appendix A

Simplifying eliminates the quadratic term and creates a 3x4 matrix of the last 3 rows:
(x^2 - 2xa*x + xa^2) + (y^2 - 2ya*y + ya^2) + (z^2 - 2za*z + za^2) = da*da
(-2xb*x + xb*xb) + (-2yb*y + yb*yb) + (-2zb*z + zb*zb) + (2xa*x - xa*xa) + (2ya*y - ya*ya) + (2za*z - za*za) = db*db - da*da
(-2xc*x + xc*xc) + (-2yc*y + yc*yc) + (-2zc*z + zc*zc) + (2xa*x - xa*xa) + (2ya*y - ya*ya) + (2za*z - za*za) = dc*dc - da*da
(-2xd*x + xd*xd) + (-2yd*y + yd*yd) + (-2zd*z + zd*zd) + (2xa*x - xa*xa) + (2ya*y - ya*ya) + (2za*z - za*za) = dd*dd - da*da

Simplifying and regrouping:
x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
-2xb*x - 2yb*y - 2zb*z + 2xa*x + 2ya*y + 2za*z = db*db - da*da - xb*xb - yb*yb - zb*zb + xa*xa + ya*ya + za*za
-2xc*x - 2yc*y - 2zc*z + 2xa*x + 2ya*y + 2za*z = dc*dc - da*da - xc*xc - yc*yc - zc*zc + xa*xa + ya*ya + za*za
-2xd*x - 2yd*y - 2zd*z + 2xa*x + 2ya*y + 2za*z = dd*dd - da*da - xd*xd - yd*yd - zd*zd + xa*xa + ya*ya + za*za

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
2x*(xa - xb) + 2y*(ya - yb) + 2z*(za - zb) = db*db - da*da - xb*xb - yb*yb - zb*zb + xa*xa + ya*ya + za*za
2x*(xa - xc) + 2y*(ya - yc) + 2z*(za - zc) = dc*dc - da*da - xc*xc - yc*yc - zc*zc + xa*xa + ya*ya + za*za
2x*(xa - xd) + 2y*(ya - yd) + 2z*(za - zd) = dd*dd - da*da - xd*xd - yd*yd - zd*zd + xa*xa + ya*ya + za*za

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x*(xa - xb) + y*(ya - yb) + z*(za - zb) = (db*db - da*da - xb*xb - yb*yb - zb*zb + xa*xa + ya*ya + za*za)/2
x*(xa - xc) + y*(ya - yc) + z*(za - zc) = (dc*dc - da*da - xc*xc - yc*yc - zc*zc + xa*xa + ya*ya + za*za)/2
x*(xa - xd) + y*(ya - yd) + z*(za - zd) = (dd*dd - da*da - xd*xd - yd*yd - zd*zd + xa*xa + ya*ya + za*za)/2

At this point we introduce substitutions to simplify the math:
e = (db*db - da*da - xb*xb - yb*yb - zb*zb + xa*xa + ya*ya + za*za)/2
f = (dc*dc - da*da - xc*xc - yc*yc - zc*zc + xa*xa + ya*ya + za*za)/2
g = (dd*dd - da*da - xd*xd - yd*yd - zd*zd + xa*xa + ya*ya + za*za)/2

Now we begin solving the matrix formed by the last 3 rows:
x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x*(xa - xb) + y*(ya - yb) + z*(za - zb) = e
x*(xa - xc) + y*(ya - yc) + z*(za - zc) = f
x*(xa - xd) + y*(ya - yd) + z*(za - zd) = g

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x + y*(ya - yb)/(xa - xb) + z*(za - zb)/(xa - xb) = e/(xa - xb)
x + y*(ya - yc)/(xa - xc) + z*(za - zc)/(xa - xc) = f/(xa - xc)
x + y*(ya - yd)/(xa - xd) + z*(za - zd)/(xa - xd) = g/(xa - xd)

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x + y*(ya - yb)/(xa - xb) + z*(za - zb)/(xa - xb) = e/(xa - xb)
0 + y*[(ya - yc)/(xa - xc) - (ya - yb)/(xa - xb)] + z*[(za - zc)/(xa - xc) - (za - zb)/(xa - xb)] =
[f/(xa - xc) - e/(xa - xb)]
0 + y*[(ya - yd)/(xa - xd) - (ya - yb)/(xa - xb)] + z*[(za - zd)/(xa - xd) - (za - zb)/(xa - xb)] =
[g/(xa - xd) - e/(xa - xb)]

More substitutions to simplify the math:
i = [(ya - yc)/(xa - xc) - (ya - yb)/(xa - xb)]
j = [(za - zc)/(xa - xc) - (za - zb)/(xa - xb)]

p = [(ya - yd)/(xa - xd) - (ya - yb)/(xa - xb)]
q = [(za - zd)/(xa - xd) - (za - zb)/(xa - xb)]

Continuing to solve the matrix:
x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x + y*(ya - yb)/(xa - xb) + z*(za - zb)/(xa - xb) = e/(xa - xb)
0 + y*i + z*j = [f/(xa - xc) - e/(xa - xb)]
0 + y*p + z*q = [g/(xa - xd) - e/(xa - xb)]

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x + y*(ya - yb)/(xa - xb) + z*(za - zb)/(xa - xb) = e/(xa - xb)
0 + y + z*j/i = [f/(xa - xc) - e/(xa - xb)]/i
0 + y + z*q/p = [g/(xa - xd) - e/(xa - xb)]/p

x*x - 2xa*x + y*y - 2ya*y + z*z - 2za*z = da*da - xa*xa - ya*ya - za*za
x + y*(ya - yb)/(xa - xb) + z*(za - zb)/(xa - xb) = e/(xa - xb)
0 + y + z*j/i = [f/(xa - xc) - e/(xa - xb)]/i
0 + 0 + z*(q/p - j/i) = { [g/(xa - xd) - e/(xa - xb)]/p - [f/(xa - xc) - e/(xa - xb)]/i }

Solution

At this point we have equations that are sufficient to create spreadsheet formulas with x and y developing from the calculations of z:. Although we could continue to explicitly solve for y and x, the math is starting to become a bit of bear with all these variables and we risk introducing human error in the calculations if we attempt to simplify further. Sufficient precision in the measurements of the k-space systems A, B, C, and D will make the effects of repeated round off errors negligible. A few decimal places more than the measuring tower's tenth of a light year precision should be sufficient (the coordinates the project is using are at least 5 past this).

Appendix A

$z = \{ [g/(xa - xd) - e/(xa - xb)]/p - [f/(xa - xc) - e/(xa - xb)]/i \}/(q/p - j/i)$
$y = [f/(xa - xc) - e/(xa - xb)]/i - z*j/i$
$x = e/(xa - xb) - y*(ya - yb)/(xa - xb) - z*(za - zb)/(xa - xb)$

where again,

- (x, y, z) is the coordinate position of the star system being measured.
- (xa, ya, za) is the coordinate position of reference system A
- (xb, yb, zb) is the coordinate position of reference system B
- (xc, yc, zc) is the coordinate position of reference system C
- (xd, yd, zd) is the coordinate position of reference system D
- "da", is the measured distance from (x, y, z) to (xa, ya, za)
- "db", is the measured distance from (x, y, z) to (xb, yb, zb)
- "dc", is the measured distance from (x, y, z) to (xc, yc, zc)
- "dd", is the measured distance from (x, y, z) to (xd, yd, zd)

and
$i = [(ya - yc)/(xa - xc) - (ya - yb)/(xa - xb)]$
$j = [(za - zc)/(xa - xc) - (za - zb)/(xa - xb)]$

$p = [(ya - yd)/(xa - xd) - (ya - yb)/(xa - xb)]$
$q = [(za - zd)/(xa - xd) - (za - zb)/(xa - xb)]$

$e = (db*db - da*da - xb*xb - yb*yb - zb*zb + xa*xa + ya*ya + za*za)/2$
$f = (dc*dc - da*da - xc*xc - yc*yc - zc*zc + xa*xa + ya*ya + za*za)/2$
$g = (dd*dd - da*da - xd*xd - yd*yd - zd*zd + xa*xa + ya*ya + za*za)/2$

Appendix B

The following data sets show the raw numbers collected from the Project Compass survey, as well as the calculated x, y, and z coordinates from the CONCORD determined (0,0,0) coordinate in New Eden. Set 1 is the data derived from co-project lead Faulx, primarily using the systems of Adacyne, Balle, Hemouner, and Kattegaud as Control Systems. Set 2 is the data derived from co-project lead Mark726, using Gateway, Hemouner (at a separate control tower from Set 1), Horkkisen, and Sakulda as Control Systems. Full data sets, including other observational data collected by the researchers, is available here. Please note that initial locations of the control towers varied as towers were destroyed by third parties. New towers were sometimes placed in new systems. Data from different control tower systems will be listed as necessary. All data is listed in light-years.

Set 1

Locus Signature	Adacyne	Balle	Hemouner	Kattegaud	X	Y	Z	Class
J100033	1339.2	1324	1317.3	1308.6	839.0915	14.6406	1,002.85	2
J100246	1332.4	1317.2	1310.4	1301.8	832.0858	13.08575	1,002.42	2
J100501	1325.5	1310.6	1302.6	1295.6	774.9325	1.18404	1,038.45	6
J100640	1329.8	1314.6	1307.8	1299.2	830.396	13.05433	1,000.45	2
J100937	1277.8	1262.6	1255.8	1247.2	796.6007	12.42588	961.1502	4
J101307	1311.8	1296.6	1289.8	1281.2	818.6976	12.83679	986.8482	2
J101757	1319	1304	1296.8	1288.6	803.5765	-12.883	1,005.56	1
J102749	1305	1289.8	1283	1274.4	814.2783	12.75461	981.7086	1
J103237	1342.2	1327	1320.4	1311.5	845.5303	7.08861	1,002.08	3
J103251	1272.3	1257.3	1249.7	1242.1	760.54	-0.94592	984.4487	5
J103353	1294.6	1279.5	1272.4	1264.2	793.4842	7.28294	983.2715	3
J103533	1321.1	1306.1	1298.7	1290.9	796.0873	2.04557	1,013.11	2
J103924	1340.3	1325.3	1317.8	1310	807.4433	-8.40763	1,034.32	2
J103948	1312.7	1297.5	1290.7	1282.1	819.2826	12.84767	987.5285	2
J104037	1328.4	1313.5	1305.4	1298.6	772.2649	8.71278	1,043.72	6
J104253	1318.7	1303.6	1296.8	1288.1	820.2332	-5.98648	991.0884	2
J104311	1352.5	1337.4	1330.5	1321.9	839.5116	-7.55556	1,021.37	4
J104809	1355.5	1340.6	1332.8	1325.5	800.3618	-4.89346	1,054.26	5
J105135	1340.5	1325.3	1319.1	1309.6	858.5508	-5.13582	985.3289	5
J105321	1336.8	1321.6	1314.7	1306.2	832.3639	11.66905	1,010.45	2
J105352	1343.3	1328.2	1321.2	1312.9	827.1919	9.15254	1,015.71	2
J105409	1291.6	1276.5	1269.3	1261.2	789.0753	5.83964	985.5214	3
J105934	1320.2	1305.3	1297.2	1290.3	769.1551	-0.2852	1,038.92	6
J110043	1314.8	1299.6	1292.9	1284.1	825.0371	5.44014	986.1545	2
J111309	1301.3	1286.3	1278.8	1271.2	779.3123	9.32434	1,000.78	3
J111619	1352.2	1337.2	1329.8	1321.9	817.5195	-6.96853	1,038.79	3
J111846	1348.4	1333.3	1326.2	1317.9	829.7562	-1.39536	1,026.04	2

Appendix B

Locus Signature	Adacyne	Balle	Hemouner	Kattegaud	X	Y	Z	Class
J112129	1305.6	1290.6	1283.4	1275.2	795.0719	-12.7818	995.2926	1
J113057	1317	1301.9	1295.1	1286.3	820.9867	-14.8759	991.4699	2
J113108	1331.1	1316	1309.2	1300.5	828.2642	-6.01639	1,000.45	2
J113221	1345.4	1330.3	1323.2	1315	825.9395	7.69244	1,022.04	2
J113250	1333.1	1318	1310.6	1302.9	806.6042	21.21156	1,023.34	4
J113347	1292.2	1277.1	1270	1261.8	791.9509	7.26359	981.4398	3
J113420	1321.8	1306.8	1299.1	1291.6	788.8738	-2.30923	1,027.59	3
J113434	1319.1	1304	1296.9	1288.6	810.9946	-1.42898	1,003.64	1
J113918	1308	1292.9	1285.8	1277.5	803.887	-1.44171	995.1521	1
J114107	1320.2	1305.1	1298	1289.7	811.699	-1.42772	1,004.48	1
J114430	1323.3	1308.4	1300.4	1293.5	771.7269	10.11878	1,035.04	6
J115008	1326.4	1311.4	1303.5	1296.4	782.8782	12.70369	1,037.15	6
J115041	1264.4	1249.3	1242.2	1233.9	775.9689	-1.49173	961.8203	5
J115310	1347.5	1332.4	1325.4	1317	831.7821	0.08533	1,020.61	2
J115738	1314.8	1299.7	1292.5	1284.4	803.8519	6.00072	1,003.31	1
J115855	1320	1305.2	1297.1	1290.2	764.2187	-10.2972	1,036.12	6
J120103	1323.1	1308.2	1300.2	1293.1	775.334	-7.76505	1,038.24	6
J120455	1339.6	1324.5	1317.1	1309.3	812.5875	12.27951	1,030.05	2
J120726	1312.2	1297	1290.2	1281.6	818.9576	12.84162	987.1506	2
J121347	1336	1321	1313.5	1305.8	802.8633	0.63718	1,029.29	4
J121452	1305.8	1290.8	1283.4	1275.6	786.4811	1.98382	1,001.32	3
J121623	1309.4	1294.4	1286.9	1279.2	786.2145	0.55956	1,008.70	4
J122137	1322.4	1307.4	1299.9	1292.2	794.3512	0.59749	1,018.76	2
J122635	1322.4	1307.4	1299.9	1292.2	794.3512	0.59749	1,018.76	2
J123450	1333.3	1318.1	1311.3	1302.7	832.6707	13.09663	1,003.10	2
J123628	1276.9	1261.7	1255.4	1246	813.7273	-6.41552	942.866	5
J124654	1298.2	1283.2	1275.8	1267.9	783.5373	-6.81315	997.1087	3
J125023	1279.3	1264.3	1256.6	1249.3	758.8384	14.93509	991.1526	5
J125049	1298.3	1283.3	1275.8	1268.2	777.4389	9.29484	998.4655	3
J125122	1324.7	1309.8	1301.7	1294.9	770.0223	8.67812	1,040.80	6
J125428	1318.7	1303.6	1296.4	1288.2	808.193	-2.87885	1,007.97	1
J125833	1301.3	1286.3	1278.8	1271.1	781.1448	0.53592	1,002.43	3
J130037	1267.5	1252.4	1245.3	1237.1	776.1705	7.06449	962.5889	5
J130045	1306.8	1291.8	1284.6	1276.4	795.8335	-12.7909	996.2118	1
J130330	1316.4	1301.2	1294.9	1285.5	839.9573	-6.53662	972.1681	4
J131240	1339.4	1324.3	1317.5	1308.8	833.6397	-6.03642	1,006.72	2
J131509	1359.8	1344.8	1337	1329.8	806.0495	14.60833	1,058.62	5
J131551	1311.4	1296.3	1289	1281.1	797.3086	13.39283	1,003.66	1
J131624	1367.2	1352	1345.2	1336.5	856.6294	4.26575	1,030.45	4
J132048	1340.1	1325	1317.9	1309.6	824.4415	-1.40489	1,019.69	2

Appendix B

Locus Signature	Adacyne	Balle	Hemouner	Kattegaud	X	Y	Z	Class
J132418	1313.9	1298.8	1292.1	1283.3	819.6613	-4.5304	982.8435	2
J132546	1356.4	1341.4	1333.6	1326.4	803.9513	14.5628	1,055.96	5
J132559	1337	1321.9	1315.1	1306.4	832.0854	-6.03063	1,004.91	2
J132721	1294.5	1279.5	1272.3	1264.1	788.0271	-12.6979	986.7899	3
J133030	1316.2	1301.1	1293.9	1285.8	804.7435	6.01044	1,004.38	1
J133121	1292.7	1277.6	1270.4	1262.3	789.7759	5.84728	986.3648	3
J133128	1306.9	1291.9	1284.8	1276.5	798.4195	-11.3553	991.6938	1
J133234	1300.2	1285.2	1277.7	1270	780.4563	0.53271	1,001.58	3
J133250	1343.5	1328.3	1321.7	1312.8	846.3821	7.09824	1,003.05	3
J133458	1352.1	1337	1330	1321.6	834.7367	0.09575	1,024.11	4
J133513	1358	1343	1335.2	1328	804.9387	14.58423	1,057.21	5
J133553	1336.2	1320.9	1314.7	1305.2	860.5554	5.00663	984.8346	5
J133906	1319.9	1305	1296.9	1290	768.9728	-0.28593	1,038.68	6
J134534	1336.5	1321.4	1314.5	1306	827.2978	1.52995	1,007.54	2
J134540	1305	1289.8	1283	1274.4	814.2783	12.75461	981.7086	1
J134833	1308.6	1293.5	1286.5	1278.1	806.7971	-0.00279	991.0102	1
J135220	1322.8	1308	1299.9	1292.9	767.7735	-19.2507	1,040.00	6
J135304	1298.2	1283	1276.4	1267.5	816.6981	6.76267	969.0812	3
J135504	1323.6	1308.7	1300.5	1293.9	764.9368	16.15918	1,042.91	6
J140019	1307.1	1292	1284.9	1276.7	801.4703	7.3837	992.8114	1
J140918	1326.4	1311.5	1303.5	1296.5	775.4811	1.18725	1,039.16	6
J140932	1284.7	1269.6	1262.8	1254.1	798.2129	-5.90445	965.4165	4
J141637	1321.1	1306.1	1298.5	1290.9	790.9879	-0.85806	1,022.40	2
J142247	1324.8	1309.8	1301.9	1294.8	781.894	12.68405	1,035.90	6
J142814	1356.6	1341.7	1333.8	1326.6	798.4193	-6.3859	1,059.89	5
J142918	1344.5	1329.4	1322.3	1314	827.2589	-1.39984	1,023.06	2
J142951	1288.1	1273	1265.9	1257.7	789.3315	7.23054	978.3107	3
J143447	1357.8	1342.8	1335.4	1327.5	821.0435	-6.98465	1,043.11	3
J143513	1298.2	1283.1	1275.9	1267.8	793.279	5.88546	990.5821	3
J143751	1326.7	1311.8	1303.7	1296.8	773.1041	-0.26925	1,044.06	6
J143922	1282.5	1267.4	1260.3	1252.2	783.9486	15.84246	972.4159	4
J144024	1342.8	1327.6	1321.1	1312.1	848.5173	8.56997	997.8053	3
J144450	1321.2	1306.2	1299	1290.8	804.9727	-12.8997	1,007.24	1
J144739	1321.9	1306.9	1299.4	1291.7	794.0382	0.59604	1,018.38	2
J144746	1351.5	1336.3	1329.5	1320.8	846.4032	4.18455	1,018.56	4
J144956	1336.9	1321.7	1314.9	1306.3	835.0103	13.14014	1,005.82	2
J145129	1345.5	1330.4	1323.5	1314.9	834.9917	-7.53085	1,016.06	4
J145155	1330.7	1315.5	1308.7	1300.1	830.9809	13.06521	1,001.13	2
J145717	1319.4	1304.2	1297.7	1288.7	833.1378	8.37047	980.3398	3
J145749	1287.2	1272	1265.3	1256.5	807.0056	5.26654	965.3568	4

Appendix B

Locus Signature	Adacyne	Balle	Hemouner	Kattegaud	X	Y	Z	Class
J145848	1284.1	1269	1262.3	1253.4	802.1097	-13.1579	962.0719	4
J145931	1316.3	1301.1	1294.4	1285.7	824.1636	14.33824	985.6206	2
J150341	1334.8	1319.6	1312.8	1304.1	835.5256	4.09818	1,005.92	2
J150700	1335.2	1320	1313.2	1304.6	833.9055	13.11959	1,004.53	2
J150745	1308.9	1293.8	1286.7	1278.5	802.6203	7.39821	994.1852	1
J151057	1280.2	1265.3	1257.6	1250.1	758.3336	-12.0475	992.5293	5
J151141	1305.2	1290.1	1282.9	1274.8	797.7374	5.93406	995.9495	1
J151811	1277.6	1262.6	1255	1247.5	762.0485	7.68818	986.9558	5
J152255	1355.7	1340.6	1333.7	1325.2	839.6674	1.5949	1,022.08	4
J152322	1343.7	1328.6	1321.5	1313.3	824.8534	7.67873	1,020.74	2
J153447	1286.2	1270.9	1264.5	1255.3	820.2945	10.57568	955.2391	5
J154900	1297.8	1282.8	1275.4	1267.6	781.4582	1.95153	995.1591	3
J155008	1292.3	1277.2	1270.1	1261.9	792.0148	7.2644	981.5161	3
J155029	1318.1	1302.9	1295.9	1287.6	815.8467	18.91691	999.2127	1
J155338	1330.4	1315.4	1307.8	1300.3	794.916	8.14829	1,027.95	4
J155600	1275.4	1260.5	1252.7	1245.4	751.1108	-4.80485	991.657	5
J155616	1313.1	1298	1291.1	1282.5	814.0713	-7.41646	991.4775	2
J155650	1327.2	1312.3	1304.3	1297.2	777.8388	-7.77876	1,041.47	6
J155935	1314.8	1299.7	1292.5	1284.4	803.8519	6.00072	1,003.31	1
J160307	1309.7	1294.6	1287.6	1279.1	809.3477	-8.84403	993.503	1
J160321	1354.7	1339.6	1332.6	1324.2	836.4066	0.10164	1,026.09	4
J160412	1315.7	1300.6	1293.8	1285	820.1428	-14.8638	990.4867	2
J160715	1316.9	1301.7	1295	1286.2	826.409	5.45334	987.7369	2
J161752	1354.7	1339.6	1332.7	1324.1	840.9321	-7.56333	1,023.04	4
J162159	1321.7	1306.8	1299.2	1291.6	786.5428	-10.8815	1,020.22	2
J162518	1323.5	1308.5	1300.9	1293.3	792.4853	-0.85374	1,024.27	2
J162753	1341.3	1326	1320	1310.3	869.154	7.98664	979.1697	5
J163641	1327.7	1312.7	1305.1	1297.5	795.1058	-0.84618	1,027.53	4
J164104	1292.2	1277.1	1270	1261.7	793.7699	-1.45984	983.0732	3
J164713	1296.7	1281.7	1274.3	1266.4	782.5933	-6.80884	995.9509	3
J164759	1314.2	1299	1292.2	1283.6	820.2574	12.86579	988.6622	1
J165058	1315.7	1300.4	1294.2	1284.8	844.9743	13.77353	967.9951	4
J165901	1310.6	1295.5	1288.4	1280.1	805.5519	-1.43873	997.1398	1
J170305	1285.2	1270.1	1263.2	1254.6	796.0564	-7.31795	970.3116	4
J170511	1298.8	1283.7	1276.4	1268.5	789.3263	13.23233	993.965	3
J171424	1311.7	1296.6	1289.7	1281.1	813.1673	-7.41151	990.4154	2
J171542	1302.3	1287.2	1280.4	1271.7	809.6117	-5.94691	978.7055	3
J171700	1312.7	1297.6	1290.5	1282.3	805.048	7.42884	997.0853	1
J172751	1299.5	1284.5	1277.1	1269.3	782.5256	1.95839	996.4691	3
J204350	1341.5	1326.3	1320.2	1310.5	863.6982	-12.7227	983.0425	5

Appendix B

Locus Signature	Adacyne	Balle	Hemouner	Kattegaud	X	Y	Z	Class
J205412	1294.5	1279.4	1272.1	1264.1	788.4246	4.43753	992.2945	3
J210536	1320.4	1305.4	1297.9	1290.2	793.0994	0.59166	1,017.22	2
J211000	1340.5	1325.5	1318	1310.2	807.5688	-8.40843	1,034.47	2
J212812	1294.3	1279.2	1272.4	1263.7	804.4304	-5.92761	972.665	3
J212851	1309.6	1294.6	1287.1	1279.4	786.3397	0.56014	1,008.85	4
J212904	1301.9	1286.8	1279.8	1271.4	802.4938	-0.01797	985.9121	1
J213058	1334.5	1319.4	1312.6	1303.9	830.4662	-6.0246	1,003.02	2
J213342	1310.1	1295.1	1288	1279.7	800.4567	-11.3759	994.1336	1
J213642	1267.3	1252.2	1245.1	1236.9	776.0427	7.06287	962.4363	5
J213734	1279.1	1264.1	1256.5	1248.9	764.7828	-0.93368	989.7372	5
J214009	1320.6	1305.4	1299	1289.8	838.3364	0.9152	978.2599	3
J215930	1327.2	1312.3	1304.2	1297.3	773.4079	-0.26802	1,044.45	6
J222822	1317.8	1302.6	1295.8	1287.1	824.4527	4.01026	993.0494	2
J222830	1342.6	1327.5	1320.4	1312.1	826.0423	-1.40202	1,021.60	2
J223348	1346.4	1331.3	1324.2	1315.9	828.4755	-1.39766	1,024.51	2
J223703	1319.5	1304.4	1297.3	1289	811.2508	-1.42852	1,003.94	1
J224217	1345.3	1330.3	1323.2	1314.8	824.7617	-20.693	1,022.67	2
J230207	1337.2	1322.1	1315.3	1306.6	832.2149	-6.03111	1,005.06	2
J231545	1294.8	1279.7	1272.6	1264.4	793.612	7.28455	983.4241	3
J231614	1349.4	1334.4	1327	1319.1	815.7574	-6.96048	1,036.63	4
J231644	1341.6	1326.5	1319.5	1311.2	826.1024	9.13693	1,014.42	2
J232441	1322.7	1307.5	1301	1291.9	837.1692	-0.53362	984.4753	3
J232801	1316.4	1301.2	1294.5	1285.8	824.2288	14.33956	985.6958	2
J233555	1326.3	1311.3	1303.8	1296.1	796.7922	0.60888	1,021.78	2

Locus Signature	Adacyne	Balle	Kattegaud	Sagain	X	Y	Z	Class
J101736	1288.1	1273	1257.7	1259	789.8168	7.50686	977.4268	3
J102849	1313.1	1298	1282.7	1283.8	799.7842	4.2893	1,007.44	1
J114735	1285.1	1270	1254.5	1256.2	798.7196	-5.76439	965.2674	4
J141611	1321.9	1306.9	1291.8	1292.6	791.5192	9.15289	1,017.90	2
J143517	1308.5	1293.3	1278	1279.4	811.4262	19.76219	988.6819	1
J145145	1322.9	1308	1292.8	1293.6	785.9985	-11.6221	1,023.50	2
J152433	1313.6	1298.4	1283	1284.6	820.2394	13.07034	987.5312	2
J160710	1307.7	1292.6	1277.3	1278.7	805.2734	9.33579	987.0405	1
J163745	1294.2	1279.1	1263.7	1265	793.2756	-2.46818	987.835	3
J204635	1333.5	1318.5	1303.3	1304.2	801.3205	0.64236	1,027.32	4

Locus Signature	Adacyne	Balle	Kattegaud	Abudban	X	Y	Z	Class
J124530	1343.9	1328.8	1313.4	1320.8	823.90	-6.66689	1,029.82	2

Locus Signature	Adacyne	Balle	Kattegaud	Modun	X	Y	Z	Class
J105705	1323.3	1308.4	1293.5	1293.2	767.45	7.68214	1,042.84	6

Set 2

Locus Signature	Sakulda	Horkkisen	Partod	Hemouner	X	Y	Z	Class
J101336	1292	1310	1303.8	1296.9	809.7776	9.69	1,005.91	1
J110810	1295.1	1313.2	1306	1298.9	773.2176	6.09	1,033.25	6
J130719	1277.9	1295.9	1290.1	1283.4	817.6435	1.40	980.8175	3
J135526	1295	1313.1	1306.2	1299.3	785.6657	-3.94	1,019.97	3
J212207	1294.1	1312	1306.5	1299.9	835.3298	0.97	981.3625	3

Locus Signature	Sakulda	Horkkisen	Gateway	Hemouner	X	Y	Z	Class
J100001	1,259.90	1,277.90	1,272.00	1,265.40	807.8103	4.87105	968.4577	4
J100250	1,292.90	1,310.90	1,304.50	1,297.80	804.8273	0.02	1,002.75	1
J100620	1,271.10	1,289.20	1,282.40	1275.6	777.9474	-3.82	997.6427	3
J101307	1,284.50	1,302.40	1,296.40	1,289.80	812.6989	4.19999	984.538	2
J101336	1,292.00	1,310.00	1,303.70	1,296.90	809.2716	8.80231	1,005.56	1
J101453	1,290.70	1,308.80	1,302.40	1,295.70	809.7392	-1.68	1,004.66	1
J101507	1,320.00	1,338.00	1,331.90	1,325.30	836.9917	-0.08328	1,016.12	4
J102057	1,327.80	1,345.90	1,339.30	1,332.40	823.5263	6.75	1,044.33	3
J102143	1,299.10	1,317.20	1,310.30	1,303.30	790.6605	6.71174	1,029.28	3
J102853	1,311.90	1,329.80	1,324.40	1,318.10	860.0459	-2.31011	986.0201	5
J103351	1,317.60	1,335.70	1,329.30	1,322.60	826.9251	-1.98	1,025.39	2
J103404	1,294.20	1,312.20	1,305.90	1,299.20	810.58	2.25	1,002.80	1
J103422	1,300.30	1,318.30	1,312.30	1,305.70	829.232	2.35977	1,000.15	2
J103512	1,314.70	1,332.80	1,326.50	1,319.90	829.9822	-6.33	1,017.67	2
J103615	1,342.50	1,360.50	1,354.20	1,347.60	841.2882	-4.94	1,035.25	5
J103701	1,240.10	1,258.10	1,251.80	1,245.10	776.074	2.69	961.2889	5
J104643	1,265.50	1,283.60	1,277.10	1,270.40	788.8193	-3.58	986.1612	3
J104718	1,321.10	1,339.10	1,332.80	1,326.10	827.7373	2.02	1,023.44	2
J104815	1,293.00	1,310.90	1,305.20	1,298.80	832.7614	-2.24	979.2499	3
J104903	1,272.80	1,290.70	1,285.00	1278.4	819.7091	10.89	972.8604	3

Appendix B

Locus Signature	Sakulda	Horkkisen	Gateway	Hemouner	X	Y	Z	Class
J104905	1,267.90	1,286.00	1,279.30	1,272.40	780.8721	4.83	998.5861	3
J105201	1,302.20	1,320.20	1,314.40	1,307.90	840.2904	0.25464	995.2111	3
J105232	1,279.50	1,297.60	1,291.30	1,284.60	807.4571	0.66219	995.0888	1
J110016	1,303.10	1,321.20	1,314.40	1,307.50	798.0065	2.36	1,026.99	4
J110051	1,287.30	1,305.30	1,298.90	1,292.20	801.2766	0.08	998.4496	1
J110448	1,324.10	1,342.10	1,335.50	1,328.70	814.6251	1.83	1,033.21	3
J110706	1,298.10	1,316.20	1,309.20	1,302.30	785.0038	-2.09	1,024.99	3
J110910	1,318.60	1,336.60	1,330.30	1,323.60	826.1428	2.04541	1,021.52	2
J111003	1,330.90	1,349.10	1,342.00	1,335.00	806.7532	0.19	1,059.90	5
J111421	1,269.30	1,287.40	1,280.70	1273.8	781.7509	4.81986	999.6779	3
J111508	1,288.90	1,306.80	1,300.90	1,294.30	820.4431	6.40	986.9328	2
J111603	1,268.80	1,286.90	1,280.20	1,273.30	781.4371	4.82	999.288	3
J111935	1,250.90	1,268.90	1,263.30	1,257.00	815.9612	-7.58	945.9456	5
J112404	1,251.00	1,268.90	1,263.00	1,256.40	795.8838	6.59497	958.197	4
J112614	1,307.10	1,325.10	1,319.10	1,312.60	833.5498	-4.31	1,000.84	2
J112715	1,295.20	1,313.40	1,306.50	1,299.60	794.4739	-1.55	1,025.38	2
J112956	1,317.20	1,335.20	1,328.90	1,322.30	825.1532	-4.61	1,015.92	2
J113530	1,297.20	1,315.40	1,308.40	1,301.50	790.7856	-3.81	1,027.90	3
J113629	1,329.30	1,347.40	1,340.70	1,334.00	819.2184	-9.00	1,037.33	3
J113712	1,353.60	1,371.60	1,365.40	1,358.80	853.5202	-2.75	1,042.73	5
J114627	1,273.20	1,291.30	1,284.70	1,277.80	789.0475	7.00	1,001.79	3
J115314	1,320.60	1,338.60	1,332.30	1,325.60	827.4184	2.03	1,023.06	2
J115554	1,261.00	1,279.00	1,273.10	1,266.50	808.5284	4.8639	969.2948	4
J120844	1,295.40	1,313.20	1,307.90	1,301.50	847.7449	8.41	973.6398	4
J120945	1,271.50	1,289.50	1,282.90	1,276.10	781.6675	2.26677	992.5467	3
J121027	1,311.50	1,329.50	1,323.60	1,317.10	841.4006	-2.10	1,003.21	3
J121558	1,256.70	1,274.80	1,268.20	1,261.40	778.5359	0.71	984.6121	4
J122118	1,296.20	1,314.30	1,307.40	1,300.50	788.7668	0.17	1,022.55	2
J122452	1,302.40	1,320.60	1,313.20	1,306.10	774.3789	0.28	1,044.74	6
J122520	1,350.80	1,368.70	1,362.70	1,356.00	855.5104	10.58	1,039.50	5
J123249	1,320.90	1,338.90	1,332.60	1,325.90	827.6098	2.03	1,023.29	2
J124126	1,278.20	1,296.20	1,289.60	1,282.70	785.9592	8.68	1,002.12	3
J124207	1,312.20	1,330.10	1,324.30	1,317.80	840.4432	1.90	999.1236	3
J124942	1,309.30	1,327.10	1,321.90	1,315.60	861.8903	3.99	978.517	5
J125023	1,252.50	1,270.60	1,263.60	1,256.60	756.9884	4.76	993.6278	5
J125243	1,265.10	1,283.10	1,276.80	1,270.00	792.1123	8.8876	984.822	3
J125727	1,317.90	1,336.00	1,329.70	1,323.00	832.1351	0.30	1,024.66	2
J125833	1,274.40	1,292.40	1,285.70	1,278.80	778.7253	6.49	1,000.10	3
J125938	1,293.80	1,311.90	1,304.90	1,298.00	782.3533	-2.05	1,021.62	3
J130001	1,298.10	1,316.00	1,310.50	1,304.20	845.9	-4.39	976.7028	4

Appendix B

Locus Signature	Sakulda	Horkkisen	Gateway	Hemouner	X	Y	Z	Class
J130334	1,318.10	1,336.00	1,330.60	1,324.30	864.1792	-2.38	990.6342	5
J130650	1,316.00	1,334.00	1,327.80	1,321.10	829.4956	4.34	1,018.56	2
J132024	1,306.20	1,324.20	1,318.20	1,311.60	833.0615	2.31	1,004.65	2
J132712	1,315.90	1,334.00	1,327.60	1,320.90	825.8391	-1.96	1,024.08	2
J133013	1,256.50	1,274.50	1,268.70	1,262.20	810.2865	0.705	960.6271	4
J133119	1,246.00	1,264.10	1,257.00	1,250.00	748.2371	2.64	989.4324	5
J133128	1,279.70	1,297.80	1,291.50	1284.8	807.5857	0.66	995.2428	1
J134096	1,246.70	1,264.80	1,257.90	1,250.90	758.1603	6.95	988.1605	5
J134333	1,257.60	1,275.60	1,269.60	1,263.10	801.4246	-3.66	963.303	4
J134431	1,263.20	1,281.30	1,274.90	1,268.10	792.2626	5.02502	987.8052	3
J135554	1,333.50	1,351.70	1,344.50	1,337.50	803.2842	-2.14	1,062.92	5
J135827	1,315.10	1,333.10	1,326.90	1,320.20	828.9181	4.35	1,017.87	2
J141004	1,273.20	1,291.20	1,284.60	1,277.70	782.826	8.69	998.2371	3
J141007	1,327.30	1,345.30	1,338.80	1,331.90	821.78	10.81637	1,039.27	3
J143345	1,311.50	1,329.40	1,323.70	1,317.20	844.9827	4.18	997.634	3
J143706	1,315.30	1,333.40	1,327.00	1,320.40	825.3593	-8.61	1,019.10	2
J144303	1,291.40	1,309.50	1,303.10	1296.4	810.1865	-1.68	1,005.20	1
J145632	1,310.10	1,328.00	1,322.20	1,315.70	839.0746	1.92	997.5402	3
J150325	1,279.70	1,297.70	1,291.40	1,284.80	801.2378	-4.11	987.2748	1
J150805	1,255.60	1,273.50	1,267.60	1,261.10	798.7725	0.21	957.3656	4
J152325	1,251.40	1,269.30	1,263.80	1,257.40	815.0354	2.58	946.2203	5
J153247	1,319.20	1,337.20	1,331.00	1,324.30	831.5487	4.32	1,021.02	2
J153528	1,327.60	1,345.60	1,339.00	1,332.10	816.9154	8.52	1,040.47	3
J154538	1,306.90	1,324.90	1,318.90	1,312.40	833.42	-4.31	1,000.68	2
J155403	1,293.70	1,311.60	1,306.00	1,299.50	838.244	6.53613	983.2768	3
J155722	1,291.80	1,309.70	1,304.00	1,297.50	832.0697	4.31	982.7942	3
J155737	1,284.00	1,301.90	1,296.00	1,289.40	817.2679	6.42	983.2176	2
J160753	1,289.80	1,307.70	1,301.80	1,295.20	821.0263	6.39	987.6152	2
J160941	1,287.00	1,305.00	1,299.10	1,292.60	825.4078	-1.82	984.6519	2
J161032	1,244.30	1,262.50	1,255.40	1,248.50	753.1846	-5.30	987.2928	5
J161303	1,308.50	1,326.50	1,320.60	1,314.10	839.4423	-2.06958	1,000.94	3
J161411	1,311.10	1,329.20	1,322.50	1,315.70	807.8929	-2.07257	1,027.77	2
J163156	1,280.80	1,298.80	1,292.50	1,285.80	802.0332	2.36	992.5191	1
J163217	1,258.20	1,276.20	1,270.10	1,263.50	797.1126	0.53	969.0077	4
J163217	1,258.20	1,276.20	1,270.10	1,263.50	797.1126	0.53	969.0077	4
J163804	1,292.00	1,310.10	1,303.60	1,296.90	805.6496	-3.92617	1,006.61	1
J164034	1,326.00	1,344.10	1,337.50	1,330.70	822.2924	0.05	1,038.37	3
J164921	1,291.00	1,309.20	1,302.30	1,295.40	791.8489	-1.50107	1,022.09	2
J170118	1,298.20	1,316.30	1,309.10	1,302.00	775.3734	6.54	1,035.89	6
J170144	1,305.80	1,323.70	1,318.10	1,311.50	846.3167	13.09	996.8747	3

Appendix B

Locus Signature	Sakulda	Horkkisen	Gateway	Hemouner	X	Y	Z	Class
J170558	1,316.00	1,334.10	1,327.80	1,321.10	830.914	0.31	1,023.20	2
J205136	1,273.80	1,291.80	1,285.80	1,279.20	812.0318	2.58	979.968	3
J210355	1,300.40	1,318.50	1,311.80	1304.9	801.2726	4.63	1,023.93	2
J224352	1,272.50	1,290.50	1,284.70	1,278.20	820.7912	0.54732	972.7353	3
J225441	1,253.20	1,271.30	1,265.20	1,258.70	799.9208	-7.44	964.3796	4
J230221	1,332.80	1,351.00	1,343.80	1,336.80	802.8546	-2.13	1,062.37	5
J231710	1,259.30	1,277.30	1,271.30	1,264.80	802.5279	-3.68	964.592	4
J232359	1,289.50	1,307.60	1,300.80	1,293.90	789.521	2.46	1,016.38	2
J232441	1,295.20	1,313.10	1,307.50	1,301.00	839.2329	6.52841	984.4056	3
J232801	1,289.10	1,307.00	1,301.10	1,294.50	820.5727	6.40	987.0845	2
J233550	1,292.80	1,310.80	1,304.40	1,297.70	804.7639	0.02	1,002.67	1
J233828	1,293.10	1,311.10	1,304.80	1,298.10	809.8784	2.25	1,001.96	1
J235001	1,289.00	1,307.00	1,300.60	1,293.90	802.3545	0.06	999.7553	1
J235447	1,285.60	1,303.50	1,297.50	1,290.90	813.4076	4.19	985.3728	2
J100001	1,259.90	1,277.90	1,272.00	1,265.40	807.8103	4.87105	968.4577	4
J100250	1,292.90	1,310.90	1,304.50	1,297.80	804.8273	0.02	1,002.75	1
J100620	1,271.10	1,289.20	1,282.40	1275.6	777.9474	-3.82	997.6427	3